

HCI-1- Human Computer Interface Design – Theory (2 hrs/Week)

Objectives: This course surveys methods for evaluating user interfaces. For projects, students will perform a heuristic evaluation, a cognitive walkthrough, a usability test and a comparison study. Certainly, a primary goal is to learn how to conduct various methods for evaluating user interfaces. However, the course also practices skills with broader application. These include:

- (i) Selecting an appropriate evaluation method and articulating its advantages and disadvantages
- (ii) Critiquing the validity of usability measures
- (iii) Understanding the role of evaluation in the design process
- (iv) Establishing useful test objectives
- (v) Preparing reports and presenting results

Learning Outcome:

After completing the module you should be able to understand the issues relating to human and computer interaction and apply them to systems design.

Specific Entry Requirements:

Pre-requisites: an understanding of basic computer audit principles, operating systems, system development life-cycle.

Key Texts

‘The Essence of Human Computer Interaction’ , C. Faulkner, Prentice Hall , 1998
‘Human Computer Interaction’ , J. Preece, Addison-Wesley

Syllabus:

1. **Introduction:** what are the goals of the study of HCI, The relationship of HCI to other fields of study, a look at the evolution of HCI, Is HCI actually Important? Less dramatic costs of poor HCI, what does HCI seek to understand, summary, tutorial exercises
2. **Human Capabilities and Limitations (The Senses):** why systems designers need to understand Human Capabilities and Limitations, the senses, vision, touch, taste and smell, summary, tutorial exercises
3. **Human Capabilities and Limitations (Mental):** mental capabilities and limitations, a simplified model of the structure of Human Memory, sensory memory, working or short term memory, long term memory, some features of memory, other characteristics of memory, implications of memory capabilities and limitations for HCI, some interface guidelines based on memory capabilities and limitations, summary, tutorial exercises

4. **Human Capabilities and limitations (Other Issues):** health and safety, some health and safety issues, ergonomics, designing for Human Diversity, General Approaches to designing with diversity, summary, tutorial exercises,
5. **Input/Output Devices:** introduction, roles of input, notes on the classification of input devices, choosing appropriate input devices –factors to consider (human, the task, environment, other constraints); roles of output, a classification of output devices – visual, auditory, touch; notes on the classification of output devices, choosing appropriate output devices- factors to consider (human, the task, environment, other constraints); summary, tutorial exercises;
6. **Interaction Styles 1:** introduction to interaction styles, principles of good interface design, interaction styles- a very brief historical perspective; command driven interfaces, menus, questions and answers dialogues, forms, summary, tutorial exercises
7. **Interaction Styles 2:** introduction to direct manipulation interfaces, the use of metaphors in direct manipulation interfaces, advantages and possible problems of direct manipulation interfaces, summary, tutorial exercises
8. **Approach to Design:** introduction, where HCI design fits in software development lifecycle, design techniques 1- guidelines and standards, design techniques 2- usability engineering, design technique 3- prototyping, summary, tutorial exercises
9. **Task Analysis:** introduction to task analysis, Norman's execution-evaluation cycle, the gulf's of execution and evaluation, hierarchical task analysis, gathering data for task analysis, using the results for task analysis, summary, tutorial exercises
10. **Evaluation:** introduction to evaluation, ways of evaluating the design prior to implementation – cognitive walkthroughs, heuristic evaluation; evaluating the implementation – experiments, observation, query based techniques; designing an evaluation strategy, summary, tutorial exercises

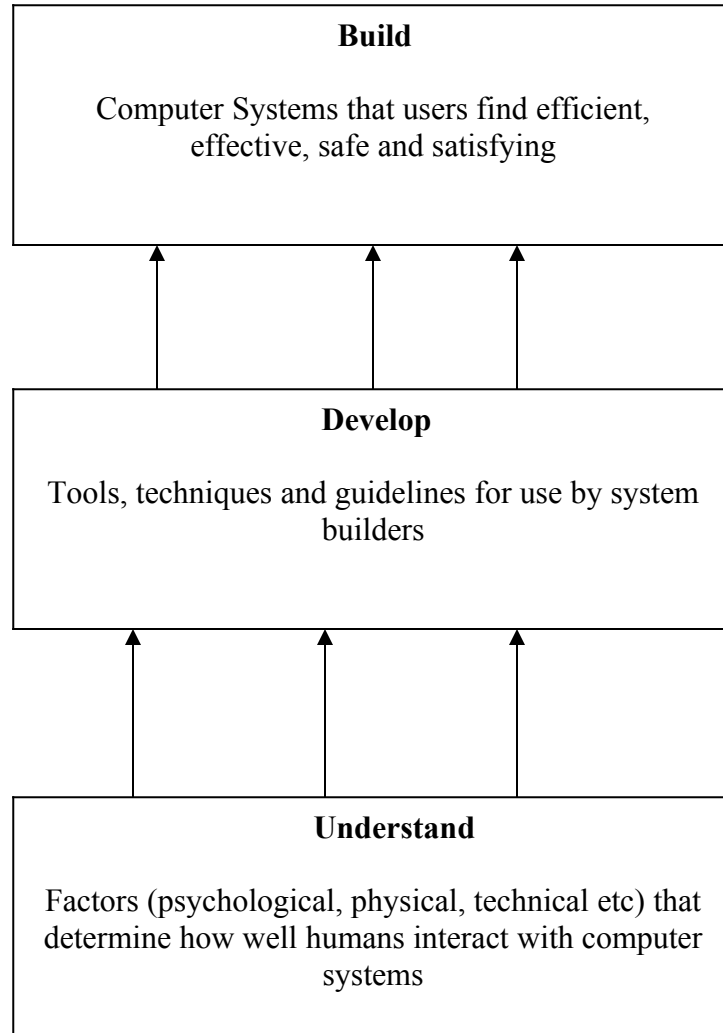
HCI- 1- INTRODUCTION

Aims and Objectives: the purpose of this lecture is to introduce the topic of Human Computer Interaction (HCI). It will identify the goals of HCI and set HCI in an historical context and discuss how it relates to other fields of study. One of the most important parts of the lecture is a description of the potential costs of not taking HCI sufficiently into account when designing systems.

Lecture Notes

What are the goals of the study of HCI (Human Computer Interaction)?

The ultimate goal of HCI is to enable people to build computer systems that users find efficient, effective, safe and satisfying to use. This, however, cannot be achieved in a vacuum, so a lower level goal is to develop tools, techniques and guidelines for use by system builders. This goal in turn relies on research that seeks to understand the various factors (psychological, physical, technical etc) that determine how well humans interact with computer systems.



The diagram shows the way in which each of the higher level goals builds on a lower one. The foundation of HCI is to have a clear understanding about the factors that influence how people interact with computerised systems.

The Relationship of HCI to Other Fields of Study

Human beings and computer systems are both hugely complex. HCI therefore draws extensively on many fields of study in seeking ways to improve their interaction. Some of the most influential fields and their main areas of input to HCI are outlined below:

Psychology has a major influence on HCI. Many HCI professionals have a background in psychology and all HCI practitioners need at least some understanding of the subject. The sub-fields of perception, cognition and the study of memory have contributed most towards building up an understanding of how people perceive and interact with computer systems.

Physiology is important in helping to understand people's physical capabilities and limitations that must be taken into account when building systems.

Sociology is becoming increasingly significant to HCI, as many computer systems are developed to aid communications and co-operation between people often working remotely.

Ergonomics (*the study of work and working conditions in order to improve people's efficiency*) pre-dates HCI and has very similar aims but applied to the design of all appliances not just computerised systems. It contributes considerable understanding about how to design physical devices that are safe and comfortable to use.

Graphic design clearly has a lot to contribute in the design of high quality graphical elements (both two and three-dimensional) that are pleasing and meaningful for people to use.

Engineering and **Computer Science** contribute in two main ways. Firstly, to the development of faster and more powerful computing devices. Secondly, to the development of software engineering as a discipline in its own right whose aim is the production of high quality software systems.

So it can be truly said that HCI is multi-disciplinary subject in that it draws on tools, techniques and understanding from many other areas of study. It is not necessary to be an expert in any of these other fields in order to build computer systems with good HCI, however, it is important to appreciate the influence they have.

Quick Quiz Question 1

The top level goal of HCI is to enable people to build systems that have certain qualities from a user's point of view. What are those qualities?
Efficiency, effectiveness, safety, satisfaction

A Brief Look at the Evolution of Human Computer Interaction

Computer systems have changed dramatically over the last 50 years. This section very briefly traces that development in terms of the types of computer system users and the predominant I/O devices in use.

1960s + 70s –The Age of the Mainframes

Direct users of computers were trained specialists such as computer operators, programmers and data input clerks. Other users interacted indirectly with the system e.g. through receiving printed reports.

Predominant I/O devices were punched cards, paper tape, line printer output, teletype consoles for operators

Late 70s + early 80s- Mini Computers

Users were similar to the group described above plus other trained technical users

The range of I/O devices in widespread use enlarged to include character based terminals, keyboards, line printers, daisy wheel, and dot matrix printers.

Late 80s to 90s – PCs

The range of users widened to include many people with little or no computer training. Home computers became common for leisure and educational use.

Widespread I/O devices included mice, high-resolution graphics, multimedia devices and laser printers.

The present and the future – Mobile Computing Age

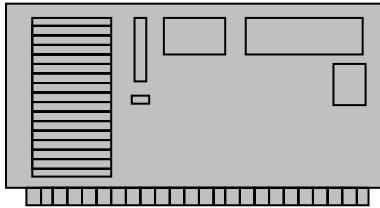
The range of users continues to enlarge to include almost everyone in highly industrialised countries such as the US. One of the main driving forces is the desire and need to use the Internet for work, leisure and everyday activities such as banking and shopping

The trend towards mobile computing devices is creating pressure to develop ever smaller and easier to use I/O devices such as hand-held scanners, folding keyboards and mini display devices. Additionally voice recognition has now developed to the degree where voice input and control is feasible.

The changes in computer users and technical advances have been accompanied by a shift in focus in computer system development. The shift is from **functionality** being the key, and sometimes only, concern towards **usability** being seen to be of equal importance.

focus on

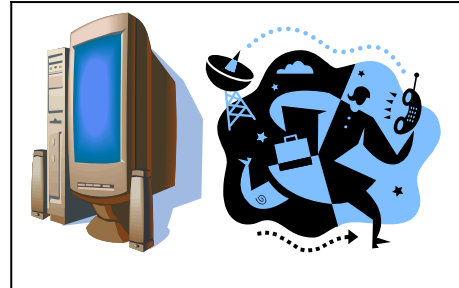
- Technology
- functionality



mainframe

focus includes

- User
- usability



Past

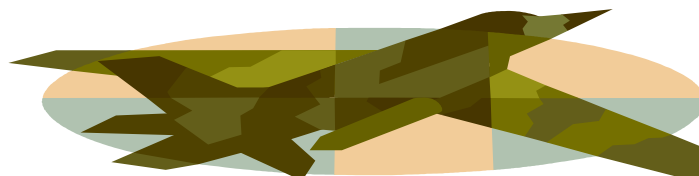
Present/future

The philosophy of designing for usability is that: *the system should be made to fit the user rather than the user be made to fit the system.*

Quick Quiz Question 2

- Ergonomics is one field of study that HCI draws on. What is the major difference between HCI and ergonomics?
- Name three other fields that HCI draws on.

Is HCI actually Important?



Sometimes taking the trouble to design systems that embody good HCI principles can seem like a luxury. Of course it's nice if the users of a system find it pleasant and satisfying to use but does it really matter? Unfortunately this attitude is sometimes adopted by managers and software developers under pressure to develop a system within the constraints of a tight timescale and budget.

The truth is that HCI is very important; it can even be a matter of life and death. For example accidents (e.g. air crashes) are often blamed on 'human error'. But human beings are by their nature prone to make mistakes, and the more overloaded they are (e.g. trying to take in too much rapidly changing information) the more likely they are to make errors. Computerised systems that are not designed to make human capabilities and

limitations into account are liable to provoke their users into making mistakes, sometimes with tragic consequences. The following case illustrates this point.

In 1988 Iran Air 655, an unarmed civilian airliner with 290 passengers, was shot down by mistake by the US Navy who thought it was a fighter plane. There were no survivors. The US Navy investigator largely blamed the computer system (Aegis) on the ship for the error. Aegis was displaying the correct information but was misinterpreted by the ship's crew...

“...the commanding officer should have some way of separating crucial information from other data. The vital data should be displayed in some fashion so that the CO and his main assistants do not have to shift their attention back and forth between displays.”

Other air disasters and incidents have been blamed on poor HCI.

Less Dramatic Costs of Poor HCI

It would be silly to suggest that all systems with poorly designed interfaces are likely to result in tragedy and death; however, there are many less dramatic costs that may be caused by such systems. Some of these potential costs are outlined below:

System Rejection by Potential Customers or Users

Many reviews of new software packages and computing devices (e.g. Personal Digital Assistants) concentrate on the package or device's usability. Bad reviews are likely to reduce sales. Of course the situation is somewhat different when considering systems that are being developed in-house by an organisation for use by its' own employees. In this case users may be obliged to use the system whether they like it or not. Even so people often find ways of avoiding using systems that they find difficult or unpleasant.

System may be very difficult / Impossible for some potential customers or users

By not taking account of the differences between people, systems may be created that are very difficult or possibly impossible for some people to use. For example, a system that relies heavily on the **use of colour** to convey crucial information may be very hard for people suffering from colour blindness to use or the **use of sound** by people with hearing impairment.

High Error Rates

When people are pushed to work at the edge of their capabilities (e.g. having their memory over stretched) they are likely to make more errors. For example the wrong goods may be dispatched in response to an order, a student's exam results may be recorded wrongly, a patient's appointment may be made for the wrong date. Most errors are not life threatening but they always have an associated cost e.g. the cost of time and effort to correct them, loss of consumer confidence, distress to the public etc.

Tasks taking longer to complete than they need to

When a system is badly designed from an HCI point of view, users often feel that they are fighting against it rather than working with it to accomplish their task. This results in inefficient use of time with tasks taking longer to achieve than they would with a well-designed systems.

User health and Safety Issues – e.g. RSI, headaches etc

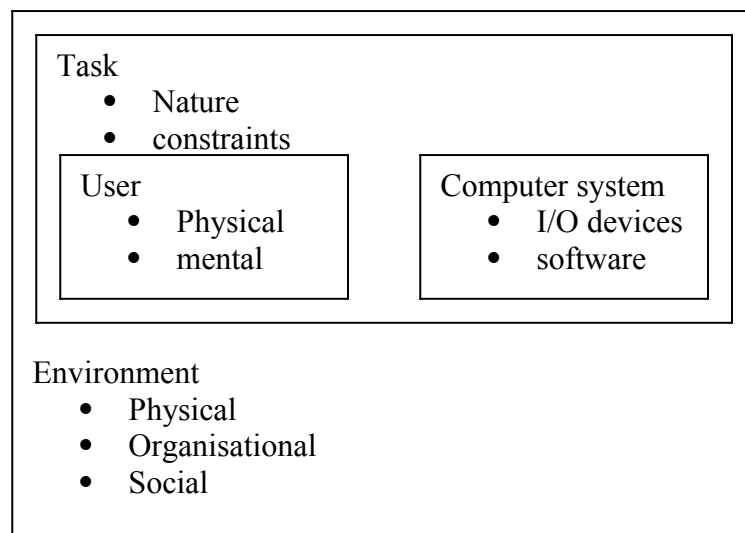
Poor designed systems can adversely affect the health of their users. For instance, poorly designed keyboards can increase the possibility of the user developing RSI (Repetitive Strain Injury). Equally, poorly designed display devices can lead to headaches.

User Dissatisfaction

If employees are forced to use a system that they don't like then this may contribute to absenteeism and possibly to high staff turnover.

What Does HCI seek to Understand?

Our start point for studying HCI is the lowest level of the three goals described at the beginning of this lecture. That is to understand factors (psychological, physical, technical etc) that determine how well humans interact with computer systems. The diagram below illustrates the four interacting elements that HCI seeks to understand. It shows the **user** interacting with some **computer system** to accomplish a **task** within an **environment**.



Of these elements we will focus on understanding:

The user: their physical and mental capabilities and limitations and how these affect the design of systems.

The computer system: the range and nature of available I/O devices and the various interface styles that can be presented by software systems.

Quick Quiz Question 3

Describe four possible costs of poor HCI

Summary

This lecture has provided a brief introduction to HCI. Having completed it you should:

- Be able to describe the main aims of HCI
- Be able to discuss the multi-disciplinary nature of HCI
- Appreciate how computer systems have evolved over the past four decades
- Be able to discuss the possible costs of systems designed without attention being paid to the HCI.

Tutorial Exercises

1. Think about some software that you use or have used in the part that you find unpleasant to use. Try to analyse exactly what you didn't like about it. Ask one or more other people the same question. Do any common themes come up?
2. It should be clear that HCI needs to be taken into account when designing web sites.
 - a) with reference to the costs of poor HCI design that were identified in the lecture, identify in as much detail as you can, the possible costs of not taking HCI into account when designing a web site.
 - b) Do you think that usability is more or less important for web sites as compared to traditional software systems and packages? Justify your answer.
3. Find a review (either on the web or in a magazine) of one of more Personal Digital Assistants (PDAs) e.g. Psion Series 7, 3com's Palm 5, Compaq's Aero. Which, if any, aspects of the system's usability does the review discuss

