



Authoring and Design for the WWW

Stephen Boyd Davis & Mimi Tessier

Centre for Electronic Arts
Middlesex University July 1996



Contents

About this handbook	5
INTRODUCTION	
Uses of the Web and the nature of HEI information	7
Why publish in electronic form?	9
Obstacles to success with the Web	10
PRINCIPLES AND THEIR IMPLICATIONS	
The uses of hypertext	12
Paper information: good and bad	18
Hypertext and the style of documents	21
HTML	24
Functional markup versus fixed formatting	29
Evaluating interactive information technologies	39
The Web as an educational medium	46
The future: a better hypertext system?	52
The future: the Web is changing	54
DESIGN INTO PRODUCTION	
Web design for non-designers	56
Some basic principles of information design	60
Computer screens are not paper	67
User-centred design	69
DESIGN CASE STUDIES	
Visual and structural design of Web documents	75
POLICY	
Creating a maintainable site	88
Checklist for making and maintaining a site	89
Control	92
Staff development issues	94
APPENDICES	
Appendix One: a note on Standards	96
Appendix Two: Some basic facts	97
Appendix Three: Adobe Acrobat	104
Resources	108
Web Resources	110
Glossary	115

Acknowledgements

This report was written by Stephen Boyd Davis, Principal Lecturer in Multimedia, with contributions by Mimi Tessier, Lecturer in Multimedia, both of the Centre for Electronic Arts at Middlesex University.

We would like to acknowledge the assistance and support provided by Andy Wilson, Avon Huxor and Russell Knights and all those postgraduate students of the centre whose projects we have used to illustrate principles of Web design:

Mediha Boran
Steven Chadwick
Claire Calcluth
Dinah Challen
Daphne Economou
Carrie Gracie
Stephen Hamilton
Lena Hassan
Sara Kelly
Apostolos Logaras
Grethe Mitchell
Annable Moffat
Simon Pickford
Mahesh Ramachandra
Gary Sammett
Frosoula Taliadorou
Samdura Weerasekera
Steven Woods

This handbook was funded by a grant from the Advisory Group on Computer Graphics: Support Initiative for Multimedia Applications

About this handbook

This handbook does not provide technical instruction in the creation of Web pages, which is available from many other sources. Technical examples are only given to illustrate points of principle. What it aims to do instead is to cover areas which are inadequately covered elsewhere and to relate these specifically to the needs of Higher Education. Some of the fundamental principles of the Web are in flux. Rather than propose ready-made answers, we attempt to present the issues so that Web authors and designers, managers and information officers, can make up their own minds.

HTML, the Hypertext Markup Language which is the basis of the original Web, is based on principles increasingly threatened by recent Web publishing practices. Will it survive in anything like its original form? What are the merits and weaknesses of the various rival solutions? Does the Web call into question some of the ways in which HEIs promulgate and use information? How can authors of Web documents recast their attitude to information, and even their writing style, to suit this medium? What do designers need to know in order to make best use of what the Web offers, and how can non-designers make informed decisions about the layout and structuring of interactive, electronic information?

Themes and limits of this handbook

There is considerable interest in the use of the Web as a location for learning, whether for on-campus students or for distance education. This handbook does not primarily deal with the pedagogic implications of these networked learning methods. However, the main focus of this handbook the information which an HEI publishes about itself cannot be considered separately from attitudes to teaching and learning. Issues of policy are dealt with, and in order to provide a foundation, important principles of electronic media are also discussed in some detail. Attention is given in a series of short case studies to the design (in its broadest sense) of Web documents. Appendices provide supporting information.

This handbook is not an academic document. Pointers to other works are provided in cases where they have immediate practical application, but there are opinions and assertions not supported by references.

The need for this handbook

The Web encourages a multiplicity of authors' and publishers'. In fact such clear roles are undermined by the Web, authors becoming their own publishers to a greater extent than in the so-called DTP Revolution. There are few practical barriers between author and public (though of course the author may still remain unread). Instead for many in HE the barrier to greater exploitation of the Web is ignorance of what can be done and how to achieve it. Many academics have not had the opportunity to try using the tools, and have perhaps been told by technical staff that the creation of Web pages is best left to them. Above all, many will have been repelled by the many poor examples of material currently available on the Web.

This handbook is designed to enable readers to:

- understand some key principles of the Web as a publishing medium
- evaluate its usefulness in their work
- evaluate the claims made for and against various aspects of the Web
- take practical steps to be a Web author, publisher or designer
- make policy for applying the Web in Higher Education

Definitions

Some Web terminology is provided in a glossary (p115). Here we define other terms as they are used in this handbook.

Publisher

Documents reside on a Server awaiting request from users. Legally, the publisher of Web documents is probably the owner of the Server, but we have used the term 'publisher' to identify the person or organisation which decides to make a document public. In some cases the publisher will also be the author of the document.

Author

We have used the term 'author' for the originator of Web material, whether the material is textual or in some other form.

Designer

The Web designer's role is changing rapidly: until recently it was confined to deciding from what textual chunks the document should be constructed, and where in those chunks graphics were to appear. Now Web design is acquiring a greater resemblance to conventional graphic design, and at the same time aims to offer many of the possibilities of interactive multimedia.

User

Using the Browser software, the User requests documents, views and interacts with them.

We have chosen the term 'user' in place of 'reader' since 'reader' implies predominantly textual documents and fails to acknowledge the interactive role of the user.

HEI

We have referred to Universities, Institutes, Academies, Art Schools and so forth by the generic term HEI, or Higher Education Institution.

INTRODUCTION

Uses of the Web and the nature of HEI information

There is controversy about the nature of the Web: whether it is best considered as publishing, broadcasting or electronic conversation. Not only is the technology of the Web adaptable to many different scales and kinds of 'publishing', it enables us to recognise that types of information which we used to see as discrete can in fact be considered together in an overarching approach to educational information.

It is important to consider the pedagogic implications of any information strategy chosen: we should not consider documentation as though it were separate from the overall educational aims of the HEI. For example, documents should encourage skills of research in the students, not undermine them.

It is increasingly realised that the Web is useful for internal publishing, as much as for publishing to the outside world. The word Intranet has been coined for this type of use. This handbook gives as much weight to these uses as it does to the Web as international publishing mechanism.

HEI Web sites now

HEIs are rapidly developing and expanding their informational structures to include the World Wide Web. These informational structures reflect both the structure of the HEIs and their attitude towards the distribution and dissemination of information.

In many ways Higher Education might be expected to hesitate in adopting this new medium and to wait until issues such as security, copyright and editorial control have clear precedents. Yet a brief review of HEI web sites reveals a culture of innovation in which the providers are beginning to explore the boundaries of the medium.

Current practice is divided between **institutional** information and **academic** information.

Common elements in many HE sites are

Public Relations

- introductions to the university, logos, maps...
- electronic prospectuses
- electronic application forms
- vacancies

Campus wide information

- notice boards
- telephone and e-mail directories
- Campus-Wide Information Systems, news and events, electronic magazines
- student charters

Student Services

- accommodation
- night line
- nurseries
- counselling and advice
- chaplaincy
- careers
- clubs and societies
- student magazines
- sports
- student union

Academic

- departmental/faculty information
- information banks
- research tool
- on-line publications
- new public spaces (virtual exhibitions)
- extended university

HEIs have complex information structures in which the needs of management, administration, student and academic groups are diverse and interdependent. Uses of the Web have so far tended to be piecemeal, to perpetuate unquestioningly existing genres of information, their styles of writing and design, who contributes to them and in what ways.

Inherited discrete information types include paper prospectuses and course handbooks, library catalogues, publicity materials, computerised module catalogues, internal administrative documents such as records of meetings, and so on.

However, many kinds of information which HEIs provide can be made to converge with the help of Web technology. Electronic methods have a great deal to offer as a means of making coherent documents out of disparate parts. Information can be presented as a unified body to the reader, even though it comprises elements stored at various locations HEI information in HEI documents, faculty information in faculty documents, and so forth. This approach is explained more fully below (Transparent connections, p13).

Thorough overhaul is required of the information strategy (if any) of most HEIs. Such an overhaul may be facilitated by a change of technology and offers a valuable opportunity to rethink the modes of authoring and the styles of address of such documents, bearing in mind changes in attitude to learning and to students, and the nature of the HEI of the future.

Why publish in electronic form?

It is useful to separate the basic advantages of screen-based electronic publishing from those of introducing interactivity. Electronic documents, even if not interactive, offer advantages over the traditional form. These include:

- Electronic media allow speedier, more efficient and more frequent updating of information than paper documents.
- The penalty for increasing the size and quantity of documentation is far less for electronic documents than for their paper equivalents because
 - no paper or photocopying consumables are used
 - there is only one copy of the document, no matter how many readers
- Some aspects of the publishing process may be partly automated, for example through the use of databases.
- There are no arbitrary limits on the size of a document part. Using paper it is impractical to provide many small documents each devoted to a particular topic, but there is effectively no minimum or maximum size for a part of an electronic document. All document parts can be at their optimum size.
- Provided the user has access to a computer, the document is always present. It cannot be mislaid.
- Elements of the documentation can be used for multiple purposes, without actual duplication. This means that an element can appear in more than one place at once, without increasing storage.
- Documents are always accessible for re-purposing. So for example student essays if submitted in electronic form can be easily and cheaply provided to succeeding students in the form of an electronic reader; or information prepared for student use can be reused for promotional purposes.
- An electronic document may potentially be larger, better indexed and more easily searchable than its paper counterpart and can be accessed at any time. Students can make inquiries in the information without the embarrassment associated with asking a person.

Obstacles to success with the Web

Most publications about the Web gloss over the difficulties involved in using it, but it is not the aim of this handbook to 'sell' the Web: it is important to acknowledge immediately some of the problems.

Problems of access

The user needs a computer and access to a network.

Excessive expectations

User's expectations may be higher than in relation to paper documents. For example, if their expectations of topicality are higher, frequent updating becomes not only possible but necessary.

Extra workload

The electronic publication may not be able to replace paper documentation (perhaps for legal reasons), and therefore may require additional work rather than replacement.

Things that do not work

At present many of the tools for browsing and making Web documents are less refined than established computer software. New versions of packages are more inclined than most to fail in some degree.

Things that work too slowly

The growth in demand for the Web has outstripped the development of the network systems which support it. In the UK, it is frequently impossible to get reasonable speed of access to the Web after about 11am. As users create more documents which are not confined to text, the traffic demands on the system increase still further.

Lack of fixity on a day by day basis

Material which is prepared with one version of HTML in mind, or hoping to make use of some innovation in the Browser packages, is overtaken by newer versions.

Users find that material which they confidently expect to view can only be seen if they download the latest software to their computer.

Difficulty of planning

Some of the changes in the Web will prove to be more than merely technical and may lead to fundamental changes in how material is published. It is difficult to make plans on software purchases, file formats, information policy and so forth, in such a changeable environment.

Difficulties with control and specialist expertise

An academic, student, or other member of an HEI may have difficulty in getting the information necessary to implement Web documents. Even once this is achieved, various obstacles may be put in the way of the intending Web publisher in terms of access to Servers and so forth. The authors of this handbook are unusually fortunate in having the enthusiastic support of network and other staff.

Lack of funds

While some of the software such as browser packages is free to Education, there are financial constraints on the scope and speed of the networks which an HEI is willing to provide. Most HEIs have adopted the policy that a department must buy its computers from its own budget, including any interfacing to the network, while the network itself is paid for by central computing funds. There are therefore two separate financial battles to be won in getting suitable access to the Web.

Need for skills

Additional skills may be required for the design, implementation and maintenance of electronic publications. The skills might or might not be those which an academic is keen to acquire. Deciding on the amount of extra work which is appropriate needs careful consideration. It is clearly important to consider staff-development needs.

PRINCIPLES AND THEIR IMPLICATIONS

The uses of hypertext

Hypertext is fundamental to HTML and the Web.

There are two key components to the way in the Web handles information. One is the idea of virtual documents which are not bound by the same physical laws as paper documents. The other is the idea of interlinking document parts.

Bush's argument for hypertext

The idea behind hypertext was first mooted in 1945 by Vannevar Bush, scientific adviser to Roosevelt, and the term itself was coined by Ted Nelson in the 1960s, but it was not until the late 1980s that two programs brought hypertext to a wider public. They were Guide (for Macintosh, Windows and other platforms) and HyperCard (for Macintosh only).

It may be useful to quote briefly from Bush's article in Atlantic Monthly in 1945. The URL for the full text may be found in Web Resources (p110).

Our ineptitude in getting at [information] is largely caused by the artificiality of systems of indexing. When data of any sort are placed in storage they are filed alphabetically or numerically.

[Information] can be only in one place, unless duplicates are used; one has to have rules as to which path will locate it, and the rules are cumbersome.

The human mind does not work that way. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts.

The heart of the 'Memex' which Bush proposed was a provision whereby any item may be caused at will to select immediately and automatically another.' The user would be able to build links between items, and follow links made by others.

The value of hypertext as an organisational approach will vary greatly from one type of information to another. A battle rages in some circles over the merits or otherwise of hypertext novels, for example. However, since hypertext is a feature of documents on the World Wide Web, it is important to understand the implications.

Advantages of interactive publication

The introduction of interactivity, which makes hypertext possible, adds five important characteristics: information filtering; interconnection; transparent connections; dynamic behaviour; and the possibilities of mixed media.

Hypertext is not synonymous with multimedia. It is quite possible for interactive

electronic text to be just that text. Even without graphics, animation, filmic images etc. interactive text may have advantages.

Information filtering

With paper documentation, it is impossible to tailor documents to the requirements of the individual, or the needs of the moment. However, using interactive electronic texts, in principle only that part of a document need be presented which a particular user requires at a particular time. For example, the user may seek only information about module dates, wishing to ignore information about curriculum content, teaching and learning styles, credits allocated and so forth. A commonly ignored benefit of computers is their ability to hide information, and a well-structured interactive document should make it easy to suppress all but what the user wants to know.

However, this advantage will only arise if the document is well designed. Here 'design' means above all the editorial structuring of the information— **information design**— rather than the imposition of a particular appearance. Of course the visual design must also articulate that structure.

Interconnection

The electronic techniques of hypertext make it easy to interconnect one item of text with another. The user interacts with one piece of text (for example by clicking the pointer) in order to reveal another. This principle can also be extended to other media such as pictures, diagrams, maps, moving images and sound.

Combined with the ability already described to present only the information the user requires, this facility for displaying relevant connected texts can provide a very congenial style of information. Only seeing what they wish, users can gain access to related information on demand.

Links allow the same document to be read in different contexts, so that for example a résumé of a member of staff might be instantly accessible from every place where that person is named, with negligible additional labour or storage requirements.

Links allow complex informational structures to be built up, centred on the user's needs. This is a two-edged sword, since it is easy for the novice to create a cat's cradle of interlinked items which are incomprehensible to the reader (this is sufficiently well recognised to have earned itself a name: the 'lost in hyperspace' problem). At best, however, structures can be devised which are better at answering the reader's needs than the rather limited range of structures available using paper. In addition, the document can change, acquiring (or losing) links and content over a period of years.

Transparent connections

A less important, but still significant, aspect of interactive electronic texts is that it should make no difference to the user where the various interconnected texts are physically located. The user need not know whether the texts to which s/he jumps are

in the same file as that which is currently open, in another file on the same storage device or on the other side of the world.

Web documents are part of an interconnected information system handling several kinds of communication. There are obvious attractions in the idea of users being able to jump seamlessly between any of the following (for example)

- a local set guide housed on a school server
- this week's timetable, housed on another server in the school
- HEI documents about assessment regulations on a central server
- the prospectus of an affiliated institution, housed at its site
- a reference document about Copyright on a server at the British Library
- most of the world's OPACs

When such schemes are considered, issues of coordination, consistency and control inevitably arise. We believe these do not differ very greatly from those of editorial and design policy for paper documents: similar approaches, promulgated as a part of staff-awareness initiatives could be used to deal with problems before they occur.

Dynamic behaviour

Even where text alone is used, interactive documents can contain other kinds of interactivity than straightforward hypertext. For example, an interactive table of programme modules could in principle allow the user to click on a module and automatically highlight any prerequisites and/or progression opportunities appropriate to it. However, it should be noted that this presupposes a substantial amount of development work by staff, a higher level of skills, and suitable authoring and delivery tools. Again a staff-development issue is raised. It is not suggested that many staff members could or should explore the intricacies of creating multiply interactive documents but perhaps they should be sufficiently knowledgeable to specify requirements for such elements to experts.

Another crude but important form of interaction includes the filling-in of electronic forms, which allows students to actively interrogate the information, and to become contributors to that information themselves.

An unquantifiable motivational aspect may be present in interactive documents, simply by virtue of their interaction. It seems possible that rather as one gets more out of talking to responsive students than to a room full of blank faces, so interactive documents by their very responsiveness may seem more congenial than an inanimate paper document. This motivational aspect has received a lot of attention in relation to interactive academic learning materials, but is also applicable to institutional information.

Mixed media

The principle of using interlinked electronic interactive texts is easily extended to other media. This means that the most appropriate medium is available for each element of the communication task. Numerical information concerning the proportions of credits for component modules might be animated in order to show their accumulation over

time. The user might be able to try 'what-if' combinations of modules and receive instant feedback on legal and illegal combinations, preferred routes, progression points, etc. A welcome to the Set might be given as a digital video presentation by a member of staff, adding an element of human warmth and engagement which would be more difficult to achieve in a paper document.

What do images do that text does not? It has to be said that there is little objective evidence for the superior communicative power of multiple media as against text supported by well thought-out illustrative graphics. However there is at least likely to be a motivational element in an interactive multi-media document, which will encourage the user to explore more deeply than might be the case with a paper handbook.

The user's experience of hypertext

While hypertext invites document authors to make non-linear structures, they are not compelled to do so. The Web can be used as a place to deliver a document which is traditionally linear and contains no links at all to other documents. Nor does it impose any particular structures—the choice lies with the author and designer. They can organise the nodes and links of hypertext documents in different ways in order to suggest to the user a variety of different structures. Examples include:

- a linear document with hypertext links to entries in a bibliography and a glossary file
- a linear document which cites a variety of texts, with links to the original sources where appropriate
- two parallel strands, with the possibility of jumping to and fro between them using hypertext links (for example to represent opposed arguments in a debate)
- summary information, with expanded versions of each item accessed via links
- a web of multiply interconnected fragments.

In looking at a hypertext document, the user will normally be equipped with a pointing device, probably a mouse. When the user identifies a word or phrase which promises to connect to another chunk of text, the user clicks (or in some systems, double-clicks) on the item and the linked text is revealed. A wide range of methods is employed to deliver this simple result. For example, how is it indicated to the user that a given text item is one which the user must interact with in order to traverse a link? How does the new text appear in relation to the original? Are there facilities for the user to return instantly to the original text? In HTML, neither publisher nor user currently has much control over how these things are done.

Virtual documents

Bush speculated that if the physicality of individual documents could be done away with, advantages would include:

- an unlimited number of instances of the 'same' document
- virtual books: instead of documents residing in the place where they originally belonged, parts of texts could be compiled at need into new 'volumes'
- trails: the very process of building a hypertext creating new links between existing document segments would be a new form of authorship, and these trails would

have intellectual value of their own, usefully exchanged between scholars and perhaps the subject of commercial transaction.

Some problems with hypertext

Bush saw traditional document structures as inimical to research, and to constructive thought. However, in proposing other structures, he did not anticipate the problems which have tended to arise in practice. Of these the most prominent is the 'lost in hyperspace' problem, where users become disorientated as they traverse one link after another and are unable to get the best value from these apparently powerful structures.

Hypertextual documents are useful only if the structure...

- adequately reflects the user's information requirements
- is clear and simple enough for users to be able to find their way through
- the content lends itself to being delivered in 'chunks'.

Anyone who is familiar with electronic mail will be aware of its tendency to abolish a sense of spatial separation, rather as telephony does. However, at least with e-mail, each document is a discrete unit arriving from a particular geographical location. The interlinking of hypertexts goes further, abolishing even this sense of place, since intimately connected parts of a document may be stored on opposite sides of the world. This lack of a sense of location raises issues for authors and document designers. Without knowing where a document 'is coming from' —literally and metaphorically— it is sometimes difficult to know how to read it.

There is a danger of making a maze of links, in which users travel around and around, rediscovering parts of the document they have already seen, unable to find the information they require. Documents can also become excessively fragmented.

Hypertextual interconnections can be advantageous, but there may be value in providing linear means of accessing those linked elements as well. For example, experiments have been done with 'guides' or 'agents' which attempt to lead the user through hypertext and hypermedia documents, describing points of interest or importance along the way.

The 'homeopathic fallacy'

Bush strongly held the view that documents should be organised 'like the mind'. Leaving aside the fact that controversy rages as to what the mind is like and how information is structured there, there is still a problem. To make a structure, even one which users can clearly perceive, is not to succeed in putting that structure into the user's mind. The educational task may be transformed, but it is not miraculously overcome. See Hammond et al, listed in **Resources** (p108)

Structures do not solve the problem of enabling the user to understand by mysteriously planting that structure in the user's mind. Users must still make an effort, requiring motivation and intelligence, to make the author's structures (or something like them) their own.

Some guidelines for hypertexts

Some rules of thumb can be extracted for Web publishers:

- **Do not link everything that can be linked.**

Use links moderately. Consider that all links in the Web look the same: the user has no way of knowing which links are important, which incidental.

- **Web links do not have types**

Web links do not easily allow different kinds of relationship between the current text and the linked text to be represented on screen. Web publishers could devise their own ways of, for example, differentiating links to primary sources from those to secondary sources, but users would have to learn this local convention, and the publisher would have to apply it with perfect consistency.

- **Linking documents means building structures**

The structures which are made through hypertext linking will often be assimilated by the user through exploration, rather than explicitly presented. These structures may not be comprehensible to anyone but the author. The author and designer must put themselves in the user's shoes, if necessary by testing prototypes on real users (see User-centred Design p69). It may be useful to provide graphical maps of the structure, and it will probably also help if these maps are themselves a means of accessing the nodes represented there (see Case Studies p86).

- **Users forget where they are**

The archetypal view in a Web browser, a single window full of text containing links which on being activated cause the current text to disappear and be wholly replaced by new text, is inimical to users' confidence and understanding. Frames, despite their non-standard nature, offer one way out of this problem by allowing new information to be brought to the screen (in one frame) while the original material remains (in another).

- **Mixed media**

Text is economical to store on computers, swift to process, and easy to deliver to the user's terminal (even if this terminal is of the crudest kind). Graphics, sound, animation and filmic imagery (in that order) are correspondingly more greedy in their storage requirements, slower to process, and more difficult to deliver to the user.

Text is a powerful medium which can communicate many different kinds of information, evoke almost any emotion, represent many different kinds of structures, concepts and qualities. In addition, within the confines of our HEI's interests and activities, we probably want to actively encourage our students to use text (whether as writers or readers) in sophisticated, thoughtful ways. We should therefore be wary of succumbing needlessly to the temptation to use other media gratuitously (and expensively) where text would be perfectly adequate.

- **New forms should be explored**

While we have urged caution, there is also scope for experiment. Hypertext readers, through the medium of the Web, are daily becoming more confident and sophisticated. New structures and ways of writing should be developed, so that the Web can find its own voice, or more probably voices.

Paper information: good and bad

A note on 'linear' paper documents

It is sometimes suggested that paper documents are linear, that their physical form allows only a beginning-middle-end style of reading. This is patently untrue: most paper documents are not read in this way.

Within 50 years of the invention of printing, page numbering had been adopted, enabling any part of a printed text to be identified with a reasonable degree of accuracy using title, author, edition and page number.

Many supposedly linear documents turn out to be anything but:

- Newspapers use headlines, subheads, captions and other devices to allow the reader to start at any of several places on the page.
- Novels use titled chunks chapters enabling the reader to locate the main points of the story for re-reading.
- Academic texts refer to other text in precise ways so that readers may pursue their enquiry with the original source. Quotation introduces a fragment of another text into the current one. Footnotes allow readers to side-step the main argument and then rejoin it.
- Non-fiction books provide a table of contents, index, chapters and sometimes numbered sections, so enabling a whole variety of different means of access.
- Encyclopaedias and dictionaries use an arbitrary (usually alphabetic) ordering to enable individual articles to be found with ease.
- Some specialised texts, such as the Bible, use complex numbering and annotation systems to facilitate glossaries, concordances and so forth.

Seen in this light, the approach taken by the Web seems **evolutionary** rather than revolutionary. It is worth noting that many of the conventions of paper documents are quite complex, and only seem natural and obvious because we are used to them.

Overcoming limitations of paper documents

A number of problems arise specifically with the documents which we produce now, for example to inform students about a course or school, which may be solved using electronic techniques.

Timing of publication and access

Course handbooks and set guides are provided at induction or mailed to students beforehand. This is almost certainly a bad time to impart this information. Even the slimmest document will tend to repel readers who do not yet know what they need to know.

Some course and school information is presented verbally during induction and is effectively 'lost' by the time students discover their need for it. Typically some of this will be important 'survival kit' information which somehow gets filtered out of official documents.

A paper document handed out at the beginning of a course is usually 'filed' by

students for later use, and never referred to again. With a caveat concerning access to equipment, we can say that electronic documents are always present, to be referred to repeatedly as the need arises. This will be especially true of information stored on servers rather than on some form of disc which can be mislaid.

Too little information

There is a tension between the need to present a comprehensive reference source and the desire to make a readable document. There is a great deal of information which students might one day need, but whose inclusion would lead to an unreadably large document.

The ability of the computer to hide information is of great use in this kind of situation. In electronic media a summary document can expand at the reader's request to give more detail—detail which is otherwise kept from view.

Too much information

Course information which is presented in course handbooks (even well-designed ones) tends to be dense, unappealing and remains unread.

Perhaps our attempts to rethink documentation in the light of electronic techniques can assist us in seeing what is wrong with our paper documentation. For example, in electronic documents it is very common to offer FAQs—frequently asked questions—which act as a guided index to the information. Such a facility is rare in paper documents; indeed many set guides and programme documents do not even have a contents list or index (surely reprehensible when we are trying to encourage skills of research in our students!). FAQs represent a user-centred view of information which is often lacking in HE.

Wrong media for its presentation

The question of which media—words, numbers, graphics, sound, animation and filmic imagery—are most effective (and in what combination) is contentious, and most of the bold statements made about it are questionable. However, we can make broad judgements with a certain amount of confidence.

Large quantities of undifferentiated text are unappealing. The answer may simply be to break text into small meaningful blocks, to tabulate text where appropriate, and to use clear diagrams. Nevertheless, textual handbooks comprise poor media for giving students certain kinds of information. For example it is difficult enough to convey adequately what members of staff look like using simple photocopied documents, let alone to give new students other 'qualitative' information about staff—their research interests or opinions on the central issues of the curriculum. There is a lack of warmth in text on paper which makes it difficult to convey some kinds of ideas—ideas which for example might better be evoked by short video sequences of staff introducing themselves individually. Such an approach might eventually be so taken for granted that it is less trouble and less work than it would be to formalise the ideas on paper, and produces results more accessible for the end-user. Certainly, with current pressures on HE, we would not suggest any innovation which would be likely to create additional work.

Unconnected

It frequently arises that documents make reference to other documents, which are often not to hand. We described some of the advantages of hypertext in allowing the user to not only see a reference to another document, but also to have immediate access to that document itself. HEIs have many documents which are separately bound and often physically remote from one another.

Unresponsive

If something is unclear in a paper document, it tends to remain unclear. By contrast, documents which are responsive to the user, for example using such simple techniques as highlighting, may be better able to answer users' needs.

Obsolete

Paper course guides are revised once a year, at best. They cannot economically be updated more frequently. They cannot contain information which is only temporarily useful. A well-managed electronic documentation system solves these problems.

Hypertext and the style of documents

Electronic technology might be regarded as neutral, having no implications for the overall style of the documents which it delivers, but this position is difficult to defend. For example, there is evident difference in style between letters sent by post and letters sent by e-mail. A relatively unfamiliar technology has encouraged a rethinking of modes of address and styles of information.

Harnessing new technology allows us to rethink an HEI's information strategy. We can create a richer, more flexible and multivocal information resource for students and staff, under the influence of electronic media.

The electronic medium promotes alterations to our documents in two important respects:

- It obliges us to write in different **language styles** suited to the medium
- It encourages us to think in a more adventurous way about the **structure** of an HEI document

These represent 'micro' and 'macro' views of the same issue.

Language style is principally concerned with style *within* a single document, say one describing the Teaching and Learning Methods used in a given set of courses. The language style needs to be one well suited to the electronic medium in order to make documents as usable and enjoyable to read as possible. The **structural style** is concerned with the broader issue of deciding what component documents should constitute, for example, a description of a course, in the light of the intertextuality which electronic media both permit and promote.

Of course the decisions made about the two issues influence each other: if we decide to use hypertext linking to incorporate the work of several authors in an HEI document, that has implications for the styles of each of them.

Language style

What is the right language style for documents on the Web? We can usefully distinguish two differing styles, the **expository** and the **declarative**, only one of which we believe is well suited to Web publishing.

Expository texts

Expository texts are well suited to the continuous reading and writing practices of traditional paper documents. Premises lead into arguments which in turn lead to conclusions. The Introduction to a paper-based course document might develop an argument over two sides of closely spaced text, equivalent to approximately *eight* screens if displayed electronically. The structure of the argument is made clear through the use of connecting words like 'therefore', 'though' and 'however'. The whole document is designed for more or less continuous reading, aims to have a unified voice, and often encourages passivity in the reader.

Declarative texts

Declarative texts are characterised by short, named sections which can be read in a number of orders. The semantic structure emerges from the 'physical' structure of paragraphs and document parts and the connections between them. Concepts of association and consequentiality which would normally be signalled through words are instead signalled by hypertext links. The way these links are used indicates whether the text to which the end-user jumps is parenthetical, glossarial, or has some other relation to the text which triggered it. This is a modular approach to writing which to a certain extent is foreign to academic traditions.

It might seem that—since for technical reasons only short chunks of text can appear on screen at once—there would be a greater need for the connecting words which tie conventional texts together. However, experience seems to suggest that the 'positioning' of the chunks in hypertext structures does the work of articulating the relationship between the parts, *without* the addition of the standard grammatical constructions.

For on-screen, hypertext documents, the **declarative** approach is preferable. Not only does it seem to be easier to read and understand in the context of hypertext screens, but it has other benefits. Carefully planned, such modularity in documentation can facilitate maintenance, and encourage authoring based on team-work. It may also promote a more active form of reading in the end-user. The relevance of this to academic material is pursued under **The Web as an educational medium** (p46)

The pluralism of electronic media

Current HEI documents do little to represent the supposedly pluralistic, changing nature of modern academic practice, in which students are allegedly encouraged to be inquisitive, to formulate their own opinions and to make for themselves the best use of the resources that the HEI provides.

HEIs offer a diversity of information, using many separate documents but they are generally official views of the most dull kind. They do not in themselves begin to represent student-centred approaches. Why cannot students themselves contribute to HEI documentation? It is odd, and regrettable, that the hard-won experience of each cohort of students is 'wasted' by not being passed on to their successors.

In some respects, the hypertext linking of multiple contributory documents can be seen as resembling conversational exchange, where closure and fixity are diminished by comparison with a paper document of the traditional kind. It is important to capitalise on these strengths.

Avoiding the deadening effect of technology

Computer technology can have a beneficial influence in provoking new thought. On the other hand, the use of computer systems can easily have a deleterious effect. Perhaps the most notorious example of the influence of computing has been in Computer Aided Learning, where there are instances of discredited approaches to teaching and learning being encapsulated in electronic form simply because they were technically easy to do. In using interactive electronic techniques to present HEI information, there is a danger

of embodying perhaps accidentally the least acceptable hierarchical aspects of the organisation, again because it is technically easy to do (HTML documents tend to acquire a hierarchical structure by default). It is essential to prioritise a student-centred view, yet the majority of Web-based HEI information systems use the hierarchies of Web documents to mirror the hierarchies of the institution.

Inseparable form and content

The form in which information is published cannot be divorced from its content. This has implications for the writing style, the document structure and the visual and interaction design. The authoring and design of hypertexts needs to take into account this sympathy between content and form. Documents need to be structured in a way which articulates their meaning and function.

HTML

This information aims to give readers a deeper understanding of the strengths and weaknesses of HTML, not instruction in its use. Increasingly, software tools will protect authors and designers of Web documents from needing to originate, edit or even see the HTML codes which are at work within their documents (see **Transparent HTML**, p54).

HTML, the HyperText Markup Language, is based on SGML, the Standard Generalised Markup Language, agreed as ISO 8879. HTML is actually defined using an SGML Document Type Declaration.

SGML was designed specifically to deliver the advantages of functional description (described below, p29). Not all of the advantages of this approach have actually been carried over in the way HTML is defined, even in recent versions. If its authors had anticipated the enormous influence of HTML arising through the explosion in use of the Web, they would probably have defined it with greater thought for future development. HTML created the success of the Web, but was not designed with that success in mind, most particularly the wide range of media and forms of interaction which it is now expected to support. Nevertheless, it provides a workable document structure which can have other media appended to it. Unlike the majority of file-formats, such as those for word-processors or multimedia packages, the specification is open, published, and can be interpreted by any browser package, of which Mosaic, Netscape and Internet Explorer are only examples.

The purpose of HTML

HTML aims to overcome four problems which have arisen though lack of standards. These problems have been that:

- proprietary hardware and software formats inhibit the exchange of information between one computer user and another
- fonts are essential to the display of text, but are intellectual property and cannot be given away unlicensed
- users have been prevented by the particular hardware available to them from viewing a document as its author intended (or at all)
- documents have typically been self-contained, not connected to other relevant documents (in other words, they do not have the advantages of hypertext systems)

HTML has its own answers to these problems, while Acrobat (see Appendix Three, p104) has others.

Proprietary hardware and software formats

HTML is an evolving (informal) international standard which aims to bypass the barriers of proprietary systems.

Fonts are property

HTML does not transmit fonts from the publisher to the user. The fonts used are those on the user's computer. Plans are afoot to address this problem directly, rather than side-stepping it as now (see The future p54)

Users constrained by hardware

HTML allows the content to be displayed in different ways on differing hardware. HTML instructions which cannot be interpreted at all by the user's computer are ignored, rather than producing an error.

Documents self-contained, unconnected

HTML offers a basic but effective system for linking any part of a document to any part of another document, regardless of where it is sited.

HTML allows document authors to specify:

- the structure and content of documents
- the links between component parts of a hypertext system
- the links to other media files such as pictures or animations

HTML achieves these objectives using text files containing only ASCII characters (the basic but widely adopted standard for specifying the alphabet, numeric digits, and some simple punctuation). ASCII character codes are recognised by almost all the world's computers, and as such offer a means of communication between one computer and another. Unicode, the replacement for ASCII, will provide better support for extended character sets, but the principle remains the same. Other, non-text, media delivered in the context of Web pages each have their own cross-platform formats, but not all of these are open, public formats like HTML.

Important characteristics of HTML

Layout as well as content of text files

Word processors, presentation packages and multimedia authoring packages can all specify the layout of text and other media components, but do so in a way which is proprietary and often uses codes which are beyond the standard ASCII set. HTML is by its nature standardised across all platforms (though there will always be difficulties due to new versions of standards emerging which the available browser software then does not match).

HTML takes a relaxed attitude to where things appear on the user's screen. This results from **1** not specifying the fonts, with all their concomitant information about line-length, line-spacing etc and **2** not wanting to make assumptions about the dimensions and other characteristics of the user's screen.

Links between component parts of a hypertext system

There are a number of other hypertext software systems such as Guide, NoteCards, HyperCard etc. They use proprietary, closed means of describing the hypertext linkages and the interactions which are offered to the user. HTML standardises the interlinking of document components. By using URLs, which provide a unique standardised address for every document on every server, HTML is able to treat all HTML documents as equally accessible, regardless of their location.

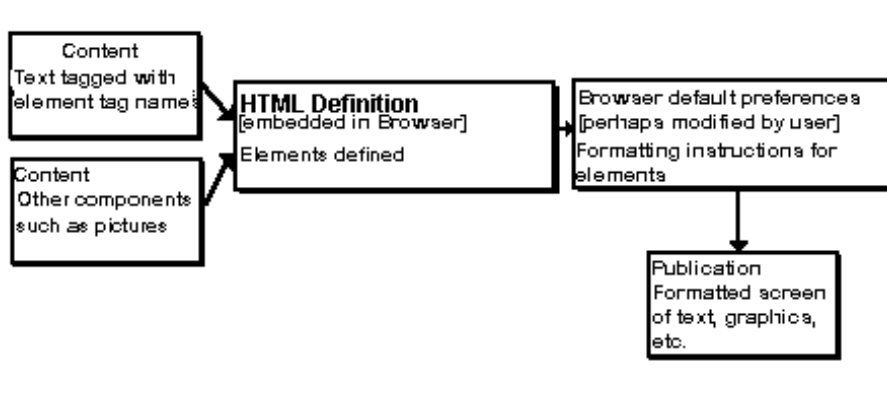
Links to other media files such as pictures or animations

Most interactive multimedia packages are able, to a greater or lesser extent, to integrate various media components into a single surface. HTML originally side-stepped this problem. Rather than display different media as integrated components of a single

document, HTML specified the kind of data to be found in the file, to which the browser package responded by opening a suitable 'viewer'—a small self-contained package which opened up alongside the browser to display this 'foreign' media type. Increasingly, browsers can display these alternative media within the main browser window, with at least some control over where in the window they appear.

How HTML works in the browser

Using HTML, the appearance of the document on the end-user's machine is dictated by a combination of the functional description decided by the document author, incorporated in the file (left in the diagram) and the formatting instructions for HTML incorporated in the browser software, perhaps modified by the preferences of the user (right). By contrast, other computer-generated documents such as those made with a word-processor are fixed with regard to their appearance when they are made.



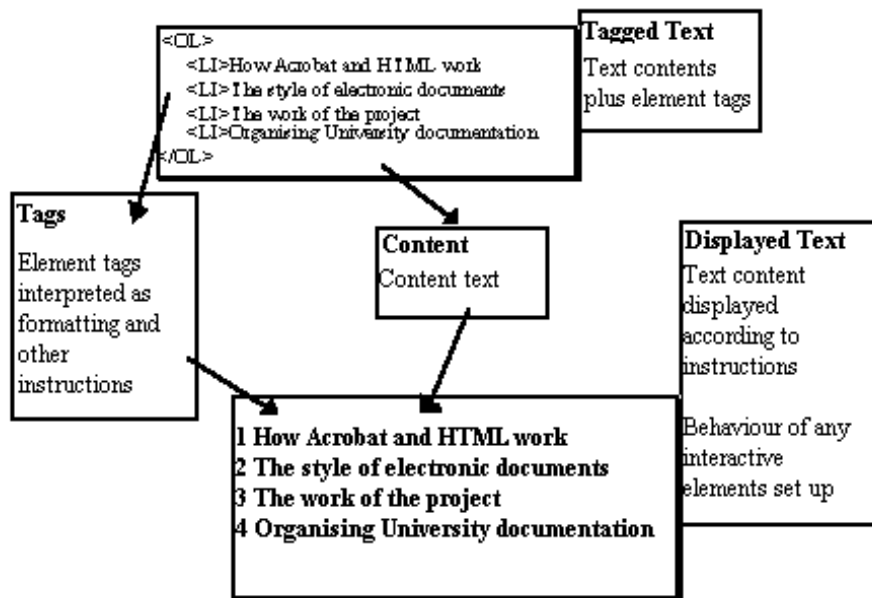
The final formatted appearance of the document is a combination of the author's functional description of its elements together with the interpretation made by the browser package (as modified by the user's preferences)

In HTML the author specifies that an element is one of a set of pre-defined types, such as Sub-Head No3 or List Item, and a definition stored in the browser software specifies the visual interpretation of this type. It is thus a system for specifying the semantic structure of the document, albeit crudely, rather than its mere appearance. The author specifies the function of an element and the browser software applies an appropriate format.

The core of an HTML document is text, of two kinds: text which is to be shown to the end-user and that which instructs the browser software how to behave. In appearance and function it therefore resembles old-fashioned word-processing and print-specification files in which textual codes—'tags' enclosed in angle brackets—are visibly embedded, and which are capable of turning on and off the various styles. The stream of text in the HTML file is split by the browser package into its two components, resulting in a display where only the content-text is visible, but its appearance and behaviour have been dictated by the now invisible tags.

Word-processing packages use codes (usually concealed from both author and reader) to give **visual** styles to elements of the document. For example a subhead might be in 14pt Baskerville Italic. HTML avoids this specific visual formatting.

When a browser package opens an HTML file (whether locally from a disc or over a network), it reads the content-text and tag-text as a continuous stream. The tags are indicated to the browser by angle-brackets (< and >).



The tag-markers < and > ensure that the tags are split off from the content text by the Browser. The tags are interpreted as instructions for formatting, interaction etc, while the content text is displayed to the user

For each element of the content, such as a headline, there will normally be a start-tag and an end-tag (eg. <H1>My headline</H1>) so the parsing process is quite simple. On finding a start tag, the browser sets the type size, weight, indentation etc. to that specified for this type of element. On finding an end-tag, it turns it off again (usually returning to the default specification for body-text, though it is unwise to assume this).

If the element is a link to another document, then the browser software can interpret mouse-clicks on that word or phrase as an instruction to display the specified document, to 'jump' to that document.

If an element calls for the display of another media type, this is then handled in an appropriate way by the browser.

Example

- 1 A paragraph of plain text containing one hypertext link to another document is opened by the browser.
- 2 The plain text (bracketed by <p> and </p> tags) is formatted according to the defaults of the browser package:
 - left-aligned
 - black type
 - Times
 - 12 point
 - plain
- 3 The embedded hypertext link is displayed as follows:
 - blue
 - underlined (but otherwise the same as the text around it)
- 4 The user alters the preferences for the Browser display:
 - the type is now, say, all 10 point Helvetica
 - the hypertext link is shown in green

A significant outcome of this empowerment of the user in relation to the document's appearance is that for those users who are visually impaired or are struggling against adverse viewing conditions, it is a simple matter to set the type styles used by the browser to more acceptable sizes.

Automating design

HTML takes further the approach adopted by advanced word-processors and page-layout packages in allowing marked-up text to be automatically laid out. Once the semantic structure of the document has been decided and encapsulated in the necessary codes, no further intervention is needed (or indeed possible). A text document is marked-up, or the text is inserted into a prepared template and the design is taken care of by the standards of HTML, modified by the end-user's preferences.

This automation deprives graphic designers of many opportunities to exercise the subtleties to which they are accustomed, but it makes for an efficient production-line approach to the laying out of large quantities of text.

This approach has a lot to offer Education, where many documents share a common structure, for example course module descriptions. Fully marked-up text can be automatically generated from a database which stores every module description. For such documents which share a structure and to a large extent a style across a whole institution, there is very little to be said for everyone creating their own formatted text. In addition, where cross-reference to a common text is required, for example to the attendance regulations, the hypertext link which invokes this single document can be inserted automatically in every module document. If it is altered, it appears in its new form in every single location where it is cited.

Functional markup versus fixed formatting —an important debate

The Web is in many ways in a state of flux. Its future direction is unpredictable. Choices made now (but largely out of our control) will dictate the kinds of documents we can make and use.

Prominent among the opposed choices is that of functional markup versus fixed formatting. While this might seem only of technical interest, the choice has a particular impact on work made for the Web. It touches on issues of communication, information and design, and affects the decisions we make about document strategies in Higher Education.



To produce a printed document using computers, we can choose a fixed format or a functional description approach

To produce a printed document like the one illustrated, we could take one of three approaches:

- **The fixed format approach**

We can use the computer to indicate explicitly the visual formatting to be applied to the various parts, for example, choosing a bold style for the headlines: this is the approach taken by simple word-processing packages.

- **The functional description approach**

We could indicate the function of each element and then as a separate process apply any specific visual formatting on the basis of that functional description. This is the approach taken by mark-up languages (and therefore by HTML, the Hypertext Markup Language for the Web).

- **A hybrid approach**

Another common approach which is a hybrid of the previous two is to use style sheets, in the way that page layout and more advanced word-processors do. An account of what differentiates this from HTML is given below (p37).

Advantages of functional description (the HTML approach)

In functional description, each element of a document is given a descriptive tag, which indicates its role, for example as a headline, as an emphasised word, as an item in a numbered list, and so forth. Here we look at the advantages in principle of this approach, and begin to see how it impacts on Web work. Key advantages are portability, the ability to make multiple publications from a single source, to make

publications which change their form according to need, and the partial automation of layout.

Portability

- Content which does not fit the available display can be reformatted automatically to suit the space available.

In practice

All popular Web browsers can reflow text to fit the space available. However few can resize graphics and other multimedia components, losing some of the advantages of this flexible approach.

Page designers may override the ability of the browser to reflow the text to fit the screen, for example by using **tables** (see 62). Under these circumstances, the user may have to scroll the browser window sideways to see all of the content, militating against one of the strengths of functional description.

- The publisher of a Web document need not know whether the user has exactly the right typefaces, since the browser software will choose from the typefaces available, according to preferences set by the user.

In practice

The issue of fonts is one of the most problematic in the exchange of electronic texts. The fundamental problem is that fonts are intellectual property and cannot be given away with the documents that use them. In any case, for users to have to install the fonts for every document they read would be intolerable. The Web adopts a simple solution, which is to avoid transmitting font information altogether: there are no HTML instructions for specifying fonts. Instead documents are reconstituted on the user's machine in whatever fonts are available (normally a default font for the browser or one chosen by the user).

- Functional descriptions can be interpreted differently by different display devices. For example, hypertext links could be displayed in colour on a colour monitor but underlined on a monochrome monitor.

In practice

This approach means that at least the textual content of documents can be delivered to users who have a text-only display. However, as increasing use is made of graphics and other media in Web pages, these advantages can also be undermined.

Multiple publications

- When a differently formatted publication is required it can be produced not by changing the functional descriptions but simply by altering the formatting instructions. By this method, material can be made to appear in radically different formats, such as on paper and on screen.

In practice

Up to a point, documents prepared for the Web can also be laid out on paper using some of the same mark-up tags as control the presentation on screen. This means

that where documents are required in both screen and paper forms, economies of effort are possible. However, due to the differences between true functional description and the hybrid approach using style-sheets adopted by most page-layout packages, some reworking will be necessary whether material is transferred from the Web to paper or vice-versa.

Filtering and configurable presentation

- When the components of a document are described functionally, the document can be presented in different ways on demand. For example, main headings alone could be presented at one moment, while greater detail is presented when the user requests it (an example of this approach is the choice between headings and detail offered by **outliner** software).

In practice

Some proprietary hypertext systems (for example, Guide) offer this possibility of unfolding text which adds to or replaces the top-level summary information within the same document. Web browsers do not offer levels of detail in this way. However, HTML does make it easy to present summary information on one 'page' and fuller detail on another. The user moves from one to the other by clicking on the summary text. It is necessary for the designer to provide a 'go back' facility which returns the user to the original summary text unless the user is to use the 'go back' facility of the browser itself.

Special needs

- Users can adjust the way in which the content is presented to suit their needs.

In practice

A larger default size of type can be chosen in most browsers. The relative sizes of larger and smaller type within the document are preserved.

Plug-ins for popular browsers allow **text-to-speech** software to read aloud the text of a Web page.

In principle, hypertext links could identify themselves by emitting a sound when pointed at. However we do not know of any browser which actually offers this kind of facility.

Integration of hypertext links in the document description

- Primitive hypertext systems separate the description of what the text looks like from its hypertext 'behaviour'. Functional description allows the same method to indicate that something is, say, an emphasised word or a hypertext link point.

In practice

Just as an element of the text can be specified as, say, Heading Level 2, so any part of the text can be made into an active item. The same is true of a picture. An active item will typically be a hypertext link to another page (an 'anchor'), but might instead open an e-mail editing window or activate some other interaction.

Since the tagging of an element is bound to the element itself the tags are embedded

in the text the function of the element will always be carried with it. This is one of the great merits of HTML over other systems which use position on the page to store the location of active areas. Without this binding of the element to its behaviour, there is a real danger that the interactive function will separate from the triggering element, typically as a result of the document having been edited.

This text has an *emphasised* word and a [hypertext](#) link in it. Each is specified in a similar way. The linking is bound to the link word in a way which withstands changes caused by editing. It is also easier to automate the process of making links, for example by using search and replace to turn all occurrences of a particular word into hypertext links.

```
<p>This text has an <em>emphasised</em> word and a <A HREF="name  
of document to link to">hypertext</A> link in it. Each is  
specified in a similar way. The linking is bound to the link  
word in a way which withstands changes caused by editing. It is  
also easier to automate the process of making links, for example  
by using search and replace to turn all occurrences of a  
particular word into hypertext links.</p>
```

Functional description

The upper text, as displayed to the user in a Web browser, was generated from the HTML markup in the text beneath it. Note that the form and use of the tags is the same, whether the 'behaviour' intended is that a text item should be visually emphasised or that it should be turned into a hypertext trigger leading to another text.

Contrast this with the method illustrated below, where hypertext links are specified by a completely different process from that used to specify the appearance.

This text has an emphasised word and a [hypertext](#) link in it. They are specified in different ways. The styling of the emphasised word is done explicitly by choosing italic in a page layout package. The creation of the hypertext 'hot-spot' is done graphically and therefore relates to a position on the page, not to the word itself. This creates a fragile hypertext easily disrupted by editing.

Fixed formatting

While the outward appearance to the user might be the same, in this example the hypertext link point was specified using a graphical position on the page. This is a fragile method, since editing and the resultant reformatting of the text will cause the links to become separated from their words!

In addition, it is not possible to automate the process of turning given words into hypertext links, since it is not really the word which is linked but the position on the page where the word lies.

Separation of roles

- Writers will usually be willing to concern themselves with the function of the elements of their work, but may lack the confidence or ability to deal with the visual appearance. Functional description allows the writer to tag the text in a semantic way, leaving aside the issue of how it will look. This can then be taken care of as a separate process independent of the content.

Even where author and designer are the same person, it is often useful to be able to separate the origination and the presentation of the content.

In practice

In authoring an HTML page, it often happens that once the page appears in the Web browser window writers does not like what they see, and may then change the functional description to cause a happier result to appear. For example, the writer decides that all the Heading Level 2 subheads in a document simply look too big and changes them all to Heading Level 3 in order to get a more acceptable appearance.

This is not strictly within the spirit of functional description, but in practice does no harm.

Since the tags which dictate the appearance are themselves simply text, it is easy to search for every occurrence of a particular tag in the text editor and replace them with a new one. This is highly preferable to the simplest fixed format approach which would require every item to be changed individually by hand.

Automated layout

- Though designers will always regard themselves as essential, there is scope in simple functional documents for ignoring their contribution altogether, relying on the design principles incorporated in Web browsers themselves. Particularly where large quantities of text are involved, any opportunity to automate the laying out of pages should be welcomed.

In practice

In creating documents for the Web, there is scope for partial automation by a variety of methods. Text is formatted by choosing appropriate functional descriptions for each element, and the browser does the rest. Where documents follow a regular pattern, templates can be prepared which contain all the necessary tags for the expected parts. If very large quantities of repetitive data are to be formatted, then it may be worth exporting it from a database with the appropriate tag automatically appended (for example by a script in a scriptable database). Taking this idea one step further, the data can be retrieved from a database on the fly and inserted into the page whenever the user chooses a particular option.

Automation of layout for Web Pages

Relying on the browser

Use the layout principles built into Web browsers

Preparing templates

Use templates (frequently used tags are placed in a suitable order)

Exporting from databases (as a one-off authoring process)

Export data from a database and use a custom-made program to insert the appropriate markup tags

Export data from a database, using its scripting language to insert the appropriate markup tags

Exporting from databases (continuously on Web server)

Use a CGI to get data on demand from the database and put it into the Web page

There are several ways of usefully automating the layout of Web pages.

This last will be the only solution where there are very large quantities of data in similar formats, especially if that data is regularly changing. For example, if course materials are delivered on-line, there will be a need for information about who the student is, which module they are currently taking, where in the module they have reached, their personal preferences, their previous records and many other related items to be taken into account in dictating what each user sees on the page. A very substantial amount of setting-up would be required for such a system.

Disadvantages of functional description

Some of the strongest opponents of the functional description approach are designers. Some of their objections are made with good reason, others not. These points are particularly relevant to Adobe Acrobat, discussed in Appendix Three, a solution based on fixed formatting, and therefore strongly contrasted to the principles of functional description.

Perceived disadvantages include: lack of control over layout and over typography; poor integration of various media; lack of resemblance to paper documents; and a lack of visual 'quality'.

Lack of control over layout

Document designers use layout not just to make a decorative page but to lead the eye of the reader usefully from one part of the information to another. HTML is accused of providing insufficient control for the designer in dictating exactly where elements of the page will appear.

In practice

Even within the limited design which straightforward HTML text provides, there is considerable scope for the user to identify which items are most important and understand how they are intended to find routes through the text.

Introduction

A unique feature of the stress model is that it provides the opportunity for individuals to empower themselves and gain greater control over their healthcare management during what has become termed the 'latent period'.

Using the stress model, the Heal Trust's therapeutic priority is to attempt to prevent the development of AIDS for people diagnosed HIV positive and to provide effective, non-toxic therapeutic options both for the prevention of the development of AIDS and for the treatment of people who already have an AIDS diagnosis.

The stress model emphasises the following points:

- microbial stress:
multiple and concurrent infections; e.g. viral, bacterial, fungal and protozoal
- toxic stress:
from recreational drug use from overuse of orthodox medical drugs.
- psychological stress
from an antibody positive diagnosis as well as psycho-social stress
- nutritional stress
from depleted antioxidant reservoirs as well as other nutritional deficiencies.

Even within straightforward textual Web pages, the use of different sizes of type, indents and bullets (all automatically applied by the browser on the basis of the HTML markup) can assist users in identifying the structure of the document the way in which the author intends them to read it.

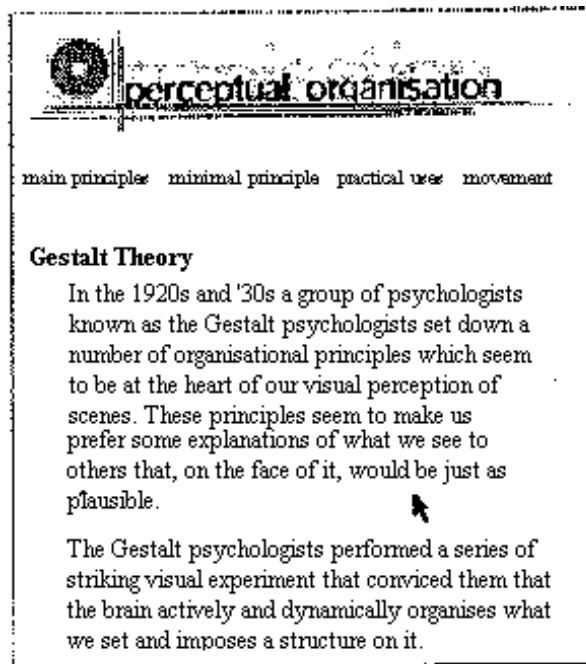
It is true that the original HTML Version 1.0 had little to offer beyond a single column of text interrupted by pictures. Later versions have provided greater facilities for, for example, multi-column layout and the placing of images. However, the use of tables which has become popular as a way of getting greater control over the placing of text removes some of the advantages of portability, since tables are designed to impede the ability of the text to reflow to fit the window available.

Lack of control over typography

Currently there is nothing which fully overcomes the problem of users not having the fonts that the publisher would like them to have (publishers cannot give away fonts because they are commercial property). Adobe, with their overriding emphasis on the appearance of documents, have gone the furthest by providing variable fonts from which something approximating the missing fonts can be reconstituted at need: it will have the same spacing, line-length and broad characteristics as the original. Even this is only a step towards what designers would like: the ability (which they have in designing paper documents) to choose from hundreds of different fonts, knowing that this will give a particular character to the publication and that what they design will be what the user sees.

In practice

Sadly, with current HTML, users will end up seeing almost every document in one or at the most two fonts. This makes it difficult for an individual document or an institution to establish a 'voice' using a distinctive font. A work-around increasingly widely adopted is to use pixel graphics for headlines in distinctive fonts. See also **Web style sheets**, under The Future, p54.

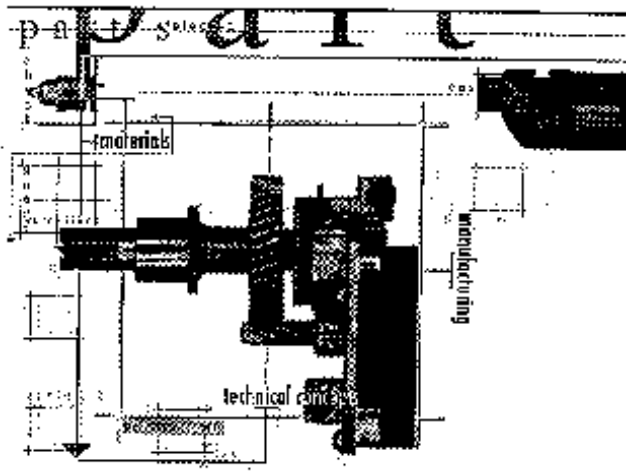


In this frame from a Web page, the top decorated title is a pixel graphic sent as a GIF file, while the subheads are normal HTML headings.

The disadvantages of this solution are that the user with a text-only browser will not see graphical headings; they cannot be searched for as text (they are just pictures of text, not the real thing); and those with poor vision will not be able to have such false text spoken using a text-to-speech converter, as they could if it were real text.

Poor integration of various media

Outside the limits of the Web, steps have been made recently in fully integrating all of the components of multimedia into a seamless surface, using authoring tools such as Macromedia Director. This is currently difficult to achieve on the Web, partly because of the inherited textual bias of HTML.



In this non-Web multimedia document a close integration of text and graphics is possible using Macromedia Director, avoiding the limitations imposed by HTML.

In practice

Though many more media types are becoming available to some Web users through the use of 'plug-ins' for browsers like Netscape, it is still difficult to produce complete media integration. Instead the user sees a patchwork of rectangles each supporting different activities. Ironically, the only way currently to achieve the sort of integration of media shown in the illustration is to make modules in Director and then deliver them as Shockwave items over the Web, but the demands on computer speed and memory of large documents of this kind are currently prohibitive.

Lack of resemblance to paper documents

This might seem an odd objection to an electronic document, but there may be occasions when a close resemblance to a paper document—a piece of virtual paper—is desirable on screen.

'Virtual paper' may be valuable when:

- the user should recognise something on screen as a familiar document
- the screen is being used to proof at a distance the appearance of a paper document
- the main purpose of the screen display is simply to enable the user to preview a document which they are being invited to print out.

Lack of visual 'quality'

The functional description approach has flexible outcomes which may well be inferior to the look of a 'designed' page on paper, since it is limited in the range of visual styles it can draw on. Paper documents by contrast can make use of distinctive typefaces and unusual layouts to achieve a different 'look'.

In practice

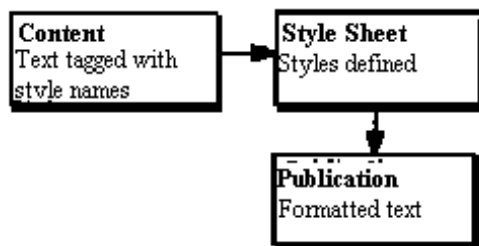
It is not right to discount this as merely an issue concerning decoration and therefore not a serious matter. If the aim of a Web page is to be read, viewed, interacted with, then the appearance of that page must be able to motivate the

reader. It is unreasonable to hope that a reader will be entirely motivated by anticipating a benefit from the content alone: if this were the case, there would be no graphic designers! However, users are fortunately often willing to sacrifice some weaknesses of the medium—in terms of its visual qualities—for the convenience and accessibility of the content.

The style-sheet approach—neither one thing nor the other

Some of the commonest software tools page-layout packages and the more advanced word-processors do not wholly adopt either fixed formatting or functional description, but a hybrid of the two involving style-sheets. The shortfalls of this approach compared with the full functional description of HTML are worth considering.

In a page-layout package, any whole paragraph may be given a named style. So for example in this handbook created in Adobe PageMaker, this current paragraph is in a style called 'body', while the one-line paragraph forming the sub-heading 'The style-sheet approach neither one thing nor the other', is in a style called 'subhead'. The definition of how these styles should appear is stored *independently*, so if we want to set every paragraph whose style is 'body' in a different font, this is easily done by changing the definition of the style. The appearance of all paragraphs in that style is instantly altered.



The style-sheet approach: tagged paragraphs of text acquire the styles assigned to them by the style sheet

If the text from such a document is exported, the tags are made visible, appended to the beginning of the relevant paragraphs in angle-brackets:

```
<body>In a page-layout package, any paragraph may be given a  
named style.
```

A paragraph output from a page-layout package. The tag is in angle-brackets at the beginning (a widely used convention to which HTML also conforms).

A benefit of this technique, and one which applies equally to markup for style-sheets and markup in HTML, is that content can be prepared in even the crudest text-editing system, since the formatting is specified only by the name of the tags, which are simply more text, partitioned off from the actual content-text by the < and > tag-markers.

HTML looks at first sight similar to these style-sheet tags. However, there are important differences: style-sheets have limitations which HTML avoids.

Style-sheets typically only work with whole paragraphs

In most page-layout packages, it is not possible to tag anything smaller than a complete paragraph. So for example, in the sentence 'We recommend that the

University move to a position of assuming that paper documents will **not** be produced,' tagging is not capable of recording that the word 'not' is in bold. In HTML on the other hand, the size of an element is immaterial—it can be as small as a single character.

```
<p>We recommend that the University move to a position of assuming
that paper documents will <emphasis>not</emphasis> be
produced.</p>
```

A paragraph of HTML. Each element has a start-tag and an end-tag. In this example, an emphasised element is contained (nested) within a paragraph element.

Thus a tag can dictate the behaviour of as small an item as a single letter, just as well as it can for a whole paragraph.

Style-sheets in page layout packages prohibit structures within structures

Given that only paragraphs can be tagged, elements cannot be 'nested' that is, one kind of element cannot be contained inside another. In HTML by contrast, nested structures represent one of the most useful features. For example, it is through the use of a nested structure that lists can be represented.

- 1 How Acrobat and HTML work
- 2 The style of electronic documents
- 3 The work of the project
- 4 Organising University documentation

```
<OL>
<LI>How Acrobat and HTML work
<LI>The style of electronic documents
<LI>The work of the project
<LI>Organising University documentation
</OL>
```

A list above as displayed and below as tagged in HTML: each line is tagged as a List Item (using the tag) and the group of lines is contained in an overall pair of tags (and) indicating that this is an Ordered (ie. numbered) List.

The tags are displayed in this example in order to clarify the principles on which HTML works, but it should be remembered that there is a decreasing need for Web publishers to edit these codes directly themselves, as more software becomes available which does the work.

One useful result is that the machine can be used to do tedious and error-prone work which would otherwise need to be done by hand. For example a new item can be introduced into a numbered list (and which HEI does not deal in extraordinary quantities of lists?) without any need to renumber: the browser does the numbering instead of the author doing it. The browser also indents the list appropriately and provides suitable spacing between the items.

Even page layout style sheets are preferable to crude fixed formatting, in that they avoid the need to do the formatting of each item individually by hand, and allow content and design to be separated. But the kinds of structures used in HTML take the style sheet concept further, and in so doing make it more effective.

Evaluating interactive information technologies

We can apply our understanding of the difference between functional description and fixed formatting to the selection of particular technologies. Even though, as we shall see, we are increasingly able to combine elements of different technologies, it is still necessary to understand their differing characteristics in order to use each effectively.

Here we offer an evaluation of three interactive publishing solutions. The specific conclusions of this evaluation will become out of date as individual technologies develop. However the underlying principles and the issues raised will not. Readers will make their own decisions about which of these are appropriate to their circumstances.

Criteria

- Platform independence
There is no excuse for making documents which only work on a PC, on a Macintosh, under Unix etc. Most HEIs have a variety of machines running various operating systems and HEIs should not perpetuate the balkanisation of proprietary systems. A number of packages such as Toolbook (Windows only) and HyperCard (Macintosh only) are immediately ruled out by this requirement.
- Economy
The cost of authoring systems is one part of the economic issue. In addition, if a licence fee is payable for each copy of the document (for example because a 'player' package is required in order to deliver the document), then for a large number of users this will in itself become a problem.
- Access
Assuming the user has access to a suitable computer, will the reader software be certainly available on it? Will the documents themselves be readily accessible?
- Ease of use
Will the authoring software be easy for the originator to use, and the delivery software likewise for the reader?
- Functions available
Will the technology chosen be able to support the range of functions required? For example, what are the facilities for hypertext linking; for displaying video; for useful forms of interaction?

Technologies evaluated

We consider here just three technologies: those of Macromedia Director, Adobe Acrobat and HTML. Our comments on their current suitability for interactive multimedia publishing should not be taken to imply any opinion about their value for other purposes.

- MacroMedia Director
This is a comprehensive multimedia package allowing a wide range of effects to be achieved. In Director the screen is a 'stage' on which objects appear at their due time

and 'perform' either under the control of the package itself, or in response to the user's actions. Until 1995 Director was irrelevant to the World Wide Web, being dedicated to local use on hard-disk or CD-ROM, but the development of Shockwave changed this. By converting Director movies to Shockwave, they can be made available as components of Web pages. In addition, Director is acquiring the ability to itself retrieve data from the Web. Director is available for Windows and Macintosh, plus 'players' for some other systems.

There are several other authoring packages for interactive multimedia, but Director is a comprehensive package widely used and in this evaluation can to a certain extent stand in for all applications of this type.

- **Adobe Acrobat**

The original emphasis of Acrobat was the on-screen presentation of documents which also existed or were intended to exist on paper, but it is increasingly seen as a system for creating screen-based material. Available for Windows, Macintosh, DOS, Unix.

Acrobat is not the only system of its kind. For example Envoy claims technical superiority to Acrobat while offering a similar range of functions. However, Adobe are such a powerful company that it must be doubted if other similar solutions will acquire a sufficient number of users to maintain momentum.

- **HTML**

HTML is not a package, but a format for information transfer. Browsers (readers) for HTML documents on the Web are available for DOS, Windows, Macintosh, Unix and other platforms. Familiar examples are Mosaic, Netscape, Internet Explorer.

HTML was described p24-28 and there is a description of Acrobat in Appendix Three, p104-7.

The evaluation

Platform independence

All three systems evaluated here aim to solve the problem of platform-independence, but in different ways.

HTML, being a standard for formatting information, rather than a package, directly addresses the issue of platform independence its main purpose after all is to overcome the problems that arise when computers of different kinds are connected to one another for information transfer.

Acrobat also aims to overcome the problems of platform dependence. It places particular emphasis on preserving the appearance of the electronic 'page', even to the extent of being able to create reasonable substitutes for fonts missing from the end-user's machine. Files for Acrobat (PDF files Portable Document Format) can be viewed in a self-contained viewer, or can be viewed using the Acrobat plug-in for browsers such as Netscape.

Director can produce stand-alone applications for Windows, Macintosh and other platforms, though the files themselves are specific to the platforms for which they are

made duplicate files are needed where two platforms are to be supported.

Director's 'Shockwave' files, offering much of the functionality of full Director files, being designed specifically for the Web, are not confined to a single platform. The file is played for the user by means of a plug-in for a browser such as Netscape.

Economy

It would be unreasonable here to give price information which would become out of date. However, the broad approach to pricing may remain the same for some time.

Director is a rather expensive authoring package, even when educational discounts are taken into account. Stand-alone Director files (ie which do not need the authoring package in order to be used) and Shockwave files can be distributed free of charge where publication is not for profit (though the use of the authoring package must be acknowledged). Where files for more than one platform are required, a copy of the authoring package must be purchased for each platform, usually Macintosh and Windows. Files made to deliver over the Web are processed in an ancillary package called Afterburner.

Acrobat has two principal components: one, moderately expensive, for authoring (Acrobat Exchange) and one for browsing (Acrobat Reader). The Reader can be distributed free with Acrobat files. The educational discount is currently substantial.

It must be admitted that the future financial position concerning the authoring and browsing tools for **HTML** documents is unclear. For example, when the most popular browser—Netscape—changed from being shareware to a commercial product, it remained free to education users. We have to assume that Netscape or a similar comprehensive browser will be on every computer in HEIs since it provides such an important component of access to the Internet, which all students and staff will want for many reasons (particularly research). Shareware and freeware browsers are also available. If comprehensive browsers like Netscape ceased to be free, the effect on the HE community would be very serious.

Ancillary packages

None of the systems considered offers a full range of tools for creating and editing the graphics, sounds or filmic sequences which may be needed as components of an electronic document. Therefore anyone involved in authoring such documents must also have access to suitable packages such as Photoshop, SoundEdit, Premiere etc.

Access

In every case, there is a need for the end-user to have access both to the documents and to suitable delivery software. In some cases for example Director the delivery software can be embedded in the documents.

A related issue is that of the **openness** of the system. The three technologies evaluated cover the range from complete openness (HTML) to a closed proprietary format (Director). The PDF (Portable Document Format) of Adobe is a published format and so in that sense is open but, unlike HTML, PDF does not have the advantage of a number of tools from a wide range suppliers to both produce and read its documents.

Ease of use

Few authoring systems are as easy to use as is claimed. An element of specialist expertise is required. For those unused to making interactive documents some conceptual difficulties arise, for example with the basic concept of hypertext, quite apart from simply learning to use the relevant packages (What expertise is needed?, p94).

Director is a large program impossible for a novice to master in short time.

Simple **HTML** documents can be created using a basic text editor: all the tagging which dictates their appearance and basic functions consists of text. However, authors are sometimes not in a position to quickly see the results of their choices, and this indirectness in which a component is specified, tested, then revised may be a problem for some authors who need a more direct and intuitive relationship with their material. Using a more visual package to generate the HTML marked up pages may be preferable and in future is likely to become the standard way of working. Examples include paper-publishing tools such as PageMaker or Quark XPress which now have HTML as an optional output, and packages specifically for creating Web pages such as Adobe's PageMill. A SIMA project to evaluate such tools is listed in the Web Resources (p110).

The browsing software for HTML documents is simple to use, partly because of its lack of a rich collection of functions (see below), and partly because the functions which it does support are implemented in a standardised manner likely to be familiar to anyone who has used window+pointer based computing systems. By contrast, documents made with Director are only standard in their appearance and behaviour if the author is both willing and competent to make them so.

In one sense **Acrobat** requires no new skills at all, since at its simplest it can be used to take pages which have been designed as sheets of paper, simply presenting these as 'virtual paper' on screen (the method is to 'print' documents to a disk-file using a virtual printer' driver, instead of to an actual printer).

Functions available

Director offers the fullest range of functions, both in terms of things the end-user can do, and the variety of behaviour which Director can produce in response; HTML and Acrobat (each considered on their own) offer far less. To achieve a seamless integration of media in a fully interactive environment, Director is unrivalled. However, Director does not offer anything very useful to the author or the user who wishes to work with straightforward hypertext. By contrast there are useful built-in hypertext-related functions in HTML browsers like Netscape which are not provided by the other packages. For example, Netscape can use coloured hypertext link marking to indicate to users if a document which is linked to the current one has recently been viewed. This is a genuinely useful facility not found in most other (non-Web) hypertext software. Web browsers can also store and display a 'history list' showing all the nodes that have been visited in the current session, and keep user-defined lists of topics worth returning to.

These facilities of HTML could be imitated by other packages, but the author would need to do all the work of constructing what is provided gratis in HTML browsers.

Adobe **Acrobat** allows documents to be presented on the user's screen which strongly resemble the original, even if the fonts of the original document are not present on the user's machine. From the point of view of the graphical appearance of the page it is therefore a strong contender. However its ability to link documents together is crude (Acrobat, p104). And at the time of writing, Acrobat has no integrated multimedia facilities.

As an environment for interesting, expressive design, HTML on its own currently offers little. It has become an important issue to try to design successfully within the limitations of such a system. However, Web pages based only on HTML do offer a set of functions which constitute a good basic hypertext environment. See **The future: a better hypertext system?** (p52).

Summary conclusions

The issues are essentially these:

- 1 Does any of these technologies offer on its own everything that the publisher of interactive electronic material requires? Can any one of the three approaches be omitted, the other two being sufficient for all purposes?
- 2 Can these technologies be used effectively together?
- 3 If hybrid solutions involving two or three of the available technologies are required, what role should each have?
- 4 Are there requirements which even these three technologies used together do not meet?

Does any of these technologies offer everything?

While HTML on its own is effective for offering simple textual and graphic information, the expectations of publishers and end-users are rapidly outstripping anything which it alone can provide. Acrobat offers a poor hypertext system but good control over document appearance, especially where resemblance to actual paper documents is important. It also is the easiest system to use, if used merely to make electronic 'virtual paper' documents. Director and other interactive multimedia packages are able to offer many facilities which are missing from both HTML and Acrobat.

In Higher Education we will want to make sets of documents which offer possibilities such as these (for instance):

- extensive text with effective hypertext linking, and which can be stored at distributed locations
- virtual paper' documents
- interactive material such as simulations which provide rich forms of interaction and which fully integrate multiple media including sound and animation

For a system of any scale and ambition therefore we must conclude that all three types of technology will be required.

Can these technologies be used together?

It is possible to get the best of all worlds by using HTML as the backbone of Web documents and augmenting it with modules employing other technologies as appropriate. Acrobat documents can be displayed in a separate windows or within the frame structure of a Web page. Shockwave (Director) files can be placed within Web pages or in a frame of their own in frame-based browsers.

Using HTML has meant, until recently, losing out on the strengths of the alternative approaches, principally 1 the full integration of different media, 2 the possibilities of more varied kinds of interaction 3 the visual quality of what can be produced. These problems can begin to be solved by either of two methods:

- The 'plug-in' architecture of popular web browsers means that to an increasing extent we can combine different media on-line as part of Web documents. Some of these media can be fully interactive for example embedding interactive multimedia components made with Director (or similar) into a 'conventional' Web page. Some additional control over the visual appearance is provided by the development of the HTML standard from version 1 through to version 3. There are also enhancements in proprietary browsers, unfortunately introduced outside the standards process. The most obvious example is the frames facility introduced by Netscape, which allows panes of the browser window to operate independently of one another.
- Another solution is to combine Web material with, say, CD-ROM. This idea has attracted considerable commercial interest, since it offers the advantages of the Web (for example for information which changes rapidly) and of other solutions (for example for large movies, sound files or heavily interactive sections). Each part of the package is thus used for what it does best.
- Developments to multimedia packages may mean that they themselves can be used effectively for retrieving data from the Web, without the need for a separate browser. (see The future p54)).

In hybrid solutions, what role should each technology have?

It must be emphasised that at present HTML is the only system to provide the structural framework within which other Web technologies can be delivered. Acrobat's weaknesses as a hypertext system rule it out from this role, and Director/Shockwave seems even less likely to be able to fulfil it.

While there is current excitement about putting virtual paper on computer screens, so that something can be printed on paper one day and put on screen the next (whether using Acrobat or some other variant of the same concept) we see this as analogous to regarding the car as a horseless carriage or photography as a form of painting. It fails to acknowledge the different nature of the medium and the possibilities which it offers for rethinking styles of communication, not least in HEIs.

Requirements even these three technologies do not meet?

We have concentrated on three technologies which are paradigmatic of particular approaches. If one listened to the advocates of each system one might think that it alone could provide everything needed. However, it is important to emphasise that for particular purposes other supplemental technologies will be required which are not

currently offered even within the three systems described.

Other component facilities which may be needed include drawn (rather than pixel-based) graphics; live video; 3D models; etc. For current information on all such Web technologies, refer to the BrowserWatch site (URL in Web Resources, p110).

For systems of any scale, there will be an increasing reliance on databases at the server end to provide a structured framework for the large quantities of information, comprising many different kinds of media, which will be used and reused for different purposes.

The Web as an educational medium

We have argued that the boundaries between those previously discrete genres—institutional information and academic information—need to be reconsidered. In this section we focus on the implications for the latter.

Within the scope of this handbook it is impossible to deal with deep and complex issues of educational effectiveness, some of which are covered in the Resources cited at p108-9, but we can at least begin to apply some of the principles of this handbook to academic material.

Authoring and design (in the broadest sense) must be addressed from within a context of learning and teaching. In order to develop successful web pages that embody the aims and objectives of a discipline the designer needs to bridge the gap between academic, technical and graphic design principles. In this sense the designer represents an agent of change, exploring the possibilities of the internet, but never losing sight of educational goals, and thereby framing the student's interaction within a pedagogic context.

Currently designers and educators are developing a number of tools that facilitate or support educational processes:

- creation of electronic information resources
- developing research tools e.g. search engines, intelligent agents
- investigation of new forms of writing
- extending publishing frameworks to deal with issues such as copyright, editorial control and security.
- improving the design of virtual environments
- developing collaborative environments
- increasing the interactive potential of the Web through multimedia

The majority of academic information tends to be of a supportive nature, and although there are examples of the web being used for course delivery and assessment, these tend to be restricted to distance learning initiatives. We have chosen to examine how the Web could be used to bring an additional value to existing courses, enhancing the student's educational experience.

Academic reasons for using the internet

We have argued that the Web is a transformational medium. When used within an academic environment it can redefine the delivery, assessment and roles of the teacher and student.

Each time a new technology is applied to teaching and learning, questions about fundamental principles and methods arise. Television and computers, for example have raised issues relating to learning theory, curricula (content, sequence) and methods (delivery, evaluations).

Marchioni 1990

The internet is beginning to reflect the diversity of teaching and learning styles. Electronic text (when combined with interactivity in the form of hypertext), discussion

groups and collaborative working can provide a pedagogic richness that was previously lacking in instructional technology. We are not claiming that hypertext in isolation represents a new development in teaching or learning, but that the Web provides a convergent surface to integrate many kinds of instructional technology.

Information

What kind of information should be provided? With electronic text it is possible to provide a corpus previously located in different areas and on different media, and to create links between these documents. Never before has it been possible to locate these diverse forms of information within the same space. Sadly, a practical limitation of current Web technology which runs counter to this approach is the impossibility of Web users (those who are only readers and not in a position to make their own Web material) creating new or additional hypertext links in existing material.

Hypertext and closure

Hypertext gives users the ability to explore a dynamic text which is neither fixed nor closed in which they actively select a path through a web of related links. Conklin (1987) has referred to it as a medium for thinking and communicating.

The Web designer should remember that the process of structuring information can lead to false assumptions and bias. Whereas the presentation of a subject within a particular framework or schema can aid the initial learning process, at higher levels of learning this schema can interfere with developing complex cognitive structures. Rand et al (1992) state that 'ill defined domains', which commonly occur at higher levels of learning, such as literary criticism, history, medicine, cannot be simplified for the sake of a clarity which is false. They argue that hypertext can be used successfully to represent such 'ill structured' domains. It is well documented that instructional technology has often failed to bridge the conceptual gap between reinforcing existing knowledge and being able to apply knowledge outside the immediate task. This is sometimes referred to as 'cognitive flexibility', and emphasises the need for learners to be able to construct new schema to solve problems for themselves.

...the ability to represent knowledge from different conceptual and case perspectives and then, when the knowledge must later be used, the ability to construct from those different conceptual and case representations a knowledge ensemble tailored to the needs of the understanding or problem-solving situation at hand.

Spiro et al 1991

There is a tendency to force new media into existing documentary frameworks which McLuhan describes as 'rear view mirror thinking' (cited in Postman 1985). Attempts to constrain hypertext within the boundaries of paper based media have not always been successful. Spiro et al propose instead using the fluid, dynamic attributes of hypertext to represent ill defined domains. This medium can broaden the curriculum and support an inter-disciplinary focus; an 'intertwining' of subjects. This aspect seems to be ideal for Higher Education where it is possible to specify a topic, but not the facts that must be learned nor the boundaries of a subject.

The Web can enhance a multi-disciplinary approach to education by providing links between disparate texts. Learners may experience a subject without traditional

boundaries and are encouraged to take on an active role by exploring areas of interest and closing off other areas for themselves. These links, although increasing the complexity of a subject, have the ability to portray alternative conceptual or methodological perspectives allowing the student to revisit the content from multiple view points.

The text is a preliminary blueprint for constructing an understanding. The information contained in the text must be combined with information outside of the text, including most prominently the prior knowledge of the learner, to form a complete and adequate representation of the text's meaning.

Spiro et al 1991

In the same way that hypertext helps defy closure between disciplines, the representation of information also undergoes a transformation. The Web provides a convergent surface for many forms of media. The designer is no longer restricted to screenfuls of text, but can now combine graphics, animation and sound to present multiple representations of a concept to a learner.

Nodes could be based on the most appropriate media, alternative media could be used, time variant concepts could be better transformed into information using time-based media like audio or video.

Mühlauser 1990

User-centred text

Electronic texts provide new possibilities for learning and teaching. In the field of creative writing. By the fact that they can be copied and edited, they can invite the reader to engage in a textual play. To use the terms developed by Barthes (1974), some texts are readerly in that they do not encourage the reader to play with meaning, whereas some texts can be writerly where the reader is not the passive consumer of meaning, but reworks the text to his or her own end. In designing web sites for teaching and learning we must take both forms of text into consideration.

An example site ('Hai-Rise', Design Case Studies p78) shifts the focus between perceiving the user as reader and as contributor /writer. It is a web site that aims to provide a space to allow the reader to comment on the poems and contribute his or her own. This student project brings out some interesting questions.

How much freedom for users' interaction?

Designing for interaction begs the question of how much freedom we allow users to author information themselves, individually or within a collaborative group.

Learners ... need to be able to collaborate with other students and with the teacher over specific units of information. Most importantly, they must be able to build their own knowledge systems, either from scratch or by abstracting, rearranging and adding to an existing database.

Duffy, Knuth 1990

Editorial control

For the Hai-Rise project, the decision was made that all contributions made by readers should be selected and filtered by the authors of the site, in the role of editor, to ensure

that it complied with the aims of the site and ensured a particular quality. Once again, we have an instance where academics must be in command of the technology, rather than at its mercy, in order to make these kinds of editorial choices. This is one case from the much broader issue of who is in control of the new publishing mechanisms (p92)

The Web as research tool

The Web's common standard for information exchange means that one can retrieve, edit and store information from many sources. There are vast databases available which when combined with search facilities such as Lycos can act as a powerful tool. In the same way it is also possible to link up to library cataloguing systems both nationally and internationally and research databases like BIDS.

The Web is also used to support the publication of electronic academic journals. The journal is an important text for students who, by familiarising themselves with the language and structure, learn to follow references and citation and eventually write their own papers. However, the electronic journal poses an interesting problem for the designer. Should one preserve the conceptual model of the book, on screen? Perhaps by mapping one model on to another the user will be able to transfer their existing knowledge based on a print culture to a new medium. Yet the electronic book is an oxymoron in that the typographic conventions of publishing are displaced by the virtual space of pixels on screen. Neither the physical properties of the paper document (its size, texture, weight or colour) or the informational structure are present within a hypertext version.

If a new technology is to be accepted, it needs to provide even more than the system it replaces in terms of functionality.

McKnight, Richardson, Dillon 1990

By presenting information previously developed for a linear structure within a non-linear hypertextual structure it is not sufficient to think that one medium will automatically transfer to another, without rethinking the aims of the journal.

The designer needs to think of providing additional functionality to a journal in electronic form. Benefits include:

- compact storage
- speed of retrieval
- extensive searching facilities
- additional media, for example
 - animation, to clarify a time-based or spatial concept
 - interactive formulae where users can try what-if models with their own data

If students, by reading paper-based journals, are learning a formalised methodology then there is need to develop new cognitive processes to be able to read hypertext journals. McKnight et al refute the notion that the reader approaches the text in a serial way: '[Readers] prefer to "jump about" from section to section, typically from introduction to references or discussion'.

McKnight et al have researched the way in which students read journals and make a number of recommendations for the design of electronic journals.

- When designing electronic journals we should accommodate the study needs of the reader, using the technology to enable them to scan and search for relevant concepts.
- We need to reduce confusion in a hypertext system about what is and what isn't a related topic to prevent loss of meaning.
- The designer and author must work closely together in order to avoid discrepancies regarding the linkage of ideas.
- Structure the information to provide different levels of granularity.
- Create collaborative environments where information is shared, debated, supported and analysed.

There has been a movement away from using technology to deliver and test specified facts, to using technology as a tool to allow students to develop their own thinking. Many researchers (Jonassen, Cunningham, Spiro, 1992) have argued that for learning to take place it is necessary to create a social framework. Using the potential of the internet as a communication medium it is possible to set up discussion group and collaborative environments. These researchers have emphasised the need to create authentic learning activities and the need to break down the boundaries between academic and non academic activities.

Hypertextual information structures require students to acknowledge multiple view points and to develop their own perspective or understanding of the topic. By making this process explicit, students can also reflect upon the process of learning.

The extended HEI

The internet allows students to experience a greater pluralism of ideas no longer bounded by a physical environment. Students can be connected across sites and across HEIs both nationally and internationally. Increasingly the non-Web aspects of the internet, such as e-mail and newsgroups, are available within Web browsers.

Usenet groups can be set up as alternative discussion groups outside class contact. (Tessier 1996) All messages are accessed and posted to the usenet group through e-mail (a feature increasingly accessible from within Web browsers). Like the telephone, and unlike the Web per se, usenet groups offer two way communication, but in addition, a message can be posted to hundreds of readers, so that all conversation takes place in a public forum.

Usenet groups can be used to encourage students to participate in a course-based discussion, with two aims:

- to provide a collaborative learning environment in which students could discuss topics, see the richness and variety of arguments, alternative points of view
- by debating issues it was hoped that students would be more prepared for their examinations. It was also hoped that it would provide greater opportunities for part-time students to take part in the debates.

Augmenting students' skills

On-line communication has a tendency to be less formal than paper-based discourse. Students often use complex cross referencing systems, quotations and graphical symbols to indicate different levels of information to create the feeling of an interactive improvised dialogue. Nevertheless if this medium is being used as part of an

academic discipline then it also threatens definitions of good writing and careful reading' (Bolter 1991). We need to be able to communicate clearly in this medium, but what this means in practice remains to be seen: it should not be taken to mean that writing styles should or will remain unaffected.

Student work on the Web

HEI staff should not regard the Web as their own, one-way, means of communicating to students. For a student or groups of students collaboratively to put work on the Web offers the following advantages:

- student motivation: as the Web becomes more a part of everyday life, students will become more blasé about it, but even so, there will be some satisfaction for students in knowing that the work can be seen beyond the confines of their course.
- peer review: once work is published in this almost effortless way, responses to it may be received from around the world, allowing students ideas to be tested in a far wider sphere than was traditionally possible.
- encouraging professionalism: much student work is effectively a private matter between student and tutor. The opportunity to have one's work seen round the world is likely to promote a greater interest in others' perceptions of one's work than would normally be the case.
- the wider community: students will have an opportunity to discover that they are not alone: feedback from students and others around the world, together with the research that students will probably undertake to discover what sites already exist touching the same areas as their own will tend to make them aware of the outside world.

The potential of the internet as a communication medium changes the interpersonal boundaries of the student's experience. The use of E-mail, Internet Relay Chat and usenet groups, together with Web pages by students and staff alike, creates an extended society and new academic groupings. In order to validate new forms of learning we need to devise new criteria and styles of assessment.

Facilitating contributory learning on the Web

A framework needs to be established to allow students and staff to contribute freely to the Web. Prerequisites include:

- liaison with external relations/publications department if material will be accessible to the outside world (and in general we believe it should be), ensuring conformity to university standards, quality assurance, and copyright.
- technical support: hardware, software and staff time
- staff time for collation of material in electronic form

These needs fit into the broader range of requirements listed under **Creating a maintainable site** (p89).

The future: a better hypertext system?

Web browsers have introduced some valuable hypertext features to a mass of users, notably the indication of links to documents which have already been opened, but there is still plenty of room for improvement.

Nielsen (see **Web Resources**) has proposed a list of facilities which browser ought to provide, which includes

- Better searching facilities
- Overview diagrams of hyper-linked document structures
- 'Tabletops' allowing some hypertext nodes and the ones connected to them to be seen simultaneously (at least some browsers now allow additional windows to be opened)
- Pictorial 'history' cache (in addition to the names of documents as now)
- Relevance ratings on anchors
- Guided tours
- Filtering of anchors

Of all these, in HE it is perhaps the last three which are of greatest importance.

Relevance rating of anchors

Once unusual, it is now common for retrievals from databases to be marked with relevance ratings. There is a need for such a system for the link anchors of the Web. This is one special case of a general need for more **types** of link than the ubiquitous **go to** of the current Web.

Guided tours

Laurillard (1993) has expressed the view that hypertext is not **educational** technology, on the grounds that it does not encapsulate a learning strategy. Laurillard's view is perhaps too dismissive given the many different kinds of hypertext which can be created, but nevertheless there is often a need to bind a hypertext more closely to a learning strategy. An obvious way of doing this is to devise virtual **tours**. Some of the characteristics of such a facility would need to include:

- tours could be created with minimal expertise
- tours could include any Web material
- staff or students would be equally free to construct tours
- students could leave and rejoin tours at any point
- cross-overs between one tour and another should be visible

A postgraduate student project exploring some of these ideas is written up in Bulmer 1995. One way to make the idea work might be through the filtering of anchors.

Filtering of anchors

A fundamental characteristic of HTML technology is that the link anchors are embedded in the document. This has the advantage of technical simplicity, since it is robust in the face of editing changes. But the disadvantage is that each file has only one set of links, and those links cannot be added or removed without editing the source file

We said (Uses of hypertext p12)) that in 1945, Vannevar Bush recognised that the trails which users would build would have their own intellectual (and commercial) value, which was *built* on the documents, but was not *part of* those documents. We can easily see how part of a page might form a part of one user-author's trail while another part of that page might be included in someone else's. Or two critics might gloss the same text, offering different links to commentary and supporting materials. It is clear that to be able to invoke and suppress particular sets of links would be useful for any Web user, but especially for educational users. The current technical structure of HTML makes this impossible.

Other hypertext systems have explored a technically different approach, where link information is kept separately from content information, in principle allowing any set of links to be summoned up or dismissed at will. **Microcosm** is a system developed at Southampton University which in addition to these advantages, is also enabled by its alternative architecture to link documents of any kind, even if the software applications which deliver them are not hypertext-capable.

The future: the Web is changing

HTML is successful because it is (more or less) standardised across computer platforms and international boundaries. However, it is limited in its functions, and many people have ambitions to make it more complex. It is to be hoped that this does not lead to the sort of counter-productive format war from which computing and other technologies have suffered so much in the past, but sadly there are signs that this is happening.

Transparent HTML

HTML may underpin the Web, and currently it may be necessary for publishers to see it and edit its codes, but this need not remain so. Postscript is a page formatting language which is sent by computers to output devices such as printers and imagesetters, but few people have ever seen—let alone edited—any Postscript. This is because textual and graphical software packages offer visual and interactional means to users of specifying what they want, and the package then generates the Postscript code to produce the specified output. Development of similar tools for Web pages is already well advanced, but it is to be hoped that the advantages of HTML's functional description model do not get cast aside in the process, leaving the specification of Web pages as just another graphical layout tool, where none of the smartness of the computer which HTML uses is available.

Style sheets

We have said several times that HTML currently fails to provide the control over document appearance that many publishers want. The least controllable aspects are fonts and layout. Initiatives supported by the World Wide Consortium (see **Web Resources**) are working on solutions to both these problems. A key aim is that, 'by attaching style sheets to the structured documents of the web (e.g. HTML), authors and readers can influence the presentation of documents without sacrificing device-independence or adding new HTML tags.' Netscape, Adobe and Microsoft all claim to support this attempt to 'develop a common way of integrating style sheets into the Web's hypertext documents.' For up to date information refer to the Consortium's page under **Style** and **Fonts**.

Multimedia on the Web

The Web has gone from being predominantly text-based two years ago to a position where graphics are normal and other media types are rapidly being integrated into the browser surface. Any media type we can think of from sound, to 3D simulations, to live two-way video, is capable of being incorporated into the Web, the only impediment being the limitations of 1 the bandwidth of the networks and 2 the processing power of servers and users' machines.

The disappearing browser

It is becoming obvious that the conceptual divide between information which is locally resident on a user's computer, and information which is on the Web, is breaking down. Packages which hitherto ignored the Web are acquiring Web-retrieval capabilities, and operating systems are in development which either treat the Web as an extension of the desktop, or vice-versa. Whereas now browsers are major software packages which are supplemented by **plug-ins** to support specialised functions, it seems likely that this metaphor will be reversed, and that the browsing facilities of computers will themselves

be plug-ins to other major activities.

The network computer

A related metaphorical shift is that from the model of 'the computer' being the box on the desk, connected to a network which is 'outside' it, to the **network computer** model, in which 'the computer' is the distributed power of the computing services at the user's disposal at any one time, regardless of where they are. An analogy might be to question whether 'using the phone' really means using the appliance on the desk, or using the telephone service to which it gives access. **Java** is the programming language most associated with this conceptual shift, since networking is inherent in it rather than supplementary.

Virtual environments

Another area of rapid growth is **virtual reality**. The VR equivalent of HTML is VRML, or Virtual Reality Modelling Language. By analogy with HTML, it aims to achieve cross-platform, trans-national standards for the specification and delivery of three-dimensional models on computer. It may offer some very important advantages over two-dimensional texts and other artefacts, but the discussion is beyond the scope of this handbook.

DESIGN INTO PRODUCTION

Web design for non-designers

What do designers do?

Design theory and design criticism are both huge subjects beyond the scope of this handbook, but it is important to understand roughly what designers do. We need to look at this in general terms, touching on the fundamental principles of information design, and then how it might apply to the Web.

Are Web designers needed?

In the early days, the Web was conceived of as a simple medium, dominated by text which was formatted automatically according to the rules of HTML, and therefore had little need for designers. Indeed, there was very little for them to do! Now however, there are far more possibilities, both in terms of the look of a Web page, and its interactivity, and the skills of a designer are more likely to be needed.

Design is not magic

Designers do not necessarily have any special gifts and mainly work not by inspiration, but on the basis of their training and experience. It is perhaps fair to say that many designers do not 'think what they are doing' in the sense that they have a theory of design which tells them what to do. Designers make many decisions intuitively based on their training and their observation of the work of others. Nevertheless, there are some core principles which inform what the designer does, even unconsciously.

Clarify, amplify, modify

A minimal role for the **information designer** is to **clarify** what the author intends through the use of layout and typography—choosing the size and weight of fonts, as well as which fonts to use, and positioning the elements within the available space.

Examples

By making headlines and subheads of different sizes, the designer clarifies which items are most prominent, or identifies items as equally important by giving them headlines of equal weight. By this means, the hierarchies inherent in the text are represented graphically to the user.

Parts of a text are parenthetical to the main argument, and so are moved into separate 'items' on the page. This is very common in magazines, where it is assumed that readers will not want to read hundreds of words of undifferentiated text, so certain items are boxed off from the main body.

In practice

On a Web page, much of the visual presentation of hierarchies is taken care of by the rules of HTML. If a paragraph is given the status of being tagged **<H1>**, it will be the boldest thing on the page, whereas **<H2>** will be less prominent and so on. In addition, paragraphs of equal prominence can be given identifying bullet-points automatically, simply by identifying them as items of an 'unordered list'.

Placing parenthetical texts in separate graphical areas of the page, is exactly the

sort of thing which HTML has traditionally been poor at. It has not even supported columns, where one column might be used for the main text and another for parenthetical text. Nor has it allowed the placing of graphical boxes around text, or the use of identifying blocks of tint or colour behind the text.

In addition to simply making clear to the user those things which are evidently in the text, the designer may also choose to **amplify** the messages in the original.

Examples

A recent fad in the advertising industry has been to pick out key words in a paragraph of copy, and present those words in different fonts, styles, sizes or colours. These words seem to jump off the page, calling disproportionate attention to themselves from the reader.

In practice

While the designer cannot currently choose different fonts in HTML, it is possible to alter the emphasis (and even the size of words in most browsers). Of course, HTML also has a very prominent built-in emphasis of its own, which it uses for an anchor, clickable hot-text which leads to a hypertext link. Many designers would like to modify the stridency of this highlight, and changes to HTML have allowed the author/designer to dictate what colour and other indication is used for these anchors.

We have discussed clarifying and amplifying the messages of the content. If designers are servants of the author, we may question whether they have any business **modifying** the content, not by copy-editing it, but changing its 'flavour' through design? In many ways designers do this all the time.

Example

Designers can make a text look friendly or intimidating, informal or academic, traditional or modern, by choosing particular typefaces and styles of layout. It is not necessary for readers to recognise a typeface to be influenced by it. It might be argued that information should be 'pure', unaffected by typographical and layout choices, but this is impossible to achieve. Even completely unformatted typescript makes an unavoidable visual statement about itself before the user begins to read.

In practice

Within HTML, no choice of typefaces has been possible. For an internal Web service, **an intranet**, there is some possibility of setting users' font 'preferences' for them in a settings file, but even this is not proof against the user subsequently making their own choices. The desire to have more control over all aspects of the appearance of the page is one of the factors driving towards solutions like that of Adobe Acrobat (p104).

The designer may mould the author's thought by providing some sort of template, however informal. So for example, if the author writes a description of a course according to some pro-forma or style guide, clearly the design will alter the sorts of things which can be said. The designer may want to constrain the amount written to fit comfortably within a single screen which does not require the user to scroll the window in order to see all the text.

In practice

With an increasingly modular approach, and perhaps also with a greater regard for the information needs of the 'customer' than previously, it is likely that templates will be created for many sorts of HEI information. In technical terms, this may provide huge advantages: rather than writing Web pages explicitly, if all module descriptions are stored in a database of identically structured module descriptions, then any enquiry about courses can simply trawl the database and present the relevant information to the user in a page made in answer to their specific query.

Good designers will always subjugate their own ego to the intentions of the author.

Designing with a purpose

Web documents serve many purposes, but this often includes the provision of substantive information. If there is information on a web page it must be there for a reason—information must have a motive behind it. The motive tells the designer to present it: what features of the information to emphasise and what to omit. Information must have an active role for the user: perhaps to make the user aware of something they never knew about, perhaps to answer a question already in the user's mind.

The motive may be:

- to provoke the user to take a new course of action
Example: a page shows how many graduates from a course get jobs in their chosen field, and the user chooses to take that course rather than another
- to alter something the user would otherwise have done
Example: by offering a 'See also...' element in a course module description, an applicant is drawn away from a course to which they are not suited
- to give information so that users may re-use it themselves
Example: you provide pointers to other people's electronic documents which students can use for their research

Many information graphics in particular have no clear rationale. Selecting, editing and designing information with a particular effect on the user in mind is an aspect of **user-centred design** (p69)

Design and pleasure

Perhaps all pleasures in HE should arise from intellectual satisfaction alone. However, if we see it as in any way our remit to motivate students, then one of the potential attractors available to us is the appearance of the many texts, both academic and institutional, which they use. Some academic textbooks seem to revel in a frosty, staid look, which is perhaps seen as appropriately serious. But any designer should be able to produce designs which combine gravitas with friendliness and accessibility (see for example the Death Resource case study, p75)

It is not the role of good designers to make a poorly written text attractive. Nor should designers feel they need to add spurious material to the core content. Edward Tufte

(1983, 1990) illustrates some notable examples of crass information design where the superfluous contributions of the designer significantly detract from the content. His books should be required reading for all information designers.

If one of the roles of design is to please the user, then whom should it please and how? This is often overlooked on an assumption that there are absolute standards of attractiveness.

Visual presentation must be appropriate to

- **the user**

Example: a page that feels right to a first year undergraduate may not do so to a postdoctoral researcher.

- **the use**

Example: information may be presented in large blocks of text if it is for extended reading and the user is likely to print it out to read under better circumstances. If instead the user has immediate information needs, then strictly itemised information with plenty of space around it will probably be preferable. For this sort of use, visual cues can help the reader to find the particular text of interest. These might be for example distinctive symbols and/or colour codes.

In practice

As always, the Web raises interesting new problems as well as solutions. If symbols are used as helpful identifiers for information, then they must be available to all users, and not made impractical by a lack of suitable browser software or speed of network.

A more subtle issue is raised by hypertext structures. Suppose that we choose to colour-code all the pages within a certain group (using HTML's background colour feature). Within that group we make reference to another page. The user sees it as being within the context of the current sub-section and is disorientated on finding that it does not in fact conform to the coding scheme. The developer knows that this is because the page is also cross-referenced from another subgroup! An inexperienced hypertext designer, accustomed only to the less interlinked structure of paper documents, may find themselves unable to handle these new design problems.

Some basic principles of information design

There are basic principles of information design which apply as much to the Web as to paper documents. In addition new issues arise which are specific to interactive electronic documents. This section provides a background to the discussion of design examples which follows.

Since HTML was devised as a means of presenting information visually, based on the functional description of the elements of the text, it is no surprise that it attempts to embody some of the basic principles of information design, which it does by laying out information according to simple 'rules' stored in the various browser packages. Examples of such simple rule-based design include the use of scale (in different font sizes) to represent importance; grouping (for example into appropriately separated paragraphs), and alignment (including indenting and the use of tabulation).

- **Scale**

We can use differences in size to indicate relative importance.

In practice

Sizing of type for headings is automated in HTML, using a hierarchy where H1 is the most important and largest, down to H6, the smallest.

Arbitrary pieces of text can be sized differently in HTML using the **** and **** tag where N is an increment in size in relation to the size defined in BASEFONT (the default is three). HTML-3 has tags called **BIG** and **SMALL**.

Pictures can be any size you wish. Originally in HTML they appeared on the user's screen in the same size as the originator's original picture, but HTML-3 offers **HEIGHT** and **WIDTH** attributes which can be set. Relative sizes of pictorial graphics are an obvious way to indicate hierarchies of importance to the user. For example, if an HEI's logo appears on every page it will be sufficient to have it as small as possible consistent with being decipherable. There is no need for this visual reminder to compete with substantive elements of the page.

Of course making items the same size as each other is a powerful cue that they have similar status—see similarity below.

- **Grouping and spacing**

Items which are clustered together are perceived as forming part of a meaningful group, especially if another separate group is also clustered.

In practice

Whereas page layout packages allow adjustment of the spacing between letters and words, no control is provided in HTML. For paragraphs, the HTML paragraph tags **<p>** and **</p>** identify the start and end of each one. To identify these paragraphs visually, Web browsers insert extra space. The typists convention of using an extra carriage-return to make a paragraph break is not used: in fact, all carriage-return characters are ignored in HTML. Because the space between paragraphs is determined by the browser, the control that a graphic designer might expect over how much space

is inserted is not available. Still less is it possible to dictate whether space is inserted before or after the paragraph.

Similar automatic spacing is used for all other HTML elements, including the various levels of heading, H1 to H6. It is impossible to get less spacing in a Web page than is automatically created, and the only option for making more space is to insert one or more complete empty lines using the **
** tag. Using extra **<p>** tags to make spaces is not correct and is unlikely to work in many browsers, simply being ignored.

Grouping is also used to enable interface controls to be perceived as forming sets with similar functions.



A cluster of controls, whose grouping implies relatedness of function.

Grouping is a powerful aid to successful information design. In tabular information (see **Alignment**) different interpretations can be promoted by using grouping in different ways.

	Coal	Gas	Oil
1992	1.2	1.3	1.2
1994	1.4	1.5	1.4
1996	1.6	1.4	1.5

In this table, comparisons within fuel categories are prioritised

	Coal	Gas	Oil
1992	1.2	1.3	1.2
1994	1.4	1.5	1.4
1996	1.6	1.4	1.5

In this table, attention is drawn instead to the profile within each year

Many browsers now support the HTML **Table** element. Tables made in this way allow a high degree of control over the placing of items.

Tables are an example of something which is tedious and error-prone when done by writing HTML code, and will certainly be automated using graphical layout tools for all but the most purist authors. For more on tables, see **Alignment**, next.

A special case of Grouping is the use of framing and other devices to form a graphical barrier between one block of information and another. See **Framing**, *below*.

● Alignment

Even where items are not neighbours, items which align will tend to be read as of similar significance, conceptually grouped. This both implies similarity between the items, and in some cases invites close attention to differences between them which might otherwise be overlooked.

In practice

One of the simplest forms of alignment in text is the indent. Indents allow the design of hierarchical documents, where, for example, definitions of terms are indented in relation to the term defined, or lists are offset from a bullet using a hanging indent.

Introduction

A unique feature of the stress model is that it provides the opportunity for individuals to empower themselves and gain greater control over their healthcare management during what has become termed the 'latent period'.

Using the stress model, the Heal Trust's therapeutic priority is to attempt to prevent the development of AIDS for people diagnosed HIV positive and to provide effective, non-toxic therapeutic options both for the prevention of the development of AIDS and for the treatment of people who already have an AIDS diagnosis.

The stress model emphasises the following points:

- microbial stress:
multiple and concurrent infections; e.g. viral, bacterial, fungal and protozoal
- toxic stress:
from recreational drug use from overuse of orthodox medical drugs.
- psychological stress
from an antibody positive diagnosis as well as psycho-social stress
- nutritional stress
from depleted antioxidant reservoirs as well as other nutritional deficiencies.

Appropriate alignment and formatting of indents is achieved through the use of HTML lists. In this example, some 'fine-tuning' has been done by using the size tags to affect the size of the text within the bulleted items.

Web browsers automate the indenting of certain HTML elements. For example, there is an element **<DL>**— the Definition List—which contains alternating **DT** and **DD** elements (for the Term and the Definition respectively). These are differentially indented to make the structure clear. The author has no control over the amount of indent, nor the exact style of indenting used.

Tabulation

The **<TABLE>** element can be used to place information at a particular location on the page. Ordinary body text and headings cannot be positioned with as much control, because of browsers' tendency to reflow text to fit the screen window available. Increasingly, Web publishers are tempted to use Tables for purposes other than ordinary tabulation, simply because of this ability to position text and other items in the manner of graphic design for paper. In some respects, the use of tables as a device to fix screen layouts goes against the spirit of HTML itself. When deciding the dimensions of such a layout, the designer is likely to assume that the design will be seen within a standard Netscape or similar window on a display of 640 by 480 pixels. When this assumption is made, then those with lower resolutions will need to scroll horizontally as well as vertically to see the whole design, and those with higher resolutions will find the design makes poor use of the available screen space we are back to the dispute between preformatting and functional description which is a theme of this handbook. If the increasing use of tables as a layout grid for entire pages is any indication, then

there is already considerable resistance to the fluidity and unpredictability of 'classic' HTML, which might suggest again that the visually preformatted approach associated with Adobe Acrobat will eventually dominate.

It is still best to use tables with restraint, where alignment and grouping are absolutely essential and are not possible by other means, rather than to try to use HTML as a rather poor page layout system.

- **Similarity, difference and emphasis**

Items which resemble one another are seen as belonging together, and as having similar meanings, or perhaps levels in a hierarchy.

Items which look different are either given prominence in terms of meaning (such as a word in **bold** type), or are interpreted as indicating a different function from the surrounding elements (for example as active, 'hot' text). In most hypertext systems, there is a danger of these two meanings being confused by the user, and Web documents are not immune to these problems.

In practice

The two most common conventions for differentiating text items from the surrounding body are italic and **bold**. Both are extensively used in this handbook. While HTML provides `` and `<I></I>` tags for this purpose, this flies in the face of the HTML philosophy, and instead the functional descriptions should always be used, namely `` for emphasis (usually rendered in italic) and `` for stronger emphasis (usually rendered in bold). The browser interprets these functional tags as best it can (for example a simple browser on a character-only display may be unable to show italic and may use underline instead).

Texts, especially academic texts, traditionally use these indicators for other purposes as well, such as italic for imported foreign expressions. No HTML functional tag exists for these special uses, so `` or `<I>` must be used despite not being quite appropriate. Similarly, as in this handbook, **bold** may be used for special terms, especially at the moment of their first introduction, as in 'The HTML DTD defines a number of elements which are' Again, no specialised tag exists to represent this function.

Hypertext anchors For text, hypertext anchors must be indicated to the user in a way which cannot be confused with any other form of emphasis. Following the example of Mosaic, Netscape uses by default a blue text-colour and an underline. The text of anchors which have already been visited is by default red in Netscape, fading to purple over a period of time. The colours both of the unvisited and the visited links can be altered using respectively the **LINK** and **VLINK** attributes. Once again there is a tension between the desire of the designer for control (and variety), and the requirement for certain comprehension. Web designers must make up their own minds, but in any case should choose colours wisely. See Colour, below.

Since the aim of the identifying colour is to differentiate anchor text from any other kind, it would be ridiculous to give a text item the appearance of a hypertext link anchor, even though the use of the `` tag and the `<U>` (underline) tag make

this possible.

Blink One of the grossest forms of emphasis, allowed by Netscape, is the BLINK tag which causes text to flash repeatedly on the screen. Such flashing text was a feature of many text-only interfaces up to the 1980s, and arguably it still has its place where safety-critical issues arise and it is imperative to attract the user's attention to a particular part of the display. However, such cases are rare, and BLINK should otherwise be avoided: motion perception is such a powerful feature of our perceptual system that a dynamic element undermines concentration on any other part of the screen.

- **Framing**

We said that grouping and alignment are powerful cues in organising information. Nevertheless, graphic designers have frequently resorted to even stronger means of directing the eye and dividing up a page, including horizontal and vertical rules, and boxes around information.

	Coal	Gas	Oil
1992	1.2	1.3	1.2
1994	1.4	1.5	1.4
1996	1.6	1.4	1.5

In this version of the table, rules are used to emphasise the profile within each year. However, such emphasis can often be created simply by the use of grouping and spacing. It is never useful to provide strong rules both vertically and horizontally.

Often, such means are excessive. Frequently they violate one of the basic rules of information design: that the content should be presented strongly while any supporting information which simply assists in presenting the content should be relatively weak. (see Tufte *passim*)

Holiday	30 Dec	31 Dec	1 Jan	2 Jan	3 Jan
12	6 Jan	7 Jan	8 Jan	9 Jan	10 Jan Teching e
13	13 Jan Assessment	14 Jan Assessment	15 Jan Assessment	16 Jan Assessmei	17 Jan Assessmer
14	20 Jan	21 Jan	22 Jan	23 Jan	24 Jan Semester

The default style for tables in Netscape is an example of good information design, in that the grid is presented in a muted tone which does not compete with the darker text within it. In this example, the small dates in the individual cells have also been set to a weak tone so that they do not compete for attention with the substantive information.

Sadly, Netscape introduced the concept of **frames** which, while they certainly solve a number of problems both of design and delivery, do so at the cost of filling the already cumbersome Netscape window with yet more obtrusive screen furniture. See Design Case Studies for examples of frames as a solution to various practical difficulties of delivery and presentation.

- **Colour**

What we loosely call 'colour' can be thought of as having three components:

Hue	green, red etc.
Saturation	colourfulness, freedom from grey
Tone	the tonal value: lightness or darkness

Since hue is psychologically the most obvious of these, it is tempting to think that difference of hue is the most useful attribute available to the designer. However, it is **tone** which is in fact the most important. For example, in order to distinguish a text item from its background, one might choose to set it in red on a background of blue—these two **hues** after all could hardly be more different. However, legibility will be poor, since the red and the blue are likely to be of similar tone. It is tonal contrast, not difference in hue, which helps distinguish adjacent colours, allowing the text to stand out clearly.



Use tonal contrast for legibility



Use tonal contrast for legibility

In the upper example, red text is placed on a blue ground. In the lower example, text in the same shade of red is placed instead on a light grey background.

Differences in tone also have great significance in providing emphasis, dictating what the user sees as important: large differences of tone (high contrasts) make information stand out, while small differences (low contrast) make a more muted statement. On a well-designed map, specific information such as the locations of towns will be marked in a strong tone such as black, while background information such as contours will be indicated with less tonal prominence. This phenomenon was used in the design of the timetable grid shown above (under **Framing**).

This effect can also be enhanced by the use of **saturation** where unsaturated (weak or dull) colours are used for background information, while more substantive information uses saturated (vivid) colours such as red or green. Such usage also pleases our subjective preferences concerning saturated colour—large areas of vivid colour tend to tire and aggravate the eye, which prefers muted shades over large areas.

Colour coding It is also a mistake to ignore tonal values when choosing a range of hues for use as colour codes. A common mistake is to put text or other items in say red, green, blue and yellow. While it is possible to find a red, a green and a blue of roughly equal tone, the yellow will always be much lighter and, if on a white background, approach invisibility (see the Case Study p85 for an example).

Where documents take advantage of the Web's natural use as an international publishing medium, assumptions should not be made about the symbolic association of hues. For example, the association of black with death and white with weddings is by no means universal, and even within one culture colours can change their meaning over time and within cultural subgroups.

Remembering colours When colour is used as a code, it must be recognised that we have poor perception of colours which are isolated from one another, and weak memory for colours when they are no longer side by side. For example, if we must remember which of two shades of green signifies the 'further info' section and which the 'help' section of our Web site, then both colours must be present when the user makes his or her choice. Otherwise the user will easily mistake one green for the other in the absence of an opportunity to compare them simultaneously.

Restraint in colour It has been said of screen design that it is best to start with a tonal design, in shades of grey, and then apply colour selectively and with restraint where it is needed. The toolbar of the Netscape interface conforms roughly to this approach. However, if the Web is a publishing medium, it offers the freedoms as well as the responsibilities of any such medium: we will not want to limit ourselves to (literally) dull pages, especially if motivation of the reader is a key factor. As with paper publishing, on some occasions an extremely sober presentation will be required, while on others we may want a carnival vividness on the screen. As always, **appropriateness** will be the acid test.

Nevertheless, Web publishers should bear in mind some good reasons for treating colour carefully:

- **Colour vision**
Not all users see full colour. About 8% of the male population and 0.5% of the female population has anomalous colour vision. Colour should not be used for critical coding unless additional information also distinguishes the elements (see Using colour redundantly, below)
- **Monochrome displays**
Not all users have access to colour displays, or may have temporarily set their machines to display in greyscale only.
- **Platform differences**
Colours which are distinguishable from one another on one display, may look similar on another. This can be caused by the different ways in which the exact colour specification of an element is mapped to the colour table used by a particular interface such as Macintosh or Windows. It may also result from differences in display hardware, especially between say cathode ray tube monitors and LCD screens. See 'Non-Dithering Colors in Browsers', listed in **Web Resources**, for a partial solution.

Using colour redundantly Colour provides a powerful adjunct to communication and to the motivation of the user, but should not be used as the sole means of conveying important information. Other cues should be used so that the colour does not have to do all the work alone. A familiar example is the use of the underline, redundantly with colour cues, in the way browsers display hypertext anchors.

Computer screens are not paper

We have emphasised that in terms of writing style, document structure, editorial control, visual and structural design, the Web deserves to be considered afresh, and that practices inherited from paper publishing should be re-evaluated. Even the physical characteristics of the two media are more different than is often admitted.

Some characteristics of the screen include:

- landscape format, usually 4 units wide by 3 units high, rather than the upright A4 format generally used for paper
- poor resolution, typically 72 dots per inch, compared with between 300 dots per inch (office laser-printer) and 1200 dots per inch (professional litho) on paper
- weightless documents (there is no possibility of judging size, importance, reading time required, by weighing in the hand)
- details of typography and layout are not wholly under the control of the originator, so the reader cannot interpret the character of the document by (for example) associating Times with authority or Futura with modernity.
- the user has no prior knowledge of the likely structure of the document. It is not necessarily familiar like a book with an index, since hypertext links may take on almost any shape of structure their originator chooses
- hypertextual link-points intrude into the content

Designing for the screen

New issues in designing for the screen include:

- Extended blocks of prose are inimical to screen-reading, since they require the user to scroll the text window. This is significantly slower than the movement of the eye in scanning an equivalent text on paper. Users must partially remove their attention from the text itself in order to attend to the mechanics of scrolling.
- Headlines tend to need repeating, because a main heading has disappeared off the top of the screen by the time the end-user gets to the paragraph to which it refers. We are probably unaware of the extent to which we use peripheral vision when reading paper, to remind ourselves of the context of the current item.
- If there are generic facilities for the user to, say, return to a contents screen, then this needs to be provided in a visible and convenient way on every screen, since at any moment, the user will not otherwise know where to look in order to find such a facility.
- Unlike documents for paper, it is often desirable to provide only the minimum necessary 'white space' between an item and the ones above and below it. The empty space which on paper provides a rest for the eye and mind, on screen simply increases

the cognitive load on users by forcing them to hold text in their heads while the white space scrolls past. However, there is no need to fill the screen gratuitously—screen-space is free. If all that is needed is a small set of links to other screens, for example, then generous use of white space around them is recommended.

- Interactive documents bring with them new notions of authorial 'good behaviour'. Some authors of electronic texts are surprisingly casual about some issues. For example, it would be unusual in a paper document for there to be a chapter name in the Contents without there being a corresponding chapter, but many interactive documents have 'links' which link to nothing, or to a message saying 'Nothing developed here yet. Sorry.' This is the down-side of the loss of a sense of finiteness and closure associated with paper-based texts.
- When a Web site is conceived or designed on behalf of someone else, a number of issues arise which differ from those for traditional paper documents. For example:
 - clients cannot brief the designer so well, because they have seen few examples on which to base their specification
 - because of constant changes in the technologies used, what is possible changes during the life of the project
 - the site must be robust across different browsers and platforms
 - delivery varies from good when network traffic is low to appalling when it is high
 - differentials in costs are quite different from those for paper (see **Cost differentials** (p91))

User-centred design

Designing what?

The aspects of Web sites about which design decisions can be taken include the...

- overall structure of linked pages
- forms of information provision
- language style and voice
- information structure within pages
- visual style
- opportunities for interaction and other feedback

In a well-designed site, all these aspects will be considered with the user's perspective in mind.

The scope of user-centred design

The design of computer systems which are effective and congenial for users is a huge discipline in its own right. SIGCHI, the Special Interest Group for Computer-Human Interaction (see Web Resources, p110), has become the largest interest group of the Association for Computing Machinery, reflecting a shift in attitude across the whole computing industry towards making products for people rather than expecting people to adapt their behaviour to products.

In this handbook we can do no more than introduce some of the key concepts of user-centred design and show how they can be applied to design for the Web. If we have emphasised the role of the user rather than the publisher in relation to all Web materials, this is not because the objectives and needs of the publisher are not important, but because these objectives can themselves best be served by aiming for a user who is stimulated and rewarded.

Constraints and the freedom to get things wrong

In the early days of the Web, only some aspects of site design were subject to any sort of design decisions. While the overall structure of linked pages, the language style and voice, and the information structure within pages were all definable, many aspects of the visual style and the user's interaction were effectively controlled by the limitations of HTML and the decisions made in advance in the design of browser packages. This meant that, to a certain extent, authors and publishers could apply their general knowledge of effective communication to the new medium.

Now the Web is becoming a richer mixture of media, and the range of possible interactions is greatly increased by developments in browsers and the provision of component technologies through the use of plug-ins. For those wishing to take advantage of this richness, there are obligations to produce sites which are genuinely effective and enjoyable for users. The more possibilities there are, the more scope there is for making an unusable, cacophonous site. It is likely that specialist expertise in interaction design will be needed.

Some core principles of user-centred design

User-centred design has been summarised crudely as ensuring that **1** the user can figure out what to do, and **2** the user can tell what is going on. These simple aims are not always as easy to achieve as they might seem.

Weaknesses of design tend to arise in the following areas

- lack of affordances
- poor use of mappings
- inadequate feedback

Affordances are those aspects of a design which make it self-explanatory. For example, a poorly designed photocopier will not show where the blank paper should be inserted or how exactly it should be placed in the machine. In a Web document, one can find hypertext triggers which look like ordinary text or graphics, or conversely, text and graphics which are not active, but which appear to be!

Mappings are the visible relationships between parts of a system, or between the system and the user. Among systems with poor object-to-object mappings, a classic example is the cooker-top which has a set of heat rings arranged in a square but a set of controls for them arranged in a straight line. Labels then become essential to clarify the relationship between the controls and the objects. A Web example of poor mapping is a graphical map of a site which shows the various pages in some particular spatial configuration, but where this spatial model is subverted by the use of arrows pointing in various incompatible directions within the individual pages.

Feedback is the means by which we know, for example, that a car engine is running because we can hear it (incidental feedback) or that a steam-boiler is in a dangerous condition because a whistle is blowing (constructed feedback). In computer systems, almost all feedback must be constructed by the system designers.

The provision of feedback has not hitherto been a problem in the design of Web pages, since for simple HTML documents most of the necessary feedback has been provided in the design of the browsers. For example, in Netscape:

- **User input is acknowledged**

When the user points at a hypertext link, the name of the linked URL is displayed in the status bar at the bottom of the screen. When the user clicks on a hypertext link, it changes tone or colour instantly.

- **Progress indication is provided**

After a hypertext link has been activated, the process of contacting the site and getting data from it is monitored in the status bar.

Such feedback is taken care of by the design of the browser, but when Web publishers incorporate other forms of interaction in their pages, for example as Shockwave components, then it is the responsibility of the designer to provide similar forms of feedback.

Example

If a control panel is provided as a navigation device, then users must know:

- whether or not their action has been registered by the software, for example by use of a momentary highlight
- whether a process is taking place, for example using a progress-indicator bar
- whether the action has been successfully completed, for example by moving an indicator dot on a map of the site

Some rules

The following are example rules from a standard text on interface design (Brown 1988), showing how they can be applied to the Web.

Display design

- **Use invariant fields on each screen**

If similar items of information are to be shown to the user or the user is expected to enter such information then similar locations on screen should be used throughout. For example, a Help button should not appear in different locations on various pages. Type size, style and colour should be similarly consistent: this is a case where the Web used to impose its own rules, but now using the **COLOR** and **SIZE** attributes we have the freedom to make mistakes.

- **Define and use terms consistently**

One word such as Home Page must not be used to mean different things. In fact the whole idea of Home in Web pages is best avoided in a user-centred design a page may be home to the publisher, but not to the user.

- **Present lists in useful orders**

Lists, for example of linked pages, should be arranged in a way suited to the use and user, not the publisher. Depending on the purpose, this may be alphabetical, classified, logically grouped, hierarchical and so forth.

- **Present similar information in similar formats**

Variety which has no meaning is counter-productive. Differentiation should only be used where it signals an important difference to the user.

- **Make instructions distinct from data**

Items which are part of the furniture of the system, or which are rubric telling the user what to do, should not look like content material, nor vice versa.

- **Present information in the form it is used**

This is the essence of successful design for users. Designers must put themselves in the user's shoes when deciding how to give or request information. For example, the questions posed in a Web-based form should be posed in terms which make sense to the intended user, avoiding Web jargon and omitting anything which would only be comprehensible to the publisher.

- **Minimise cursor/pointer movement**

If there are two hypertext or other controls which are frequently needed one after the other, they should be placed together on the screen (as are the go-forward and go-back buttons in the Netscape interface).

- **Use of icons**

Icons can be used for compactness and memorableness. However they are frequently no improvement on text, sometimes worse.

Dialogue Design

- Provide input acknowledge and progress indicators

See Feedback above for an example.

- **Indicate modes**

A 'mode' is a state of the system. For example, in computer menus, an item will be disabled (grey) if it cannot meaningfully or legally be selected in the current circumstances. If there is something users must not do at a certain juncture, this should be clear to users before they attempt to do it. It is important to avoid unnecessary modality: designers must not prevent users doing things they have a perfect right to do!

- **Give access to settings**

The user can be helped and reassured by having permanent access to status information, for example by indicating to users where they are on a graphical map of the site. In addition, anything which could reasonably be interacted with, should indeed be interactive. So a map of the site should not only provide feedback as to the user's current location, but also be a control panel which the user can click on to change that location.

The frame facility of some browsers is helpful in allowing controls to be constantly present even when other information is changing.

Users' errors

Users will make errors, especially as systems become more complex. User-centred designers work with error in mind, trying to prevent misunderstandings and slips by the user, but not supposing that such errors will never occur.

When finally users do make mistakes, error messages should be instructive, polite, brief, appropriate to users, consistent, specific and directive.

The design process

Nielsen gives an account (in 'User Interface Design for Sun's WWW Site', see **Web Resources**) of the design process for a Web site. Different publishers and designers will adopt different approaches, but it may be useful to outline how Nielsen's team set about the task, especially in their use of 'off-screen' methods.

Initial design was done away from the computer as a card-sorting test. A number of functions and areas which the site was intended to support were written on individual

cards and a small group of subjects was asked to group the cards into logical sets and apply a hierarchical order within the set. This is more efficient than beginning by coding several HTML pages. It can also allow early elimination of some problems, for example terms which no subjects understand, and omissions and inclusions which subjects object to.

In the Sun site a prior decision had been taken to use icons, so another component of their design process was the trialling and modification of icon designs both individually and as a set. Subjects were asked to match the icons to the previously devised categories from the card-sorting exercise.

Main screens were mocked up on paper and subjects were asked to point to the various components of the page and say what they thought they did and which other elements they led to.

It should be noted that the trialling of ideas for the site was reactive. The system designers made proposals which were then modified in the light of feedback. This is generally preferable to asking users what they want, since this can lead not as might be thought to too many ideas, but to a paucity of ideas where all those questioned answer only on the basis of other, perhaps inadequate, systems which they have seen. Nevertheless, the *ab initio* approach has its place, especially where a constructive brainstorming session with intended users is possible.

Usability testing

Without testing, user-centred design is a sham. It is essential to find out what users really do when they encounter the site. There are many ways of testing information systems, from quantitative methods tested with scientific rigour through to informal observation. Publishers will choose the methods most appropriate to their site and their needs, since clearly there is a difference in the levels of complexity of pages and sites, and even more importantly between the purposes which sites are designed to serve.

It has been pointed out that there is no such thing as the average user. It is important that testing takes place using subjects who represent the actual intended audience. For informal testing aimed at improving a site rather than at proving a methodological point, it is also preferable to test in realistic circumstances. So, for example, if an on-line course module is developed as part of a suite of activities, it should properly be tested in a simulation of the real usage, rather than in isolation. Of course in some circumstances these are counsels of perfection. The key point is that **any testing is better than no testing**.

Aspects which will require testing include technical tests in various browsers, under different operating systems and on varying hardware, both locally and remotely. However these technical tests are only part of the story user-testing of the content, structure and interaction is just as important.

Some test methods

Test methods (some of which are likely to be beyond the budget of most HE developers) include the following

- Direct observation of users: watching the system in use and making notes
- Indirect observation, for example using video recording
- Think-aloud, where users describe what they are doing or trying to do
- Software logging: a number of server-based programs are now able to monitor what users are doing (though not what they are thinking!)
- Post-hoc interviews and questionnaires

A readable account of the strengths and weakness of these methods is provided in Preece 1994.

Some test findings

Sun's usability studies suggested to them that:

People have little patience with poorly designed Web sites. Trust of the content in a site is based partly on a perception of its organisation and design.

Users do not like scrolling. Information not at the top of the screen is only read by very interested users.

Reading speeds are 25% slower on screen than from paper. To compensate, 'users recklessly skip over any text that they deem to be fluff, and scan for highlighted items'.

DESIGN CASE STUDIES

Visual and structural design of Web documents

Designers need to rethink many aspects of their craft when faced with HTML, which provides both more and less than ordinary document design environments such as Word, WordPerfect, ClarisWorks, Quark Xpress or PageMaker. It is essential that designers work with HTML rather than against it, making the best use of what it can do.

We have become accustomed to some particular freedoms inherent in ordinary document design environments, to which HTML does not conform. On the other hand it allows the thoughtful author and designer some excellent techniques for structuring and presenting ideas.

In this section we offer some illustrated examples of postgraduate student projects from the Centre for Electronic Arts at Middlesex University. The students produced this work while studying for the MA Design for Interactive Media. Only a few of the projects deal directly with educational issues, but all have useful insights to offer into current Web design.

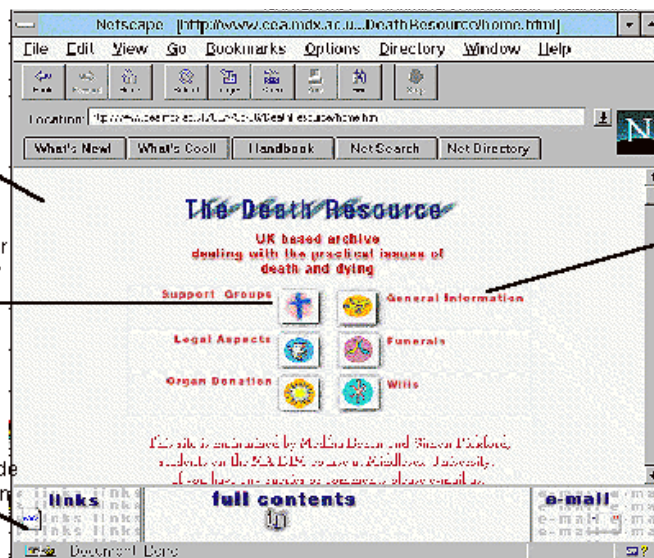
Design case studies

1 The Death Resource

The use of a plain white background overcomes the drab appearance of the standard Netscape window.

A drop-shadow created in a paint program makes clear that these items may be clicked, even though they do not have the default blue border of 'hot' items.

Netscape's frame facility is used to divide the main presentation window from these control panels



In the interests of preserving the look of the page, each of these text items is a picture. This also allows text to be antialiased, which is not currently possible within most browsers.

The aim of this Web site is to provide, in a clear and accessible way, information which will be of immediate practical use to those involved with a death. A design was needed which offered openness and informality without appearing trivial or patronising.

It is particularly important that the visual and interaction design of such a site does not get in the way of clear and effective communication. The opening page presents a simple and uncluttered appearance.

Background colour matters

Replacing the standard grey of the browser window with white evokes concepts of clarity and lightness.

Graphical buttons

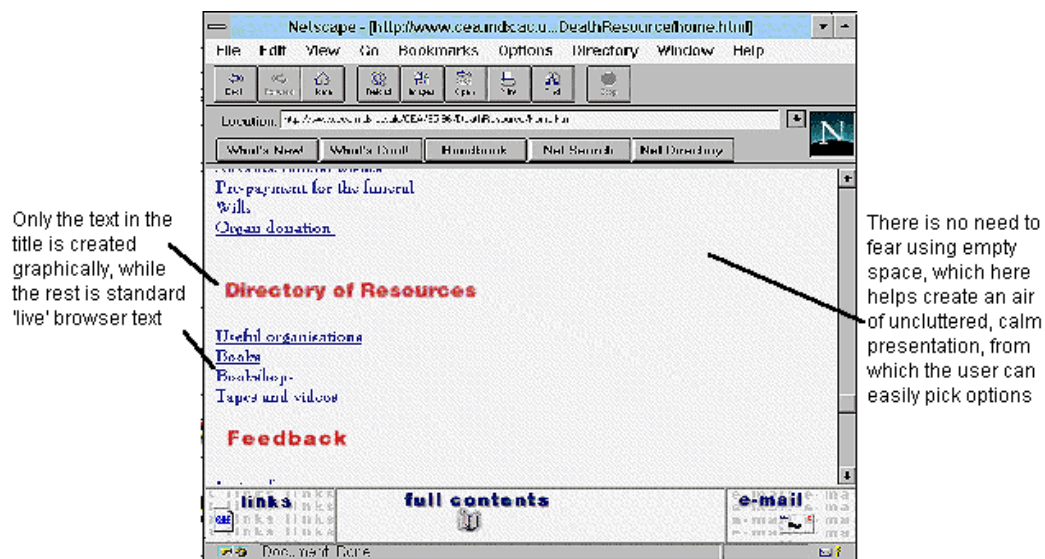
Areas of the screen are indicated as clickable using the by now standard convention of drop shadows. There is little room for doubt as to which items on the screen are clickable and which not, despite the absence of the standard blue box around 'hot' graphics.

It is of course essential not to misuse such graphical conventions for things which in fact are not active.

Graphical text

'Live' text in browsers has disadvantages: the designer cannot choose the font (since the font may not be on the user's machine); and the text cannot be anti-aliased (which would help disguise the jaggedness of the screen pixels by blending the edges into the background).

Rendering the text in a graphics program overcomes these problems, but at a price. The download time will be longer, more work is required of the designer, and the text cannot be found by any searching process (since to the machine it is just graphic pixels). Text-only browsers will not display these graphics at all, so it is essential to use HTML's **ALT** attribute within the **** tag to put a textual substitute in place of each missing graphic.



Information structure

The title page need contain little text. By presenting this sparse appearance, it avoids overwhelming the user. The six buttons lead to logically grouped clusters of information.

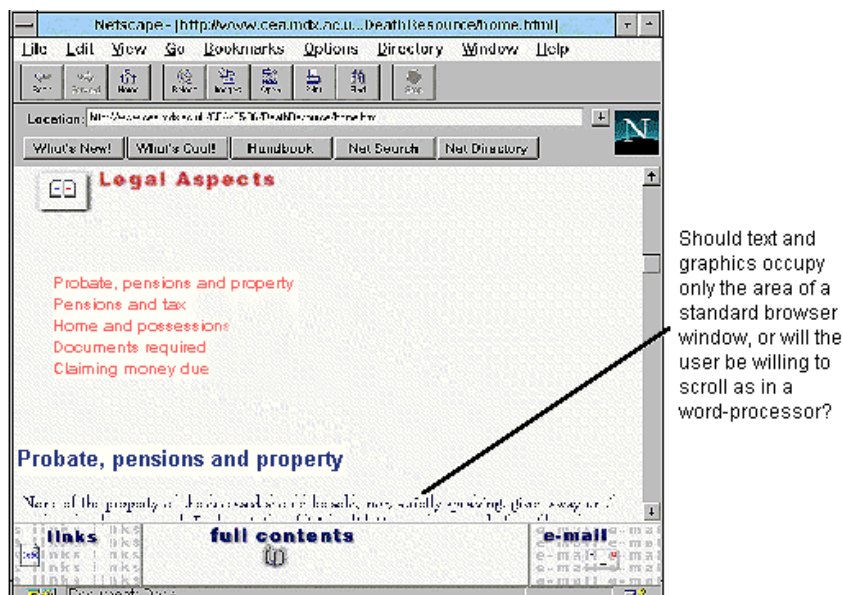
Items which need to be constantly available to the user are presented in three Netscape frames at the bottom of the screen. The links item only presents links to

existing sites created by others, and deliberately does not include links which are internal to this site. The **e-mail** item allows the user to mail an enquiry or comment at any time (the browser opens its e-mail facility when the user clicks on this area), using the **mailto: mail_address** form of URL.

Technical aspects of frames

The main technical advantage of frames is that, when one frame is updated by the arrival of new information, the other frames of the browser window are left undisturbed. Only the frame targeted is re-rendered. This means that downloading time is not wasted, and the user is not distracted by unchanged items being needlessly redrawn.

However, as browsers become better able to support the positioning of information within a single frame, and selective updating within single frames becomes possible, the need for the frame structure may decline. From an information design point of view, frames are regrettable since they introduce yet more screen-furniture which is not part of the actual information.



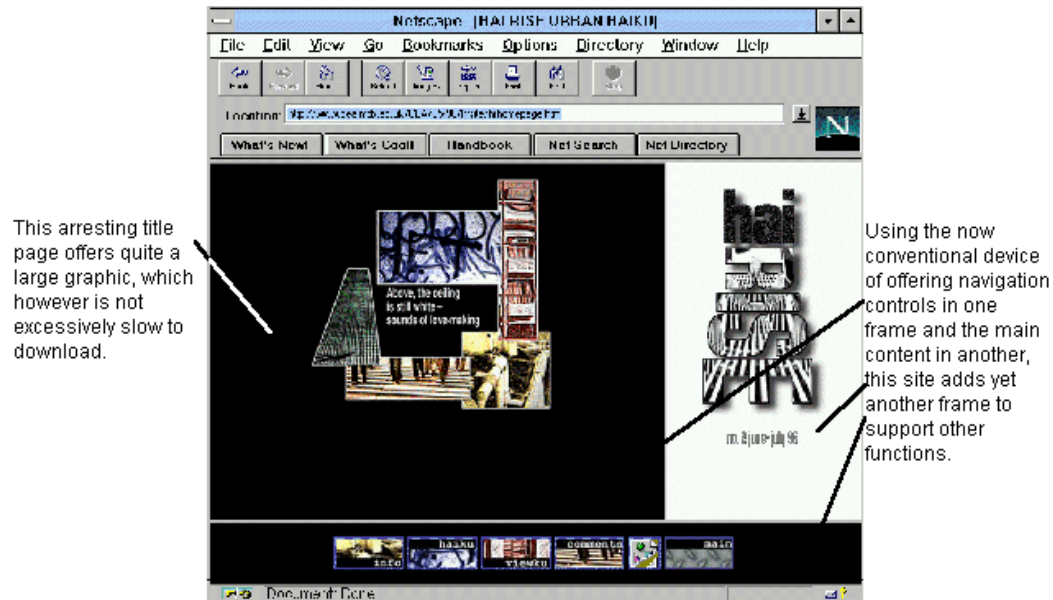
To scroll or not to scroll?

Casual visitors to Web pages do not generally make the effort to scroll a browser window in order to uncover further information. However, with an already motivated user, it may be acceptable to present text which is longer than the standard window. If an extensive document is presented in this way, it is kind to the user to provide hypertext anchors at the top of the page, and perhaps at the bottom as well, which allow the user to jump to the various subheads elsewhere in the same page.

If frames are not used, and therefore there is no place to present a separate set of navigation controls, then it is also considerate to provide navigation buttons at the top and bottom of a long document, and even, for a very long document, at intervals in between.

It is important to remember that not all displays show the same area of pixels, so that it is always unwise to make assumptions about what is and is not within the user's view.

2 The Hai-Rise Urban Haiku Site



The site is intended to facilitate the exchange of ideas within a small special interest group for urban haiku poetry and act as an attractive publishing medium where users are invited to respond, and perhaps themselves become contributors.

The creators of this site felt that the existing Web-based poetry sites were unable to rival printed books in terms of attractiveness, and that the potential of electronic media was not being fully exploited. They also wanted to offer the possibility of graphical and interactive 'haiku' in addition to the conventional form.

The main frame

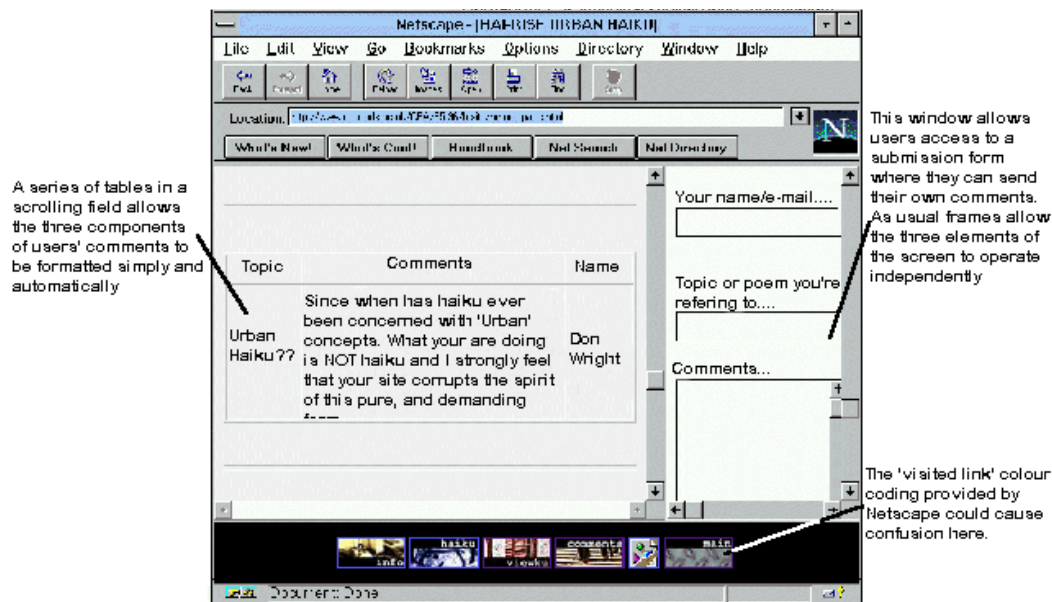
The main frame displays the primary content the poems which have been commissioned or submitted. Web pages make a good location for time-varying content. This publication allows any or all of the content to be replaced or extended. New contributions can be seamlessly incorporated into the main body.

The 'nav bar'

The use of a navigation bar is now commonplace in Web documents, and frames lend themselves to this usage. However, there is a contrary trend in the design of much interactive multimedia (for example on CD-ROM) to do away with these clusters of buttons and instead to provide triggers to additional information within the substance of the screen. As Web documents become more able to incorporate interactive elements at predetermined positions on the page, it is likely that a similar trend will take place in Web design.

Graphical text

As with the Death Resource above some text is prepared in a graphics package. The creators of this site felt strongly that they wanted the text to be presented in the best possible way, with the maximum of control, and so gave themselves the task of laying out each poem in a graphics package. Clearly this is only realistic for haiku, and not for epic poetry which might extend over scores of screens! This re-emphasises the importance of considering **maintenance** in the initial design of a site.



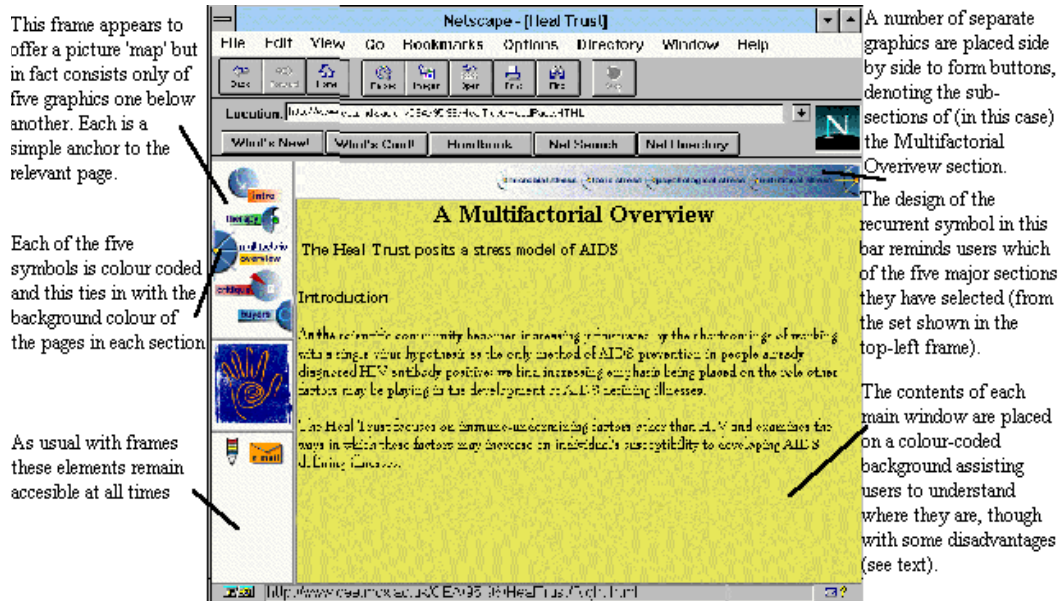
Automated formatting

It is important to avoid writing HTML code unnecessarily. Here the formatting of users' submitted comments is semi-automatic. Comments received as e-mail are broken down into their three component parts (in this case by a HyperCard program) and output with all the necessary HTML codes to be correctly appended as a new table to the end of the scrolling page. In this prototype, a human editor has to operate the program which does the conversion, but this process itself could be automated. However full automation would raise obvious issues of **editorial control**, since any comment submitted would appear instantly in the site, without the opportunity for editorial intervention.

Colour coding and confusion

In the navigation bar, two items are highlighted in the 'visited link' colour of the standard Netscape interface. In this context this may well cause confusion, since a highlight is often used on such a row of buttons to indicate which of the sections denoted is visible now. Here instead, as more sections are visited more of the buttons will acquire highlights. At the time of writing, it would take a certain amount of extra trouble to produce a highlighting system of the conventional kind which really did show which was the current view. This is the sort of problem which will be increasingly easy to solve using 'plug-in' modules such as Shockwave or Java for standard browsers.

3 The Heal Trust



The site offers information about a distinctive medical charity. The client wanted to use a very large amount of text to explain the charity's policy. There is an assumption of a high level of commitment on the part of the user which may not be justified. The screen is perhaps not the right place to present extended text documents, though this can perhaps be countered by the fact that users can print out such text for reading from paper.

One of the tasks facing the designers was to make the large quantity of data manageable. Part of the approach adopted was to use five colour-coded sections.

Colour-coding

In this site, the five major sections were similarly colour coded in the five 'buttons' in the top-left navigation panel frame and in the background colour of the main text frame. In this way, users can easily tell which section they are currently reading. However, since not all users will see colour, the cue is also reflected in the form of the recurrent symbol for each subsection which become visible in the top navigation bar.

Navigation controls

The use of frames provides an easy way of giving the user an overview of the site and means of getting to its various parts, independently of other frames which may change. In this site, two navigation bars one top left and the other across the top of the screen together provide means of reaching both sections and subsections of the site. This is more congenial for the user than multiple clicks to make hypertext jumps from one text to another (see diagram).

Where such controls are graphical as well as textual, users are assisted in remembering the sections which they have visited before by distinctive symbols and colours.

Intro	Therapy	Multifactorial	Critique	Buyers
		Microbial stress		
		Toxic stress		
		Psychological stress		
		Nutritional stress		

The parts of the Heal Trust site form a matrix. Any part can be reached quickly using two sets of navigation controls which are always on screen

4 The IATEFL Special Interest Group Site

The site is aimed at members of a large organisation for teachers of English as a foreign language, which has several special interest groups. It is a demonstrator of the possibilities of small-scale multimedia over the Web.

The screenshot shows the Netscape browser window displaying the IATEFL Special Interest Group Site. The browser's address bar shows the URL 'http://www.iatefl.org/sgs/sgs.html'. The site features a colorful, abstract background with a central graphic of a face and the text 'Combine the vowelsounds to make the diphthongs'. Below this, there are two red circular buttons labeled 'SGS' and 'IATEFL'. The browser's status bar at the bottom shows 'http://www.iatefl.org/sgs/sgs.html'.

Annotations on the screenshot include:

- A 'corporate identity' is maintained for this site using a consistent background throughout.
- By the user of the browser's 'tile' feature, a small image file can be made to go a long way.
- Each of several pages offers a Shockwave multimedia element, providing richer interaction than HTML inherently supports.
- This site does not use a constant set of navigation controls, but provides instead a means of returning to two master menus from every screen.

The main focus of this prototype was the use of Macromedia **Shockwave** to provide richer styles of interaction than HTML itself supports. The user must previously download the necessary **plug-in**. It is conventional to provide a link on any site which requires such a plug-in to a legitimate source from which the user can acquire it (usually free of charge). The browser must be one which conforms to the plug-in architecture. No additional software is needed on the server.

Richer forms of interaction

The set of Shockwave plug-ins provides browsers with the ability to deliver various proprietary Macromedia file formats over the Web, within the browser window. These include Director, Freehand and Authorware. For this site, small Director files were converted to the Shockwave format using Macromedia's Afterburner and embedded in HTML pages. Such Director files combine multiple media with interactivity devised using the Lingo scripting language.

In the example shown, a Shockwave component (file size 66K) allows the user to experiment with combining vowels to make diphthongs. The user enters a formula as though on a simple calculator, and then hears the resulting sound. The Lingo coding takes care of allowing only meaningful input at any one moment, so that for example the user must put the '+' operator in before trying to add another vowel.

Other multimedia components of this site include an interactive literature quiz and an 'identify the accent' puzzle.

The file size of such components was a limitation, since the whole Shockwave element is downloaded, including its sounds. This is changing, as progress is made with continuous streaming of data from server to browser.

Integrating multimedia components in the Web page

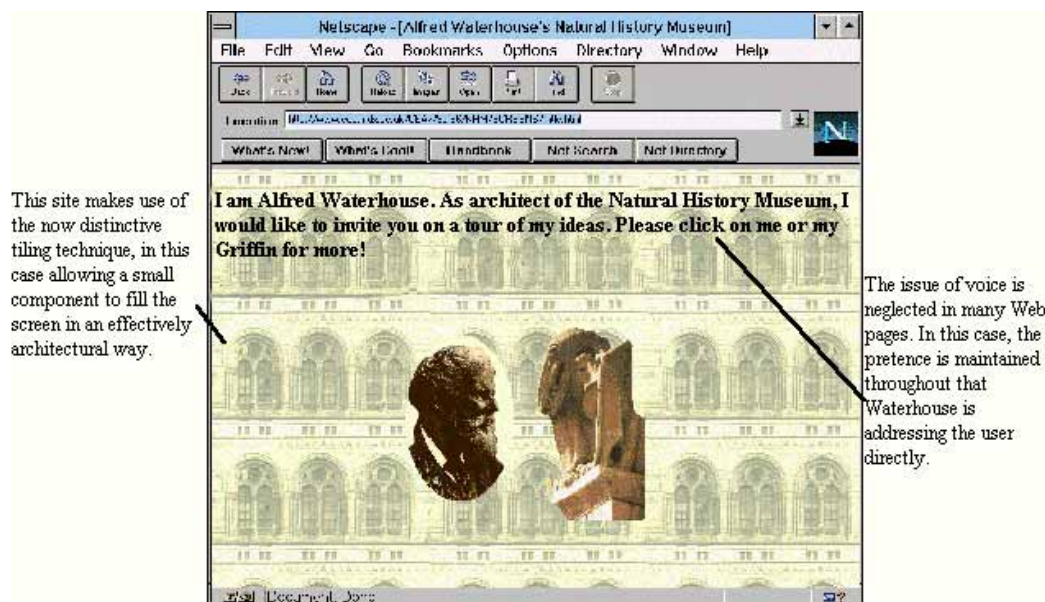
The design of multimedia for CD-ROM, point-of-information services and so forth tries increasingly to produce a fully integrated screen where the various interactive components are part of a seamless whole. This has not been easy on the Web, and the designers of this site have used a simple device to help integrate the Shockwave item into the main screen, namely that the colours and tiled background texture are the same for each. See the Archaeology Adventure site below for another approach.

5 The Museum Building Site

The site aims to sensitise the user of the Natural History Museum to the museum building as architecture, rather than just a container of objects. The building is unusual in that it was purpose-built to reflect the nature of the collections which it houses, with extensive use of natural-world motifs in stone and other materials. Typical use is envisaged to be before or after a school visit to the museum itself.

Who's talking?

A neglected issue in the design of Web sites is that of **language**, and in particular **voice**. Different media, and different genres within those media, require different styles of address. Radio, television, newspapers, encyclopaedias, business letters, novels all adopt very different language styles. A letter sent by e-mail will usually differ from one sent on paper, having something perhaps in common with a telephone conversation. By contrast, many Web pages, especially those produced by HEIs, have a deadening formality derived from validation documents and departmental reports.



The right language for the Web?

No one yet knows what is the 'natural' language of Web documents, but since the technology makes possible the construction of many-to-many documents rather than the traditional one-to-many model of HEI information, we would argue for a multivocal and varied approach which is not limited to any particular style of address. There will be occasions for formality, and authority, but there will also be many occasions when a feeling of immediacy and informality is far more effective. There is much to learn from radio and television in this respect.



A simple navigational device used in the Natural History Museum site, representing the actual physical orientation of the parts of the building described. Users can see which section they are in by observing which lozenge is 'missing' from the window.

A context-sensitive navigation control

Providing a navigation control which allows the user to click on any major section, and which then displays clearly which part the user has selected, seems a modest requirement of any hypermedia system. However, within the technical limitations (at the time this site was developed) it proved surprisingly difficult. The simple but cumbersome solution adopted here was to have a different version of the navigation graphic for each of the seven areas, each with the appropriate lozenge missing! This is just the sort of weakness which will decline as the Web acquires a fuller set of features from mainstream multimedia. One solution to this problem is to make a control panel as a Shockwave file, and offer it in a frame of its own, though this in itself is not ideal (see Archaeology Adventure site next).

6 The Archaeology Adventure site

This site aims to offer the user two modes of use— conventional enquiry-based approach of Web reference documents, and a narrative approach slightly more akin to television. The low density of information in the main frame is complemented by a wealth of background detail available through the surrounding areas.

Permanent and topical information

The frame structure of the page allows information which forms the core of each 'issue' to be presented centre-screen, and to be altered independently of the supporting information around, much of which remains the same, for example glossaries of terms and guidance on how to use the site.

Random access and guided tours

The difficulty of getting 'value' out of hypertexts has often been remarked on and is caused partly by the absence of any guidance as to where users should go next. It is a clear problem of some kinds of resource-based learning materials. This site offers a possible solution in providing a ready-built guided tour of the material which the user can abandon at any time, reverting to the more usual enquiry-based clicking, using the control panel bottom-right.

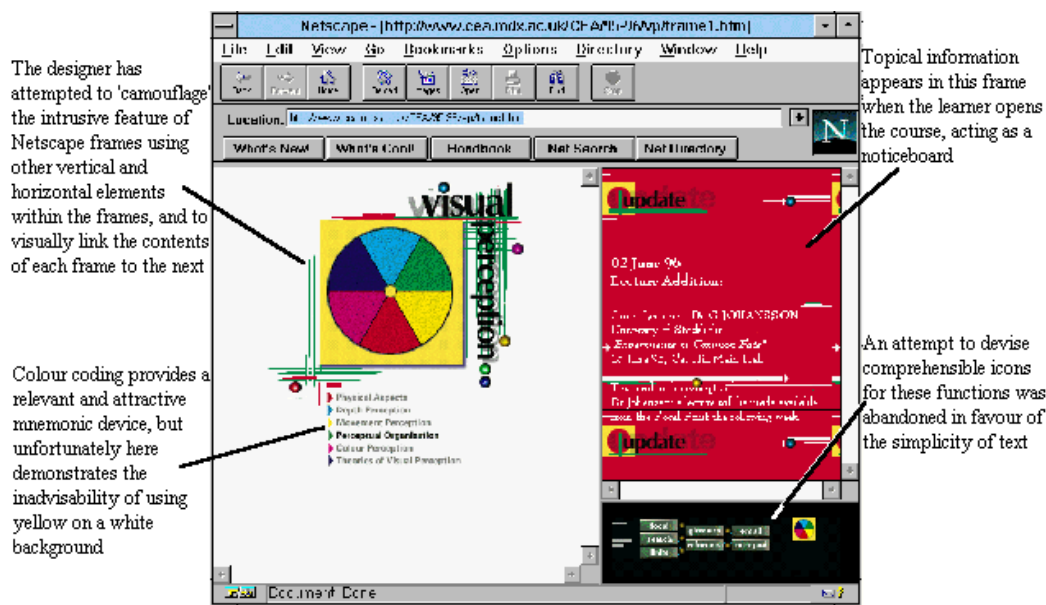
Appropriate multimedia

Although the backbone of the site is HTML text, most of its pages also contain other elements. In the screen illustrated, an animated GIF is used to show an archaeological find from several angles in its discoverer's hands, while other screens use similar techniques to demonstrate a computer graphic reconstruction of a ruined building. These elements provide entertainment value, and are also genuinely better at demonstrating a point than text or a still graphic.

Voice, language and tense

Once again, the issue of language is important: in this case a chatty informal style was adopted—in the present tense to give a feeling that the user was observing contemporaneous events rather than a record of accomplished fact. The use of time and place information augments this feeling of process rather than stasis, which is difficult to achieve in the largely inert environment of the Web page, where generally nothing happens until the user clicks something.

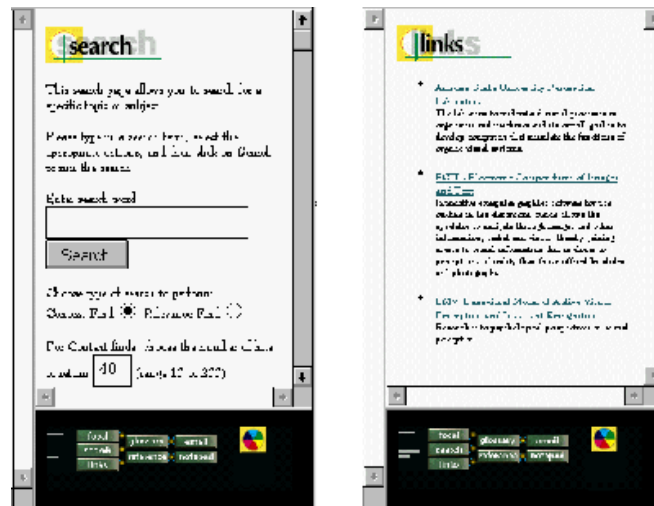
7 The Visual Perception Course site



To learn about Visual Perception through text, or even photographs and diagrams, is not ideal. The learner often needs to see ideas presented dynamically, for example to show change over time, or to reveal unperceived aspects of an optical illusion. This site embeds small but effective animations and interactive demonstrations in informational text, and also shows the possibility of providing a simple construction environment where learners can make their own contribution.

Words or icons?

Some interface designers have become obsessed with devising icons to represent functions of software systems, frequently producing something which is perplexing and perhaps not even easy to remember (so undermining one of the major claimed advantages of icons). If the material on the site is only being provided in a single language, there is also little benefit to be had from the supposed international comprehension of visual symbols. For the control panel of this site the simplicity of text labelled buttons was preferred.



The top-right frame is used to provide a range of functions including a search facility, bibliography, glossary, e-mail facility for contacting fellow learners and staff, and links to other sites. Searching routines and other extended functions can be found as shareware on Web sites around the world.

Communicative animation

A famous experiment is illustrated using animation: the puzzling static dots are perceived as belonging on a human form, when that form moves

A single, appropriate icon is used throughout to indicate to the user that they can trigger an animation. But if they do not, the animation will eventually run once anyway.

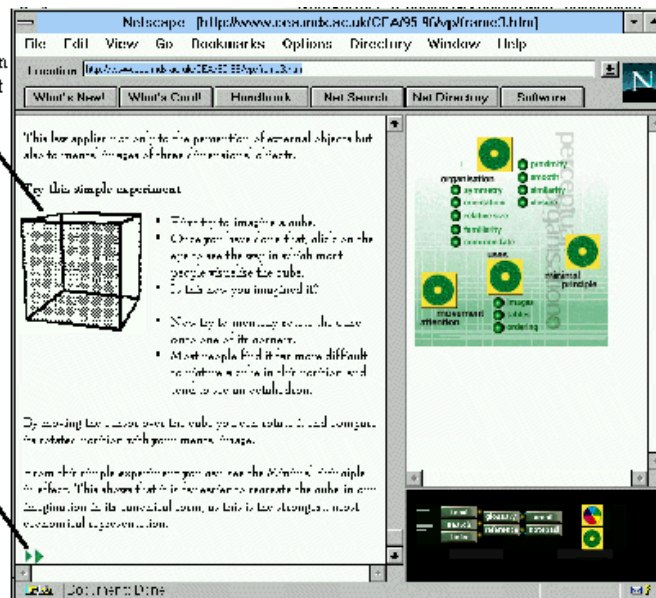
The default content for this frame is a map of the course. Learners can see how items are grouped, and access any section at will or work through a sequence.

Once the user has entered a part of the course, icons allowing access to both the topmost level and the top of the current section are available

Animations are ideally suited to illustrating concepts like the one shown, where a puzzling image is made comprehensible by movement. The cluster of dots is immediately perceived as belonging to a human form once it begins to move. In case learners are still not clear what they are looking at, the moving cluster is replaced after a few seconds by a matching animation sequence of a moving human.

A Shockwave animation allows users to feel that they are manipulating the cube, even though no actual 3D data is present. They can turn it in any direction and observe the optical effects.

Material is broken up into reasonably short scrolling pages, which end with a simple control indicating how to get to the next section.



Animations, whether linear or interactive, may be worth both the trouble of their construction and the extra time to download when as here they are genuinely the most effective form of information.

Postscript

Several of the things which were difficult to do when these projects were created between November 1995 and June 1996 are now easy. Keeping up with what is possible, and the best methods available for achieving a particular objective, seems likely to remain part of the Web designer's remit for the foreseeable future.

POLICY

Creating a maintainable site

An up-to-date and consistent site

The Web is perceived as dynamic and up-to-the-minute. This puts a greater onus on the providers of Web pages than would be the case with paper documents. Users expect information to be correct today. For example, course fees may be changed by the HEI, and users will expect the relevant page to reflect the up-to-date figure, whereas for a paper document they would be more forgiving.

Some information on a site will change rarely, but must still be consistent from place to place. For example, the HEI's academic regulations may remain constant for years, but it is vital that they are represented identically in every location which needs them. A way of achieving this is to keep such information in one place only and link to it from any page that needs it.

User expectations of the complexity and richness of pages is increasing. While at one time, simply to have a Web page was enough, users now expect at least some graphics, and more sophisticated text layout. Soon, animation may be seen as necessary (even when it is not).

Intending Web publishers must ask themselves

- how much time will be involved per week or per month?
- is the structure easily adaptable to changing requirements?
- what strategy do we have for checking the validity of links?
- do we depend on others' goodwill which may decline over an extended period?

Example solutions

- To keep a large site up to date it may be necessary to store most of the content in databases and format the pages at need, rather than to prepare pages by 'hand'.
- How does the user know a site is up to date? Pages should be individually dated where this is considered important. If the user's perception of immediacy is important, a What's New? banner can be added to the page, or a distinctive symbol can be placed next to new items in lists. However this *adds* to the maintenance task, since What's New? indicators which are out of date will both irritate the user and embarrass the publisher.
- For consistency of content, it is important to keep common elements in a single place and cross-link to them, instead of repeating information in several places, when different versions may accidentally come into existence.

Checklist for making and maintaining a site

The aim of this rather daunting checklist is not to discourage would-be publishers from making Web sites. Many items can be omitted for smaller and simpler projects. However some items will carry a considerable cost, either in real terms or otherwise, and this list may therefore be useful for both planning and budgeting.

It is impossible to over-stress the importance of testing, which should encompass not just technical tests, but also iterative user-testing and redesign of the content , structure and any complex interactions (Usability testing, p73).

Pre-development

Concept development

- Analyse needs of potential users
- Assess site development skills available and acquirable through training
- Assess level of technology available to users
- Audit existing documents which can be used or worked from
- Consult
 - Computer support staff
 - Information or external relations department of HEI
 - Other schools, faculties, services of HEI
- Choose
 - Sources of material
 - Appropriate technologies for chosen use and users
- Staff

Provide

- Server
 - Hardware
 - Software
 - Network and IP Address
- Authoring
 - Packages for the production, as appropriate, of
 - text
 - graphics
 - sound
 - video
 - multimedia
 - 3D
 - databases

Editorial control

- Establish
 - editorial policy
 - design policy
 - mechanism for
 - clearing copyright with outside parties
 - making IPR agreements with internal contributors
 - preventing or removing illegal material
 - policy on write-access to server

Establish

- Budget
- Responsibilities of individuals
- To whom answerable
- Practical design guidelines
- Timetable for initial development
- Timetable for review
- Staff training

Text production

Convert electronic texts from various formats

Acquire text through scanning and OCR of paper documents

Editing

 Edit and originate texts suited to the use, user and medium

 Construct appropriate hypertextual links

Produce and use templates (see also Design)

Design

Design consistent visual and interactional interface

or

Design framework for disparate contributions

Produce and use templates (see also Text production)

Design

 modular graphics for repeated use

 screens, downloadable documents etc.

 interaction

 hypertext links

 multimedia interactions

 audio, video, 3D, VR and other components

User-test and refine structural and interactional aspects

Graphic production

Convert electronic graphics from various formats

Acquire graphics through scanning of transparencies, video and paper documents

Originate photographic material

Construct digital graphics

 illustrations

 diagrams

 charts

 logos, bullets, backgrounds, etc.

Sound production

Convert electronic sound files from various formats

Acquire sounds through recording and re-recording

Cast voices for spoken word

Originate music, sound, voice

Upsample, downsample, apply effects to sound

Video production

Convert digital and analogue video and film from various formats

Originate, edit etc. video material

Multimedia production

Convert component material from various formats

Acquire component material through scanning, recording etc.

Write scripts, programs and CGIs to support user interaction

Database production

Convert data from various formats

Construct suitable record structures in databases

Gather and enter new data

3D production

Convert existing data eg. CAD files

Create and render models

Convert to appropriate formats

proprietary, eg. QuicktimeVR

VRML (Virtual Reality Modelling Language), animated GIF

Technical support

Organise material on server

Devise CGIs to support special functions, eg. clickable maps, database query

Test

in various browsers

under different operating systems

on various hardware

locally and remotely

Technical maintenance

Respond to users' bug reports

Periodically test internal and external links for validity

Provide upgrades to principal and ancillary software

Test in new browser packages etc.

Maintenance and development

Periodically review site(s)

Provide new material, facilities or experiences for users

Ensure continued accuracy of information

Append, remove parts

Test validity and relevance of links

Take action concerning unapproved material in collaborative sites

General

Liaise with other contributors as needed

Keep informed on changing technical aspects

Learn new packages, techniques, formats and standards

Cost differentials

For the publisher of paper documents, there are obvious differences between the cost of, say, black and white print on cheap paper and full colour print on glossy card. There are cost differentials in Web publishing, but they are not the same. For example, full colour is effectively free for the Web publisher it takes no more time or storage to create a colour picture than a black and white one. Since there are virtually no material costs, the differences instead are dictated by the need for time and specialist expertise. Initial costs will be high if complex interactions are made for example using Shockwave or Java. Running costs will be high if maintenance of the site involves buying in specialist expertise or if the system is so fragile in its design that major portions must be altered or tested each time a small part is revised.

Control

The control of interlinked information

We have emphasised the potential for interlinking information. For example, in institutional information the pages about programme, set, school, faculty, and so forth can be unified for the user, but served from separate, appropriate locations. Likewise alternative perspectives can be provided, such as an institutional view and a Student Union view.

However, issues of control arise:

- Is there an overall structure to the web of documents? Who devises it and ensures its continuation?
- Who is in editorial control over the content of the separate parts?
- Who should author documents about what?
- Who should design the documents? Is a 'house style' required, or does that undermine the potentially multivocal nature of the site? What level of consistency is appropriate?
- Which documents are linked to each other, and how?
- Who is responsible for maintaining valid connections between documents?
- How do users know whose document they are reading?

These are not questions which can be answered by this handbook, varying as they will from institution to institution, case to case.

Example internal guidelines

As an indicator of the level of detail involved in some of these issues, we cite a few informal guidelines which have been used for one particular departmental server:

- All file-names and hot-spots should clearly indicate the nature of the information to which they lead and where it is held, perhaps using icons, labels, or colour-coding.
- Two hot-spots should not lead to the same place if they have different names (and vice versa).
- Aim to site all documents on the servers where they really belong (for example, we do not need every school to write its own commentary on the HEI's Alumni Association: this is an HEI task).
- All links must seem to make sense to the user in both directions, eg. from School to Faculty information and from Faculty to School.

Technical and editorial control

Even though we have advocated that many voices should be represented in HEI documentation, we cannot escape the responsibility for ensuring that correct information is accessible to students. This implies an editorial role.

If information is stored on servers, those machines are from a technical point of view often the responsibility of computing services staff. Some technical expertise is required to maintain the information on servers—incorporating new documents, updating

hypertext links when new documents have been appended, writing scripts to handle user-interaction, and so forth. As a result there is a risk that editorial decisions about the information will be made by those who are providing the technical service—often inappropriately. The shortcomings of many HEI Campus Wide Information Systems are almost certainly the result of their being written, edited and designed, as well as implemented, by computing support staff. Our indebtedness to the enthusiasm and expertise of computing staff should not blind us to the fact that they are not necessarily the best editors of documentation.

It is important therefore that the use of technology does not cause dependency on technologists. Currently, most academic staff have insufficient knowledge to be able even to specify what they want, let alone to attempt to construct it for themselves. Ignorance of the possibilities is preventing them from having a policy. There are staff-development implications.

A note on the Web and the law

This is not the place to discuss the huge subject of the relationship between Web activity and the laws concerning intellectual property, defamation, obscenity and so forth.

Perhaps the most important point is that the Web is not exempt from any of the laws of publishing or public utterance. The fact that the law is currently regularly flouted on the Web, for example by people publishing works which they do not own, does not mean that it can be done with impunity. As the Web moves from a fringe activity to a mainstream form of publishing, governments and other bodies take an increasing interest in policing it.

A SIMA project which deals with a wide range of legal issues is listed under **Web Resources**.

Staff development issues

What expertise is needed to create Web pages?

Often in this handbook we have referred to the 'author' as if the origination of the document was undertaken by an individual. In fact a number of variant arrangements are possible depending on the make-up of the team. Even in the following descriptions, the 'author' may in fact be several contributors. So not only may sites be developed by **teams** of individuals with widely varying skills, there is also scope for small-scale projects to be done by multi-skilled **individuals**.

- Authors can write the text using a simple word-processor, if they wish inserting the relevant tags as they go along. They must be conversant with HTML.
- An author writes the text and the designer inserts tags in order to articulate the sense of the document. This requires that the designer must be conversant with HTML, and must also be capable of interpreting the author's intentions.
- The designer creates tags in a template, and the author inserts content, cutting and pasting any elements which are needed a variable number of times. Some understanding of what the tags mean is necessary for authors, in order that they can diagnose the cause of unexpected effects when testing the document.
- Specialised software is used to hold text elements (for example in a database) and it outputs the text correctly tagged. This approach is useful for a document type which is needed often and which must conform to a standard structure. The author need know little or nothing about HTML.

The underlying expertise required falls into four categories:

- information technology
- hypertext
- HTML
- interactive techniques

Information technology

To create Web pages even to specify them for execution by others one must grasp the essentials of information technology generally. Some mundane but important aspects of digital media which should be understood are: the concept of file-formats; the potential for transferring information from place to place and program to program; the differing storage requirements of various media.

World Wide Web awareness should be built into the general programme of IT education for staff (and of course students).

Hypertext

The concept of hypertext is an unfamiliar one for most members of an HEI. This unfamiliarity encompasses writing, editing and design, all of which must be considered afresh. If we are to make full use of the potential of the Web, then an awareness of the principles of hypertext, illustrated by good finished examples, is essential.

The conceptual issues of hypertext, its strengths and weaknesses as an educational and informational medium should be exposed through courses, seminars and other activities. Departments should be proactively encouraged to make a variety of experiments in delivering information electronically.

HTML

Some staff and students will wish to do their own HTML authoring. Increasingly, there are software tools which alleviate some of the difficulties of using the HTML mark-up system. However for those intending to do significant work in this area, the need for a nuts-and-bolts understanding of HTML is currently still unavoidable.

The possibility of using templates and other forms of assistance should also be investigated.

Those staff who are interested should have an opportunity to learn how to author HTML at a variety of levels of complexity.

Interactivity

While HTML provides for straightforward hypertext, there are many aspects of interactivity which it does not inherently support. For more wide ranging interactions, expertise in Java, Director or some other truly interactive technology is required. Greater freedom to design complex, multimedia documents brings with it a need for well-informed user-centred design.

HEIs need to maintain and develop a core of expertise in these skills, which are currently in short supply. An understanding of user-centred design is as important as technical expertise.

The most highly skilled originators of Web documents will be conversant with all five of these areas, but many HEI staff and students will be able to do useful work on the basis of only one or two.

As sites become bigger and more complex, significant supporting **technical** expertise becomes necessary. Specialist skills in usability **testing** may be required, though if such expertise is not available, this should not be an excuse for avoiding informal testing and revision of the site.

Appendix One: a note on Standards

Without standards for the transfer of information from place to place, machine to machine, network to network, and from one software package to another, the World Wide Web would not work. This is not the case in most other areas of computing, where proprietary formats for information are the norm. For example, individual word-processing packages have emerged over the years which must now be provided with a suite of translation filters if they are to import and export 'foreign' formats.

There are three possible approaches for the developer of a new computing package or system:

1 **ignore** existing or imminent standards

2 design a unique product which it is hoped will **dominate** the market and set a new *de facto* standard

Such standards may emerge when any company so dominates the field that others find themselves obliged to follow that company's lead. An example is Postscript, developed by Adobe as a means of sending graphic and typographic information between computers and in particular between computers and printing devices.

3 design a product which conforms to some existing or emergent **agreed** standard.

A standards body may be established for some area of common interest between many companies and organisations. The World Wide Web consortium (see Resources) is concerned with developing standards for the Web which benefit users and not any particular manufacturer.

Approaches 2 and 3 are closely related in practice: major companies sit on standards bodies and influence policy, while the standards bodies themselves tend to work within the same broad parameters individual companies at any given time.

The trouble with standards

Standards are not always wholly beneficial. Since they must be fixed at a given time with a certain view of the technology, of its applications and of the needs of users, they can eventually become an impediment to progress. Two things can happen: a rival standard may overtake the original or a new version of the original standard may be agreed. Nowadays, standards are in a state of almost perpetual revision, so that even within a true agreed standard there will be problems with versions.

Some new aspects of Web 'standards' are dictated not by the Web standards body but by Netscape, up to now the biggest single commercial influence on the Web, and increasingly by Microsoft.

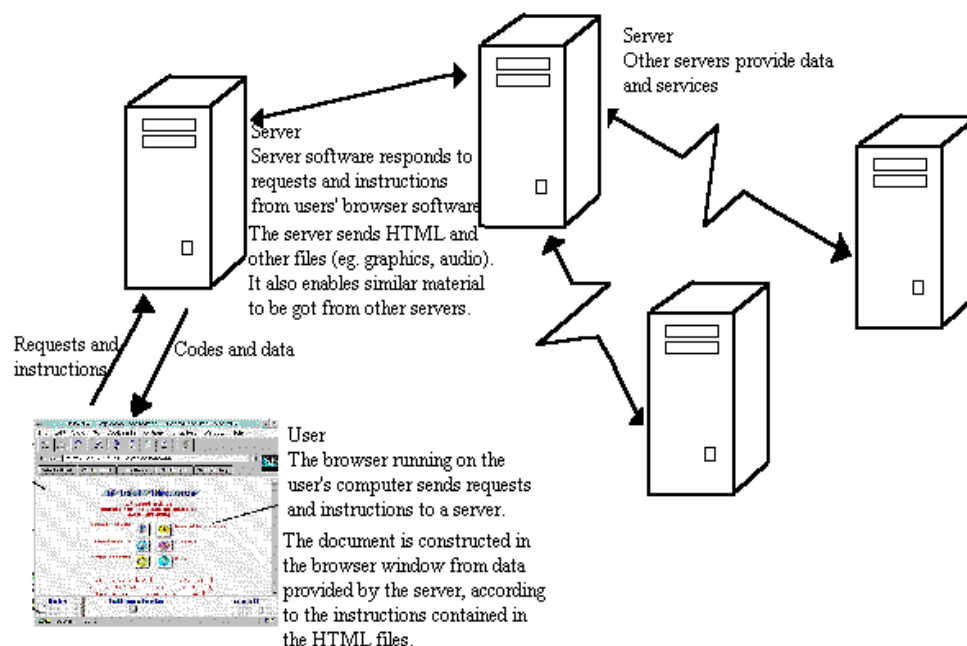
See the home pages of the various interested companies and also of the World Wide Web Consortium, under Web Resources.

Appendix Two: Some basic facts

The Web is electronic, computer based

Computers are used by the **publisher** to

- **store documents**
these documents are disk-files containing text, still images, animations, video, sound and interactive elements
each file normally contains information of a single type, rather than mixed media, but the browser software is capable of integrating these into the appearance of a single document
- **'serve' the documents to the users over networks**
server software on the publisher's computer responds to requests sent by the user's computer, sending the files in return
- **run computer programs that assist the user**
ancillary computer programs may be run on the server, for example to get information from a database on the user's behalf
Computers are used by the **user** to
- request documents from servers



whenever the user operates a control in the browser software, or triggers an active element in the current document, this is transmitted back to the server as a command or request, leading to a response by the server

- **present documents to the user**
documents are displayed on the user's computer, in a way appropriate to their file type, so text files appear in a scrolling window, sound files are passed to the sound-output hardware, etc.
separate components (text and graphics files retrieved from the server for example) can be composited together by the browser software into the appearance of a single document. The files which are brought together in this way need not be on the same server.

The Web is based on networks

The World Wide Web depends on networks connected to each other, using agreed forms of addressing and protocols for transferring files. It uses a variety of different forms of physical connection, which can in principle be ignored. When using the phone, we do not normally worry about how the physical connections are made, and the same ought to be true of the Web. In practice, publishers and users may need to deal with such issues as the **bandwidth** of the immediate network, and of the **gateways** which connect it to the rest of the world, and this may require them to influence the network and computing policies of their HEI.

The Web costs the user nothing

The Web is free, to the extent that there are currently no charges based on the duration or distance of Web transactions. Use of the Web costs nothing if the HEI provides

- a computer
- suitable software
- connection to the internet
- enough time to make use of it

The HEI pays fees to be connected, but does not (yet) charge the user personally. The academic connection carries with it certain restrictions, such as prohibiting commercial use (but this does not mean that academic Web publishers cannot inform their users about courses and other services that they offer).

An increasing number of sites on the Web are charging a fee for access to their information. This trend is likely to continue and poses serious problems for future Education. For the entrepreneurial individual or institution however, it represents an opportunity to publish in a new form which may eventually yield a new income.

Costs of the Web to the publisher

Publishers of Web documents may find that their HEI provides all the facilities described above plus the use of a Web Server on which to mount their files. As the Web becomes more a part of everyday life, losing its novelty value, the willingness to provide material support and services for free is likely to decline. It will become increasingly important to budget at the outset for server space and for the development and maintenance of pages (see Creating a maintainable site, p88).

Requirements for users

The minimum requirements for the Web user are a computer connected to a network, a web browser package such as Netscape, and an IP address, normally provided by the HEI's computing services. The user may also have ancillary software in the form of **plug-ins** and **helper applications** for reading data other than text and simple graphics. The user's computer can be a PC, a Macintosh, a Unix machine, anything for which network connection is possible and browser software is available.

Requirements for creating documents

The content creator needs a computer on which to originate and edit pages, and the individual components of those pages. Basic textual pages can be made with the simplest text editor. More specialised tools allow the HTML code tags to be visually differentiated from the text content, to make editing easier. Greater sophistication is provided by special-purpose tools or by page-layout tools which have adaptations for making Web material.

An increasing number of packages whose main purpose has been the production of paper documents are now claiming to provide facilities for the production of HTML. Examples include Microsoft Word, ClarisWorks, Quark Xpress and PageMaker (the Adobe packages Illustrator and PageMaker also offer direct output to PDF files). Claims of HTML-compatible output are easy to make and need to be treated with a certain amount of suspicion. While it is easy to see how an ordinary word-processor or page-layout package can be adapted to output the relevant codes to make a headline bold (for example), it is much less easy to imagine that they provide access to more advanced (and useful) facilities of HTML such as identifying various kinds of lists. Also unclear is how the production of hypertext links might be handled, or of clickable maps. In some cases, the aspects of HTML authoring which are difficult and tedious to do 'by hand'—such as **tables**—are the very aspects which are not automated by these extended packages.

An advantage of extensions to existing software packages is that the learning process will be a short one if the author/designer is already familiar with it in the context of paper publishing. Also, where both paper and Web output are required, there may be economies (but with the usual caveat that writing and designing for paper and screen are not the same). An alternative approach is taken by packages like Adobe PageMill, specifically for the graphical layout of Web documents. It is likely that this sort of package will grow in importance and become more capable than in its early versions.

For additional media, additional tools are required. These include creation and editing tools for images, sounds, movies, 3D models and fully interactive components.

A study of authoring packages has been undertaken for the AGOCG SIMA initiative, see Web Resources, p110.

Requirements for serving documents

The computer which acts as a server must be fast and reliable, and capable of efficient networking. The computing power required is (crudely) the number of simultaneous users multiplied by the **bandwidth** required for an adequate service for each of them, so a very popular site will make greater demands on the server than one which supports only a few users at a time. It is necessary to budget for the worst case of multiple simultaneous connections, since if users find a site inaccessible at peak times, then almost by definition, a maximum number of users have been disappointed at the time when they most wanted access.

A web server software package alone will be sufficient for basic Web publishing. Greater sophistication is provided by CGIs which offer additional functions for authors and users, for example **clickable maps**—pictures on which the user can click at a particular location to access various sources. CGIs can be found on a variety of shareware sites. To enable communication between a Web page and a database package, a CGI plus a suitable database package will be required. Staff able and willing to create or modify CGIs may be needed.

Additional data provision such as streamed audio—sound which can be delivered continuously over the Web rather than needing to be first downloaded to the user's computer—may require additional server software. It is important to estimate the extra pressures on the network and the server associated which would arise from providing a stream of audio data to several simultaneous users, compared with simpler pages where for much of the time users are viewing the material passively at their machine and little network traffic is involved.

A full checklist of requirements for Web publishing is provided under **Policy** on p89.

Getting support

Any computer which can write text can be used to create simple Web pages, and this can be done independently by an individual, but in order to publish those pages the individual needs goodwill from the HEI's computing services who will provide both time and commitment.

Connection on-campus

The commonest form of connection is one provided within the user's institution, typically by the computer centre. It is one which the academic need know little about, since all the technical set-up will probably be done by computing staff. They should be happy to provide the relevant browser software (which is usually free to HEIs) and the physical access to the network. However, staff on campuses which are not networked may need to lobby for their needs to be recognised.

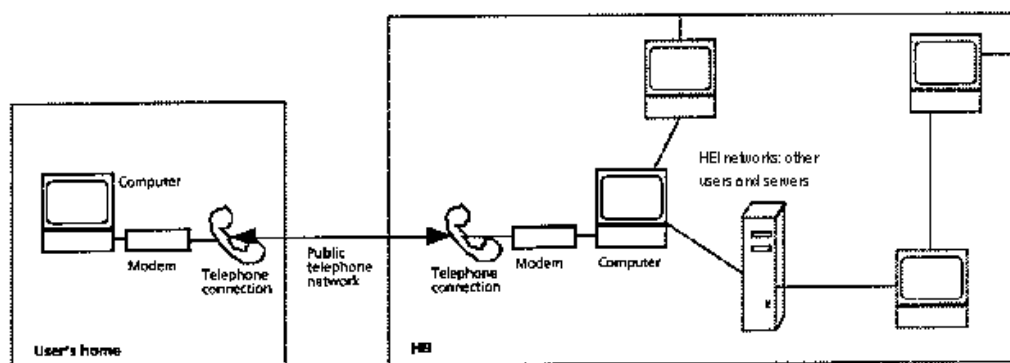
There are different policies in institutions about who should pay for the various components of connection to the Web. It is important to talk to the computer centre about what is needed and why. It may be necessary to prepare a good case beforehand, using information from a colleague or someone in another HEI who already has access.

Connection from home

Users can connect to the Internet from home via their HEI, rather than paying a commercial internet service provider which would typically mean paying both a subscription and a connect charge. While some might see the idea of being connected to work when at home as threatening, this low-cost Internet access can also be seen as a perk of the job.

Connection to the HEI is achieved using two modems, one the user's responsibility and connected to their phone line at home, the other in the HEI. Setting up a modem should be easy, but often advice is needed to explain unexpected problems. Once set

up, stored configuration settings enable the modem to know how to connect in future. It is then just a matter of running an appropriate program to remake the connection whenever it is needed. The HEI's modem will not be dedicated to a single user but will take calls from a number of off-site users. Normally the user will need passwords, imposed in order to prevent unauthorised access. It is effectively impossible (for all but the dedicated hacker) to get connected without the cooperation of the HEI's computing services. Some HEIs are far ahead in providing this kind of access for both staff and students, while others have hardly begun to recognise the possibilities.



The dial-up user is connected via public telephone lines to the HEI's network. Speeds will be lower than when connected directly to the network internally.

All the time the user is connected to the HEI, even if not actually doing anything, charges are adding to the user's personal telephone bill. However, the phone charges are for connection to the HEI perhaps only a local call away and are unaffected by the distance away of the Web sites which the user 'visits'. It is as cheap to look at a document in India as one in the UK. Home dial-up users cannot make phone calls at the same time as using their modem (unless they lease a second line) nor can they be phoned by others while connected.

The faster the connection to the HEI the user wants, the more expensive the user's modem. However, there is no point in exceeding the speed of the HEI's modem at the other end. Some HEIs provide modems for staff, but most do not. It is worth checking with computing services staff to find out if they recommend particular modems before committing to a personal outlay.

How users see hypertext in the Web

In a Web browser such as Netscape, the first thing the user sees on opening a file (probably one on a distant server) is a scrolling window of text and perhaps graphics.

Web users can view documents by any of the following means:

- open a document explicitly, if they know its 'address'
- search a variety of indexes for it, by title, keyword and so forth
- open it from the document they are currently viewing by interacting with a 'hypertext anchor'—an item in the current document such as a word or picture. The link must have been created by the author of the document.

A Web document may (unusually) contain no items which link to other documents, in which case users, if they wish to open another document, must open it explicitly. However, the likelihood is that the document contains links to other document parts. These parts may be elsewhere in the same document, or they may be in other files, perhaps local, perhaps on completely separate servers at huge geographical distances.

If the current file does contain links to other document parts, then this is indicated using colour, underlining, or other style attributes, which are often configurable by the user (and are stored in a Preferences file). In Netscape, as in most systems, the activation of a link is achieved simply by clicking on the 'hot text'. If, having traversed a link, the user wishes to return to the original document, the standard facilities of the browser provide a 'go back' button for this purpose.

In addition to the formatting which indicates links to other documents, the HTML coding of documents used on the Web also provides facilities for differentiating between body-text and various levels of headings, and for formatting structured elements such as a variety of lists.

How the Web finds resources

Browser software finds material using URLs Uniform Resource Locators. In order for a document stored somewhere on the Web to appear on the user's screen, the browser must have access to this address information.

A URL contains more than just the address of a distant server. The first part of the URL tells the browser software how to exchange information with it. In the case of straightforward links to HTML documents, it will be http (for HyperText Transfer Protocol). So common is this that many Web browsers allow it to be omitted when typing in a URL manually.

Connecting

When the Browser program is run, it will initially attempt to open whatever URL is set up in its configuration or preferences file. This can be altered for future occasions by the user. A dial-up user using a modem may need to run a configuration program first to actually open the connection to the HEI's modem. From then on, opening further URLs is done manually or by interacting with the document on display. While at one time only items of text or whole pictures could act as triggers to open other URLs in this way, an increasing range of interactions can now produce this result, including clicking on parts of a picture or interacting with a fully multimedia component.



The user enters a URL by hand, in this case in a dialog box provided by the Open Location option in Netscape



The user moves the pointer over a hypertext anchor which, when clicked, will open the corresponding URL. In this example from Netscape, the URL associated with the hypertext link is displayed in the status bar at the bottom of the window

In addition, browsers may provide:

Back reload the last URL visited

History List reload a URL visited in the current session

Bookmarks reload favourite URLs, whose addresses are stored with the user preferences

Reload reload the current URL, for example in case of problems with its current display

Appendix Three: Adobe Acrobat

General character

Acrobat was designed to serve two purposes:

- To allow paper documents to be presented on screen, particularly for example in proofing a layout which might need to be electronically transmitted to the other side of the world. This it can do without the end-user having either the correct fonts or the application which generated the original pages (for example Quark Xpress, PageMaker, FrameMaker).
- To enable the production of on-screen documents. This is increasingly important.

Acrobat puts emphasis on the appearance of the page and in doing so takes the fixed formatting approach. It contrasts strongly with HTML which emphasises the structural components of the content, and which is currently not capable of specifying exactly how the page should look.

We can compare Acrobat's approach to the four problems in interactive electronic publishing which we identified in discussing HTML (p24).

Proprietary hardware and software formats

Adobe's PDF file format is open and published, but not an agreed standard. Its design represents Adobe's view of what should be possible. However, we should recall that Postscript, without which high-quality desktop publishing might not have been achieved, was (and still is) an Adobe proprietary format. PDF files must be read with the Acrobat reader, which can be distributed free by the document publisher.

Fonts are property

Acrobat PDF documents can contain embedded definitions of the fonts needed. Property is protected in that the end-user cannot extract the fonts and use them in another document (Adobe are themselves major font publishers). Alternatively, when a document which does not contain embedded font information arrives at the user's machine, an approximation of the font is created on demand, using Adobe Multiple Master fonts.

Users constrained by hardware

Unlike HTML, Adobe documents have pages with actual dimensions, for example A4, and are in that sense 'virtual paper'. Rather than the document being fitted to the available space on the display, the user scrolls the document in the Acrobat viewer window (or sub-window within a Web browser). This scrolling can be avoided, at least for standard monitors, by designing pages which are the correct format for the screen but this approach, however desirable, clashes with the temptation to simply transfer wholesale to the screen existing documents designed for paper.

Documents self-contained, unconnected

Initially, PDF files could only link in hypertext fashion to other documents stored on the same server, and were therefore useless as components of distributed hypertext systems. However, the links embedded in PDF files can now be true URLs, allowing

proper addressing of distant documents.

The PDF format is still extremely limited in its ability to create proper, maintainable hypertext links.

Features of the package

At its simplest, the user can 'print' a file to the PDF Writer (a virtual printer), which then makes a Portable Document Format file, which can be viewed on any platform for which an Acrobat Reader is available (Windows, Macintosh, DOS, Unix). The reader for Macintosh and Windows can be distributed free of charge. When the end-users open a document with the Reader, they can read it page by page, jump to any page, search for any word or phrase, and view the pages at a variety of degrees of magnification.

If the publisher wishes to provide a greater range of functions to the user, then they must use Acrobat Exchange. This application allows the authors to open a PDF file made with the PDF Writer and augment it in certain ways.

These include:

- creating a table of contents ('bookmarks') from which the user can pick by clicking the pointer
- adding annotations in the form of electronic post-it notes, which may be put anywhere on the 'page'
- creating links from any part of any page to another location within the same document or to a location in another document
- creating 'articles'. These enable end-users to follow a particular sequence of information in the document without needing to find for themselves the location on the page of the next block. This is useful for multi-column documents, where the next part of the 'story' is at the top of the next column, rather than the beginning of the next page.

Other facilities in Acrobat Exchange include document security and facilities for deleting and adding pages, substituting pages, merging separate documents etc.

Using the package Acrobat Catalog authors can also create an index to enable faster searching by the end-user.

Some weaknesses of the Acrobat approach

The strengths of Acrobat are plain: the ease of production and the ability to guarantee what the end-user will see. Some of the weaknesses listed here may be avoided by future versions.

Poor facilities in the tool-set

None of the facilities for authors are automated to any useful extent within the Exchange package. Bookmarks can only be created manually one-by-one. Links must each be built by hand (whereas in HTML even the simplest word-processor could be used, say, to turn every occurrence of the word 'University' into a hypertext link to

another document).

Other packages can produce PDF files directly, without resorting to the PDF writer, and in these cases, automation of certain functions is greatly improved. For example in Adobe PageMaker (Version 6) if a table of contents has been made for the publication, then, when a PDF file is made, this table can optionally be converted into the PDF bookmark list.

Document editing and maintenance

Hypertext links in PDF files are specified graphically, that is by their position on the page, not by the element such as a word or a picture which is to act as the trigger. At first site this seems unproblematic, since a strength of PDF is its ability to specify robustly exactly where items appear on each page. However, if we now imagine the creation and editing of a multipage document, the problems start to become apparent. If we create link hotspots (which we have to do by hand) on several pages, we have created a very fragile system, since if we edit the original and re- print' the PDF file, text flow has caused the text to shift away from under its hotspot, and this will be true for very hotspot on all the succeeding pages. This is exactly the danger we highlighted in discussing the weakness of fixed formatting approaches (p29).

Technically, this problem is not insoluble for future versions. However, using the current way in which Acrobat works, it effectively prevents the production of robust, maintainable documents.

Virtual paper?

In some respects, Acrobat's ease of transition from paper to screen-based documents can be seen as a problem rather than a virtue. It means that many documents will be produced which have been neither written nor designed for the screen. Parallel efforts by other manufacturers, for example the facility of the Microsoft Internet Explorer to directly display Microsoft Word and Excel documents without modification, should also be treated with care. It is important to distinguish between documents designed for on-screen interactive use and those pieces of virtual paper which are appropriately presented on screen as a representation of paper documents. Each medium has its strengths, and the Web will evolve its own genres with their own styles and modes of address, beyond the display of would-be paper.

Resources

HTML practical

Graham, Ian S 1996: *HTML Sourcebook a complete guide to HTML 3.0* Wiley 1996
Though rather badly organised due to piecemeal updating, a vital comprehensive reference book, and up-to-date.

Evans, Tim 1995: *10 Minute guide to HTML* Que Corp. 1995
A good, simple introduction, actually twenty-three 10-minute sessions.

Hypertext

ACM, Communications February 1994 Vol 37 No 2 themed issue on *Hypermedia*

ACM, Communications August 1995 Vol 38 No 8 themed issue on *Designing Hypermedia Applications*

Bolter, Jay David 1991: *Writing Space the computer, hypertext and the history of writing* Lawrence Erlbaum, New Jersey 1991

Bulmer, Martin GS 1995: *Hypertext, the Navigation Metaphor and Tracking* unpublished postgraduate essay, Centre for Electronic Arts, Middlesex University February 1995

Conklin, J 1987: 'Hypertext: A survey and introduction' in IEEE Computer, 20(9), 1987, pp 17-41

Lanham, Richard 1993: *The electronic word democracy, technology and the arts* University of Chicago Press, 1993

Martin, James 1990: *Hyperdocuments and how to create them* Prentice Hall, New Jersey 1990

Nielsen, Jakob 1995: *Multimedia and hypertext: the Internet and beyond* Academic Press 1995

Schuler, W; Hanneman, J and Streitz, N (eds.) 1995 *Designing user interfaces for hypermedia* (Esprit research report Project 6532) Springer 1995

User-centred design

Brown, C Marlin 'Lin' 1988: *Human-Computer Interface Design Guidelines* Ablex Pub. Corp. New Jersey, 1988

Laurel, Brenda 1990: *The art of human-computer interface design* Addison-Wesley, 1990

Marcus, Aaron 1992: *Graphic design for electronic documents and user interfaces* ACM Press, New York 1992

Norman, Donald A 1988: *The psychology of everyday things* Basic Books, New York 1988

Preece, Jenny 1994: *Human-Computer Interaction* The Open University, UK 1994
Good section on usability testing

Shneiderman, Ben 1992 *Designing the user interface* Addison-Wesley 1992

Information design

Tufte E 1983 *The visual display of quantitative information* Graphics Press, Cheshire, Conn. 1983

Tufte E 1990 *Envisioning information* Graphics Press, Cheshire, Conn. 1990

Hypertext as educational medium

ACM, Communications April 1996 Vol 39 No 4 themed issue on Learner-Centered Design

Laurillard, Diana 1993: *Rethinking University Teaching* Routledge 1993

McKendree J, Reader W and Hammond N 'The "homeopathic fallacy" in learning from hypertext' in *Interactions* July 1995 ACM New York

Marchioni, G 1990: 'Evaluating Hypermedia-Based Learning', from Nato ASI Series, Vol F67, *Designing Hypermedia for Learning*, edited D. H. Jonassen and H. Mandl, Springer-Verlag, Berlin, 1990.

Mühlauer, M 1990: 'Hyperinformation Requirements for Integrated Authoring/Learning Environments' from Nato ASI Series, Vol F67, *Designing Hypermedia for Learning*, edited D. H. Jonassen and H. Mandl, Springer-Verlag, Berlin, 1990

Spiro R, Feltovich P, Jacobson M and Coulson R 1991: 'Cognitive Flexibility and Constructivism, and Hypertext'. *Journal of Educational Technology*, May 1991

Duffy, T and Knuth, R 1990: 'Hypermedia and Instruction: Where is the Match?' from Nato ASI Series, Vol F67, *Designing Hypermedia for Learning*, edited D. H. Jonassen and H. Mandl, Springer-Verlag, Berlin, 1990

McKnight C, Richardson J and Dillon A 1990: 'Journal Articles as Learning Resources: What can Hypertext Offer?' from Nato ASI Series, Vol F67, *Designing Hypermedia for Learning*, edited D. H. Jonassen and H. Mandl, Springer-Verlag, Berlin, 1990

Tessier, M: 'Usenet groups as a participatory medium' presented at the Computers and Writing Conference, 1996

Data types

Burger, Jeff: *The Desktop Multimedia Bible* Addison-Wesley

This book is a good primer in the characteristics of different types of digital media, though not specific to the Web.

Other references

Davis, Stephen Boyd 1996: 'The Interactive Word', in Eurographics UK Conference Proceedings Imperial College, 28 March 1996 Volume 2 pp197-205

Barthes, R 1974: *S/Z*, Hill and Wang, New York 1974

Postman, N 1985: *Amusing Ourselves to Death*, Penguin, NY, 1985, p83

Web Resources

Note If a resource has been moved from the exact location specified and therefore cannot be found by your Web browser, look at the main site where it was located: it may well have been moved within the site. For example, if the precise address <http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html> fails to produce the document, then look at <http://www.ncsa.uiuc.edu/> (the first part of the same address) to try and locate it from there.

General

- **NCSA A Beginner's Guide to HTML**

<http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html>

This is a general primer for HTML, covering Getting Started, HTML Documents, Markup Tags, Character Formatting, Linking, Inline Images, Tables, Fill-out Forms and Troubleshooting.

- **Web Development Information**

<http://www-slis.lib.indiana.edu/Internet/programmer-page.html>

This site offers links to several other useful sites under the following broad headings: HTML Starting points, Style Guides, Reference Guides and Technical Information and Documentation; Server Management; PERL and CGI.

- **Web 66: Cookbook**

<http://web66.coled.umn.edu/Cookbook/contents.html>

This site aims to offer a mix of information and linked resources so that intending Web publishers can find everything they need to set up a site. It has Macintosh and Windows specific areas.

- **Introduction to HTML**

<http://www.utoronto.ca/webdocs/HTMLdocs/NewHTML/htmlindex.html>

This site is useful in separating out the non-standard extensions from the general material. It includes Introduction to HTML, the HEAD and BODY elements of an HTML Document, Stepping up to HTML 3, Netscape & Microsoft Extensions, Uniform Resource Locators (URLs) and Interaction with the Server (with examples).

- **Maricopa Center for Learning and Instruction**

<http://www.mccli.dist.maricopa.edu/>

The Maricopa Center provides a wide range of instructional materials for various interactive technologies including HTML and Director.

- **ANU - Quality, Guidelines & Standards**

<http://coombs.anu.edu.au/SpecialProj/QLTY/QtyHome.html>

This site includes sections on the design, production and maintenance of WWW Resources, Gopher Information Facilities, FTP Information Facilities, Databases, Mailing Lists, USENET systems, and information about Internet Relay Chat (IRC). It also points to the scholarly papers collection next.

- **ANU Quality, Guidelines & Standards for Internet Resources: Scholarly Papers**

<http://coombs.anu.edu.au/SpecialProj/QLTY/QtyPapers.html#papers>

This facility, provided by the Australian National University, keeps track of scholarly papers dealing with standards, measures and management procedures aimed at improving the quality of networked information facilities.

- **Style Guide for Online Hypertext**

<http://www.w3.org/pub/WWW/Provider/Style/>

One of several useful documents and links provided by the World Wide Web Consortium, see entry under Background below.

Legal and ethical

- **Legal issues on the WWW**

<http://info.mcc.ac.uk/CGU/SIMA/legal/title.html>

A comprehensive survey of the legal issues relating to the development and use of Word Wide Web technology at educational sites, by Andrew Charlesworth of the Information Law and Technology Unit at the University of Hull. A SIMA Project.

- **EFFweb - The Electronic Frontier Foundation**

<http://www2.eff.org/>

The Electronic Frontier Foundation proclaims itself as a non-profit civil liberties organization working in the public interest to protect privacy, free expression, and access to public resources and information in new media Products and technologies

- **BrowserWatch**

<http://browserwatch.iworld.com/>

BrowserWatch is an essential site for information about browsers and plug-ins. However, it does not express a view about which new technologies are important and which are not, so it is important to look critically at the various sites to which BrowserWatch points.

- **Microsoft Internet Explorer**

<http://www.microsoft.com/ie/>

From ignoring the Web, Microsoft has moved rapidly to attempt to dominate it. The company's thoughts on the integration of the Web and the personal computer desktop are worth considering.

- **World Wide Web Software Tools**

<http://www.ncl.ac.uk/wwwtools/>

This survey takes the form of a set of web pages covering tools on the Macintosh, PC and Unix platforms, some on-line tools, and a report. A SIMA Project.

- **Adobe Systems Incorporated**

<http://www.adobe.com/>

A comprehensive site about Adobe products, future plans, publications etc.

- **Netscape**

<http://home.netscape.com/>

A comprehensive site about Netscape products, intranets, development, plus a wide range of instructional materials for Web publishers.

http://home.netscape.com/assist/net_sites/index.html

The Assistance section of the Netscape site has useful material on authoring documents and developer tools.

http://home.netscape.com/comprod/at_work/white_paper/index.html

A series of 'white papers' on the use of the Web for intranets.

Technical detail

- **JPEG image compression**

<http://www.cis.ohio-state.edu/hypertext/faq/usenet/jpeg-faq/part1/faq.html>

Includes twenty-one sections on the JPEG graphic file format, including how to choose between JPEG and GIF, and advice on achieving the best form of JPEG compression for a given purpose.

- **Non-Dithering Colors in Browsers**

<http://www.lynda.com/hex.html>

The Browser Safe Palettes only contain 216 colors out of the possible 256, because the remaining 40 colors vary on Macs and PCs. By eliminating the 40 variable colors, this palette is optimized for cross-platform use. The author recommends the Browser Safe Palette for flat-colour illustrations rather than for remapping colour photographs. There is a test page to prove the point.

Style

- **Yale C/AIM WWW Style Manual**

http://info.med.yale.edu/caim/StyleManual_Top.HTML

A Web style manual by Patrick Lynch of the Yale Centre for Advanced Instructional Media, covering Interface Design in Web systems, Page Design and Optimizing Performance in Web Pages, with appendices on Web Authoring Resources, Graphic Interface Design and Multimedia

- **Do's and Don'ts of Web style**

<http://millkern.com/do-dont.html>

A light-hearted but useful summary.

- **The Alert Box: Current Issues in User Interface Design**

<http://www.sun.com/columns/alertbox.html>

An intelligent monthly column by Jakob Nielsen, SunSoft Distinguished Engineer which has included such topics as the Top Ten Mistakes of Web Design, The Internet Desktop and In defense of Paper.

- **User Interface Design for Sun's WWW Site**

<http://www.sun.com/sun-on-net/uidesign/>

An interesting case study by Jakob Nielsen of the interface design for Sun's own Web site, including their fundamental design concepts, iterations of the home page design and icon designs, and an account of the 'usability engineering' methods used in the design process.

- **What is good hypertext writing?**

<http://kbs.cs.tu-berlin.de/~jutta/ht/writing.html>

In Jutta Degener's view, 'The two pitfalls of writing hypertext copy are links and emotions. Links are a new stylistic element that writers must learn to handle. The emotional problem is harder: we must snap out of the 'host' or 'provider' role, must get away from the excitement of guiding another person through the text, and get back to just writing.' A useful contribution to the debate.

Background

- **As We May Think**

<http://www.isg.sfu.ca/~duchier/misc/vbush/>

The complete text of Bush's 1945 article, which set out under the name Memex many of the principles of what subsequently became hypertext.

- **Advisory Group on Computer Graphics (AGOCG) World Wide Web Server**

<http://www.agocg.ac.uk:8080/agocg/>

The Advisory Group on Computer Graphics (AGOCG) is an initiative of the Joint Information Systems Committee (JISC) of the Higher Education Funding Councils and the Research Councils. AGOCG provides a single national focus for computer graphics, visualization and multimedia within the UK higher education community and is concerned with the handling of visual information and its processing.

This handbook was developed with the support of AGOCG's **Support Initiative for Multimedia Applications**.

- **ACM/SIGCHI Home Page**

<http://www.acm.org/sigchi/>

SIGCHI is the special interest group for computer-human interaction of the Association for Computing Machinery, New York. 'ACM SIGCHI brings together people working on the design, evaluation, implementation, and study of interactive computing systems for human use. ACM SIGCHI provides an international, interdisciplinary forum for the exchange of ideas about the field of human-computer interaction (HCI).'

SIGCHI publishes a monthly bulletin and a quarterly magazine called - Interactions

- **ACM/SIGLINK Home Page**

<http://www.acm.org/siglink/>

SIGLINK is the special interest group for hypertext of the Association for Computing Machinery, New York. 'SIGLINK is a forum for the promotion, dissemination, and exchange of ideas concerning hypertext research, technologies, and applications among scientists, systems designers, and end-users.'

SIGLINK publishes a Newsletter. The ACM itself publishes monthly Communications as well as journals and books.

- **The World Wide Web Consortium (W3C)**

<http://www.w3.org/pub/WWW/>

'The World Wide Web Consortium exists to realize the full potential of the Web. W3C is an industry consortium which develops common standards for the evolution of the Web by producing specifications and reference software. Although W3C is funded by industrial members, its products are freely available to all.'

- **The World-Wide Web Virtual Library**

<http://www.w3.org/vl/>

The Virtual Library has sections on Communications and Telecommunications (<http://www.analysys.co.uk/commslib.htm>) and on Electronic Journals (<http://www.edoc.com/ejournal/>) amongst many others.

- **British HCI Group**

<http://kmi.open.ac.uk/~simonb/bcs-hci/hci-grp.html>

'The British Human-Computer Interaction Group was set up as a Specialist Group of the British Computer Society in 1984, to provide an umbrella organisation for all those working on the requirements analysis, design, implementation and evaluation of technology for human use.'

- **KMi, Open University, UK**

<http://kmi.open.ac.uk/>

The Knowledge Media Institute is a grouping of the OU's research into learning applications of new technologies. 'We share a belief that our future depends on understanding and sharing knowledge, and we therefore aim to define the future of life-long learning by harnessing and shaping the technologies which underpin it.'

- **Media-Lab, MIT**

<http://www.media.mit.edu/>

'MIT's Media Laboratory, founded in 1985, carries on advanced research into a broad range of information technologies including digital television, holographic imaging, computer music, computer vision, electronic publishing, artificial intelligence, human/machine interface design, and education-related technologies. Our charter is to invent and creatively exploit new media for human well-being and individual satisfaction without regard to present-day constraints.'

Glossary

Bandwidth

When information is sent from one computer to another, the maximum speed at which it can travel is dictated by the capacity of the link as it were the diameter of the pipeline. Bandwidth is therefore measured as an amount of data per second. For a given route from one computer to another, the maximum speed of data transfer is dictated by the point of worst bandwidth in the chain. Transfer rates are seriously affected by network traffic, so vary depending on whether use is at peak times or quiet times.

Browser

The software which enables the user to find Web documents and use them is a Browser. Browsers are available for different kinds of computer. The simplest will work on a small inexpensive computer, though it must of course be connected to a network. As more complex multimedia documents are published on the Web, larger, faster computers are required to support the appropriate browsers.

Clickable maps

A picture can be a Web hypertext anchor as easily as a word. However, HTML does not inherently support pictures which trigger different links depending on where they are clicked. These are clickable maps, and currently require three components on the server: the image, a map file specifying which regions do what, and a CGI to handle the process.

Colour table

Anything displayed on a computer which supports only 256 colours (the most common figure) will have its colours assigned to the particular 256 colours available at the time, dictated either by the machine's operating system or the current application (such as a browser). This is the colour table, also known as the palette or CLUT (colour lookup table)

The colours in a graphic which was prepared using one colour table will look wrong (often completely wrong) if represented using another lookup table. This can happen if the colours in the originator's palette are not successfully recreated for the user by the browser package. It is vital to use a suitable palette when preparing images for the Web, and to test images on a variety of machines. See the Web pages listed under Technical Details in Web Resources, p110.

Compression

Compression is an essential tool in overcoming the problems of bandwidth. Files on the server are compressed, transmitted in compressed form, and decompressed at the destination. Time is used up in the decompression process, but this compares favourably with the delays caused by slow downloading. Different type of data are compressed in different ways. See also Graphics.

Graphics

A picture file of 100K uses as much data as 17,000 words. While pictures may have advantages both in term of conveying information and enhancing the look of a Web page, they should be kept to file-sizes (after compression) below 30K.

For a picture which occupies all of a standard display, 640 pixels wide by 480 pixels deep, the number of bytes required before compression is 300K. This assumes that the picture uses one byte (8 bits) for each pixel. Such a 'bit-depth' will give an adequate representation of most images, and is standard for GIF files, commonly used on the Web. Using more bits per pixel would mean a greater amount of data to be transferred: for 16-bit, twice as much as for 8-bit; for 24-bit, three times as much. A disadvantage of using 8-bit colour is that it involves the use of **colour tables**.

For two useful sites on graphics compatibility and JPEG and GIF file-formats for the Web, see the Technical Detail section of the Web Resources.

Graphics paint and draw

There is an important distinction between graphical information stored as pixels, units of fixed size representing colour and tone, here called **paint** graphics, and that stored as the geometry and other attributes of **drawn** objects.

Graphics on the Web have been dominated by paint format images stored as GIF or JPEG files. However, as publishers and users become frustrated by their limitations, draw formats will become more common.

The distinction between paint and draw graphics has implications for the way in which graphics are originated, edited, stored and displayed. Draw files consume file-space on an object-by-object basis, so simple images are economical to store, complex ones more extravagant. They are often more economical than equivalent paint images. For the Web, the single most important disadvantage of paint images is that their resolution is set when they are created. Even if a browser or a plug-in provides a facility to zoom in on an image for a closer view (most do not) eventually the user will only see bigger and bigger pixels. For a draw image however, the geometry can be scaled in a much more useful way, for example allowing a user to study detail in a large diagram at one moment and get an overview of it the next. When a draw object is enlarged, it will be redrawn on the screen with acceptable resolution.

Many kinds of images, particularly photographic, cannot only be represented in paint format, but for any sort of diagrammatic information draw formats are preferable. File-formats which can represent drawn imagery include Acrobat and Shockwave for Freehand.

Helper

Helper applications were the forerunners of plug-ins. While plug-ins deliver 'foreign' file types within the main browser, helper applications open a separate window for their own display. Helper applications can normally also be used independently of the browser, unlike plug-ins.

HTML

Text for the Web is 'marked up' using HTML, the Hypertext Markup Language, which is an informally agreed (but developing) standard. Originally authors and publishers were obliged to get to grips with the details of HTML, but increasingly they can rely on software tools which protect them from this level of detail.

Hypertext

Hypertext is text (and these days other media too) delivered in an interactive electronic environment. Users on viewing one part of a hypertext can interact with parts of it (for example by clicking the pointer over words, headings or pictures) to view another related document.

HTML was designed with hypertext in mind, and text is till the skeleton on which everything else hangs. Hypertext linking in HTML is more sophisticated for text than for other media types: using text, it is easy to make structures where individual parts of texts (words, phrases) lead to specified parts of other texts. However, when it come to other media, this is not so easy. It would be very difficult within the Web to make a structure for filmic sequences, where a particular frame in one movie linked to a frame in another. Similarly, while clickable image-maps allow one picture to have various discrete active areas, it would be difficult to jump to a particular part of another picture (or even of the same picture).

Outliner

Outliner packages allow users to switch between top-level views of texts and more detailed views. Unlike some proprietary hypertext systems, HTML does not easily support this idea of folding and unfolding levels of detail.

Page

A 'page' on the Web is one chunk of information having its own 'address' or URL (Uniform Resource Locator) so that the user's computer can find it. A page will be a single file on the server, but may have embedded in it other files such as graphics, sounds and animations. There is no limit to the length of a page: the term does not denote a unit of fixed size as in the pages of a book.

Plug-in

Many software packages of all kinds have become modular to the extent that they can be enhanced with additional functions by mini-programs which are connected to them. A Web browsers which support plug-ins does not itself need to be able to handle all conceivable types of data, since a special requirement is catered for by the appropriate plug-in. Example uses include sound, increased interactivity and the display of video. The plug-in must be installed by the end-user. Some data types also require special software on the server where they are sited. Plug-ins are not normally usable independently of the browser.

Server

For documents to be available on the Web, they must be stored on a suitable Server. This is a network-connected computer of moderate to high specification, and runs a Server Application a software package which is capable of responding to requests for files which it then transmits to users.

Site

A site on the Web uses a Server to offer a collection of related Web pages. Not all the pages which notionally comprise a single site need actually be on a single server, or even in one physical location.

Speed

All computer data, whether graphics, text, sound, video, is stored in similar digital files which are measured in bytes and their multiples.

The size in bytes affects:

- memory usage, while residing in the active working memory of the Web user's computer
- storage, for example on the Server, or on the disc of the user's computer if for any reason it must be stored there while being processed
- transfer rates, the speed with which a file can be transferred from the server to the user's computer

Of these three, the most important for the Web by far is the transfer rate, because the speed with which data can be moved from the server to the user dramatically affects the usability. If users have to wait too long for information, or for a response to an interaction, they will usually give up. Significant improvements in transfer rate can be achieved using a variety of compression methods.

Tables

Tables are grid-like structures containing other elements. The grid itself need not be visible. Tables can be used to position elements more precisely on the Web page than by other means, but at the cost of decreasing the flexibility with which the information can fit into different displays.

Testing

Testing of a Web site includes both technical testing, to ensure that it works in all respects, and user-testing, to ensure that it achieves its intended purpose. See The Design Process (p72)

Text

Text is very economically stored on computers, especially in unformatted form (with no information about position, style, typeface etc). The average length word (five letters plus its following space) occupies 6 bytes. So ten thousand words occupies 58K, and two PhD theses each 80,000 words long would easily fit on a single floppy disc (capacity 1.4Mb).

Text in computer graphics represents a special case of the difference between Paint and Draw (see also Graphics). Most importantly, draw text is 'live' text, which can be searched, sorted and generally manipulated as text. Paint text, on the other hand, while it is originated using text-editing tools, is not stored in the computer as text but as a pixel-based graphic: it is just another picture.

Live text can be

- sorted
- searched
- created or altered by the end-user
- created or altered by a computer program
- converted to the spoken word by a text-to-speech program

Since live text is rendered onto the screen each time the text is viewed, its appearance will suffer greatly if the font information (dictating the correct shape and spacing of the letter forms) is not available every time it appears. The commercial nature of fonts is one of the principal difficulties with which any system for the transfer of electronic texts must deal.

The advantages and disadvantages of paint text are essentially the opposite of those for live text.

- Paint text cannot be sorted, searched, altered or spoken since it is not really text.
- However, it has the great advantage that whatever font was used to create it, it will always have the appearance originally intended. In addition, in the current absence of facilities for live anti-aliasing of text in Web browsers (blending the edges of the letterforms with their background in order to disguise the jaggedness of the pixels) paint text which has been previously anti-aliased in a paint package will generally have a more acceptable appearance.

Text-to-speech

Most operating systems for desktop computers now have optional extensions which convert text to the spoken word, with greater or lesser realism and sophistication. Text which is really graphics cannot be spoken in this way.

URL

Uniform Resource Locators are internet addresses comprising three elements **1** the protocol, which indicates what kinds of messages can be exchanged **2** the domain name, which identifies the server using a unique address **3** the pathname or location on the server where the relevant file or other resource is located.

WWW, the Web

The Web is one application of the Internet which, by linking up networks, provides connection of computer to computer around the globe. Originally mainly textual, the Web is now a multimedia publishing mechanism which allows anyone with a Server to make documents available to other computer users. The kinds of 'publishing' of which the Web is capable are more varied and flexible than the term implies; also, there are many users of the Web which need not be 'World Wide'.