C M T 3 2 1 0

Understanding the Human Element in HCI

Module Handbook

Semester 2
2001/2002
Bounds Green

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School of Computing Science

Contents

Module Summary

Introduction

The aim of this course is to make you aware of the importance of understanding users in the design of computer systems, and to introduce you to various techniques that you can use to help you design more usable systems.

We will consider users from a range of different perspectives, and see how we can apply that understanding for designing usable systems. Our starting point is that users use computer systems to achieve things; those things may change the state of the domain (or 'world') or may mostly change the state of the user's knowledge, or the user's sense of pleasure. Designing well is about optimising the changes.

Some lectures will be focusing on the user and computer system as a 'closed world', ignoring other outside influences; others will be looking at the user's view of the 'big picture': how the user and computer system fit together within the domain, or how the user interacts with colleagues. Throughout this course, though, the user is the central focus, and the design of computer systems to support users as they go about their work and leisure activities is the secondary concern.

You should emerge from this course with a better understanding of users and design, and also skills in knowledge acquisition and evaluation techniques.

Contacting the Module Leader

You can contact your module leader in the following ways:

My office is at Trent Park in the Repton building, which is the last building after Lakeview. However, if you need to see me please come during my office hours.

Office Hours at Bounds Green are held in the Duty Tutor room of Computing Science after the lecture.

Email	e.duncker@mdx.ac.uk
Telephone	020 8411 4261
Web page	http://www.cs.mdx.ac.uk/staffpages/elke
Module web page	http://www.cs.mdx.ac.uk/staffpages/elke/com3210.html

Rationale Including Aims

MODULE CODE	**CMT3210**
TITLE	**HCI: Understanding the Human Element**
LEVEL	**3**
CREDIT POINTS	**20**
BARRED COMBINATION	**none**
CO-REQUISITE	**none**
PRE-REQUISITE	**COM2200**

AIMS

This module will provide the student with theories and models of the ways users think and work that have implications for user interface design. It provides an understanding of the underlying processes of human perception, information processing, and collaborative, socially organised action, and demonstrates their relevance to user interface design. You will learn how to apply mechanisms such as feedback, user support, navigation aids and good screen design in constructing interface designs that match users' needs. You will also learn techniques for evaluating user interface designs that are grounded in theory.

SYLLABUS

User differences – physical, psychological, social and cultural, in experience & knowledge.
Cognitive psychology – human abilities and limitations in information processing, including perception, memory and attention, mental models.
User models.
HCI formalisms and cognitive psychology.
Interaction design, screen design, metaphors, navigation.
Interaction styles, including natural language.
Feedback and errors. Controls.
Computer supported co-operative work.
Social and individual impact of user interfaces.

TEACHING AND LEARNING STRATEGIES

Lectures to deliver theoretical material
Laboratory work to apply interface design models and evaluation methods
Group based seminar work to apply theory and relate it to design practice.

LEARNING UNIT CONTACT DURATIONS PER WEEK

MODULE LEADER
Dr Elke Duncker

Learning Outcomes

At the end of this module you should be able to:-

Knowledge

- Describe theories and results from behavioural sciences that lead to understanding of human information processing abilities and limitations.
- Describe theories of how people communicate and work together, and the impact of social context on work.
- Discuss how such theory can inform the design of interactive systems.
- Discuss ways of making interface design choices in order to match user needs and capabilities.
- Distinguish between requirements and tasks in the work domain, and those concerned with the user interface

Cognitive Skills

- Relate theories of human action and cognition to the practice of designing and evaluating interactive systems
- Select theories and models that are appropriate to particular design problems and contexts.
- Make use of standard usability evaluation techniques to critique designs from a usability perspective, and to propose improvements

Subject Specific Skills

- Design interactive systems that are usable and meet the users' needs.
- Demonstrate an ability to apply theories of human activity and cognitive processes during interactive system design.

Transferable Skills

- Work together with peers on design tasks
- Conduct independent literature review and research into a specific topic
- Make oral presentations in class showing evidence of good understanding of the relevance of psychological theory in user interface design
- Critique one's own design work with a view to making it more usable

Assessment Scheme

- Unseen Examination 50% 4 questions out of 6
- Coursework 50 %, including:
  - Individual summary
  - Individual presentation
  - Individual design work
  - Evaluation & reflection

Reading Materials

Core Text

Preece, J. et al.. *Human-Compute Interaction*. Reading, MA: Addison-Wesley. 1994. ISBN: 0201627698.

IMPORTANT NOTICE: Don't buy the book above, although we may be working with it. If you want to buy a textbook, wait for the following book to be published:

Preece, Sharp, Rogers Interaction Design: Beyond Human-Computer Interaction. Wiley and Sons February 2002.

Additional Text

Baecker, R. et al., (eds) *Readings in Human-Computer Interaction: Toward the Year 2000*, Second edition. Morgan Kaufmann Publishers. 1995. ISBN: 1558602461.

Carroll, J. (ed.). *Human-Computer Interaction in the New Millennium*. Addison Wesley, Boston and ACM Press, New York 2002

Dix, A et al., Human-Computer Interaction. London: Prentice Hall International. 1998. ISBN: 0132398648.

Landauer, T. *The trouble with computers; usefulness, usability and productivity*. MIT Press. 1995. ISBN: 0262621088.

Newman, W. and Lamming, M. *Interactive Systems Design*. Reading, MA: Addison-Wesley. 1995. ISBN: 0201631628.

Norman, D.A. *The Design of Everyday Things*, Doubleday, 1990. ISBN: 0262640376.

Shneiderman, B. *Designing the User Interface: Strategies for Effective Human-Computer Interaction.* Addison-Wesley. 1998. ISBN: 0201694972.

Journals

- ACM SIGCHI Bulletin
- ACM Transactions on Computer-Human Interaction
- Behaviour and Information Technology
- Human-Computer Interaction
- IEEE Transactions on Human Factors
- The information Society
- Interacting with Computers
- International Journal of Human-Computer Studies

- User Modelling and User-Adapted Interaction

Other libraries

Useful material can also be found at other libraries in London. See
http://www.axp.mdx.ac.uk/~Jean12/mdx_only/itsource.htm
for information about other libraries.

Other resources

You will be expected to make use of on-line resources too. One place to find additional journal articles etc is the ACM digital library at
http://www.acm.org/dl/
Very interesting, very comprehensive, US based. Various high level journals, magazines, and ACM-conference and workshop proceedings. Especially interesting: CHI, Hypertext/Hypermedia, and Multimedia.

Every attempt has been made to ensure this information is correct at the time of publishing, however additional information may be provided in the module handbook.

Book Purchase Suggestions

Preece, Sharp, Rogers Interaction Design: Beyond Human-Computer Interaction. Wiley and Sons February 2002.

Study hours outside class contact

Lecture	1:30
Seminars	1:30
Other	1:00
Total Study Hours per Semester	180:00

Brief Guide to Web-based Module Material

Lecture slides, Lab-, and Seminar materials become available on the Web on the day when they are used in class. Important information about deadlines and requirements will also be published on the Web. You can find this information at:
http://www.cs.mdx.ac.uk/staffpages/elke1/cmt3210/

URLs of Web sites to be evaluated in week 2:

1) Kid's games site of Yahoo
http://www.yahooligans.com/

2) BBC Science site about the human body:
http://www.bbc.co.uk/science/humanbody/

3) Science Museum: Web exhibition Millennium bug
http://www.sciencemuseum.org.uk/on-line/y2k/index.asp

Coursework

You will be given two pieces of coursework, the first being a summary with an oral presentation to be held in the seminar and the second being the development of a prototype in the laboratory classes which has to be documented in a project folder.

The summary and the project folder have to be handed in to the Student Office at Bounds Green where it will be dated (stamp). For your own protection you should complete a receipt form that you hand in with the coursework. If the student office is open, you can hand in coursework and receipt to the officer behind the counter. If the student office is closed you can use the letterbox next to the counter. Post your coursework including the completed receipt form through this letterbox. The student office empties the letterbox every workday at 5pm. You can pick up your receipt during the opening hours of the student office.

Written work should normally be handed in on the campus at which the module is being taught; if for any reason you have to hand it in at another campus please point this out to the student office so that it can be sent to the correct campus. If, in an emergency, you have to send in written assessed work by post you must send it by recorded delivery to the appropriate student office and you will have to keep the Post Office receipt. It will be deemed to have been submitted on the date of the postmark.

Coursework 1: Summary and oral presentation of a theoretical HCI topic

Summarising particular topics and giving oral presentations are essential to professional performance. Therefore, you will be required to read an allocated topic, to summarise it, to write a summary of approximately 300 words (one page) and to present the topic to your colleagues in the seminar. You will also be asked to prepare another topic to ask questions after another person's presentation.

The topics are part of the course syllabus as listed below. The topics will be assigned in week 1. Each student will have at least three weeks to prepare the summary of their own topic (~300 words) and 3 questions for another topic.

The summary has to follow the structure laid out below.
Most summary topic are related to chapters of the old Preece-textbook, but you are expected to consult psychology, sociology and educational textbooks and other information resources for details, e.g. Journal articles. Potential resources are listed above.

You have to submit your summary to the Student office at Bounds Green in week 4.

The deadline for submitting the summary to the student office at Bounds Green is Friday Week 4 at 3pm.

The student office has forms that serve as cover page and marking sheet. They have a receipt form attached. You need to complete both forms with the module code, name

of the module leader and your names and student numbers on it in order for the student office to know to whom to forward it to. **Do not use plastic wallets!** Simply staple your coursework or put it in a folder that can be easily opened!

You will also have to bring 20 copies of your summary to the seminar. Alternatively you can send the summary to all students and teachers of the module by email and bring only 5 copies to the lecture one of which is for the lecturer. Late submission, missing cover pages and missing handout summaries in the lecture will inevitably lead to minus marks. This will be 1point for each day that the submission is late (weekends count as two days), and 1 point for missing cover pages or missing handout summaries.

The **presentations** will take place in the weeks 5 to 10 and will take 10 minutes. You are expected to prepare up to five slides for your presentation, preferably in PowerPoint. In order to give you a fair chance for a good presentation we will briefly discuss presentation skills in week 4. In the section 'General hints and tips' you find a brief introduction on how to give a good presentation and how to make good slides. In the same section you also find the structure for the summary. The summary and the presentation together will be worth 30% of the total coursework mark, which is 15% of the total grade for this module.

Each presentations will be followed by a discussion, which will be started off by **questions** prepared by one of the students in the audience. The questions themselves are not going to be marked. However, if you fail to prepare your questions you will face a penalty of 5 points. This amounts to 3% of the maximum coursework mark.

Topics for Coursework 1

1. Understanding users

1 Cognitive frameworks for HCI, week 5
2 Situated action and behaviour, week 5
3 Behaviourist, constructivist and ecological approaches, week 5
4 Human perception and representation of information, week 6
5 Knowledge and data representation on the screen, week 6
6 Mental models and conceptual models, week 6
7 Metaphors, week 6
8 Educational aspects: Learning theories, week 7
9 Children as computer users: The application of developmental psychology and educational theory to user interfaces, week 7
10 Enabling technology: User interface design and special needs week 7
11 Social aspects: CSCW -group communication and co-operation, week 8
12 Organisational aspects: computers and work organisation, week 8
13 Computers and Fun, week 8

3. Design methods

14 Principles and methods of user-centred design, week 9
15 Gathering requirements, week 9
16 Structured and envisioning design, week 9
17 Prototyping and design rationale, week 9,

4. Evaluation

18 The role of evaluation, week 10,
19 Methods of data collection for evaluation, week 10,
20 Interpretive and Predictive Evaluation, week 10,

A bibliography for the topics above will be handed out during the seminar in week 1. However, these references are only starting points. You are required to search for more literature in the library and online. It will be noticed whether or not you will have used additional literature and that will be reflected in the marks for the summary.

Overview presentation and question topics

Presentation			Questions	
Topic	Week		Topic	Week
1	5		10	7
2	5		11	8
3	5		12	8
4	6		13	8
5	6		14	9
6	6		15	9
7	6		16	9
8	7		17	9
9	7		18	10
10	7		19	10
11	8		20	10
12	8		1	5
13	8		2	5
14	9		3	5
15	9		4	6
16	9		5	6
17	9		6	6
18	10		7	6
19	10		8	7
20	10		9	7

The above schedule details which question topic is tied to which summary topic and when the presentation and the questions are due. For instance, if you have chosen topic no 5 for your presentation you also have to prepare the questions for topic number 14. Your presentation will be in week six and your questions are due in week nine. You are not allowed to change or swap topics. Only the seminar tutor can make amendments to this schedule.

Assessment

Coursework 1 is worth 30% of the total coursework (=15% of the total mark of the module). Half of the coursework 1 mark goes towards the summary and the other half towards the presentation. Five points (=3% of the coursework mark) will be deducted for missing questions on another groups topic.

The assessment criteria for each part are the following.

Presentation
(including slides)
Content
Clarity and structure
Visual aids
Speech and interactiveness
Time management

Summary
Content
Clarity and conciseness
Presentation, style, references
Grammar, spelling, and expression

Questions
No marking, but penalty for missing questions.

Structure of a 300 word summary

(Compulsory for coursework 1)

- Title: topic
- Student author's name
- Definition / concise description of your topic.
- Three to five most essential aspects of the topic each aspect a bullet point with no more than 50 words.
- One or two critical/problematic points for discussion each one a bullet point with no more than 50 words
- References

No quotes, no plagiarism: You are not allowed to copy text from the Web or from articles and books into this summary. All text has to be yours. For plagiarism and correct referencing see below.

Coursework 2: Web-based interface design and implementation

Coursework 2 is designed to help you develop and practice a range of skills:

- Analysing user requirements and seeking domain information
- Interface and Web page design and implementation
- design evaluation and critical analysis

You will need these skills to complete high-quality projects, both as part of your studies and later within commercial / industrial organisations.

Instructions for coursework 2

The science museum popularises interesting topics of science and technology. The Science Museum in London wants to add another exhibit to its Web exhibition. This time they want to explain the process of 'programming'. You have been hired as a freelance Web designer to design the interactive Web page to the best standards of HCI. The audience of the Science Museum Web site ranges from school children to pensioners, but the majority of visitors is under 25. You cannot assume any kind of knowledge except for a basic command of English and your audience has a short span of concentration. Therefore your Web site has a maximum of 10 screens. You are also warned to be careful about the use of metaphors. An uneducated audience like yours cannot understand computing metaphors.
Your Web site has to have three characteristics:

1) it has to be engaging and interactive,
2) it has to be fun,
3) it has to provide the user with a visible result at the end.

You are not allowed to change any of these arrangements.

In due course you will have to carry out a hierarchical task analysis, a requirement analysis, a paper design, a design rationale, a prototype, an evaluation of your prototype and a final critique of your prototype, the schedule and deadlines for each of which are given below. For developing your prototype you can use the tool of your choice, but you have to mention which tool you used. Recommended are Dreamweaver or Director.

Resources

You are expected to gather information from a wide range of books, journals and electronic sources for this coursework. Some of these can be found in the section 'reading materials' of this handbook. You should credit your sources in your reports according to the rules explained in the section 'how to quote - correctly'.

Assessment

This coursework is worth 60% of the total coursework mark (=30% of the total module mark). You will be assessed on:

- the quality of your requirements analysis
- the design of the interface and interaction structure of your Web site.
- the quality of your evaluation of other people's pages.
- the quality of your critique of your own pages.
- your ability to present information in a clear and interesting manner.

Project folder

All the parts of **coursework 2** have to be collected **in a project folder. (Do not use plastic wallets! I hate them!)** Your first part of coursework 2 (evaluation of an existing Web page) has to be put into this folder and will be signed during the lab. The following parts of your coursework will then be added to your folder and signed as they are completed. You definitely should meet all deadlines shown below. Marks will be deducted for late submissions that are not supported by good documentary

evidence of you being unable to complete your work in time. This means, if you cannot produce the your homework at the beginning of the lab session for which it is due, zero marks will be given for this part of the coursework. Late submission of the whole coursework 2 leads to a deduction of point per day. More than 5 days delay will lead to zero marks.

Your evaluation of other peoples Web sites should be constructive. Marks will be deducted for non-constructive criticism.

Schedule and Deadlines

You should be working on this coursework, dealing with information finding, design work and the practicalities of implementation in parallel, from the beginning of the course. All deadlines in the below schedule are dead serious. If you miss it, i.e. if you cannot produce the required piece of work at the beginning of the lab session, you won't get any credits for this part of your work, unless you have written evidence that you were unable to attend to your homework. A table with subtasks and deadlines is provided at the end of this section.

- In the first week the lab session gives you time to reactivate your htmland Java knowledge, to try the tools available and to make a choice which tool you are going to use.
- In the second week you will evaluate the interactive Web sites of thekIDS Yahoo site and two Web exhibits of the Science Museum. The URLs are listed in the reading material section and below. You will write a short evaluation report about the three Web sites to show that you have gained a general understanding of HCI issues. This evaluation report has to be put in a coloured plastic folder (not a plastic wallet!) and has to be produced **at the beginning** of the 3rd lab session.
- To demonstrate that you have understood the domain of selling/purchasing mobile phones on the Web you will carry out a hierarchical task analysis and an requirement analysis. The task analysis has to be ready by the end of week 3, the requirement specification by the end of week 4. The task analysis and requirement specification has to be added to your plastic folder and has to be produced at the beginning of the 5th lab session.
- In week 5 you will design on paper. You will design the structure and the looks of your Web site and the Web pages with some basic functionalities (links). While thinking about your design, you should be noting design issues and alternatives, and preparing a rationale for why your design is the way it is. As part of the process of designing your pages on paper, you will produce a paper design and a design rationale by the beginning of the 6th lab session. The paper design is meant to be done in the form of story boards, the design rationale may be in any form you consider appropriate, and might include QOC diagrams. Both together will have to be shown at the beginning of lab session 6.
- It is important that you finish your paper design in time! Otherwise you will loose out on the chance to get some feedback on it and to improve your design before you implement it.
- In week 6 you will evaluate somebody else's paper design and somebody will evaluate yours. For this purpose we will use the method of cognitive walkthrough. After the evaluation you will develop your prototype. You should complete your prototype by the end of week 9 and print out colour copies of your pages and put

them into your plastic folder. I will control the completion of the prototype at the beginning of lab 10.

- It is essential that you finish the prototype before week 10. If you have not finished your prototype by week 10 you will miss out on important feedback for a possible re-design and the related marks for it.
- In week 10 we will evaluate the prototypes. Everybody will evaluate some other student's Web site. The same methods as used for the paper design, will now be applied to the prototypes. You will have to write an evaluation report about your evaluation of somebody else's prototype. (Deadline Friday week 10). The report has to be added to the folder.
- In week 11 you will have to criticise your own Web site based on the evaluation of the week before. You will have to think about what you would do differently now and to sketch out a redesign. The criticism and the redesign have to be finished before Friday week 11 and to be added to the folder.
- In week 12 we will upload the Web sites to a special server. It is your responsibility to ensure that all necessary files have been uploaded and that all links work on the server (and not only locally on your computer). Allow enough time for fixing problems!
- The folder with all parts of coursework 2 has to be completed with a cover page from the student office, containing the usual information plus the tool that you used. The folder of **Coursework 2 has to be submitted to the student office at Bounds Green by Friday week 12, 3pm.** I will look at the actual pages. Late submission will lead to subtraction of 1 point per day. Missing parts will also lead to the usual subtraction of 1 point missing links will lead to less marks.

Components of the Project Folder to be submitted

The project folder has to contain the following items:

1. Evaluation of the three Web sites
2. Task analysis for your own project
3. Requirement specification for your project
4. Paper design
5. Evaluation of somebody else's Web site carried out by you
6. Evaluation of your Web site carried out by somebody else
7. Self-critique of your Web site.
8. Screen shots of your Web site
9. Name of your folder on the Web server

Overview deadlines for project folder components

Assignment	Finished by Friday of Week	Date
Evaluation report for an existing interface	2	15.2.02
Hierarchical task analysis for your project	3	22.2.02
Requirement specification	4	1.3.02
Paper design and Design Rationale	5	8.3.02

Implementation and testing of interface prototype completed	9	19.4.02
Evaluation report	10	26.4.02
Critique of own interface and re-design	11	3.5.02
Submission of total coursework 2 to the Students Office at Bounds Green	**12**	**10.5.02**
Upload prototype	12	10.5.02

Where to submit

Written assessed coursework must be submitted to the student office *where it will be dated and receipted.* You should keep your receipt - it is for your own protection.

Do not hand written assessed coursework directly to your tutor.

Written work should normally be handed in on the campus at which the module is being taught; if for any reason you have to hand it in at another campus please point this out to the student office so that it can be sent to the correct campus. If, in an emergency, you have to send in written assessed work by post you must send it by recorded delivery to the appropriate student office and keep the Post Office receipt. It will be deemed to have been submitted on the date of the postmark.

General hints and tips for coursework preparation

How to prepare and give a presentation

When presenting information, you should bear in mind the following:

- The presentation should be coherent and well structured, so that the reader can absorb the information and argument easily, and can readily see why you present the information. For every sentence / paragraph / section / page, you should be asking yourself:
  - How does this follow from the previous sentence / paragraph / section / page?
  - Why is it part of the story?
  - Will it be clear to the reader why it is part of the story?

- You should have an introductory slide stating clearly the title of your presentation and your name(s).
- You may want to have a slide with the definition of your topic.
- You also need a slide that shows the main points of your summary.
- You may want to have an extra slide for weaknesses, problematic points
- You may want to make use of various PowerPoint functions i.e. inserting pictures, using Build effects, Transition settings etc.
- You have to talk your audience through each bullet point.
- You have to speak loud and clear such that you will be heard in the last row of the lecture theatre

- Don't turn your back to the audience.
- Look at your audience, be interactive, draw your audience into the presentation
- Make it as interesting as possible

How to make slides for a presentation

The easiest way to produce acceptable slide is using PowerPoint. It automatically does most of the points below.

- Slides always have a title.
- Slides ideally contain not more than three points/statements. If you feel you need to say more you should think of splitting it up into two slides.
- The first slide always shows the name(s) of the author(s) and the title of the presentation. Other slides can show the names of the author(s) as header or footer.
- Colour is nice, but it needs to be used with care.
- Drawings and pictures can support your statements.
- Use the spelling checker even if the spelling checker does not find all types of mistakes.
- Text has to be legible; i.e. letters have to be large enough to be read in the last row of your audience. If you drop the slide on the floor and you can read it, it is ok for most occasions.

How to use references – correctly

A reference is there for two purposes. The first is to indicate which sources of information you have used — to back up your arguments. The second is to allow the reader to follow up your argument by looking up your sources. The following are examples of the correct and effective use of references within the text:

> 1) "There is evidence that purple aliens have taken up residence in suburbia. For example, Scully and Mulder (1993) report that in a questionnaire survey of 200 shoppers in Tesco's, 23% of respondents claimed to have seen purple creatures with two heads near the frozen food section. However, this evidence is open to challenge..."
>
> 2) "There have been several experiments (e.g. Akinbode, 1991; Smith & Wesson, 1989) that have studied the use of chocolate sauce as a lubricant for computer keyboards. These studies have consistently found that chocolate sauce makes a complete mess of any keyboard, rendering it unusable."
>
> 3) "Young and Oldenfield, in a study reported by Eberts (1994, p.999), investigated the use of elephants as memory sources and found that although they never forget, they do tend to corrupt the data in various interesting ways." [Note: you can use this approach to references to show where *you* got the information from, even if it's not the original source.]

Now you have short referenced the used literature within the text. However, the reader needs to be able to look up your references. For this purpose s/he needs more information called the full reference. The full reference is usually given at the end of your paper. The following full references are an example for referencing at the end of a text.

References:

Akinbode, F. (1991) A comparative study of Cadbury's and Terry's chocolate sauces. *International Journal of Edible Lubricants.* Vol. 4, No. 3. pp.121-123.
Eberts, R. (1994) *User Interface Design.* New York: Prentice Hall.
Scully, D. & Mulder, F. (1993) Supermarket shopping and its effects on shopper sanity. *Cognitive Psychology International.* March issue, pp. 43-47.
Smith, J. & Wesson, S. (1989) The use of alternative lubricants on computer keyboards. *Journal of Ridiculous Ergonomics.* Vol. 2. pp.25-36.

For journal or magazine articles, you give authors, year, title of article, title of journal, volume number and page numbers. For books, you give authors, year, title, city of publication, publisher. For real examples, look in any quality journal or textbook.

A further important point is to be aware that different sources of information have different credibility. Refereed journals and books have more authority than non-refereed books or magazines. Information obtained from the Web can sometimes be very unreliable, unless you know a lot about the source of the information.
You must **not** copy any material from others' web pages. If it is relevant to your work, you should design your pages to point to the relevant page and indicate why it is relevant.

Coursework Return

If you wish your work to be returned to you, please submit the coursework with a self-addressed, open envelope attached. Do not put the coursework in the envelope! Write your address in the usual place and the following information in the top left hand corner of the envelope:

- lecturer marking the work;
- your student number;
- campus at which the module was taken;
- module number;
- semester; and
- academic year.

Receipts for this work and other work submitted outside opening hours can be collected from the student office.

Electronic submission of prototype

Coursework may not be submitted in electronic form except for the prototype which has to be uploaded to a server in week 12.

Feedback to students on coursework

You will receive feedback on your work in the following way:
Design work in lab classes: oral feedback from lecturers and other students
Presentation and summary in seminar classes: written feedback from the lecturer on evaluation form. The presentations will be marked in class, the summaries will be marked by the lecturers and given back in the seminar class.

Cover pages for Coursework

The following two pages contain the cover pages for your summary and your project folder. Do NOT rip out these pages; copy them!

CMT3210
Summary

Deadline for Submission
1 March 2002

Seminar/Lab Tutor: …….

Student Name…….

Student Number…….

Campus: **Bounds Green**

School of Computing Science
Dr Elke Duncker

CMT3210

Projectfolder

Deadline for Submission

10 May 2002

Seminar/Lab Tutor: ……

Student Name…….

Student Number…….

Campus: **Bounds Green**

School of Computing Science
Dr Elke Duncker

Lecture Plan

Week	Title	Content	Reading
1	Introduction.	Introduction to the module Putting the user at the centre Individual, organisational, social, and cultural differences	Landauer (1995) Newman & Lamming (1995) Ch. 1 & 2
2	The user domain	Understanding the domain. Understanding the user's knowledge Interviewing and observational techniques. Protocol analysis.	Newman & Lamming (1995) Ch. 5 Preece Ch. 19 Shneiderman Ch. 3
3	Conceptualising the context of use	Model Human Processor Norman's action cycle Situated behaviour	Newman & Lamming (1995) Ch. 3
4	Mental models	The designer's conceptual model Mental models Metaphors	Newman & Lamming (1995) Ch. 13
5	Rationality and planning	Planning and reactive behaviour GOMS, Cognitive Walkthrough Programmable User Modelling Rationality-based design principles	Preece Ch. 20 & 33
6	Learning	Styles of reasoning. Models of learning Habituated behaviour	Preece Ch. 8
7	Memory and attention	working memory and other meory models Retrospective memory Prospective memory Attention Modalities and multimodal systems	Dix et al (1998) Ch. 15
8	Perception	Visual structures Gestalt psychology Input coherence Feedback and help systems	Preece Ch. 4
9	Interaction	Language and action Models of dialogue Coherence and topic shifts	Dix et al (1998) Ch. 14
10	External Cognition	Artefacts and representations External cognition Computational offloading	Scaife & Rogers
11	Co-operation	CSCW Distributed cognition GroupWare, CMC and shared artefacts, Awareness	Dix et al (1998) Ch. 13 & 14 Hutchins et al. (2000) Rogers (1997)
12	Revision	Topics as chosen by students	

Module Plan

Week	Lecture topic	Seminar topic/activity	Lab activity	Deadlines	Date
1	Introductory lecture	Signing up for topics for summary, presentations and questions	Choosing a tool for prototype development		
2	The user domain	Designing and conducting Interviews	Evaluating existing Interfaces	Finish Evaluation report for the three interfaces.	15.2.
3	Conceptualising the context of use	Coding and analysing interview and observation material	Design work: hierarchical task analysis for a Web site	Finish task analysis for own Web site	22.2.
4	The user's image of the machine: mental models	Cognitive walkthrough Presentation skills	Design work: Requirement specification, Paper design	**Submit summary to student office TP** Finish requirement specification	**1.3**.
5	How users choose what to do: rationality and planning	Student presentations with discussion Topics 1,2 and 3	Design work: Paper design	Finish paper design and Design Rationale for Web design AT HOME	**8.3.**
6	Learning	Student presentations with discussion Topics 4, 5, 6, and 7	Evaluation paper: cognitive walkthrough Re-design and implementation		15.3.
7	Memory and attention	Student presentations with discussion Topics 8, 9, and 10	Implementation of prototype		22.3.
8	Perception	Student presentations with discussion Topics 11, 12, 13	Implementation prototype		13.4.
9	Interaction	Student presentations with discussion Topics 14, 15, 16, 17	Implementation prototype	Complete implementation and testing of Web pages	20.4.
10	External Cognition	Student presentations with discussion Topics 18, 19, 20	Evaluation work: heuristic evaluation	Evaluation report	27.4.
11	Co-operation		Critique and Re-design	Critique of own pages	3.5.
12	Revision		Uploading	Upload Web site prototype **Submit project folder to student office TP**	**10.5**.

Teaching and Learning Materials

Coursenotes

Week 1: Introduction

Putting the user at the centre
People are an essential component of interactive systems. Understanding how people perceive things, remember things, solve problems and generally interact is essential to the effective design of systems. In this course we study approaches to improving the usability of systems, focusing on people and the ways we think and work.
User concerns in design:
task analysis
guidelines and principles
broad understanding of human capabilities
how we perceive things
how we remember things
how we construct an understanding of complex systems
how we interact in a complex world
tailoring systems to users' needs
giving appropriate feedback
giving help
designing the interaction
designs for group working
User concerns in evaluation:
cognitive task analysis
modelling problem solving
users' knowledge and device representations
heuristic evaluation
principles and "footprints"
testing systems empirically
Aspects of users:
Understanding the importance of domain knowledge in guiding users' behaviour
Influences on the user: situated behaviour and deliberate behaviour
The user's image of the machine: mental models
How users choose what to do: rationality and planning
Making sense from prior experience: learning
Memory and attention and different modes of communicating
Making sense of the world: error and perception
Understanding interaction in its own right: dialogue
Working together: computer support for group working
Situated behaviour vs. information processing
The '**situated'** approach: the user is viewed as located in and reacting to the social and physical environment:

Lucy Suchman (1987), in a book about situated behaviour, compares much of our activity in the real world as being like a canoeist shooting the rapids: while they have an overall goal – to get to the bottom in one piece – they may not have a detailed plan about how to get there, but react to the environment, in response to the water movements and

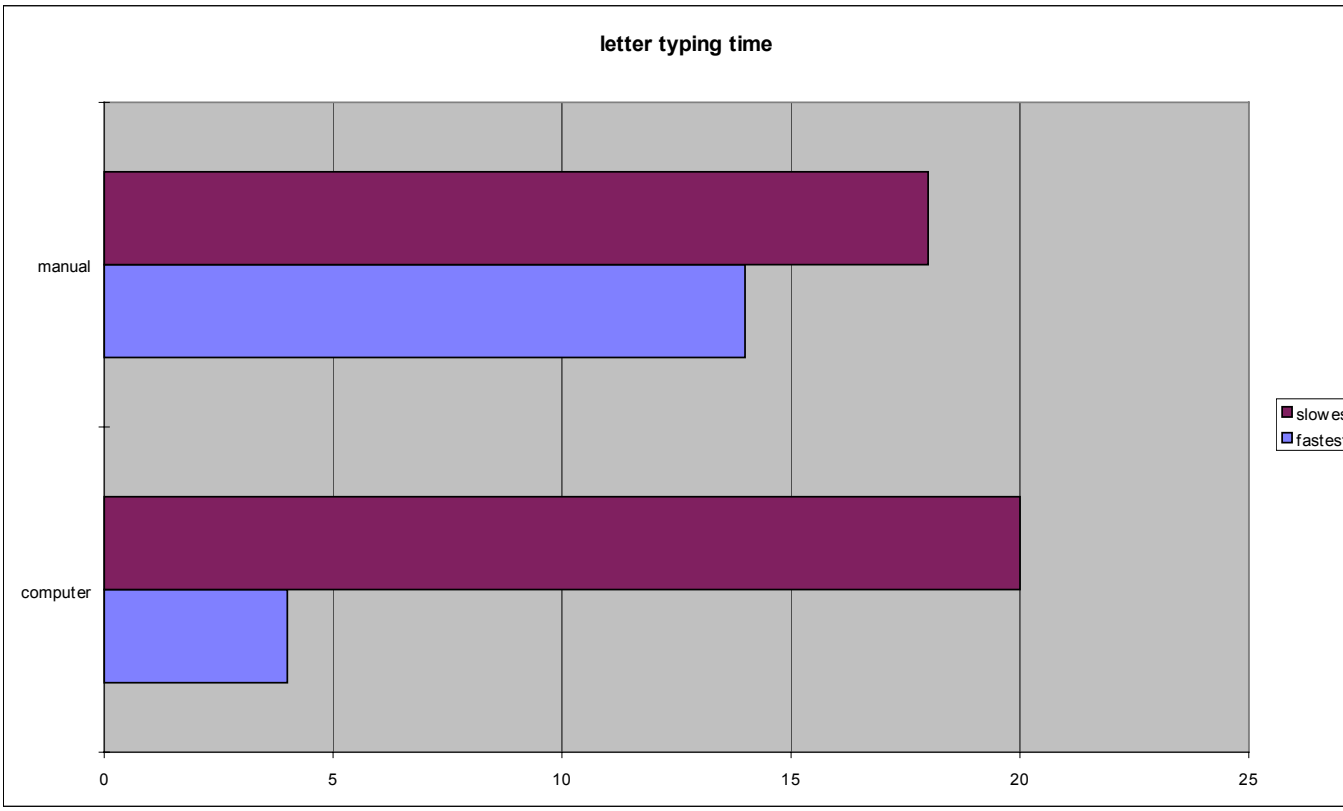
the positions of rocks. Plans and goals are constantly subject to modification and are often just to explain things afterwards.

The **'information processor'** approach: the user is viewed as taking in information, processing it, and then responding to it:

In the 'information processing' approach, the user is viewed as receiving inputs from the world, then forming plans and executing them, so behaviour is viewed as being deliberate, and only loosely influenced by changes in the environment.

Relating domain and device concerns
Important idea: users use computer systems to achieve things; those things may change the state of the domain (or 'world') or may mostly change the state of the user's knowledge, or the user's sense of pleasure. Designing well is about optimising the changes. Thus, what the user is working with is an internal representation of the world and an internal representation of the device and its representation of the world... but at the end of the day, the user is concerned more with changes to the world (or their knowledge of it) than to the device.
Individual differences:
We have:
different physical abilities:
different cognitive abilities:
beliefs, experience, goals, problem-solving capabilities
different reasoning styles:
verbal and spatial
spatial memory;
logical reasoning.
different motivations:
e.g. why do some of us enjoy computer games or technical problems and others not?
How many of you love gadgets?
How about the power of being able to produce lovely printout, neat displays?
Also age and education.

What are the implicit design assumptions built in to most of the systems you encounter?
How might a designer accommodate non-standard users better?
Individual differences are generally more significant than design differences in determining performance.



Problem: programmers and software designers are smart people!

[Video from Tony?]

Week 2: the user domain

To understand users' behaviour in context, we need to understand the domain they are working in. This involves what is traditionally called 'task analysis' – which includes an understanding of both task procedures and the objects the user is working with – and also an understanding of how the user works *in context*.

Possible methods
observation
ethnography and related approaches
interviews
more or less structured
questionnaires
more or less formal
protocol analysis
analysing a trace of user actions or user commentary
controlled experiments
"good science" but no use whatsoever (as far as I can ascertain) for understanding the domain the user is working in
Which is good for what?
What are the limitations of each?
Generating good questions
Whatever techniques are to be used, you need to consider some questions before you start:
What's the purpose of this investigation?
Who are the users of the (proposed) system?
What constraints need to be taken into account?
What are the most appropriate techniques?
Ethnography and other observational techniques
Ethnography done 'properly' is a research method used in anthropology and involves studying people in their natural environment, in the same way as one might study remote tribes in the rain forest. Ethnographic studies aim to understand how the social groups work, the roles of individuals within the group, social practices, culture, etc..
For the purpose of designing computer systems that will suit their users, a form of 'mini-ethnography' that involves short periods of observation, supplemented by interviews and think-aloud protocols, is usually more useful (for example "contextual inquiry" – Holtzblatt and Beyer, 1998).
Interviews
Interviews may be more or less structured. To be useful, questions need to be at least partly planned in advance.
Questionnaires
What are questionnaires good for?
evaluations, judgements, attitudes, beliefs, opinions
When are interviews better?

Reliability: how reproducible are the results?
re-ask the same question a different way
split the test into two parts
Validity: how well does the questionnaire measure that it's supposed to?
hard to measure, but for example is there external evidence to support the conclusions?
Factor loadings: might there be different reasons for people giving the same answer?

Think of voting in the House of Commons!
Different types of questions:
open-ended
multiple-choice
but beware mis-leading categories — e.g. are you a student or an employee? Do I own a TV if my parents have given me one on permanent loan?
Scalar
Likert scales
numeric scales
qualitative labels. E.g.:

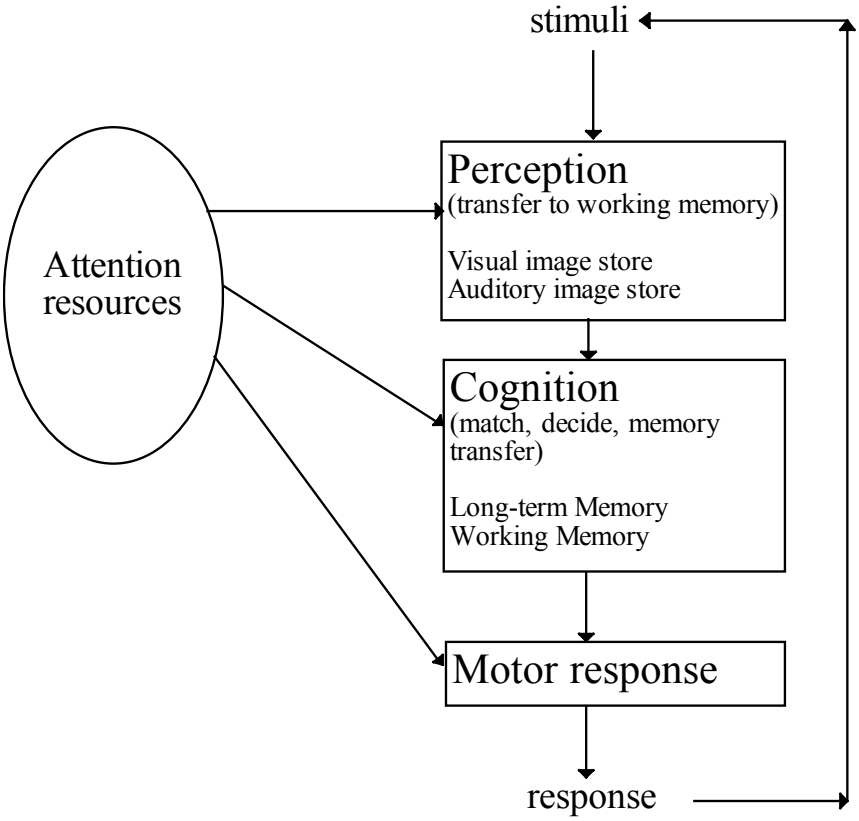
Never	Seldom	Sometimes	Generally	Always

Strongly disagree	Disagree	Slightly disagree	No preference	Slightly agree	Agree	Strongly agree

Designing questions:
To be avoided:
double negatives
excessive background
other people's views
negatives (if possible)
...so what's wrong with the following:
Most people believe that questionnaire items are not subjective. Do you agree?
How could it be better written?
Protocol analysis
This involves taking a record of user activity – whether taking notes during observation, using a tape recorder or using video.
Tape and video recordings need to be transcribed – either in full or selectively.
Transcribing video is difficult and time-consuming; just note as much detail as is useful.
Protocols often have to be *coded* using a coding scheme that is developed for the purpose.
Task analysis
Task analysis generally involves one or more of the knowledge acquisition techniques just discussed, supplemented by a particular way of structuring the information acquired. This has been covered in other courses (e.g. COM2200; COM3221) in more detail.

Week 3: Conceptualising the user domain

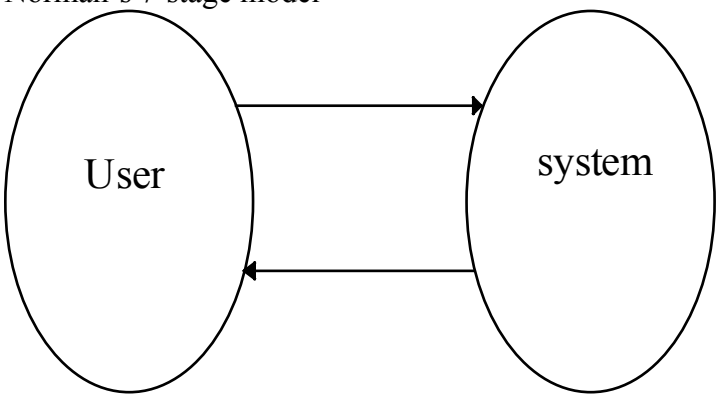
The Model Human Processor



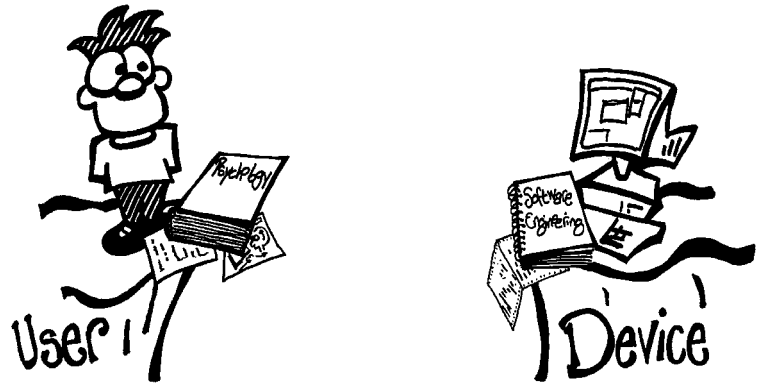
Tenets of the MHP

Perception is not immediate. Users actively process the presented information
processing takes time
order of processing events (and other properties of them) matter
different mental codes are used to represent information at different stages
channels have finite capacity; there are limits on how much information can be processed
the chunk is the important unit of information. Acquisition of chunks depends on learning

Norman's 7-stage model



The seven stages are:
Goal formation (domain)
Intention formation (for this system)
Action Specification (selecting action sequence to address goal)
Action Execution (doing it)
Perceiving system state
Interpreting system state
Evaluation (checking results against goals & intentions)
Norman's gulfs



Gulf of evaluation:
Gulf of execution:

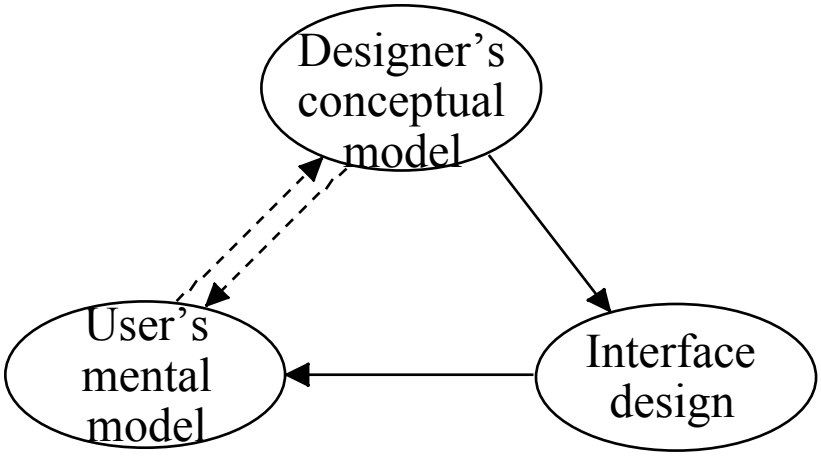
Note importance of feedback for confirming the effect of actions and recognising errors.
Note: there are environmental and other influences on user too.

Week 4: The user's image of the machine: mental models

What is a "mental model"?
An internal representation of a system that can be interrogated and manipulated.
Mental models are concrete.
Mental models can be run.
Mental models are constructed from experience.
Mental models are generally incomplete and inaccurate, but serve a purpose
Example: a camera:
what are the components and how do they fit together?
how does it work?
what causes what?
how do you use it?
how do you use your understanding when something goes wrong?
Example: the London Underground map.

- what is it good for?
- what isn't it much use for?

The contents of a model
Kieras (1982) categorised the kinds of knowledge that people have about a device as follows.
Label or name of the device
Function or purpose (what goals can be accomplished)
Controls and indicators
Inputs, outputs and connections
Power sources and requirements
External layout and appearance
Internal layout and appearance
External behaviour (input-output function)
How to operate the device to accomplish goals
Procedures for troubleshooting and maintenance
Internal structure and mechanisms (how it works)
A runnable mental model = how-it-works knowledge + how-to-use-the-how-it-works-knowledge knowledge !
How-it-works knowledge may be at various levels of detail.
Strategic knowledge includes various strategies — e.g. inference, prediction, diagnosis. These are *transferable* skills.
Where do mental models come from?
a) declarative and procedural models
b) feedback, hypothesis-testing (but beware mode errors)
c) manuals and help systems
d) analogy and metaphors
e) designer's conceptual model:



Note that this view puts the designer at the centre: the designer's job is to enable the user to assimilate their view by getting the device to project an appropriate image of itself. This is necessary for device-only constructs (where the challenge is to make these as easy to learn and make sense of as possible) but should not be the approach for domain concepts.

Putting the user at the centre

The alternative user-centred view is not well-presented in the literature. In this view, the user's conception is centre; approaches such as ETIT (Moran, 1982), Yoked State Spaces (Payne, 1990) and Cognitive Complexity Theory (Kieras & Polson, 1985) have tried to get to grips with this idea, but all have proved too difficult to work with for routine application.

OSM is our attempt to get to grips with this subject. The idea of an OSM is that the analyst describes the user's view of the domain and the representation embodied within the device (that the user has to work with) and looks at the degree of 'fit' between the two. OSM differs from previous attempts to relate domain and device models by focusing on objects (or entities) rather than on processes (or tasks).

Week 5: rationality and planning

General claims about human cognition
(from Anderson 1993)
(1) There are two memory stores: a short-term store and a long-term store.
(2) Knowledge is represented in terms of visual images and words.
(3) Human information processing is achieved by connectionist networks of neural-like elements.
(4) Cognitive skills are realised by production rules.
(5) People solve problems by means-ends analysis.

Problem: none of these claims is refutable.
(1) has been superseded by the notions of long term memory and working memory (a subset of LTM that is activated).

Time bands of rationality:
Newell (1990) offers a way of thinking about cognition in terms of time bands:
days - months: social band
minutes - hours: rational band
0.1 seconds - seconds: cognitive band
10^{-4} - 10^{-2} seconds: biological band
"Rational" = people act so as to attain goals, given the structure of the task and their inputs of information, and bounded by limitations on their knowledge and processing ability.
Human problem solving & rationality
Pollock (1993) defines rationality: "a rational agent has beliefs reflecting the state of its environment, and it likes or dislikes its situation. When it finds the world not entirely to its liking, it tries to change that. Its cognitive architecture is the mechanism whereby it chooses courses of action aimed at making the world more to its liking."
Means-Ends reasoning
Means-ends reasoning: if the user knows that doing X will achieve Y under condition Z and the user wants to achieve Y, then the user will consider X as a candidate thing to do, and if condition Z doesn't hold at the moment then the user will adopt achieving Z as an additional goal. [If Z already holds then X can be done immediately.]
See resource notes on cognitive modelling.
GOMS model:
Goals things we want to achieve
Operators basic actions we can perform
Methods compiled skills
Selection rules ways we make decisions
N.B. GOMS considers expert behaviour, and there's much more to cognition than that!
Knowledge, planning, …
Decisions: envisioning, cost-benefit trade-offs, visual salience…

Cognitive Walkthrough
Cognitive Walkthrough is an approach to evaluation that is based on the idea that the user is learning about the interface in an exploratory way, and has goals, and is applying simple means-ends reasoning.
Preparation of the cognitive Walkthrough: You have to produce the following texts:

User description (What can be assumed about their prior experience and knowledge?)
Task(s) description (Here a 'task' refers to achieving a particular outcome, not the procedure for achieving it.)
Action-display sequence list (one for each task)
System or Interface description (your paper design, a manual , etc.).
The analysts then consider each task in turn. One step in the action display sequence list consists of one user action and the related system display (the reaction by the system). For each step, the analysts then attempt to construct a convincing story that answers the following questions:
Is the next goal clear at this stage
Is the appropriate action obvious
Is it clear that this action leads to the goal?
What problems are there in performing the action?
Each analyst should be alert to places where the user might experience difficulty.

PUM
The idea behind a Programmable User Model is that the analyst should define the knowledge that the user needs to perform a chosen task (or tasks), to 'program' a cognitive architecture and see how the modelled user behaves. The cognitive architecture is a simple problem solver that applies means-ends analysis. The analyst's job is to describe what the user needs to know, and how any necessary information is made available to the user, so that the user can both perform the task and know when the goal has been achieved. The knowledge description consists of three parts:

- a set of declarations, listing

the *conceptual objects* that the user is manipulating when working with the device, and
relationships between those objects

- a description of the user's knowledge, consisting of

conceptual operations, which embody the knowledge the user needs about actions and effects,
the user's *initial knowledge*, and
the user's *task*, in terms of relations that should hold true in the goal state.

- a device description, listing

the *device commands* that are available, in terms of the way the device state changes as a result of the user issuing each command,
the initial *device state*, in terms of relations that hold true in that state, and
what information is *displayed* to the user.

The origins of many design principles
Any of the approaches listed here can be used to define a set of design principles. That is: if we assume that any of these techniques has any validity then it can be used to identify principles that a design should satisfy. E.g.:
Mismatch in conceptual representation: are there important domain concepts the user has to work with that are not directly represented in the device, so that the user has to manipulate them indirectly?
Discoverability: are there essential concepts that the user has to work with to achieve their domain goals that are not clearly represented at the interface?
Enforced explicitness: to work with the device, does the user have to make explicit data about the domain or device that would more naturally remain unstated?

Task-action mapping: when the user is aiming to achieve some small thing in the domain, are the corresponding device actions clear?
Confusable labels: In terms of the things the user is trying to achieve in the domain, using a graphical user interface, are the labels clear? his issue is also addressed explicitly in the application of Cognitive Walkthrough.
Order errors: are there circumstances in which doing *A* the *B* has a different effect from doing *B* then *A*, but the actions can be performed in either order, and the user may not be aware of the order constraint?
Mode errors: does the device has alternative modes, that the user may not be aware of?
Observability: are there essential aspects of the state of the device (or domain) that are not observable at the time when they are needed?
Predictability: is it reasonable to expect the user to know all the factors that determine the effect, and be aware of the current state of all those factors?
Side-effects: are there effects of conceptual operations that are not part of the purpose of the operation and are not visible to the user?
Post-completion errors: are there cases when the main goal has been completed but other aspects of the state may be left in an incorrect state?

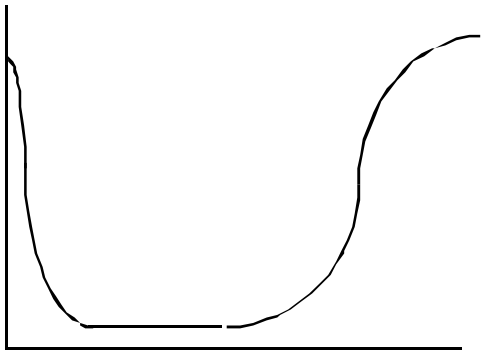
The paper at the end of this handbook discussed design principles and their relation to underlying cognitive theory in more detail.

Week 6: Learning

Analogical reasoning
Sasse (1998):
An analogy provides an explicit, referentially isomorphic mapping between objects in two domains; valid analogies can only therefore be constructed between similar domains. (Old knowledge is used to solve a new problem.)
A metaphor is a looser mapping that points out similarities between domains without making explicit links between individual objects. A metaphor is open-ended and arbitrary, and its primary function is to initiate a process of active learning in the user.
Consider: killing a tumour is like a general's army attacking a fortress surrounded by mines.
Consider: your operating system is like a desktop.
Models of learning
concept formation
User acquire new concepts. E.g. small children acquire concepts of four-legged furry creature then refine it to 'dog', 'cat', 'horse' etc. Users of computer systems need to acquire many new concepts, such as 'operating system', 'web page', 'server', etc.
explanation-based learning
Users learn concepts or procedures or acquire mental models through explanation
legitimate peripheral participation
An apprenticeship model.
development of mental model
From explanation, by analogy, from feedback etc.
learning by chunking
Forming general rules from specific instances.
E.g. declarative chunks: old London numbers: 0181 362 6163 need to be re-learnt: 020 8362 6163
Procedural chunks: learned patterns of behaviour -- e.g. learning to drive.
proceduralisation
from declarative to procedural knowledge -- going from planning (e.g. a PUM model) to learnt procedures (e.g. a GOMS model)
Strong habit intrusion (Reason 1990): users will behave in a habitual way even if it's not appropriate.

Week 7: Memory and attention

The Model Human Processor:
Auditory memory (decays in around 200 msec)
Code: physical, acoustic
Visual memory (decays in around 1500 msec)
Code: physical, visual
Working memory (decays in around 7 sec)
Code: visual or acoustic
Long term memory lasts indefinitely
Code: semantic
Motor response is free of memory!
(see week 3)
Memory:
Empirical finding: people can hold 7±2 chunks in working memory.
Primacy and recency effects:



Recognition and recall
Retrospective and prospective memory
One form of 'distributed cognition' is the use of external memory aids.
N.B. the work on memory --especially working memory -- is still the subject of ongoing research. E.g. post-completion errors can be viewed as a failure of prospective memory due to diminished 'weighting' on the semantic memory element.
Attention:
Visual attention is based on location. May be encoded verbally or iconically.
Auditory attention is based on pitch, volume & timbre.
Metaphors for attention: The searchlight / the resource
Stimulus-response compatibility and stimulus—central-processor—response compatibility: compatibility of information form and layout. E.g. cooker controls.
Dual tasks: focused and monitoring.
Consider how film directors keep attention across cuts; how can we apply this in interface design?
Different mental codes and modalities:

code modality	visual	auditory
spatial		
verbal		

Verbal and spatial memory: how do you remember a PIN that you have to type?
Multi-modal systems

Users interact using multiple modalities. There is strong evidence that users cannot process incoherent data streams at the same time (without sharing resources). E.g. can you easily do the following:
Driving while talking?
Speaking or listening to speech while reading?
Writing and listening to music?
Input coherence: an example of incoherent input is the 'lip synch' problem of a badly edited film. Important for networked systems where bandwidth is limited.

Week 8: Perception

Think back to Norman's action cycle
Feedback
Feedback is necessary for helping people to form an understanding of the device (cf. mental models).
E.g. calculator:
“Clear” key first clears number then clears operation.
[25 + 15 clear clear —> 25]
Users typically press clear key many times.
Users typically prefer to use bits of paper than to use calculator memory.
Feedback is also necessary to support user keeping track of state of device (imagine working with a computer while the monitor is turned off).
Errors
Error types:
a) slips
    e.g. cause by layout (buttons too close together)
    e.g. 'strong habit intrusions'
b) misconceptions
    — about what does what
    — about the state of the system
(Relate these to Norman's Gulfs)
c) other types of errors: e.g. is a post-completion error a slip?
Examples:
Example 1: Kegworth air disaster:
A simplified account of this says that:
one of the (two) engines was smoking (and later on fire)
when crew throttled back the good engine, the problem seemed to go away (because the autothrottle matched this by throttling back the failing one)
dials on the display were showing the correct information about the cause of the problem
those dials were considered unreliable by the flight crew
the smoke from one engine was being funnelled across to the opposite side of the cockpit
the flight crew were re-programming the flight management system shortly before the crash
Note importance of feedback, but also confirmation bias.

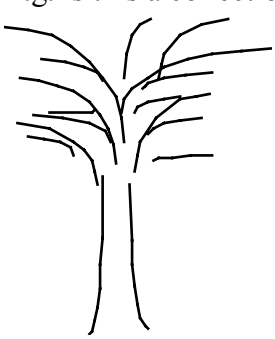
Example 2: Strasbourg
The aeroplane crashed into the mountain because it descended too fast. One interpretation of the available data is that the pilot entered data, intending to request a descent angle of 3.3 degrees at a time when the flight management system was accepting data on descent in thousands of feet per minute. Thus the aircraft descended a rate of 3300 ft/min instead of the intended 800 ft/min. The flight management system gives relatively little feedback about what mode it is in.
** “mode error” **
[Black Box video]

Example: “Help” key on Macintosh:
The “help” key is right next to the “delete” key on the Mac keyboard. I regularly press “help” then “delete”…

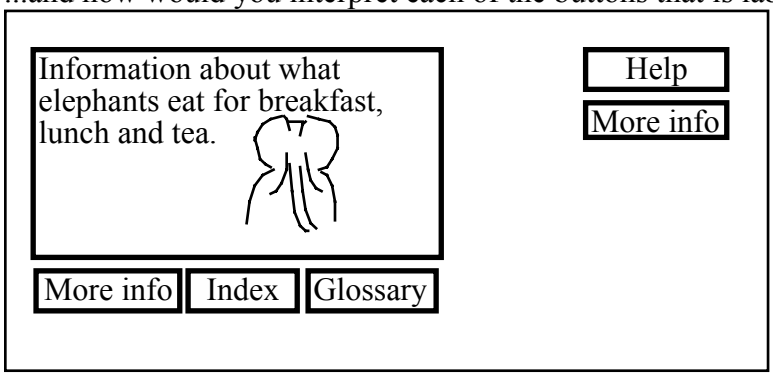
Visual structures

Gestalt psychology: we make sense of 'the whole' and interpret information in context.

E.g. is this a collection of curves or a tree?



...and how would you interpret each of the buttons that is labelled 'more info'?



Week 9: Interaction

Paradigms for Human-Computer Interaction:
Direct manipulation: you act in the computer's world
Affordances: pressability, dragability, turnability, etc.
Command-line: you ask the computer to act on your behalf
Syntax is important
Syntax: the surface structure of a communication.
Semantics: what it means.
Pragmatics: what to do about it.

E.g.: in the bar: "Do you have any peanuts?"
E.g.: from the compiler: "Error 87 at line 36."
Language and action
Searle asserts that language changes the state of the world, and proposes that an utterance is designed to accomplish "speech-acts" of there are the following five types:
Assertions – that commit the speaker to something being the case
Directives – both questions and commands
Commissives – that commit the speaker to doing something
Expressives – that express some emotion (e.g. praising or apologising)
Declarations – that bring about the declared state (e.g. 'I declare you husband and wife')
How does this relate to computer system design? A number of computer systems have been built that support commands based on speech acts to allow people to communicate.
Properties of language
Some have argued that speech acts are too restrictive, and have looked at the properties of language as uset in ordinary conversation. For instance:
Openings, closings and adjacency pairs.
E.g. in the bar:
A: "Do you want another pint?"
B: "What's the time?"
A: "Ten to ten."
B: "OK, yes, thanks."

E.g. anthropormorphising my Mac:
A: "Copy this file to that disk."
M: "Can't. The disk's full."
A: "Delete those files to make space."
M: "OK. Done that."
A: "***Now*** copy this file."

Topic shifts:
Grosz & Sidner (1986) propose a stack model of topic shifts in interaction. How might this apply in computer system design?
e.g. expert systems, unselected window
Wizard of Oz
... to study desirable patterns of interaction.

What are the limitations of Wizard of Oz?

Week 10: External Cognition

How do you remember the time of this lecture, the location of a party of the phone number of someone you've just met? Of course, it is possible to memorise these things and recall them later, when needed, but much of the time, we "memorise" things by writing them down. The task of remembering is therefore replaced cognitively less demanding tasks of finding and reading. Many cognitive tasks are similarly transformed by clever use of the things in our environments, and humans are good at constructing objects and artefacts that ease cognitive load. (Compare the Roman and Arabic numeral systems. Which one makes the cognitive burden of arithmetic more manageable).

Much of what has already been said in this module focuses on the processes and representations that exist in the head of the user of a computer system. However, it is clear that an important aspect of human activity is the fact that almost everything we do makes use of external artefacts. Any theoretical understanding of how people use computers must take into account the role of the outside world.

External artefacts

Example: a game for two players. The players take turns picking numbers in the range 1 to 9. The first player to have picked numbers that add up to 15. The game sounds hard, but if the problem is represented in the right way it becomes much easier.

2	7	6
9	5	1
4	4	8

Other example: Using a "nomogram". Solving equations / looking at a graph?)

So, how do external artefacts work?

External memory:.As we've seen above,

Computational offloading: Organise external representation so that the perceptual or computational task faced by a person is lower.

Example: using flight progress strips in air traffic control. Seems like a really antiquated system, ripe for computerisation; many proposals exist for replacing . However, strips are a compact and efficient representation that transform a complex problem in 4-D geometry into a simple series of perceptual judgements and comparisons.

Cognitive tasks and perceptual tasks: **Compare different displays. Which can help to answer different questions?**

Implications for design:

Know what kinds of cognitive tasks the system is intended to support

Know what kinds of computation people are good at – especially making use of peoples' perceptual abilities.

Find representations that ease cognitive work.

Week 11: Co-operation

CSCW
Computer Supported Collaborative Working.
Examples:
Computer mediated communication (e.g. email, video conferencing, chat rooms, bulletin boards)
Shared artefacts (e.g. editors, diaries, argumentation tools)
Workflow systems allow people to work on the same data in a controlled manner. (e.g. Lotus Notes)
Groupware time-space matrix
(when and where is a system designed to be used?)

Place **Time**	**same place**	**at a distance**
synchronous		
asynchronous		

Changing roles
Examples:
Meeting rooms and Decision Support Systems: capture reasoning; reduce effects of power relationships; good for divergent thinking but not convergent.
X can make demands on Y if X can access more information about Y (e.g. shared diaries).
X can support Y if they share more information about their tasks.
Human-Human Interaction
...normally makes use of:
facial expressions
turn-taking
personal space, relative positions and posture (body language)
eye contact and gaze
back channels
shared context
How are these affected when communicating at a distance?
Distributed cognition
Information and responsibilities are shared around a group of people.
Examples:
Football team
Flight crew in a cockpit
Navigation team on bridge of ship
Helpdesk team
Design challenges
How to:
Synchronise activities
Maintain mutual awareness of state
Respect privacy
Avoid having to make too much explicit

Example of a Previous Examination Paper

Note: the syllabus changes from year to year, so this paper (from 1996) includes some material that is not covered this year. You will be expected to answer 4 from 6 questions, in a three hour examination.

1. Mental models and cognitive models

a) Define the terms "model", "mental model" and "cognitive model". (8 marks)

b) Outline important roles for mental models and cognitive models in HCI design. (8 marks).

c) The BookWorm Bookshop is a specialist shop that produces and markets personalised books (so that the purchaser can specify the names and attributes of characters to go in a story and then have a unique book produced to their specification). It is setting up an on-line browsing facility so that customers can specify their personalised information and then check the result before confirming the order. Design a screen that allows the customer to look through an electronic copy of the book before confirming the order, and highlight how your design supports the user in acquiring an appropriate mental model of the way the system works. (9 marks)

2. User testing

a) There are different kinds of experiment that an interface designer might wish to conduct while developing a novel interface. Define the following terms in relation to experimental design and briefly discuss their significance in relation to experimental design. (12 marks)
dependent and independent variables
confounding variables
balancing subjects
within-subject design
between-subject design

b) The following description has been given of the testing of a new User Interface:
"Formative testing in the Usability Lab. Conducted primarily in the groundbreaking Usability Lab, formative testing collects data as test subjects perform specific tasks, such as launching a program, finding a file, and installing a printer. The Usability Lab has nine testing suites, each with a one-way mirror, cameras, and other equipment for recording and observing users as they work. Central to the Lab's operations is online data-collection software that helps specialists collect cognitive and quantitative process data as subjects work through the set of tasks.
Usability tests are observed firsthand by the design team and are essential in future designs. The experience of test subjects has ranged from novice user to intermediate/advanced users, so the test results focus on new computer users as well as users familiar with Windows.
Longitudinal testing: Conducted at customer sites and in the Usability Lab, longitudinal testing involves testing the UI as a whole with real users over longer periods of time.

UI-expert and industry-expert review: In the fall of 1993, a panel of UI experts and industry experts was assembled to review and critique the UI for Windows95. In addition, four independent consultants each spent large blocks of time with Windows95 and gave extensive feedback."
Discuss strengths and limitations of the approaches to testing described here, considering costs, benefits, and limitations to the kinds of results that each approach can yield. (13 marks)

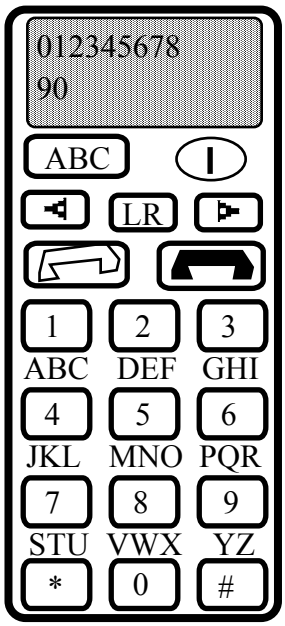
3. Programmable User Modelling Analysis

a) Briefly describe PUMA in terms of the 5 stages of the analysis and the three main sources of user knowledge. (10 marks)
b) Summarise briefly the meaning of each of the following terms in a PUMA operator description:

user-purpose:
tracked:
precondition:
filter:
device-command:

(5 marks)

c) The Connections-R-Us Mobile Phone Company has designed a new 'phone for the older consumer. Their market research has shown that this consumer group wants a phone with larger buttons but less functionality than most traditional mobile 'phones, so they have restricted the functionality to just making a connection (press the button displaying the white handset), finishing call (press button displaying black handset), storing or retrieving a number and dialling.



To simply dial a number, the user makes sure the 'phone is switched on (press top-right button to turn it on), dials the number, then presses the white-phone key.
To store a displayed number, the user presses the "ABC" key then enters the name (by pressing the number keys rapidly the required number of times) then presses the "ABC" key again. The user can then dial the newly stored number simply by pressing the white-phone key.
To retrieve a stored number, the user presses the "ABC" key then scrolls through the list of names using the arrow keys then presses the "ABC" key again when the desired

name is found. The user can then dial the retrieved number simply by pressing the white-phone key.
Once the user has finished a call, the number is removed from the display. It can be retrieved by pressing “LR”.
The PUMA declarations and operation descriptions for the simple dialling task are

OBJECTS:
number: 01813625000, 01234567890, ...
name: middlesex, parents, ...
phone: my-phone

PREDICATES:
is-switched-on(phone) -- detected by looking
has-number (name, number)
is-displayed (number) -- detected by looking
is-connected(phone, number)

OPERATIONS
operation switch-on (phone: P)
user-purpose: is-switched-on(P)
filter: not is-switched-on(P)
device-command: press “on/off” switch

operation dial-number (number: N, phone: P)
user-purpose: is-displayed(N)
precondition: is-switched-on(P)
device-command: press digits to construct number

operation make-call (number: N, phone: P)
user-purpose: is-connected (P,N)
precondition: is-displayed(N)
device-command: press “white phone” key

TASK
is-connected (my-phone, parents)
Write further operation descriptions and a task definition using the same notation to describe the additional information the user needs to know to store a number. You will probably find that you want to add more information to some operations that have already been defined, and that you need a new predicate. Comment on where the user gets all the knowledge they need from. (10 marks)

4. Computer Supported Collaborative Working

a) Define the terms “synchronous” and “asynchronous” in relation to Computer Supported Collaborative Working. Give an example of one system of each type. (4 marks)

b) Consider the following three tasks that involve several people:
i) writing a collaborative document;
ii) processing the paperwork that traces a fault from reporting to being fixed;

iii) making a major strategic decision.

For each, discuss how the task might be achieved without technological support, identify two kinds of technological support that could enhance the process (one "traditional" and one CSCW), and discuss how the technology changes the process, from both a user's and an organisational perspective. (21 marks)

5. Interaction styles for learning and support

a) Define the terms "initiative" and "control" and discuss their significance in relation to the design of interactive systems (6 marks)

b) Write two contrasting help messages that explain the use of commandX for achieving effectY and briefly discuss their relative merits from a system developer's and a user's point of view. (8 marks)

b) Discuss the relative merits of alternative ways of balancing the initiative between user and computer system for helping users to learn about how to use a particular application program. Give examples (real or hypothetical) of each alternative. (11 marks)

6. Memory and attention

a) Describe the Model Human Processor (of Card, Moran & Newell) in terms of processing and memory. (8 marks)

b) There is an empirical finding that people can hold 7±2 items in working memory. Discuss how you might take this finding into account when designing:

i) a collection of pop-up and pull-down menus for a new application

ii) a series of forms where answers on one form depend on answers on preceding ones

iii) a secure password system where the minimum length of password is to be 12 characters, and no real words are permitted.

(6 marks)

c) The Super-Cola factory is a completely automated plant which runs routinely without operator intervention. The technicians who are on stand-by to correct any problems spend most of their time helping out in the merchandise store next door. The store can sometimes get very noisy, particularly if there are lots of children visiting. The state of the plant is monitored by the check-out assistants, who have specialised multimedia terminals that allow them to monitor the plant while also billing customers for their goods. If there is a problem on the production line, the assistant needs to be made aware of it immediately, to be able to locate where on the production line the problem is, and to call a technician to fix it. Design a terminal to enable the assistant to monitor the state of the plant at all times, and to locate faults when they occur, while also performing the routine task of customer billing. Explain in detail how theories of attention have informed your design. (11 marks)

Outline answers for the example paper

1. Mental models and cognitive models

a) Define the terms "model", "mental model" and "cognitive model". (8 marks)

A "model" is a representation of something that is constructed for a purpose. It might demonstrate or predict physical, behavioural or other properties of the modelled system. (2 marks)

A mental model is a mental representation (in the head) of the artefact being used which helps the user in working with the artefact. (3 marks)

A cognitive model is a representation of ways people think. It is a model "in the world" of what happens in the head. So far, cognitive models only deal with rational problem solving. Most "traditional" cognitive models are based on the Information Processing (or Model Human Processor) paradigm. (3 marks)

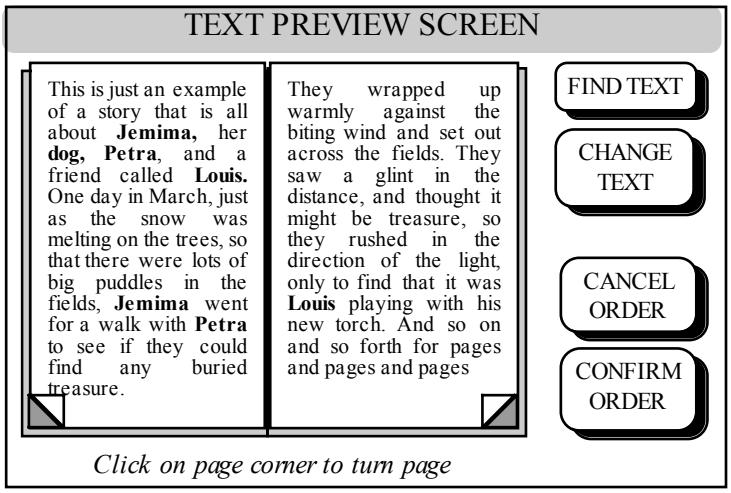
b) Briefly outline important roles for mental models and cognitive models in HCI design. (8 marks)

For any complex artefact, users will be working with a mental model of it. The designer's task is to help the user to acquire an appropriate mental model that will make that usage effective. This can be done by employing analogies and metaphors, and by giving adequate feedback. (4 marks)

Cognitive models can give designers a way of thinking about usability issues in situations where they cannot do valid usability trials with representative "real" users, or to give them a deeper understanding of those issues than that gained just by observation. (4 marks)

c) The BookWorm Bookshop is a specialist shop that produces and markets personalised books (so that the purchaser can specify the names and attributes of characters to go in a story and then have a unique book produced to their specification). It is setting up an on-line browsing facility so that customers can specify their personalised information and then check the result before confirming the order. Design a screen that allows the customer to look through an electronic copy of the book before confirming the order, and highlight how your design supports the user in acquiring an appropriate mental model of the way the system works. (9 marks)

There is scope for a lot of variation here! The following is just an example of a possible answer:



On this screen, we see:

- Clear labels to show what the screen is for, and clear instructions on what to do, to help users to acquire an appropriate mental model of the role and use of the screen.

- Buttons with (hopefully!) clear labels that are intended to look “clickable” to afford clicking.
- Buttons are grouped according to functionality to help the user understand the relatedness of functions.
- An electronic book that looks like a paper book, so that the user can see what the final artefact will look like, and use experience of turning pages in a real book to help understand the analogy of clicking on the corners to turn pages.

Subsequent screens (reached by pressing buttons) give suitable feedback about the role and purpose of the screen, to help the user learn quickly what each is for, and to recognise any errors as quickly as possible.

2. User testing

a) There are different kinds of experiment that an interface designer might wish to conduct while developing a novel interface. Define the following terms in relation to experimental design and briefly discuss their significance in relation to experimental design. (12 marks)

• dependent and independent variables

These are the cause and effect variables in the experiment. Independent variables are the ones being manipulated in the experimental design, and dependent ones are the ones that are changing as a consequence. The aim of an experiment is to demonstrate this relationship.

• confounding variables

These are uncontrollable (or uncontrolled) variables, or extraneous factors, that may influence results in an unwanted way. A good experimental design will minimise or eliminate such variables.

• balancing subjects

This involves matching experimental subjects for any factors that might influence the outcome of the experiment, such as age, sex or previous experience, so that similar numbers of each type of subject are in each experimental group.

• within-subject design

The same subjects are used in each experimental condition. The experiment should be designed so that each group of subjects performs under each condition in a different order.

• between-subject design

Different subjects are used for each experimental condition. This is used if experience under one condition is likely to strongly influence performance under subsequent conditions.

b) The following description is given of the testing of a new User Interface:

Formative testing in the Usability Lab. Conducted primarily in the groundbreaking Usability Lab, formative testing collects data as test subjects perform specific tasks, such as launching a program, finding a file, and installing a printer. The Usability Lab has nine testing suite, each with a one-way mirror, cameras, and other equipment for recording and observing users as they work. Central to the Lab’s operations is online data-collection software that helps specialists collect cognitive and quantitative process data as subjects work through the set of tasks.

Usability test area observed firsthand by the design team and are essential in future designs. The experience of test subjects has ranged from novice user to intermediate/advanced users, so the test results focus on new computer users as well as users familiar with Windows.

Longitudinal testing: Conducted at customer sites and I the Usability Lab, longitudinal testing involves testing the UI as a whole with real user over longer periods of time.

UI-expert and industry-expert review: In the fall of 1993, a panel of UI experts and industry experts was assembled to review and critique the UI for Windows95. In addition, four

independent consultants each spent large blocks of time with Windows95 and gave extensive feedback.

Discuss strengths and limitations of the approaches to testing described here, considering costs, benefits, and limitations to the kinds of results that each approach can yield. (13 marks)

Formative: expensive in terms of costs of subjects for a realistically sized study and of costs of analysing data. Benefits include: a well-designed experiment can establish cause-and-effect relationships; even more informal experiments can highlight user behaviours that were not anticipated by the developers. There are problems of ecological validity; such experiments give a good trace of errors users make and things they find clear or difficult on experimenter-defined tasks, but (a) doesn't find out anything about how user actually work with the system, and (b) doesn't find any errors or difficulties that only pertain to non-tested tasks. Wording of task descriptions can influence performance. Surface performance can be the same for different underlying reasons, and a simple trace of performance may not give adequate insight into the design features that are causing that performance. Subjects must be well matched to the target population.

Longitudinal: It is difficult to get quality data from longitudinal testing unless it is conducted in short bursts. It is expensive. It has good ecological validity provided that data is collected from real users doing natural tasks. It may miss critical difficulties that occur in abnormal situations. It is unlikely to establish reliable cause-effect relationships.

Expert review: can help identify problems that user testing misses, and is more likely to give an account of the causes of problems. Depends heavily on the expertise of the experts, and on their understanding of the end users of the system. Results can be very subjective.

3. Programmable User Modelling Analysis

a) Briefly describe PUMA in terms of the 5 stages of the analysis and the three main sources of user knowledge. (10 marks)

PUMA involves describing the knowledge a user needs to perform a task, in the following stages:

1) Identifying candidate tasks:

The first stage is to identify candidate tasks for analysis by reference to the tasks the device is intended to support.

2) Identifying conceptual operations:

The second stage is to identify *conceptual operations* to perform the candidate tasks. A conceptual operation corresponds to a single device command that is selected under certain conditions to achieve a particular purpose.

3) Describing the user's knowledge in the Instruction Language:

The next stage is to describe the knowledge the user needs in terms of an Instruction Language (IL).

If no such difficulties are found then the analyst can proceed to hand simulation.

4) Hand-simulation of the model:

Hand simulation may be done for just one operation or for a complete candidate task.

5) Running the model:

The IL description is a programming language for a Programmable User Model. The behaviour of this model can be compared with intended user behaviour; if there is a mis-match, then the analyst can refer to the trace of behaviour to identify the cause of the mis-match.

The three main sources of knowledge are pre-existing knowledge, visible effects and tracked information.

b) Summarise briefly the meaning of each of the following terms in a PUMA operator description:

user-purpose:
tracked:
precondition:
filter:
device-command:

(5 marks)

user-purpose: what the user would select this operation for

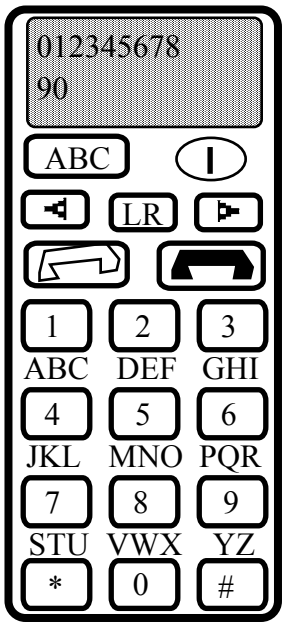
tracked: information the user knows by tracking known effects of the operation

precondition: condition that the user may sub-goal to achieve, and which must be true before this operation will achieve its user purpose.

filter: condition that must be true before the user would select this operation, but that the user would not or cannot set out explicitly to achieve.

device-command: the corresponding device action.

c) The Connections-R-Us Mobile Phone Company has designed a new 'phone for the older consumer. Their market research has shown that this consumer group wants a phone with larger buttons but less functionality than most traditional mobile 'phones, so they have restricted the functionality to just making a connection (press the button displaying the white handset), finishing call (press button displaying black handset), storing or retrieving a number and dialling.



To simply dial a number, the user makes sure the 'phone is switched on (press top-right button to turn it on), dials the number, then presses the white-phone key.

To store a displayed number, the user presses the "ABC" key then enters the name (by pressing the number keys rapidly the required number of times) then presses the "ABC" key again. The user can then dial the newly stored number simply by pressing the white-phone key.

To retrieve a stored number, the user presses the "ABC" key then scrolls through the list of names using the arrow keys then presses the "ABC" key again when the desired name is found. The user can then dial the retrieved number simply by pressing the white-phone key.

Once the user has finished a call, the number is removed from the display. It can be retrieved by pressing "LR".

The PUMA declarations and operation descriptions for the simple dialling task are

OBJECTS:

number: 01813625000, 01234567890, ...

name: middlesex, parents, ...

phone: my-phone

PREDICATES:

is-switched-on(phone) -- detected by looking
has-number (name, number)
is-displayed (number) -- detected by looking
is-connected(phone, number)

OPERATIONS

operation switch-on (phone: P)
user-purpose: is-switched-on(P)
filter: not is-switched-on(P)
device-command: press “on/off” switch

operation dial-number (number: N, phone: P)
user-purpose: is-displayed(N)
precondition: is-switched-on(P)
device-command: press digits to construct number

operation make-call (number: N, phone: P)
user-purpose: is-connected (P,N)
precondition: is-displayed(N)
device-command: press “white phone” key

TASK

is-connected (my-phone, parents)

Write further operation descriptions and a task definition using the same notation to describe the additional information the user needs to know to store a number. You will probably find that you want to add more information to the “make-call” operation, and that you need a new predicate. Comment on where the user gets all the knowledge they need from. (10 marks)

There are actually several possible variants of which this is one:

PREDICATE

in-alpha-mode(phone)

OPERATIONS

operation set-alpha-mode (phone: P)
user-purpose: in-alpha-mode(P)
filter: not in-alpha-mode(P)
tracked:in-alpha-mode(P)
device-command: press “ABC” switch

operation set-number-mode (phone: P)
user-purpose: not in-alpha-mode(P)
filter: in-alpha-mode(P)

tracked:not in-alpha-mode(P)
device-command: press “ABC” switch

operation assign-name-to-number (number: N, phone: P, name: M)

user-purpose: has-number(M,N)
precondition: is-displayed(N)
in-alpha-mode(P)
device-command: press number-keys to construct name

operation make-call (number: N, phone: P)

user-purpose: is-connected (P,N)
precondition: is-displayed(N)
in-alpha-mode(P)
device-command: press “white phone” key

TASK

has-number (012345647890, parents)

The user gets most knowledge from the state of the display. However, there doesn’t seem to be any direct indication of whether the device is in alpha mode or numeric mode, so the user might make mode errors.

4. Computer Supported Collaborative Working

a) Define the terms “synchronous” and “asynchronous” in relation to Computer Supported Collaborative Working. Give an example of one system of each type. (4 marks)

Synchronous = at the same time. E.g. videophone or online chat

Asynchronous = at different times. E.g. email or workflow.

b) Consider the following three tasks that involve several people:

i) writing a collaborative document;
ii) processing the paperwork that traces a fault from reporting to being fixed;
iii) making a major strategic decision.

For each, discuss how the task might be achieved without technological support, identify two kinds of technological support that could enhance the process (one “traditional” and one CSCW), and discuss how the technology changes the process, from both a user’s and an organisational perspective. (21 marks)

7 marks for each part of the answer. Answers to this are likely to be varied. The main concern is that they should be reasonable and demonstrate a good understanding of the ways the technology influences both individual experience and organisational processes:

i) difficult to do with no tech. support. Would probably involve extensive advance planning to agree structure of document and content of sections before writing and typing up. Iteration would be very difficult.

Basic technical support would be a word processor and the ability to transfer versions of the document between authors. Version control and “ownership” of the latest version would be important. It becomes possible to have multiple iterations and change the document substantially, so less initial planning is needed. However, this may result in problems such as abrupt changes in style between sections! Co-authors have to have access to compatible word processors to be able to work effectively together.

Version management becomes even more of an issue with collaborative writing tools such as multi-user editors. Issues such as the range of effect of “undo” and how (or whether) lock-out occurs within sections of the document can severely effect the usability of the tool. However, people can now work in parallel, and not have to wait their turn. There is ample evidence that such tools cannot be used very early in the process, when ideas on content and structure of the document are still fluid and people still tend to perform best by having face-to-face meetings and scribbling things out on pieces of paper.

ii) This is generally referred to as “workflow”. Old-style workflow involved forms being filled in and passed from one person to another, according to some documented or well-understood procedure. Tracing the progress of a particular job (e.g. finding out what stage the investigation of a fault had got to when the customer enquired about it) could be difficult.

Batch-processing data files could be used to store information about each job, so that there was a central repository of information about it. This tends to go with organisations with a centralised structure. The current situation of a job can be established (as long as everyone has entered the data appropriately), but there is a de-coupling between the updating of data and the actual processing of the job.

Workflow software supports the flow of information through the system, allowing the organisational structure to be de-centralised, but generally making it difficult for people to deal with exceptions in a sensible way within the structure. So there’s neat automation for routine cases, but difficult ones may actually become harder to handle. Or people may find ways to “fool” the system. It becomes easier to track the progress of a job, and also easier for management to find out how information flows around the organisation and the identify any bottlenecks.

iii) Strategic decision making traditionally involved either one person making the decision and imposing it to be acted upon by everyone else, or involved people getting together in a room and battling it out, with flip-charts and pens. Dominant personalities tended to dominate proceedings, so traditional hierarchies were reinforced. People observed turn-taking conventions, so that some important issues got forgotten.

Traditional DSSs are generally tools to help people structure and restructure information, with “what-if” projections. The results of such projections can be presented within a group context, but serve the role mainly of giving the group more information.

GDSS: people participate in parallel; traditional hierarchies are broken down; people might be anonymous; people don’t have to be physically co-located. It’s often better for brainstorming (“divergent” discussion) than for reaching a conclusion (“convergent” discussion). Ultimately, people tend to reach consensus best in face-to-face situations.

5. Interaction styles for learning and support

a) Define the terms “initiative” and “control” and discuss their significance in relation to the design of interactive systems (6 marks)

Initiative = who starts something, or defines its direction.

Control = who determines the outcome of an interaction

Interactions may feature largely user initiative (e.g. most office applications), system initiative (e.g. many expert systems) or mixed initiative (e.g. some ITSs).

Control determines whether or not the user can achieve their goals -- e.g. despite interventions from other agents in a multi-agent system.

Initiative and control are closely related, but not synonymous.

b) Write two constrasting help messages that explain the use of commandX for achieving effectY and briefly discuss their relative merits from a system developer's and a user's point of view. (8 marks)

"CommandX is the command you use when you want to achieve effectY"

-- easy to implement because it just needs to be indexed by the list of all available commands, but difficult for the user to exploit, because the user needs to already know the command name to be able to find out information about it. (4 marks)

"To achieve effectY, you should use commandX."

-- more difficult to implement because the developer has to anticipate the range of ways in which the user might formulate queries (or think about their tasks) to provide an appropriate indexing mechanism. Easier for the user to access because this form of help provides a better mapping to the way the user is likely to think about their tasks. (4 marks)

c) Discuss the relative merits of alternative interaction styles for helping users to learn about how to use a particular application program. Give examples (real or hypothetical) of each interaction style. (11 marks)

Answer should cover points:

* traditional help systems are user-driven. The user needs to know how to phrase the question to find the answer they need, or to recognise salient words in the help index.

* Things like bubble-help are user-initiated but then system driven. The user gets the information whether or not they want it, and they will frequently ignore it.

* Tutorial software is often system-driven. This can be a good way of introducing users to the basic functionality of the system, but cannot be related to real user tasks and is therefore only generally useful early in the learning process. E.g. the Guide or Toolbook tutorial.

* Software agents that monitor user activity and pop up unprompted when they detect inefficient patterns of interaction are gradually being developed. The usefulness and acceptability of such agents has not yet been well investigated. E.g. Rich's collaborative interface agents.

6. Memory and attention

a) Describe the Model Human Processor (of Card, Moran & Newell) in terms of processing and memory. (8 marks)

Stimuli are transformed as they pass (in order) through 3 stages of processing: perception, cognition and motor response.

Sensory memory consists of auditory memory (with a decay time of around 200 msec) and visual memory (decays in around 1500 msec).

Cognition involves matching, decision making and transfer to memory. Long term memory lasts indefinitely. Short term memory generally holds around 7 chunks of information.

Motor response is free of memory!

b) There is an empirical finding that people can hold 7±2 items in working memory. Discuss how you might take this finding into account when designing:
i) a collection of pop-up and pull-down menus for a new application
ii) a series of forms where answers on one form depend on answers on preceding ones
iii) a secure password system where the minimum length of password is to be 12 characters, and no real words are permitted. (6 marks)

i) not relevant, but make menu headers meaningful

ii) display information from previous forms if users are likely to need to relate new information to previously entered information.

iii) help users to chunk information by grouping it in some way that is meaningful to them.

c) The Super-Cola factory is a completely automated plant which runs routinely without operator intervention. The technicians who are on stand-by to correct any problems spend most of their time helping out in the merchandise store next door. The store can sometimes get very noisy, particularly if there are lots of children visiting. The state of the plant is monitored by the check-out assistants, who have specialised multimedia terminals that allow them to monitor the plant while also billing customers for their goods. If there is a problem on the production line, the assistant needs to be made aware of it immediately, to be able to locate where on the production line the problem is, and to call a technician to fix it. Design a terminal to enable the assistant to monitor the state of the plant at all times, and to locate faults when they occur, while also performing the routine task of customer billing. Explain in detail how theories of attention have informed your design. (11 marks)

All sorts of possibilities!

In a noisy environment, routine monitoring should be visual, rather than auditory. Some kind of visual representation of the plant should be constantly present very near the user's normal viewing position so that shift of focus of attention ("modality switching") between tasks is minimal. Visual structures are generally easier to monitor as a secondary task than verbal ones, so representation should be diagrammatic.

Users can only focus attention on one task at a time, while maintaining background awareness of the state of others. To focus on the monitoring task, the user has to switch attention from the main (selling) task.

We have limited ability to share attention between tasks, so the selling screen must be a very simple design.

Even in malfunction situations, the user might be distracted by persistent auditory warnings while trying to locate information about the fault on the screen, so while there is probably value in having an auditory alarm to initially alert the user to the problem (in a distinctive tone that is easily discriminated from background noise), this should not persist.

Examiner's Report COM3210 2000/01

Examiners: Ann Blandford & Bob Fields.

Note that this report is on a different exam than the one described above.

General comments:

Learning outcomes tested:
The aims of this examination was to test students' understanding of the properties of users, as relevant to the design of interactive computer systems, and their ability to apply that understanding in the design and evaluation of interactive systems.

Comments on the answers:
Overall, performance on this examination was reasonable, with a good spread of marks across the 20 point scale. The greatest mistakes were (as usual) students not reading the question correctly or omitting to answer parts of the question. Also, some students re-stated the same point several times in the answer; this does not get awarded more marks!
An indication of what constitutes a good answer to each question is included in the model answers for the paper. These are not repeated here; this report focuses on difficulties experienced by a substantial subset of students.

Comments on answers to Question 1
Responses to this question were generally good.
Part a: many students achieved full marks. A few confused the user (email sender) perceiving and interpreting information with the recipient of the message doing the same: Norman's action cycle refers to one user (in this case, the sender) and their perception of the system.
Part b: generally good answers.
Part c: a wide range of answers. Many students omitted to discuss the poor mapping of the up-down arrows to their various functions. Most students omitted explicit discussion of possible user errors. Several repeated the same information within their answers.

Comments on answers to Question 2
Results for question 2 were more mixed.
Part a: many students clearly had not understood 'external cognition', and gave inappropriate answers.
Part b: generally good answers.
Part c: a wide range of answers. Many students failed to engage with the question, which was about presentation of information, not ticket booking, and focused on external cognition.

Comments on answers to Question 3
Results for question 3 were generally reasonable.
Part a: answers generally good.

Part b: answers were mixed: working memory limitations do not mean that a menu should only contain 7 items; neither does a menu system rely on recall (as items can easily be viewed). Answers for part (ii) were better than those for part (i).
Part c: most students could explain this well. A few had completely misunderstood the question.
Part d: many students gave good answers for part d. A few misread the question and proposed the design of electronic books or a simple book ordering system (without reference to support for memory).

Comments on answers to Question 4

Results for question 4 were disappointing, given that cognitive walkthrough was covered in seminars and included in the coursework (maybe some students therefore did not bother to revise it for the examination).
Part a: very few students answered part a adequately. The question referred to the assumptions (i.e. underlying theory) behind the approach, not to how it is applied.
Part b: mixed answers: students should have done better on this.
Part c: very few students did an adequate walkthrough. Either they asked the correct questions, but only once each for the entire task, or they stepped through the task asking the wrong questions. Even the few who stepped through the task correctly did not do so in an insightful way, appearing to go through the motions of answering without actually thinking about what the questions mean. A few students demonstrated insight without following the intended procedure.

Comments on answers to Question 5

Few students tackled question 5, but those who did generally performed reasonably well.
Part a: most students answered this part correctly.
Part b: results for part b were mixed. The main difficulty was students not giving full answers to all the sub-parts of the question.
Part c: most students gave reasonable answers to part c. A few failed to distinguish between the different kinds of support that were appropriate for the different tasks.

Comments on answers to Question 6

Almost all students attempted question 6, but few performed well on it.
Part a: most students could describe a mental model, but fewer could discuss clearly how an understanding of MMs can be used in design.
Part b: many answers failed to engage properly with the question, giving a textbook description of the various kinds of studies that could be used without relating them clearly to this task and its idiosyncrasies. Most students proposed questionnaires as one of the techniques they would apply without any clear explanation of how the results would be useful in this context.
Part c: this was a difficult question, and very few students gave adequate answers to it. Many described a simple mapping or billing system without any reference to mental models.

Useful Information

Feedback to Students

This School has a student website dedicated to enrolled Computing Science students, which provides information to support you on your programme of study. Including information on the School's Academic staff and:

- Module Handbooks
- Subject Handbook
- Course Material
- Exam/ Coursework Reports
- Duty Academic Rota's
- Time-Tables
- Revision Time-table Information
- Student Allocation System (SAS)
- Boards of Study Minutes

And other useful information such as
Links to biCSS
24-7: Your information Heaven at Middlesex University
Library Catalogue
Student Allocation System (SAS)

School Policy on passing all Components of Module

Students must pass both assessed components of a module individually, coursework and examination in order to pass the module overall. ie failure in one of the components will result in a failure of the module.

Academic Dishonesty

Taking unfair advantage in assessment is considered a serious offence by the university which will take action against any student who contravenes the regulation through negligence, foolishness or deliberate intent.

Academic dishonesty is a corrosive force in the academic life of the university; it jeopardises the quality of education and devalues the degrees and awards of the university.

The full regulations on academic dishonesty are given in the University Guide and Regulations, Section F Infringement of assessment regulations - Academic dishonesty.

Plagiarism

The presentation by a student as his or her own work of a body of material (written, visual or oral) which is wholly or partly the work of another.

Make sure written material is acknowledge through the use of quotation marks, references and bibliographies. Information on the correct way of acknowledging work form other sources is available from campus libraries.

Appeals

The full regulations on appeals are given in the University Guide and Regulations. Section G - Appeal regulations and procedures

Examples of all Typical/Previous Examination Papers

Please go to the University 24-7 website – http://www.mdx.ac.uk/24-7 – Academic – Exam Paper Database http://www.mdx.ac.uk/cgibin/mdx/exam/searchscreenexam.asp –for copies of previous examination papers in all subject areas across the University

24-7

24-7 is the new website for every Middlesex student. Turn to it for advice and up-to-date information any time of the day or night.

Explore 24-7 on: www.mdx.ac.uk/24-7