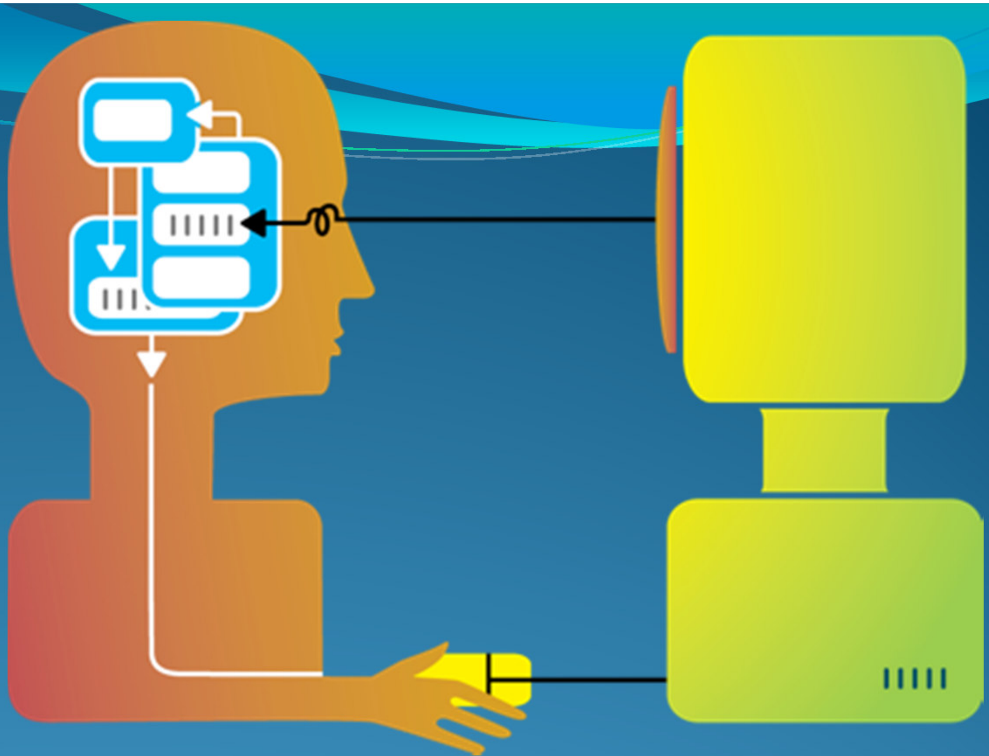


Human Computer Interaction(HCI)

Second Stage

Lecture 1: Introduction

by

Hazim N. Abed

Introduction

- Human-computer interaction (HCI) is the study of how people design, implement, and use interactive computer systems and how computers affect individuals, organizations, and society. This encompasses not only ease of use but also new interaction techniques for supporting user tasks, providing better access to information, and creating more powerful forms of communication.

Introduction

It involves

- input and output devices and the interaction techniques that use them;
- How information is presented and requested;
- How the computer's actions are controlled and monitored;
- All forms of help, documentation, and training;
- The tools used to design, build, test, and evaluate user interfaces;
- The processes that developers follow when creating Interfaces.

Introduction

- HCI in the large is an interdisciplinary area. It is emerging as a specialty concern within several disciplines, each with different emphases: computer science (application design and engineering of human interfaces), psychology (the application of theories of cognitive processes and the empirical analysis of user behavior), sociology and anthropology (interactions between technology, work, and organization), and industrial design (interactive products).

HCI Definition

The most famous definition of "Human Computer Interaction" is

- **"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."**

HCI Definition

Computer

A computer system comprises various elements, each of which affects the user of the system.

1. Input devices for interactive use, allowing text entry, drawing and selection from the screen:

- **Text entry**: traditional keyboard, phone text entry, speech and handwriting
- **Pointing**: principally the mouse, but also touch pad, stylus, and others
- **3D interaction devices**

HCI Definition

2. Output display devices for interactive use:

- Different types of screen mostly using some form of bitmap display
- Large displays and situated displays for shared and public use
- Digital paper may be usable in the near future

3. Memory:

- Short-term memory: RAM
- Long-term memory: magnetic and optical disks
- Capacity limitations related to document and video storage
- Access methods as they limit or help the user

HCI Definition

4. Processing:

- The effects when systems run too slow or too fast, the myth of the infinitely fast machine
- Limitations on processing speed
- Networks and their impact on system performance

- Computers may be in the form of embedded computational machines, such as parts of spacecraft cockpits or microwave ovens. Because the techniques for designing these interfaces bear so much relationship to the techniques for designing workstations interfaces, they can be profitably treated together

HCI Definition

Human

Humans are limited in their capacity to process information. This has important implications for design.

Information is received and responses given via a number of input and output channels:

- Visual channel
- Auditory channel
- Haptic channel
- Movement

HCI Definition

Information is stored in memory:

- Sensory memory
- Short-term (working) memory
- Long-term memory

Information is processed and applied:

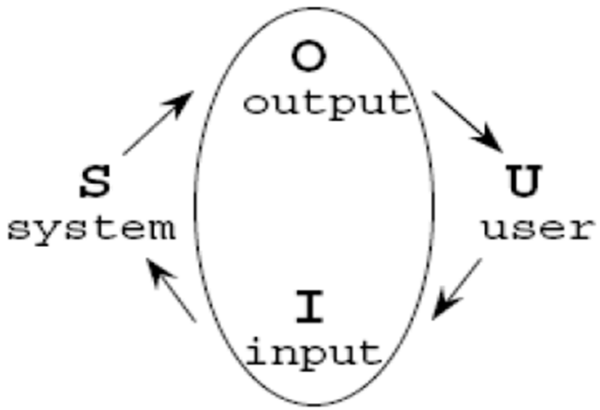
- Reasoning
- Problem solving
- Skill acquisition
- Error

HCI Definition

Interaction

The communication between the user and the system. Their interaction framework has four parts:

- User
- Input
- System
- Output



HCI Definition

Human-computer interaction is concerned with the joint performance of tasks by humans and machines;

- The structure of communication between human and machine
- Human capabilities to use machines (including the learnability of interfaces)
- Algorithms and programming of the interface itself
- Engineering concerns that arise in designing and building interfaces
- The process of specification, design, and implementation of interfaces
- Design trade-offs.
- Human-computer interaction thus has science
- Engineering
- Design aspects

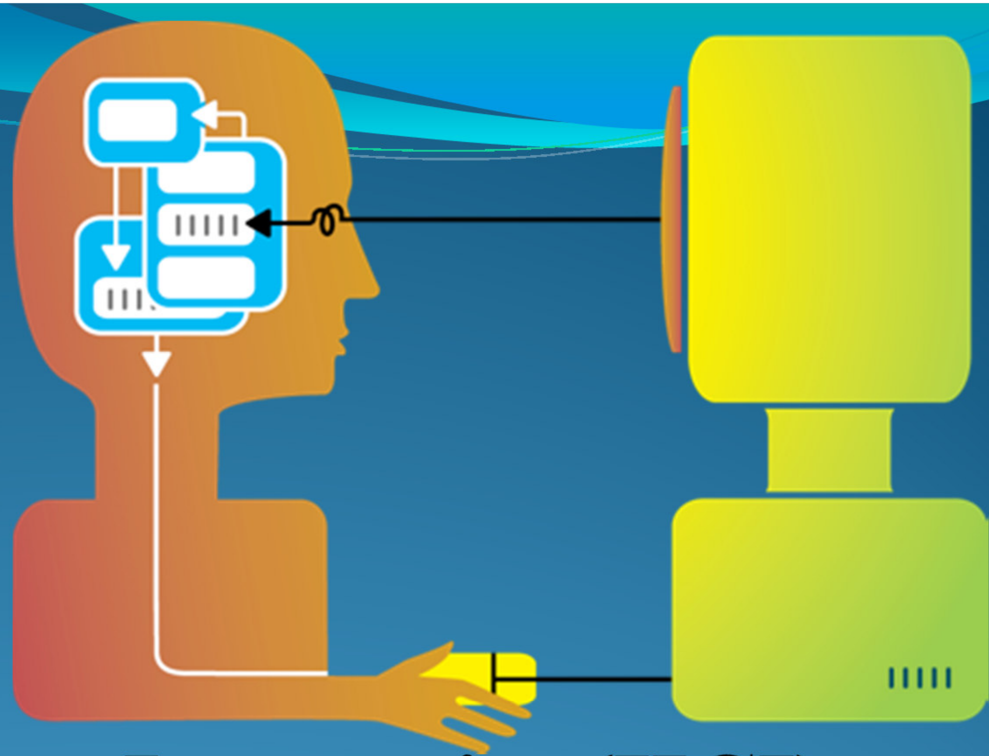
Goals of HCI

Goals

The goals of HCI are to produce usable and safe system, as well as functional systems. In order to produce computer system with good usability, developer must attempt to:

- Understand the factors that determines how people use technology
- Develop tools and technique to enable building suitable system
- Achieve efficient, effective and safe interaction
- Put people first

The End



Human Computer Interaction(HCI)

2nd Stage

Lecture 2:Human perception and information processing

by

Hazim N. Abed

Human perception

- We know that humans perceive data, but we are not as sure of how we perceive. We know that visualizations present data that is then perceived, but:
    - How are these visualizations perceived?
    - How do we know that our visual representations are not interpreted differently by different viewers?
    - How can we be sure that the data we present is understood?
- We study perception to better control the presentation of data, and eventually to harness human perception.

Human perception

- There are many definitions and theories of perception. Most define perception:

"as the process of recognizing (being aware of), organizing (gathering and storing), and interpreting (binding to knowledge) sensory information".

- Perception deals with the human senses that generate signals from the environment through sight, hearing, touch, smell and taste.

Human perception

- Vision and audition are the most well understood. Simply put, perception is the process by which we interpret the world around us, forming a mental representation of the environment.

- This representation is not isomorphic to the world, but it's subject to many correspondence differences and errors. The brain makes assumptions about the world to overcome the inherent ambiguity in all sensory data, and in response to the task at hand.

Human perception

- Visual representations of objects are often misinterpreted, either because they do not match our perceptual system, or they were intended to be misinterpreted. Illusions are a primary source of such misinterpretations.

- Figures 2.1 and 2.2 highlight our inability to notice visual problems except on more detailed perusal. The drawings are those of physically non realizable objects.

Human perception

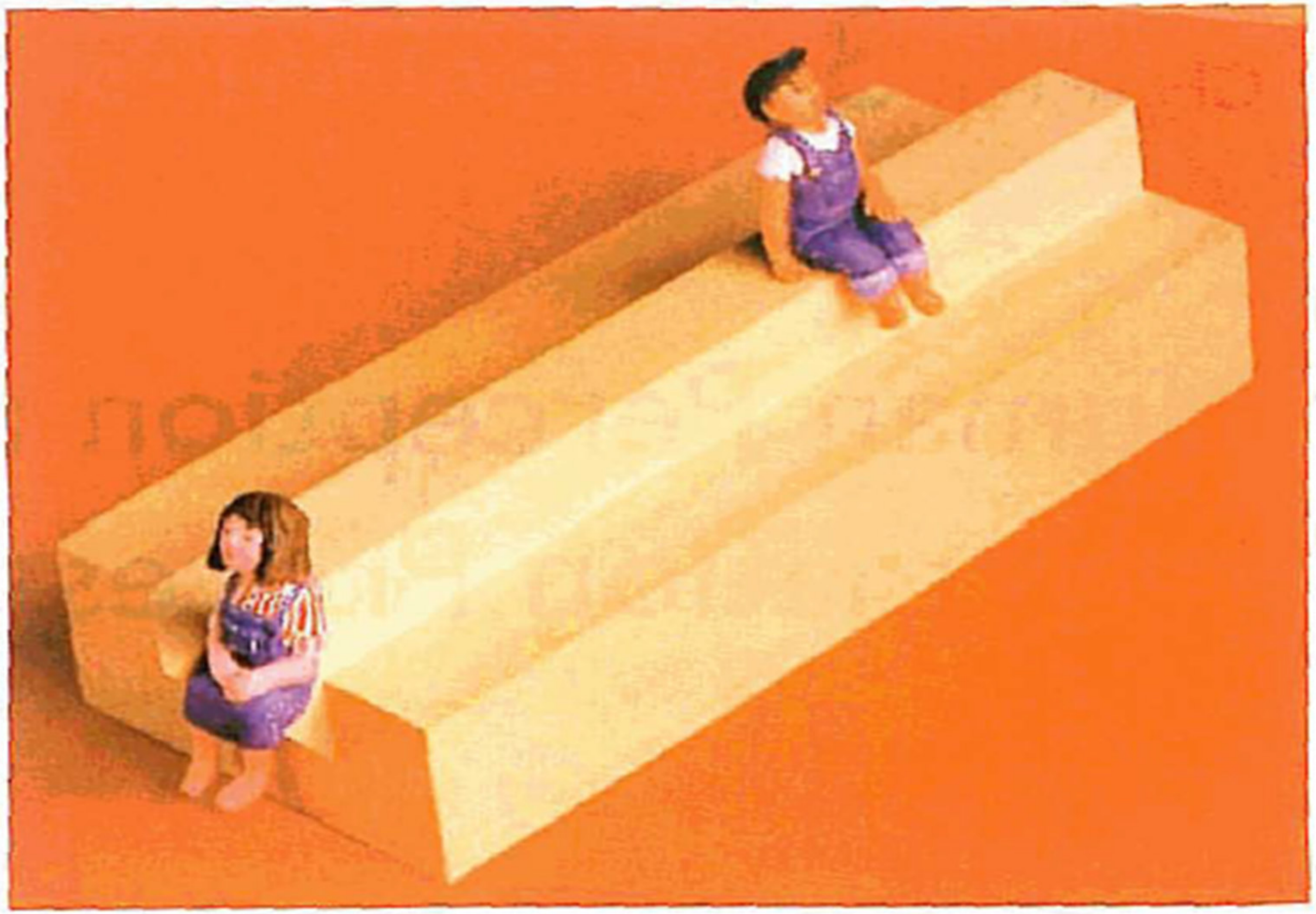


Figure 2.1: Two seated figures, making sense at a higher, more abstract level, but still disturbing .On closer inspection, these seats are not realizable.

Human perception

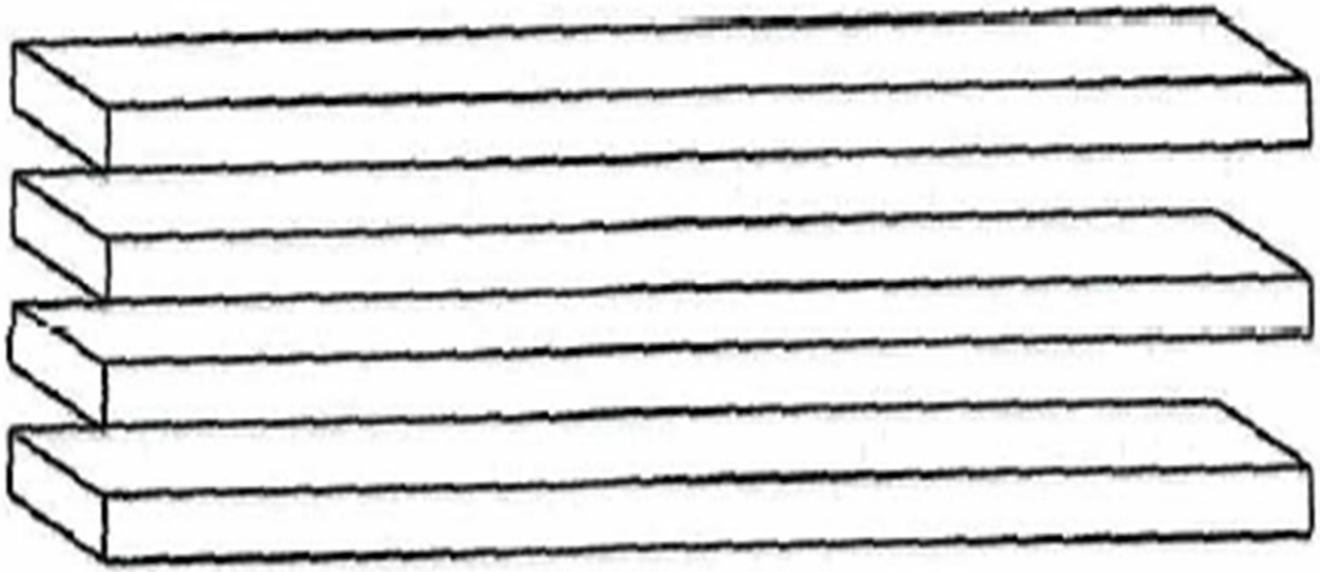


Figure 2.2: Four # three. As in Figure 2.1, this object would have a problem being built (there are four boards on the left and three on the right).

Human perception

- Sometimes the ambiguity presented is easily seen, but more difficult to explain. Sometimes it is not even perceived.

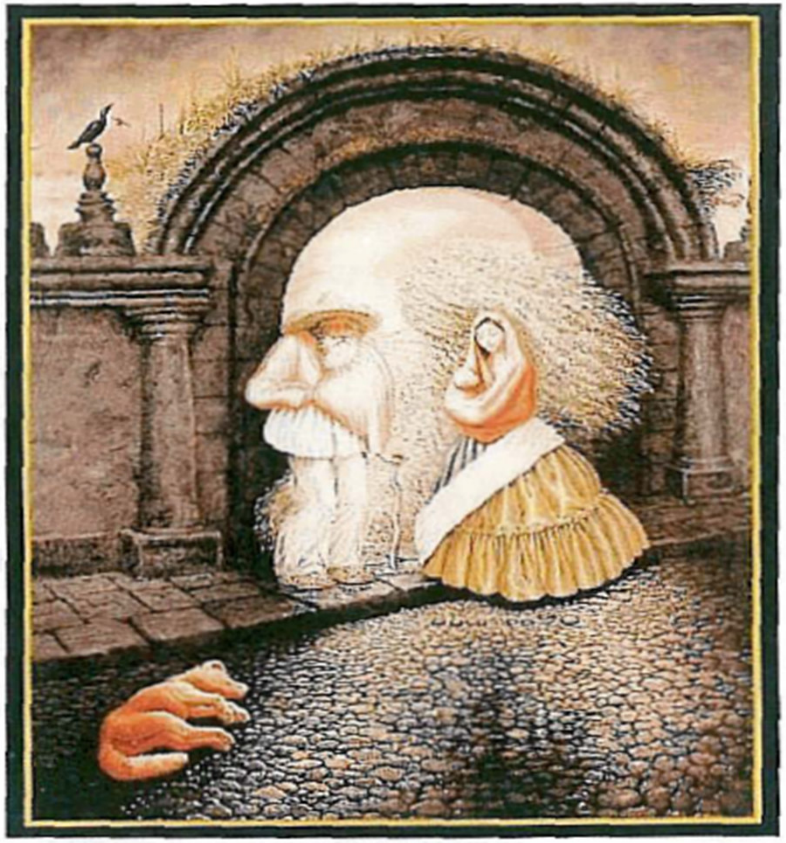


Figure 2.3: A more complex illusion: there are two people drawn as part of the face.

Human perception

- Figure 2.3 highlights that on first glance an image may represent a primary object, one that is perceived more obviously than the secondary others that may require more effort or time. There are many such illusions, and these are easy to construct. In effect, the artist puts together a primary image out of secondary images. There may even be tertiary ones. Tools have been developed to support such imagery.

Human perception

- For example, Rob Silvers uses a computational technique to form an image composed of a mosaic of smaller given images (see Figure 2.4 and Figure 2.5, which contains a detailed view).

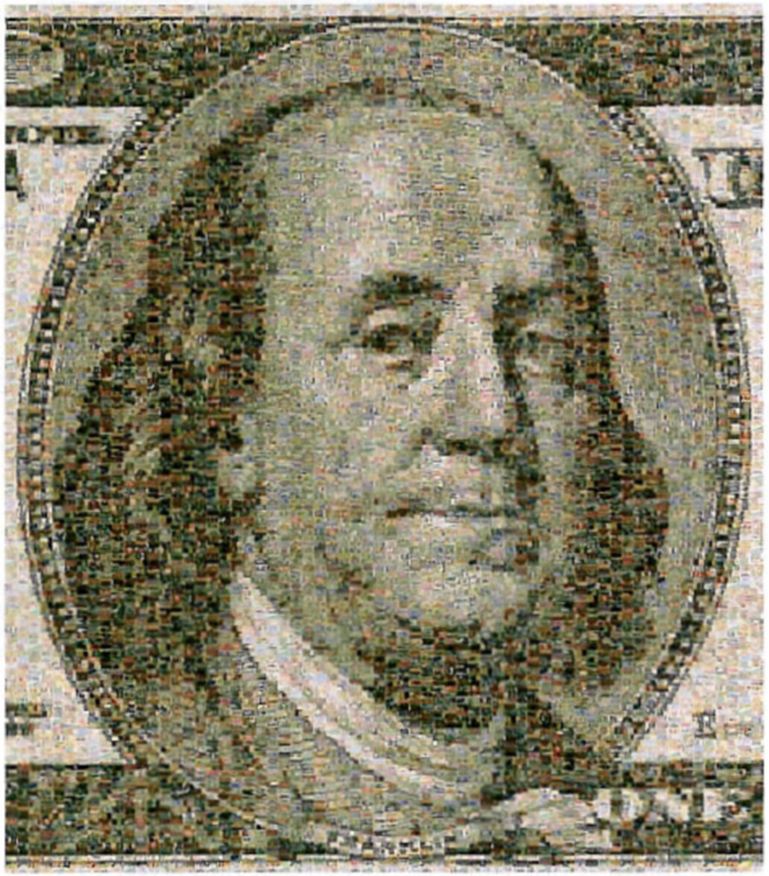


Figure 2.4: Photomosaic of Benjamin Franklin using images of international paper money or bank notes. (Photomosaic@ by Robert Silvers, http://www.photomosaic.com.).

Human perception

Figure 2.5: Close-up view of the eye in Figure 3.4. (Photomosaic@ by Robert Silvers, http //: www.photomosaic.com.)

Human perception

- Our visual machinery also performs similar computations, but perhaps not as we would expect. Figure 2.6 highlight that our vision system is, foremost, not static, and secondly, often not under our full control. It is clear that there appear to be black squares being generated between the white spaces in Figure 2.6(a) and black circles in Figure 2.6(b).

Human perception

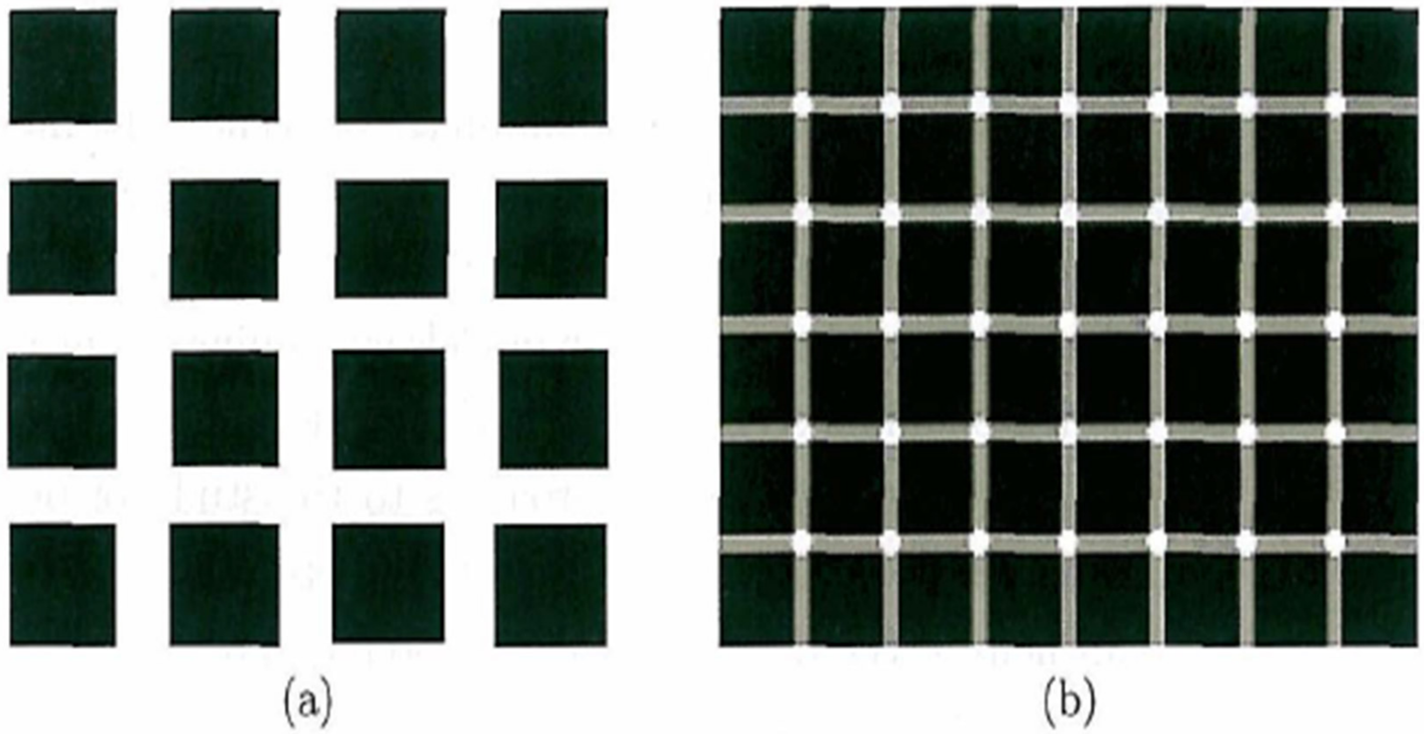


Figure 2.6: The Hermann grid illusion: (a) illusionary black squares appear over the complete image as you gaze at it; (b) similar to (a) but even more dynamic and engaging.

Human perception

- Why? If we forcibly stare at an intersection of the spaces between the black squares, we can actually stop the "spots" from appearing. This is akin to our stopping breathing. When we visualize data, we need to make sure that no such interferences are present that would impede the understanding of what we are trying to convey in the visualizations.

Human perception

- Similarly, Figure 2.7(a) and (b) highlight that there is more to our visual system than meets the eye (pun intended). In both of these images, we seem to have machinery forcing the interpretation of the objects we see in a specific manner. **The study of perception is to identify not just this machinery, but the whole process of perception, from sensation to knowledge**.

Human perception

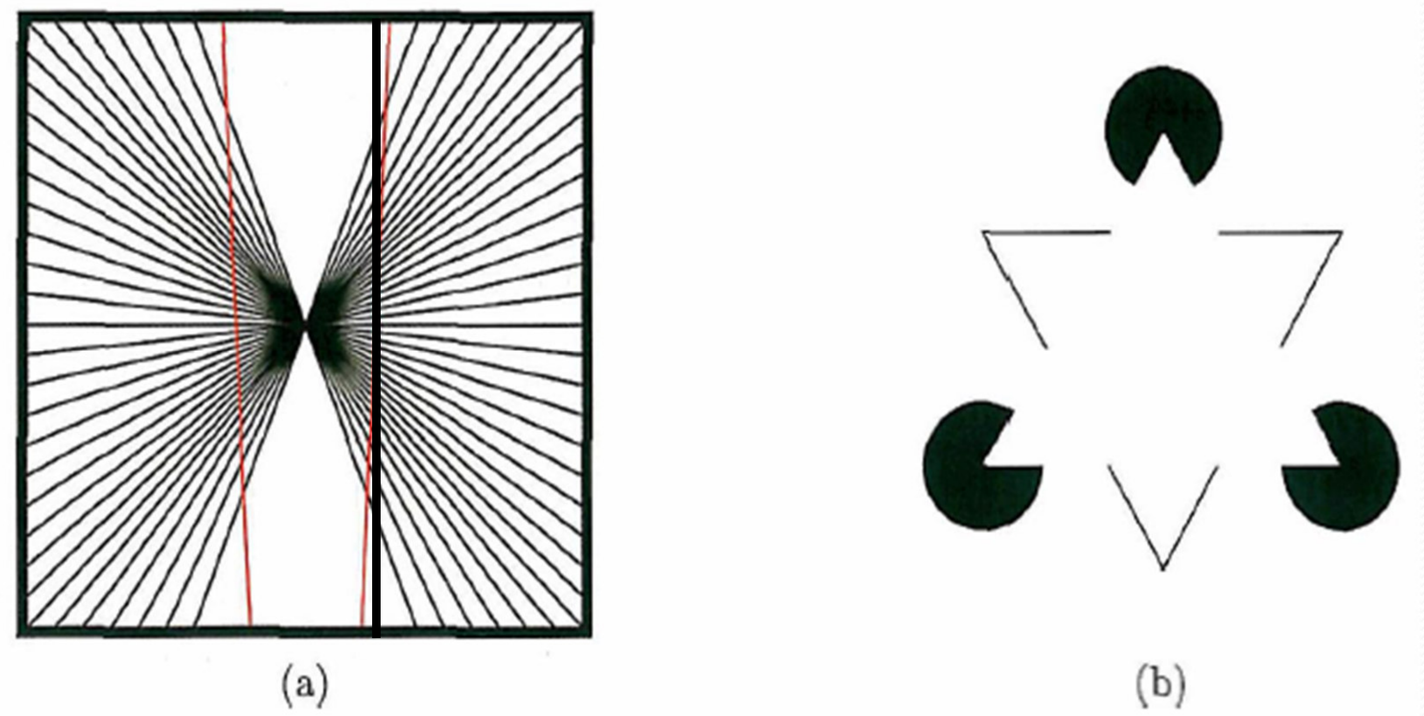


Figure 2.7: (a) The Hering illusion: red lines are straight. (Use a straight edge to verify).

(b) The Kanizsa illusion: a triangle seems to pop out of the image even though no such triangle is drawn.

Human perception

- What is causing the lines not to appear perfectly straight, or the triangle to stand out? More generally can we explain the causes of these and other illusions we see? These are the important questions we need to answer in order to be able to generate synthetic images that will represent data unambiguously and not pop out an artifact.

Human perception

- These illusions are due to our perceptual system's structure, and the assumptions it makes about an image or scene. The interpretations are due to a variety of reasons and are the result of how the process works. To understand this process and identify its structure, we first need to measure what we see and then develop models explaining the measured results. These models should also help explain the illusions.

Human perception

- There are two main approaches to the study of perception. One deals with measures, and the other with models. Both are linked.

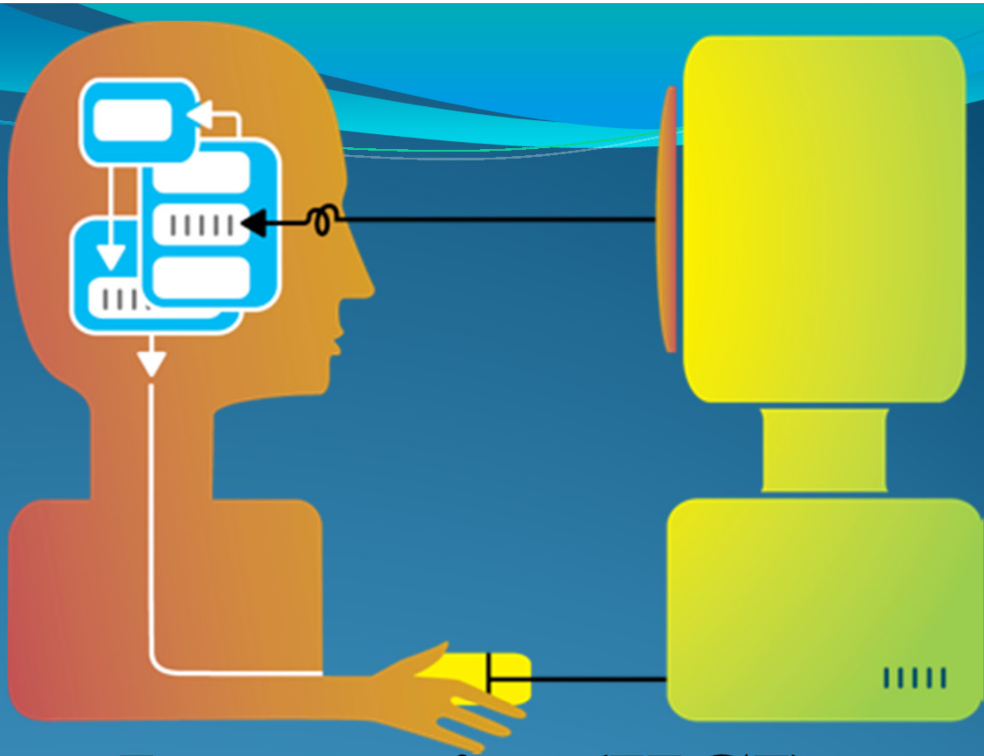
- Measurements can help in the development of a model, and in turn, a model should help predict future outcomes, which call then be measured to validate the model.

Human perception

- We can measure low-level sensory perception (which line is longer) or higher level perception (can you recognize the bird in this scene?).

- Each requires a different set of tools and approaches. This approach, however, still does not explain why we see these differences, or why we recognize objects. That requires a model of the process.

The End



Human Computer Interaction(HCI)

2nd Stage

Lecture 3:Human perception and information processing

by

Hazim N. Abed

Human Information Processing

Cognition

- Cognition is the processing of information from the world around us. It includes perception, attention, pattern matching, memory, language processing, decision making, and problem solving. Cognitive load is the amount of mental resources needed to perform a given task.

Human Information Processing

- All user interfaces make cognitive demands on users. Users must master special rules of system use, learn new concepts, and retain information in short-term memory. They must create and refine a mental model of how the system works and how they should use it. Systems that use purely auditory interfaces further challenge human memory and attention because they present information serially and non-persistently.

Human Information Processing

- Successful user interface designs must respect the limitations of human cognitive processing. If a design requires the user to hold too many items in short-term memory or to learn a complex set of commands too quickly, it will fail.

- There are three cognitive challenges you should consider as your design progresses:

- **Conceptual complexity**: How complex are the new concepts callers must learn? How well do new mental structures match concepts and procedures that users are already familiar with?

Human Information Processing

- **Memory load**: How much information must callers hold in their short-term memory? How much new material (e.g., commands, procedures) must they learn?

- **Attention**: Is it easy for the caller to attend to the most salient information? Will callers' attention be divided? If they are momentarily distracted (e.g., while driving), can they seamlessly continue their interaction with the system when they are ready?

Human Information Processing

Cognitive Frameworks

- Cognition is the process by which we gain knowledge. The processes, which contribute to cognition, include:
  - Understanding
  - Remembering
  - Reasoning
  - Attending
  - Being aware
  - Acquiring skills
  - Creating new ideas

Human Information Processing

- A key aim of HCI is to understand how humans interact with computers, and to represent how knowledge is passed between the two.

- The basis for this aspect of HCI is the science of cognitive psychology. The results of work of cognitive psychologists provide many lessons, which can be applied in the design of computer interfaces. These results are expressed in the form of cognitive frameworks.

Human Information Processing

- HCI is fundamentally an information-processing task. The human information processing approach is based on the idea that human performance, from displayed information to a response, is a function of several processing stages. The nature of these stages, how they are arranged, and the factors that influence how quickly and accurately a particular stage operates, can be discovered through appropriate research methods.

Human Information Processing

- Human information processing analyses are used in HCI in several ways.
  - Basic facts and theories about information-processing capabilities are taken into consideration when designing interfaces and tasks
  - Information-processing methods are used in HCI to conduct empirical studies evaluating the cognitive requirements of various tasks in which a human uses a computer
  - Computational models developed in HCI are intended to characterize the information processing of a user interacting with a computer, and to predict, or model, human performance with alternative interfaces.

The Multi-Store Model of Memory

- A model of memory formed of three ' buffers', which will store memories and control processes, which move information between the buffers. The three stores identified are:

  - Sensory information store
  - Short-term memory (more recently known as working memory)
  - Long-term memory

Human Information Processing

The Model Human Information Processor

- An important concept from cognitive psychology is the model human processor (MHIP). This describes the cognitive process that people go through between perception and action. It is important to the study of HCI because cognitive processing can have a significant effect on performance, including task completion time, number of errors, and ease of use. This model was based on the human information-processing model.
- The model human processor consists of three interacting systems. Each has its own memory and processor.

Human Information Processing

Perceptual processor

- Outputs into audio storage
- Outputs into visual storage

Cognitive processor

- Outputs into working memory.
- Has access to:
  - Working memory
  - Long term memory

Motor processor

- Carries out actions

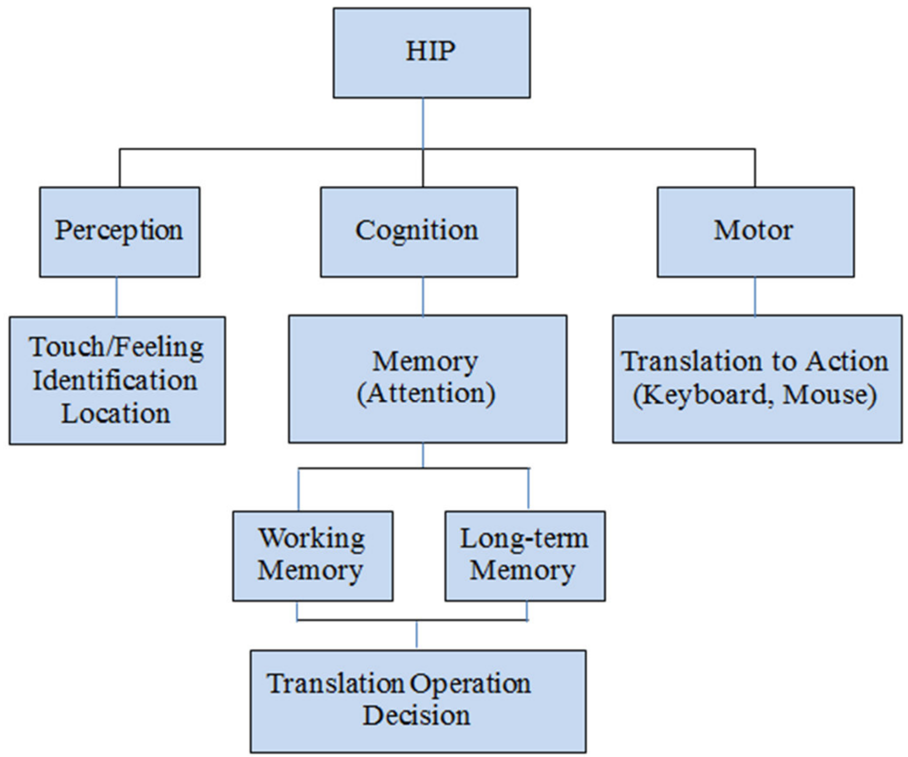


Figure 3.1: Human Information Process

Human Information Processing

Distributed Cognition

Distributed cognition is a framework proposed by Hutchins (1991). Its basis is that to explain human behavior you have to look beyond the individual human and the individual task. The functional system is a collection of actors, technology, setting and the interrelations to one another. Examples of functional systems, which have been studied include:

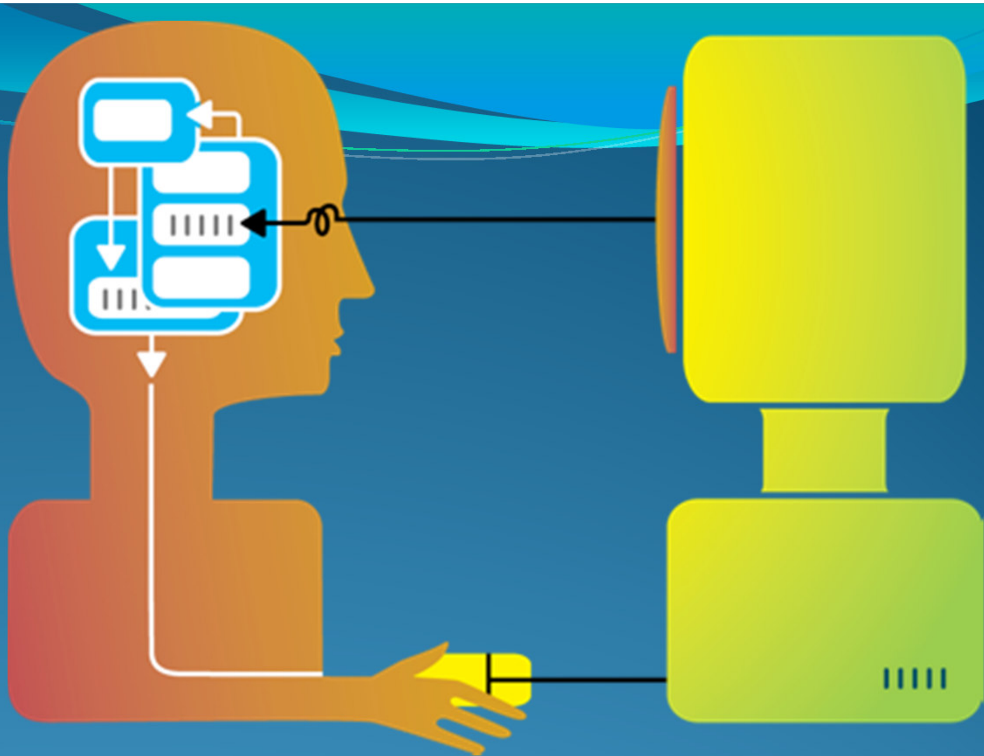
- Ship Navigation
- Air Traffic Control
- Computer Programming Teams

Human Information Processing

- The technique is used to analyze coordination of components in the functional system. It looks at

  - Information and how it propagates through the system
  - How it transforms between the different representational states found in the functional system

The End



Human Computer Interaction(HCI)

2nd Stage

Lecture 4: Interaction Design Basics

by

Hazim N. Abed

Interaction Design Basics (Overview)

- Interaction design is about creating interventions in often complex situations using technology of many kinds including PC software, the web and physical devices
- **Design involves:**
  - Achieving goals within constraints and trade-off between these
  - Understanding the raw materials: computer and human
  - Accepting limitations of humans and of design
- **The design process has several stages and is iterative and never complete**

Interaction Design Basics (Overview)

- **Interaction starts with getting to know the users and their context:**
  - Finding out who they are and what they are like … probably not like you!
  - Talking to them, watching them

- **Scenarios are rich design stories, which can be used and reused throughout design**
  - They help us see what users will want to do
  - They give a step-by-step walkthrough of users' interactions: including what they see, do and are thinking

Interaction Design Basics (Overview)

- **Users need to find their way around a system; this involves**
  - Helping users know where they are, where they have been and what they can do next
  - Creating overall structures that are easy to understand and fit the users' needs
  - Designing comprehensible screens and control panels

Interaction Design Basics (Overview)

- **Complexity of design means we don’t get it right first time:**
  - So we need iteration and prototypes to try out and evaluate
  - But iteration can get trapped in local maxima, designs that have no simple improvements, but are not good
  - Theory and models can help give good start points

Interaction Design Basics (Introduction)

- Some of HCI is focused on understanding: the academic study of the way people interact with technology. However, a large part of HCI is about doing things and making things – design.

- In this lecturers we will think about interaction design. Note that we are not just thinking about the design of interactive systems, but about the interaction itself.

Interaction Design Basics (Introduction)

- So, interaction design is not just about the artefact that is produced, whether a physical device or a computer program, but about understanding and choosing how that is going to affect the way people work.

- Furthermore, the artefacts we give to people are not just these devices and programs, but also manuals, tutorials, on-line help systems. In some cases we may realize that no additional system is required at all; we may simply suggest a different way of using existing tools.

Interaction Design Basics (Introduction)

- Because of this it may be better not to think of designing a system, or an artefact, but to think instead about designing interventions. The product of a design exercise is that we intervene to change the situation as it is; we hope, of course, changing it for the better!.

What is design?

So what is design? A simple definition is:

"Achieving goals within constraints"

- This does not capture everything about design, but helps to focus us on certain things:

Interaction Design Basics

- **Goals** – What is the purpose of the design we are intending to produce? Who is it for? Why do they want it? .

- **For example,** if we are designing a wireless personal movie player, we may think about young affluent users wanting to watch the latest movies whilst on the move and download free copies, and perhaps wanting to share this with a few friends.

Interaction Design Basics

Constraints:

- What materials must we use?
- What standards must we adopt?
- How much can it cost?
- How much time do we have to develop it?
- Are there health and safety issues?
- In the case of the personal movie player: does it have to withstand rain? Must we use existing video standards to download movies? Do we need to build in copyright protection?

Interaction Design Basics

- Therefor cannot always achieve all our goals within the constraints. So perhaps one of the most important thing about design is:

- **Trade-off:** Choosing which goals or constraints can be relaxed so that others can be met. "Is a situation that involves losing one quality or aspect of something in return for gaining another quality or aspect".

- **For example**: When copying music from compact disks to a computer, lossy compression formats, such as MP3, are used routinely to save harddisk space, but information is thrown away to the detriment of sound quality

Interaction Design Basics

- Often the most exciting moments in design are when you get a radically different idea that allows you to satisfy several apparently contradictory constraints.

- However, the more common skill needed in design is to accept the conflict and choose the most appropriate trade-off

Interaction Design Basics

- Instead, the best designs are where the designer understands the trade-offs and the factors affecting them. Paradoxically, if you focus on the trade-off itself the more radical solutions also become more apparent.

The golden rule of design

- Part of the understanding we need is about the circumstances and context of the particular design problem. There are also more generic concepts to understand. The designs we produce may be different, but often the raw materials are the same. This leads us to the ***golden rule of design***:

Interaction Design Basics

- The designs we produce may be different, but often the raw materials are the same. This leads us to the *golden rule of design*:

Understand your materials

- For Human–Computer Interaction the obvious materials are the human and the computer. That is we must:

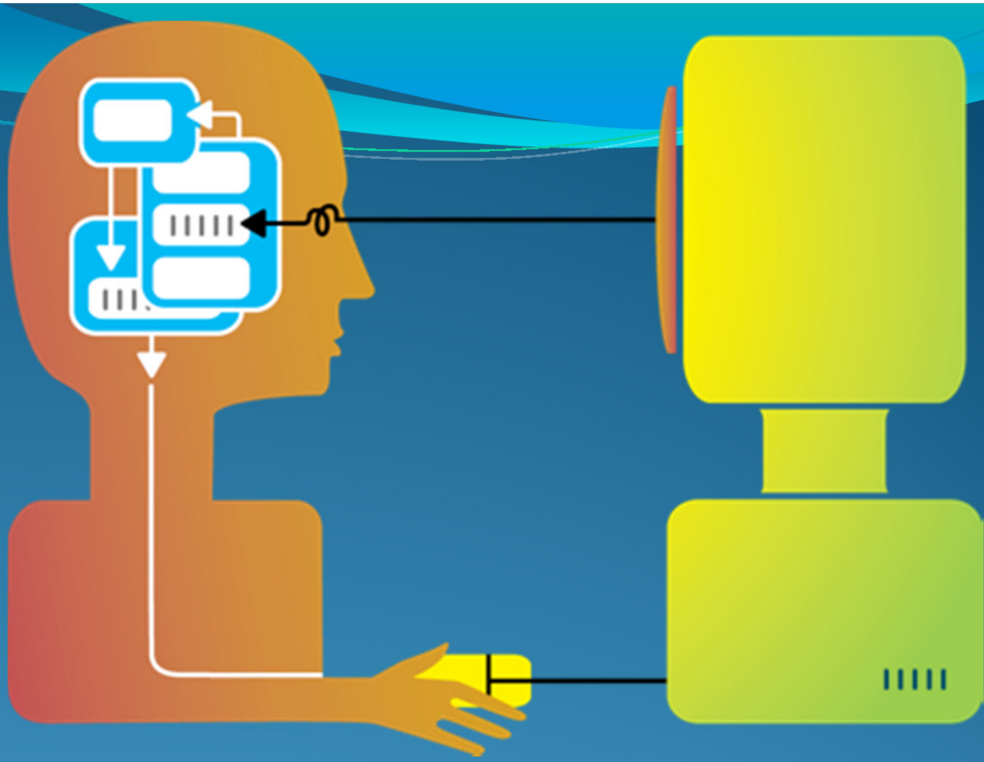
1. Understand computers

  - limitations, capacities, tools, platforms

2. Understand people

  - psychological, social aspects, human error

The End



Human Computer Interaction(HCI)

2nd Stage

Lecture 5: Interaction Design Basics

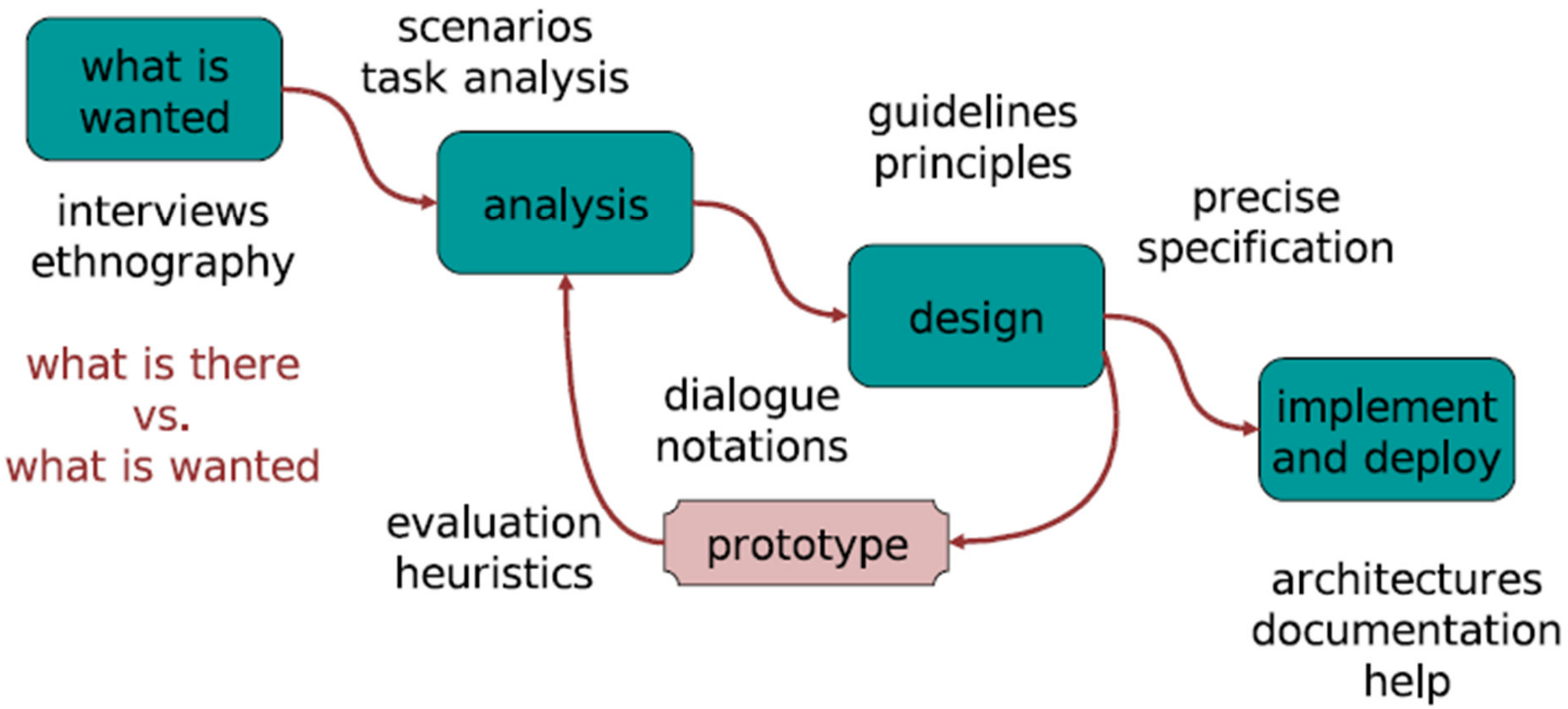
by

Hazim N. Abed

Process of Design

Interaction Design Basics (the Process of Design)

- **Figure 5.1 show the process of design**



Interaction Design Basics (the Process of Design)

1. **Requirements – What is wanted**

- The first stage is establishing what exactly is needed. As a precursor to this it is usually necessary to find out what is currently happening. For example, how do people currently watch movies? What sort of personal appliances do they currently use?

“What is there and what is wanted”

- There are a number of techniques used for this in HCI: interviewing people, videotaping them, looking at the documents and objects that they work with, observing them directly

Interaction Design Basics (the Process of Design)

2. **Analysis**

- The results of observation and interview need to be ordered in some way to bring out key issues and communicate with later stages of design.

"Ordering and understanding"

3. **Design**

"What to do and how to decide"

4. **Iteration and Prototyping**

- Humans are complex and we cannot expect to get designs right first time. We therefore need to evaluate a design to see how well it is working and where there can be improvements.

Interaction Design Basics (the Process of Design)

“Getting it right … and finding what is really needed!”

5. **Implementation and Deployment**

- Finally, when we are happy with our design we need to create it and deploy it. This will involve writing code, perhaps making hardware, writing documentation and manuals – everything that goes into a real system that can be given to others.

“Making it and getting it out there”

User Focus

Interaction Design Basics (the Process of Design)

- Over time many people are affected directly or indirectly by a system and these people are called **stakeholders**. Obviously tracing the tenuous links between people could go on forever and you need to draw boundaries as to whom you should consider. This depends very much on the nature of the systems being designed, but largely requires plain common sense**. So, how do you get to know your users?**

Interaction Design Basics (the Process of Design)

1. **Who are they?**

- the first thing to find out is **who your users are**. **Are they young or old**, **experienced computer users or novices**? In many cases it may not be obvious who the users are, so you may need to ask these questions again as you find out more about the system and its context. Therefore, questions becomes harder to answer if you are designing generic software, such as a word processor, as there are many different users with different purposes and characteristics

Interaction Design Basics (the Process of Design)

2. **Probably not Like you!**

- When designing a system it is easy to design it as if you were the main user: you assume your own interests and abilities. So often you hear a designer say “but it’s obvious what to do”. It may be obvious for her! This is not helped by the fact that many software houses are primarily filled with male developers. Although individuals differ a lot there is a tendency for women to have better empathetic skills.

Interaction Design Basics (the Process of Design)

3. **Talk to them**

- It is hard to get yourself inside someone else's head, so the best thing is usually to ask them. This can take many forms: structured interviews about their job or life, open-ended discussions, or bringing the potential users fully into the design process. By involving users throughout the design process it is possible to get a deep knowledge of their work context and needs. The obvious effect of this is that it produces better designs

Interaction Design Basics (the Process of Design)

4. **Watch them**

- Although what people tell you is of the utmost importance, it is not the whole story.
- When black-belt judo players are asked how they throw an opponent, their explanations do not match what they actually do.

Interaction Design Basics (the Process of Design)

5. **Use your Imagination**

- Even if you would like to involve many users throughout your design exercise it is not always possible. It may be too costly, it may be hard to get time with them, it may be that there are just too many. However, even if you cannot use actual users you can at least try to imagine what it is like for them.

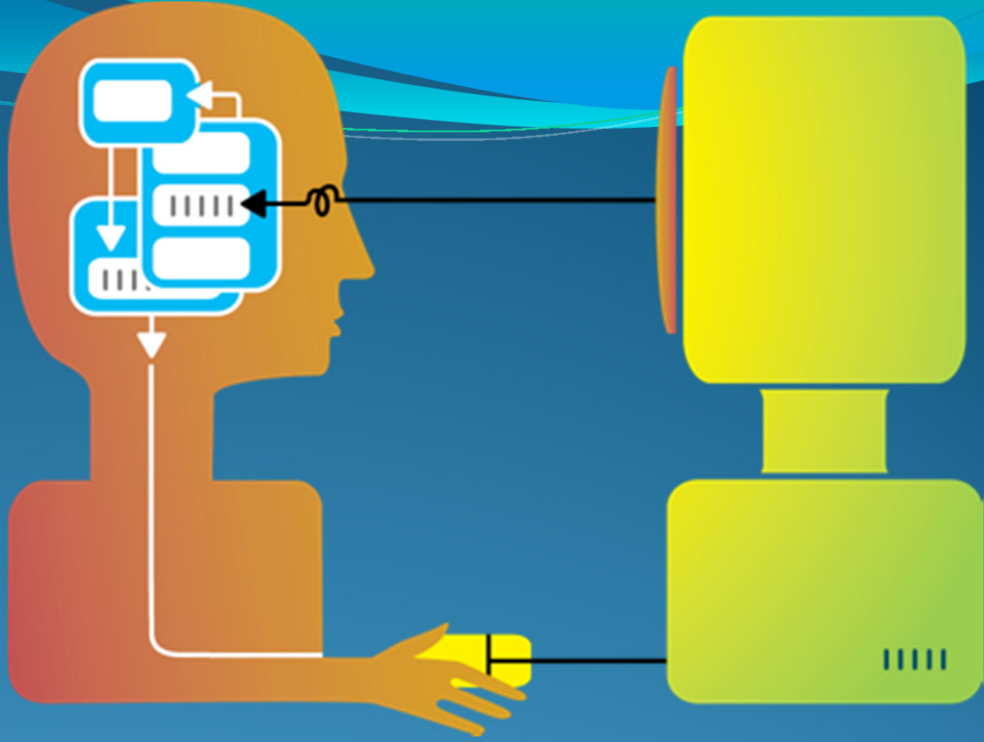
Interaction Design Basics (the Process of Design)

- One method that has been quite successful in helping design teams produce user focused designs is the ***persona***. A ***persona*** is a rich picture of an imaginary person who represents your core user group. Figure below gives an example persona of Betty the warehouse manager. A design team will have several of these personae covering different types of intended users and different roles

Interaction Design Basics (the Process of Design)

Betty is 37 years old, She has been Warehouse Manager for five years and worked for Simpkins Brothers Engineering for twelve years. She didn't go to university, but has studied in her evenings for a business diploma. She has two children aged 15 and 7 and does not like to work late. She did part of an introductory in-house computer course some years ago, but it was interupted when she was promoted and could no longer afford to take the time. Her vision is perfect, but her right-hand movement is slightly restricted following an industrial accident 3 years ago. She is enthusiastic about her work and is happy to delegate responsibility and take suggestions from her staff. However, she does feel threatened by the introduction of yet another new computer system (the third in her time at SBE).

The End



Human Computer Interaction(HCI)

2^{nd} Stage

Lecture 6: Interaction Design Basics

by

Hazim N. Abed

Interaction Design Basics (Scenarios)

- **Scenarios**: Stories for design use and reuse.

- **Scenarios** are perhaps the simplest design representation, but one of the most flexible and powerful.

Interaction Design Basics

- Figure 6.1 gives an example of a scenario for the personal movie player. Like the persona it is perhaps more detailed than appears necessary, but the detail helps make the events seem real. The figure shows plain text, but scenarios can be augmented by sketches, simulated screen shots, etc. These sketches and pictures are called storyboards and are similar to the techniques used in film-making to envisage plot-lines.

Interaction Design Basics

Brian would like to see the new film "Moments of Significance" and wants to invite Alsion, but he knows she doesn't like "arty" films. He decides to take a look at it to see if she would like it and so connects to one of the movie sharing networks. He uses his work machine as it has a higher bandwidth connection, but feels a bit guilty. He knows he will be getting an illegal copy of the film, but decides it is OK as he is intending to go to the cinema to watch it. After it downloads to his machine he takes out his new personal movie player. He presses the 'menu' button and on the small LCD screen he scrolls using the arrow keys to 'bluetooth connect' and presses the select button. On his computer the movie download program now has an icon showing that it has recognised a compatable device and he drags the icon of the film over the icon for the player. On the player the LCD screen says "downloading now", a percent done indicator and small wirling icon.

Interaction Design Basics

- Scenarios force you to think about the design in detail and notice potential problems before they happen.

- If you add more detail you can get to a step-by-step account of the user–system interactions and then ask **‘what is the user intending now”, “what is the system doing now”.** This can help to verify that the design would make sense to the user and also that proposed implementation architectures would work.

Interaction Design Basics

- **Scenarios can be used to:**

1. **Communicate with others** – other designers, clients or users. It is easy to misunderstand each other whilst discussing abstract ideas. Concrete examples of use are far easier to share.
2. **Validate other models** – A detailed scenario can be 'played' against various more formal representations such as task models or dialogue and navigation models
3. **Express dynamics** – Individual screen shots and pictures give you a sense of what a system would look like, but not how it behaves.

Interaction Design Basics

- **Scenarios** are a resource that can be used and reused throughout the design process: helping us see
  - What is wanted,
  - Suggesting how users will deal with the potential design,
  - Checking that proposed implementations will work, and
  - Generating test cases for final evaluation.

Navigation design

Interaction Design Basics

- Object of design is not just a computer system or device, but the socio-technical intervention as a whole. However, as design progresses we come to a point where we do need to consider these most tangible outputs of design. Therefore, there are several levels of interaction with the computer:

1. **Widgets**: The appropriate choice of widgets and wording in menus and buttons will help you know how to use them for a particular selection or action.

Interaction Design Basics

2. **Screens or Windows**: You need to find things on the screen, understand the logical grouping of buttons.

3. **Navigation within the application:** You need to be able to understand what will happen when a button is pressed, to understand where you are in the interaction.

4. **Environment**: The word processor has to read documents from disk, perhaps some are on remote networks. You swap between applications, perhaps cut and paste.

Navigation Design

- **1st task**
  - Who is using application?
  - How do they think about it?
  - What will they do with it?
- **2nd task – think about structure**
  - local structure – one screen or page
  - global structure – site, movement between screens

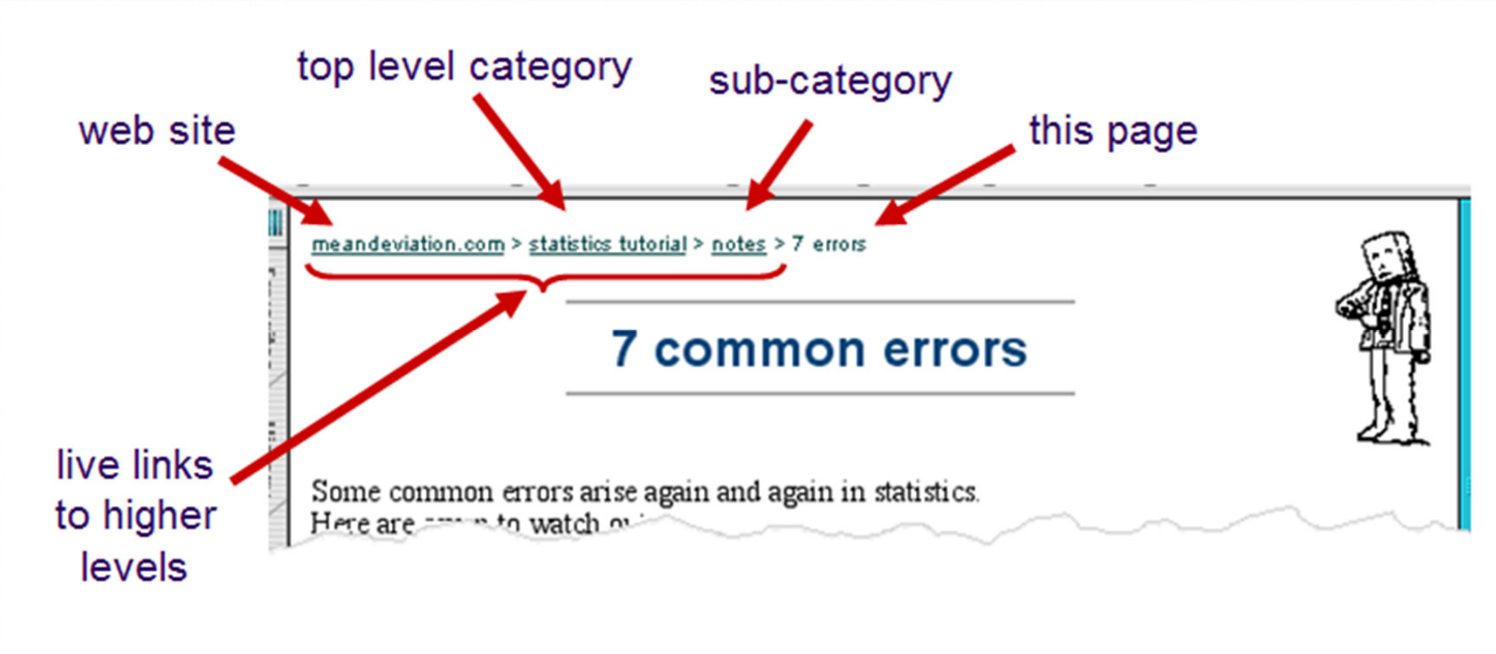
Interaction Design Basics

Much interaction is goal-seeking behavior

- Users know what they are after
- Users know a partial model of system
- Ideal world users would take shortest path to achieve goal, pressing right buttons and links in order
- Real world, users meander through system and make assessments at each point if they are getting closer to goal

1. Local structure

1. know where you are
   - show bread crumbs, path of titles, progress bars, etc.



Interaction Design Basics

2. know what you can do there

- **What can be pressed or clicked to go somewhere or do something.**
- For example, on the web the standard underlined links make it clear which text is clickable and which is not. However, in order to improve the appearance of the page many sites change the color of links and may remove the underline too. This is especially confusing if underline is then used as simple emphasis on words that are not links!

Interaction Design Basics

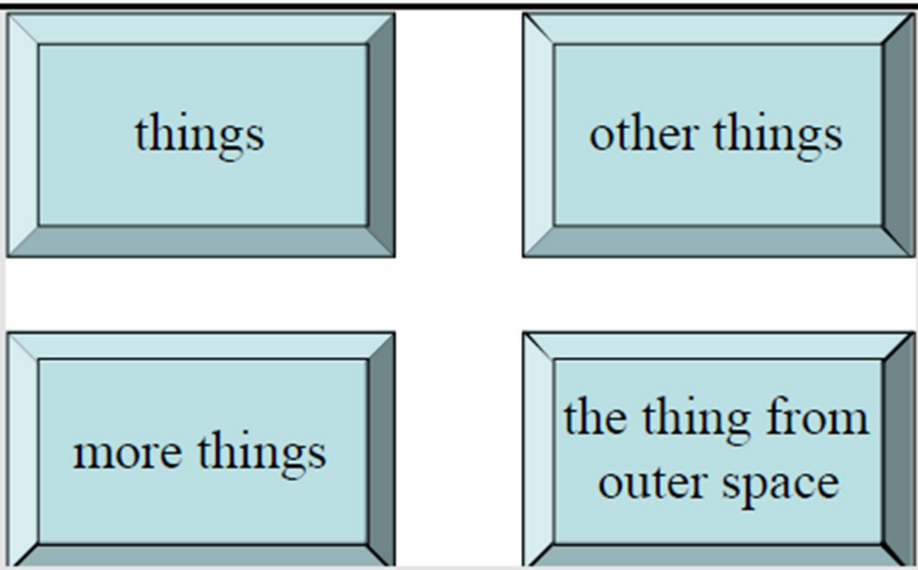
3. know where you are going – or what will happen.

   - Tool tips for icons, 'back' mechanism to return in case you go somewhere you didn't mean to

Design Focus – Beware the big button trap

Public information systems often have touch screens and so have large buttons. Watch someone using one of these and how often they go to the wrong screen and have to use 'back or 'home' to try again. If you look more closely you will find that each button has only one or two words on it giving the title of the next screen and possibly some sort of icon. Quite rightly the button label will be in a large font as users may have poor eyesight.

Interaction Design Basics



It is hard to choose appropriate labels that mean the same for everyone, especially when the breadth of the screen hierarchy is fixed by the maximum number of buttons. So it is no wonder that people get confused. However, there is usually plenty of room for additional explanation in a smaller font, possibly just the next level of button labels, or a sentence of explanation. It may not look as pretty, but it may means that people actually find the information they are looking for.

Interaction Design Basics

4. know where you've been – or what you've done
    - Confirmation
    - Feedback
    - History, and back button

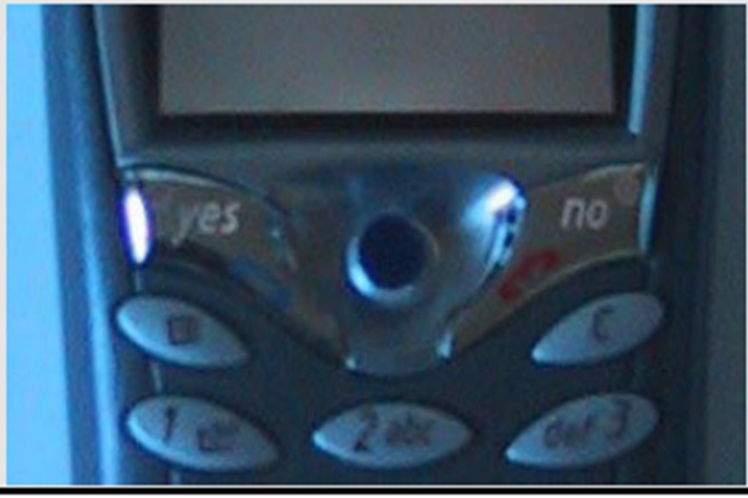
Design Focus – modes

Alan's mobile phone has a lock feature to prevent accidental use. To remove the lock he has to press the "C" (cancel) button which then asks for an additional "yes" to confirm removing the lock. So, in 'locked' mode "C" followed by "yes" means "turn off lock" and these are the most frequent actions when Alan takes the phone from his pocket.

Interaction Design Basics

However, Alan is forgetful and sometimes puts the phone in his pocket unlocked. This leads to occasional embarrassing phone calls and also to another problem.

The “yes” button is quite big and so this is often pressed while in his pocket. This puts the phone into “dial recent numbers” mode with a list of recent calls on screen. In this mode, pressing “C” gives a prompt “Delete number” and pressing “yes” then deletes the number from the phone’s adress book. Unhappily, this often means he takes the phone from his pocket, automatically presses “C”, “yes” only to see as he looks down to the handset the fatal words “number deleted”. Of course there is no undo!



2. Global structure – hierarchical organization

- We will now look at the overall structure of an application. This is the way the various screens, pages or device states link to one another.

- One way to organize a system is in some form of hierarchy. This is typically organized along functional boundaries (that is different kinds of things), but may be organized by roles, user type, or some more esoteric breakdown such as modules in an educational system.

Interaction Design Basics

- The hierarchy links screens, pages or states in logical groupings. For example, figure 6.2 gives a high level breakdown of some sort of messaging system.

- This sort of hierarchy can be used purely to help during design, but can also be used to structure the actual system. For example, this may reflect the menu structure of a PC application or the site structure on the web.

Interaction Design Basics

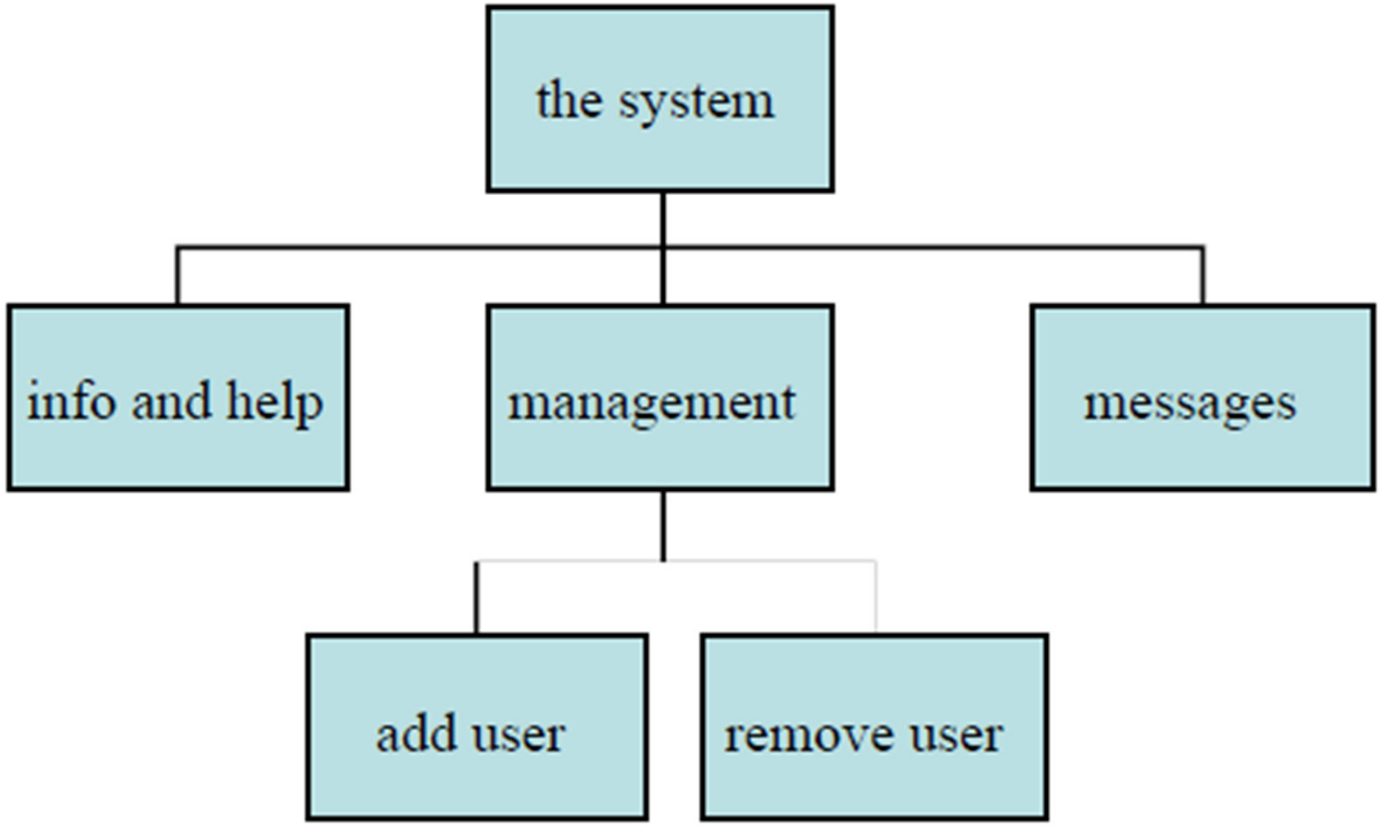


Figure 6.2 Application functional hierarchy

Interaction Design Basics

- Any sort of information structuring is difficult, but there is evidence that people find hierarchies simpler than most. On of the difficulties with organizing information or system functionality is that different people have different internal structures for their knowledge, and may use different vocabulary.

- This is one of the places where a detailed knowledge of the intended users is essential: it is no good creating a hierarchy that the designers understand, but not the users ... and all too commonly this is exactly what happens.

Interaction Design Basics

- There is also evidence that deep hierarchies are difficult to navigate, so it is better to have broad top-level categories, or to present several levels of menu on one screen or web page.

3.Global Structure-Dialog

- In a pure information system or static web site it may be sufficient to have a fully hierarchical structure, perhaps with next/previous links between items in the same group.

- **Refers to pattern of interactions between user and a system**

Interaction Design Basics

- Recall that scenarios gave just one path through the system. To describe a full system we need to take into account different paths through a system and loops where the system returns to the same screen. There are various ways to do this,

- A simple way is to use a network diagram showing the principal states or screens linked together with arrows: This can:
  - Show what leads to what
  - Show what happens when
  - Include branches and loops - take into account different paths through system and loops that return to same screen
  - More task oriented than hierarchy

Screen Design and Layout

Interaction Design Basics

- How to put the different elements that make up interactive applications together.

- The basic Principles at the screen level reflect other areas of interaction.
  - Ask – what is the user doing?
  - Think – what information is required? what order are things likely to be needed?
  - Design - form follows function: let the required interactions drive the layout

Iteration and prototyping

Interaction Design Basics

- Because human situations are complex and designers are not infallible it is likely that our first design will not be perfect! For this reason almost all interaction design includes some form of iteration of ideas.

- This often starts early on with paper designs and story boards being demonstrated to colleagues and potential users. Later in the design process one might use mockups of physical devices or tools such as Shockwave or Visual Basic to create prototype versions of software.

Interaction Design Basics

- Any of these prototypes, whether paper-based or running software, can then be evaluated to see whether they are acceptable and where there is room for improvement. This sort of evaluation, intended to improve designs, is called **formative** evaluation. This is in contrast to **summative** evaluation, which is performed at the end to verify whether the product is good enough.

Interaction Design Basics

- The result of evaluating the system will usually be a list of faults or problems and this is followed by a redesign exercise, which is then prototyped, evaluated ... Figure 6.3 shows this process. The end point is when there are no more problems that can economically be fixed.

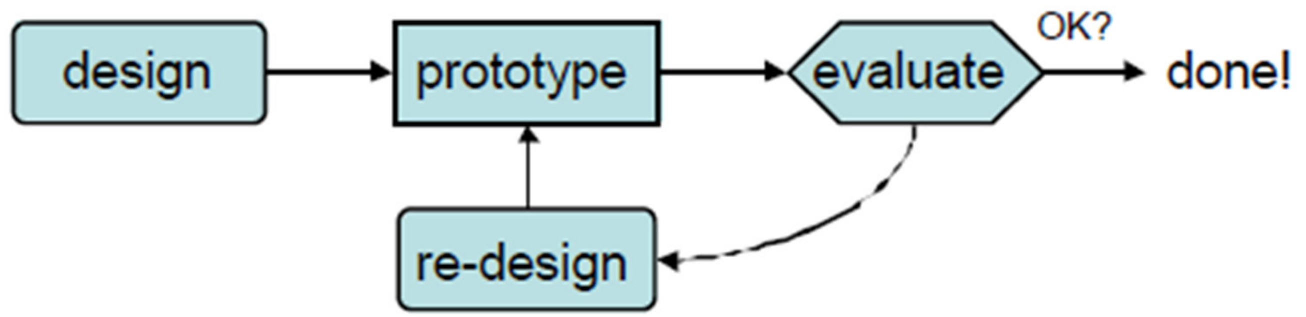


Figure 6.3 Role of prototyping

Interaction Design Basics

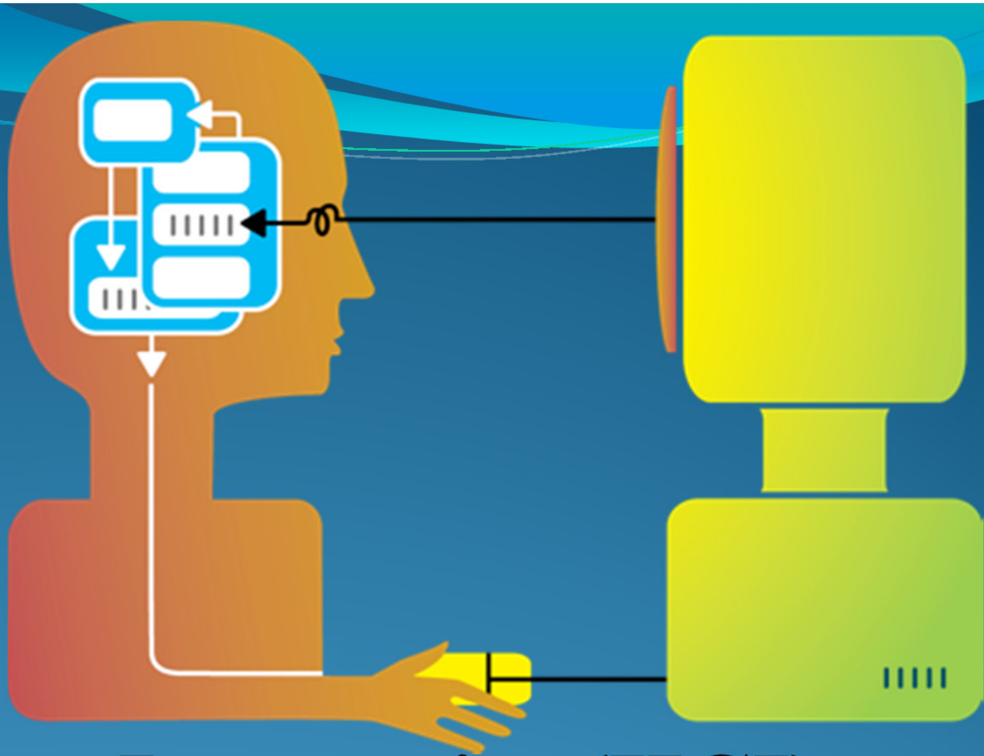
- Two things to improve prototyping methods

    1. Understand what is wrong and how to improve it

    2. Choose a good starting point

- **A really good designer might guess a good initial design based on experience and judgment**.

The End



Human Computer Interaction(HCI)

2^{nd} Stage

Lecture 7: Models of human computer interaction

by

Hazim N. Abed

Models of Human Computer Interaction

Definitions of some Terms of Interaction:

- **Domain**: expertise, knowledge in some real world Activity. In GUI domain concepts such as geometric shape, colour, Symbols etc are involved.
- **Task**: operation to manipulate concepts in a domain.
- **Goal**: desired output from a performed task. Ex in GUI: A button
- **Intention**: specific action required to meet the goal
- **Task analysis**: Study of the problem space

Models of Human Computer Interaction

- In HCI interaction models are translations between user and system

- There are different Interaction Models mentioned in HCI
  - Donald Norman’s Interaction Model
  - Abowd & Beale’s Model

Models of Human Computer Interaction

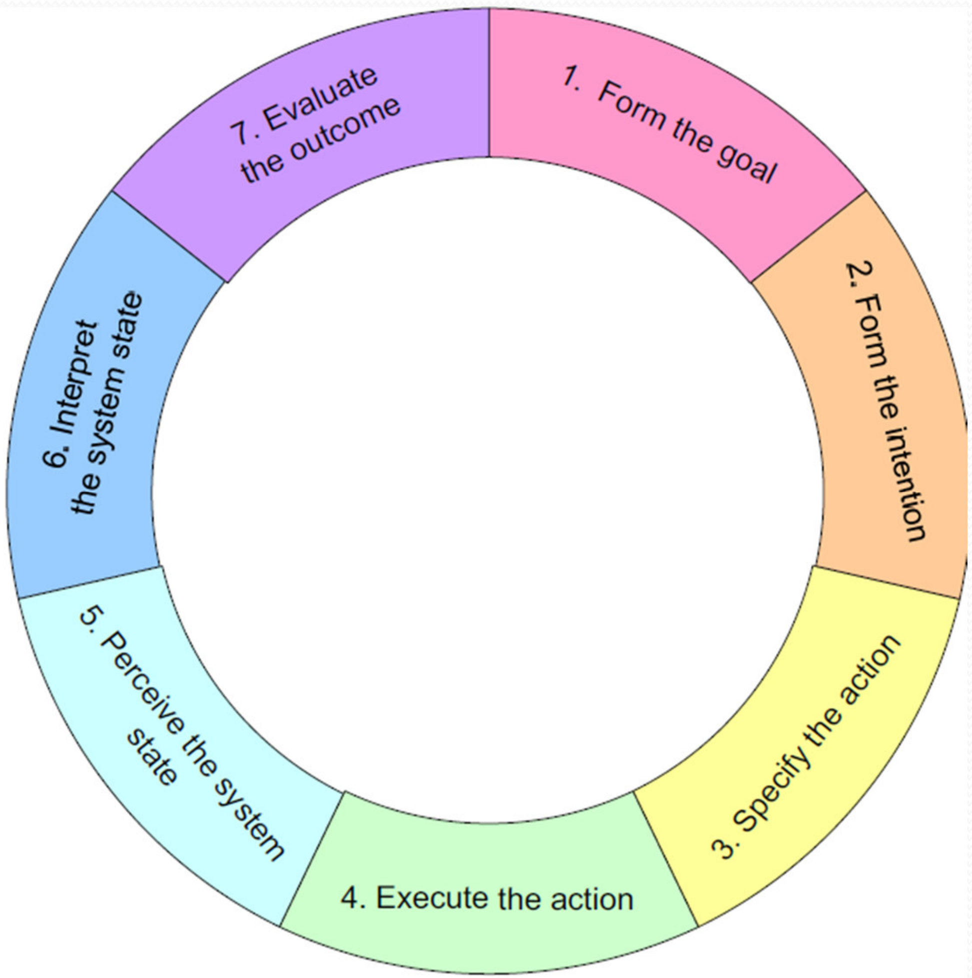
Donald Norman’s Interaction Model

- Donald Norman’s Interaction model concentrates on the Users Thought processes and accompanying actions.

- Norman proposed that actions are performed by the users in cycle such as
- (i) Establishing a goal
- (ii) Executing the action
- (iii) Evaluating the results

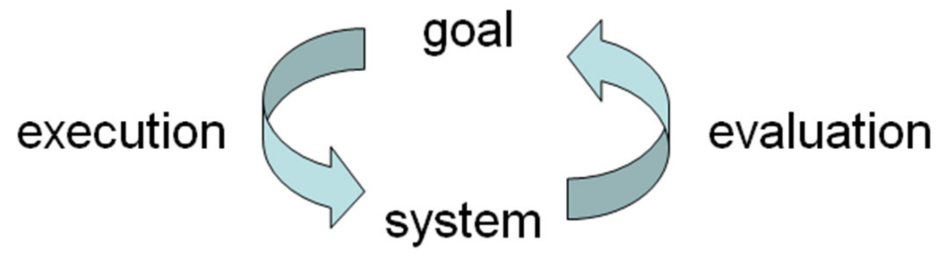
Models of Human Computer Interaction

- Norman’s Model of Interaction consists of seven stages as follows:



- Donald Norman’s Interaction model

Models of Human Computer Interaction



1. user establishes the goal — **Goal**
2. formulates intention
3. specifies actions at interface
4. executes action — **Execution**
5. perceives system state
6. interprets system state
7. evaluates system state with respect to goal — **Evaluation**

Models of Human Computer Interaction

- As a basis for his Interaction Model Norman proposed the following levels of abstraction of knowledge of the user:

Task Level	Task Level: task level is to analyze the user's needs and to structure the task domain in such a way, that a computer system can play a part in it. The task level describes the structure of the tasks which can be delegated to the computer system.
Goal Level	
Semantic level	Semantic level describes the set of objects, attributes, and operations, the system and the user can communicate. Semantics is about how the user interprets it and makes meanings out of the system.

Models of Human Computer Interaction

Syntax level	Syntax level describes which conceptual entities and operations may be referred to in a particular command context or system state.
Lexical level	Lexical level: language , wording.
Physical Level	

Models of Human Computer Interaction

- Norman's HCI model consists of three types:

1. User's Mental Model ;
2. System Image Model ;
3. Conceptual Model.

1. User's Mental Model ;

- The User's Mental Model is the model of a machine's working that a user creates when learning and using a computer. It is not technically accurate. It may also be not stable over time.

Models of Human Computer Interaction

- User's mental models keep changing , evolving as learning continues.

- In a way Mental Models are models people have of themselves, others and environment.

- The mental model of a device is formed by interpreting its perceived actions and its visible structure.

Models of Human Computer Interaction

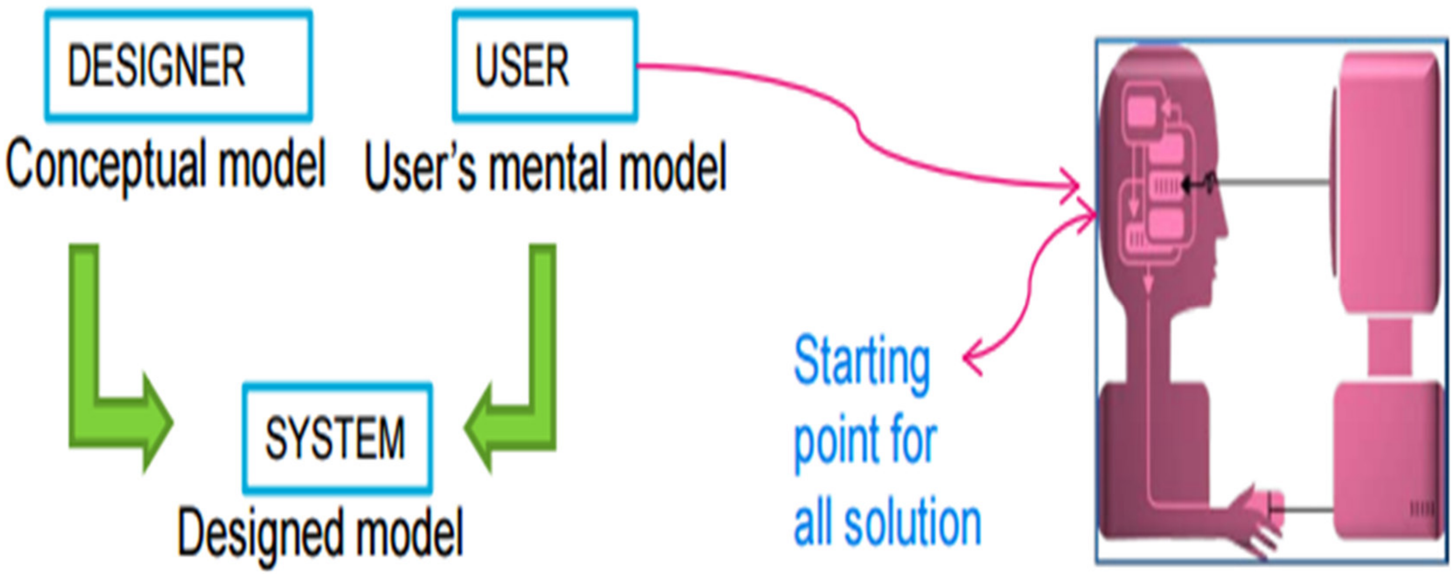
2. System image Model

- The System image Model is the visible physical part of the computing system / device.

3.The Conceptual Model.

- This is the technically accurate model of the computer / device / system created by designers / teachers/researchers for their specific internal technical use.

Models of Human Computer Interaction

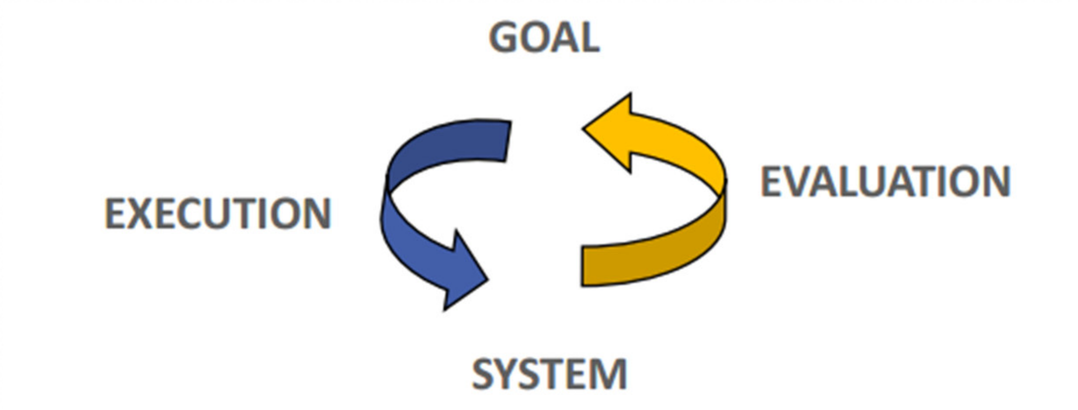


Models of Human Computer Interaction

Norman applies the Model to explain why some interfaces cause problems to the users. Some systems are harder to use than others

- He uses the terms "**Gulf of execution**' and ' **Gulf of evaluation**'. Normans model (also some times called as Gulf Model) is useful in understanding the reasons of interface failures from the users point of view. The Seven stages of action model is an elaboration of the Gulf model.

Models of Human Computer Interaction



- **Gulf of Execution** represents the difference between user's formulation of the action to reach their goals and the actions allowed by the system.

User's formulation of action ≠ Actions allowed by the system.

Models of Human Computer Interaction

- **The Gulf of Evaluation** is the difference between physical presentation of system state and the expectations of the user.

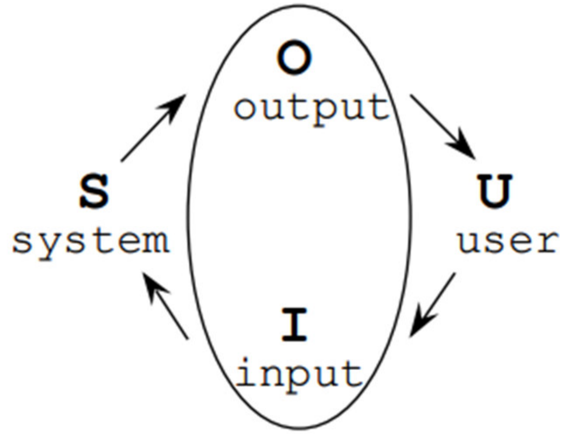
User's Expectation ≠ system's presentation.

Models of Human Computer Interaction

Abowd and Beale Model

- Extension of Norman, their interaction framework has 4 parts

1. User
2. Input
3. System
4. Output



- Each has its own unique language

Interaction ➔ Translation between languages

Problems in interaction = Problems in translation

Models of Human Computer Interaction

- **User intentions translated into actions at the interface**
  - → translated into alterations of system state
    - → reflected in the output display
      - → interpreted by the user

- **General framework for understanding interaction**
  - not restricted to electronic computer systems
  - identifies all major components involved in interaction
  - allows comparative assessment of systems
  - an abstraction

Models of Human Computer Interaction

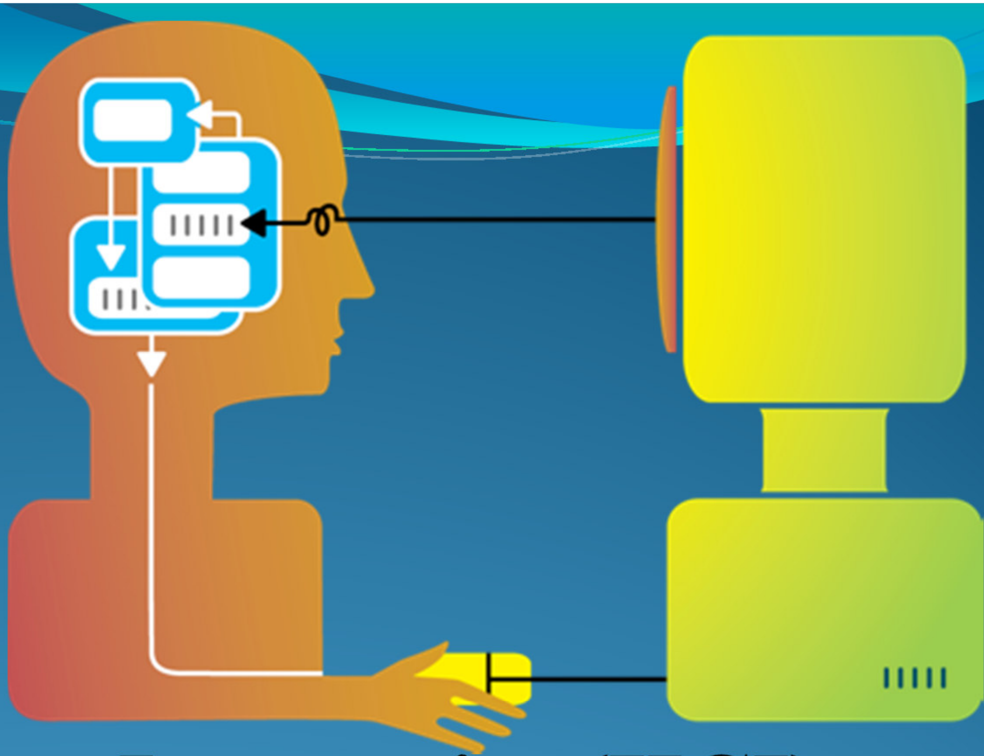
Interaction Style:

- Having understood Interaction Frame work as a model let us Look at Interaction Styles

- **Some common interaction styles**
    - Command line interface
    - Menus
    - Natural language
    - Question/answer and Query dialogue (Ex: SQL)

Models of Human Computer Interaction

- Three–dimensional interfaces
- Gestural Interfaces
- Vice operated commands
- Thought (mind) operated commands



Human Computer Interaction(HCI)

2nd Stage

Lecture 8:HCI in the software process , Evaluation Techniques, Usability

by

Hazim N. Abed

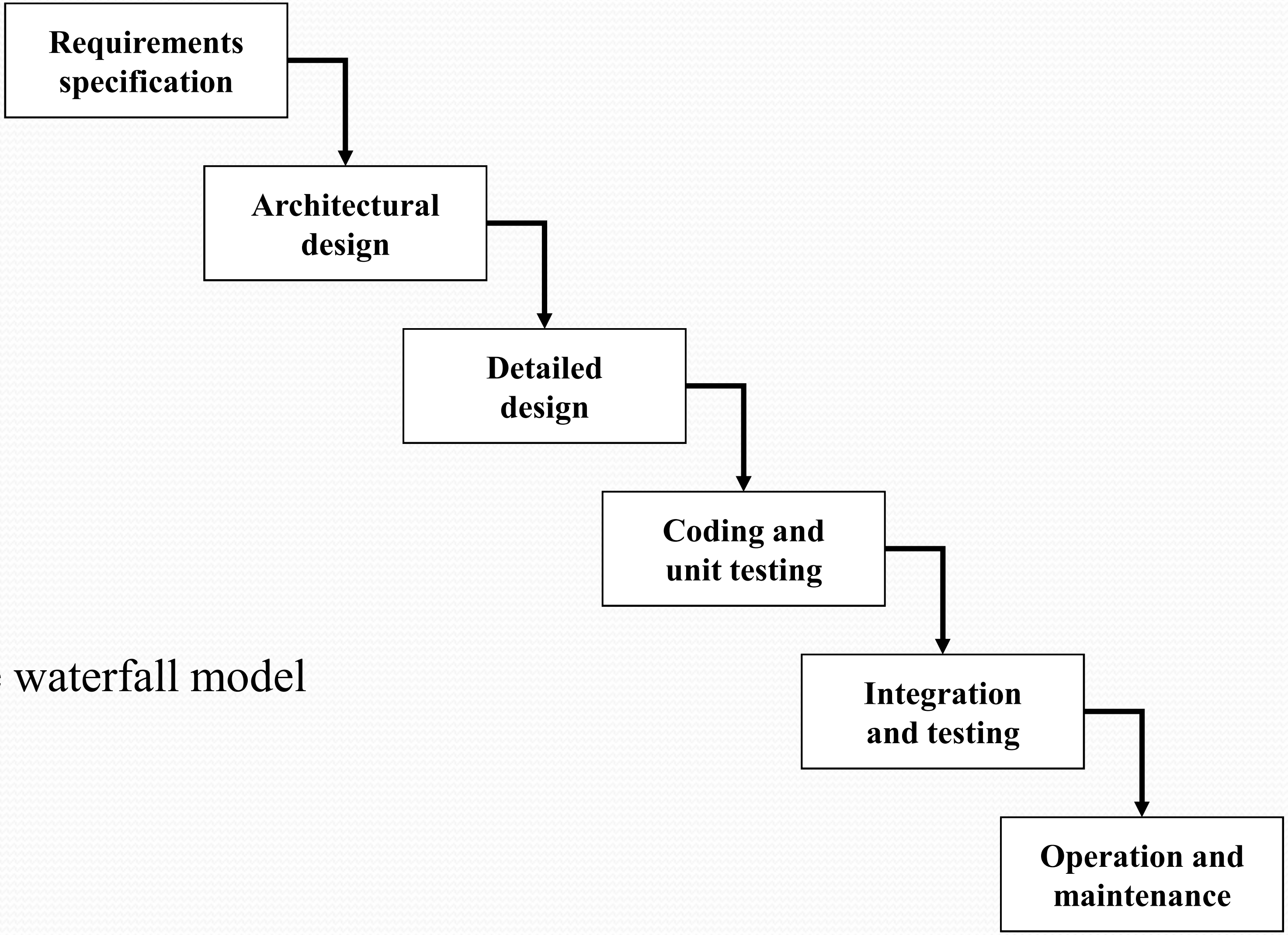
HCI in the software process

1. The software lifecycle

- Software engineering is the emerging discipline for understanding the design process, or life cycle.

- Designing for usability occurs at all stages of the life cycle, not as a single isolated activity

HCI in the software process



The waterfall model

HCI in the software process

Activities in the life cycle

- **Requirements specification**

designer and customer try capture *what* the system is expected to provide can be expressed in natural language or more precise languages, such as a task analysis would provide

HCI in the software process

- **Architectural design**

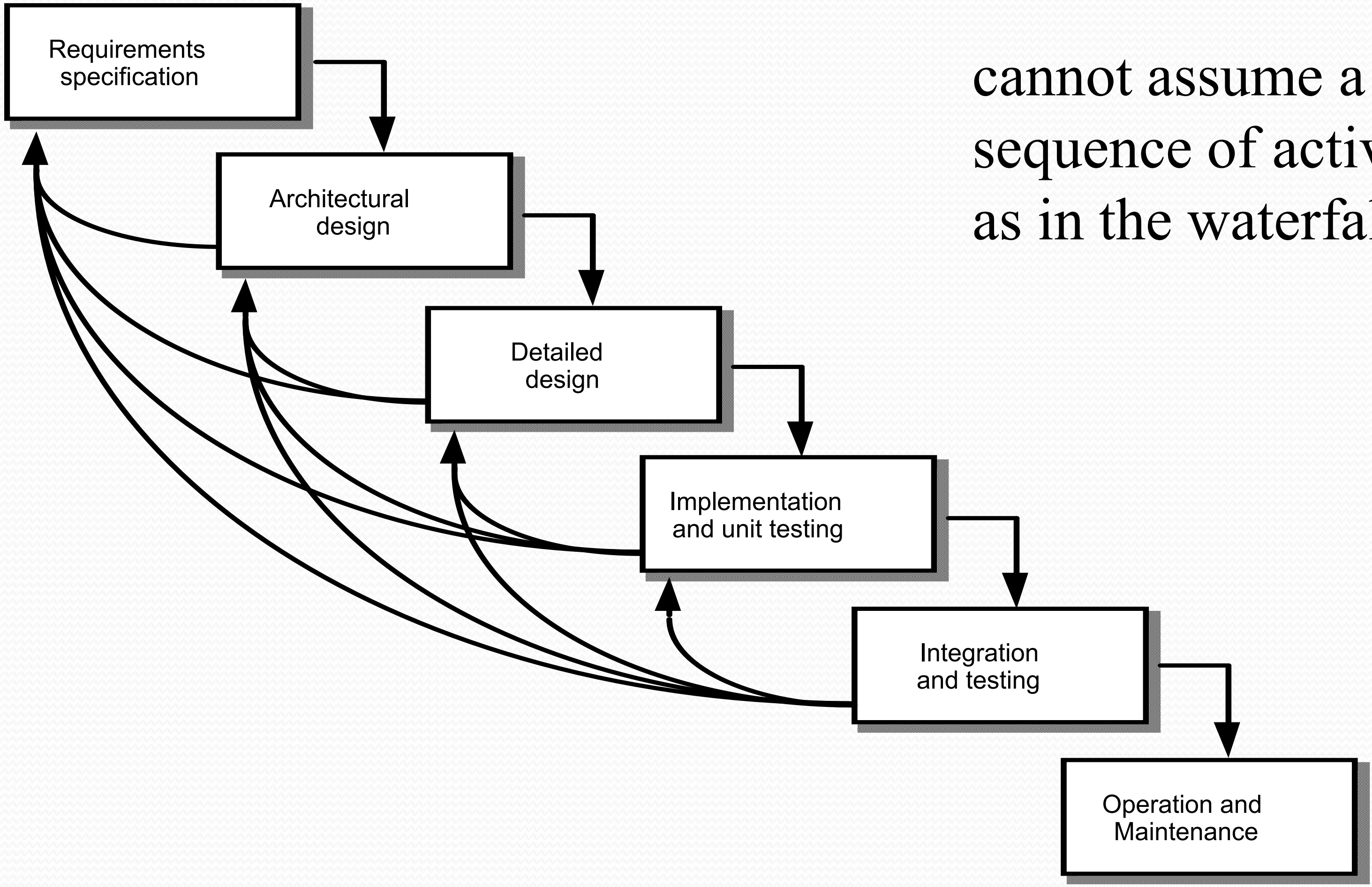
high-level description of *how* the system will provide the services required factor system into major components of the system and how they are interrelated needs to satisfy both functional and nonfunctional requirements

Detailed design

refinement of architectural components and interrelations to identify modules to be implemented separately the refinement is governed by the nonfunctional requirements

HCI in the software process

The life cycle for interactive systems



cannot assume a linear
sequence of activities
as in the waterfall model

HCI in the software process

2. Usability engineering

- The ultimate test of usability based on measurement of user experience

- Usability engineering demands that specific usability measures be made explicit as requirements

Usability specification

- usability attribute/principle
- measuring concept
- measuring method
- now level/ worst case/ planned level/ best case

HCI in the software process

Problems

- usability specification requires level of detail that may not be possible early in design satisfying a usability specification does not necessarily satisfy usability

HCI in the software process

3. Iterative design and prototyping

- Iterative design overcomes inherent problems of incomplete requirements

Prototypes

simulate or animate some features of intended system

different types of prototypes

- throw-away
- incremental
- evolutionary

HCI in the software process

Management issues

- time
- planning
- non-functional features
- contracts

HCI in the software process

4. Design rationale

Design rationale is information that explains why a computer system is the way it is.

Benefits of design rationale

- communication throughout life cycle
- reuse of design knowledge across products
- enforces design discipline
- presents arguments for design trade-offs
- organizes potentially large design space
- capturing contextual information

Evaluation Techniques

Evaluation

- tests usability and functionality of system
- occurs in laboratory, field and/or in collaboration with users
- evaluates both design and implementation
- should be considered at all stages in the design life cycle

Goals of Evaluation

- assess extent of system functionality
- assess effect of interface on user
- identify specific problems

Evaluation Techniques

Evaluation Techniques

- Model-based-Evaluator can work through the model -e.g. counting the number of actions needed, or checking for consistency
- Expert-based -People experienced in interface design are asked to take the role of less experienced users and describe the potential problems they foresee arising for such users.
- Observational evaluation involves watching people and collecting data that provides information about what users do when they interact with a system.

Evaluation Techniques

- Co-operative evaluation is when the expert observes and helps. People are encouraged to ‘think aloud’ about the problems they are having.

- Survey evaluation: Using similar methods to requirements - interviews, questionnaires, etc. -but the focus is on seeing if you have got it right.

Evaluation Techniques

- Experimental evaluation

–May be performed in a usability laboratory, so that an evaluator can manipulate a number of factors associated with interface design and study their effects on various aspects of user performance.

–May be set up in a computer laboratory with little interruption from evaluator where people undertake benchmark tests

Usability

Usability

Relates to the question of quality and efficiency. E.g. how well does a product support the user to reach a certain goal or to perform a certain task.

What is Usability

"Usability is a quality attribute that assesses how easy user interfaces are to use. The word 'usability' also refers to methods for improving ease-of-use during the design process."

Usability

Usability has five quality components:

1. Learn ability: How easy is it for users to accomplish basic tasks the first time they encounter the design?

2. Efficiency: Once users have learned the design, how quickly can they perform tasks?

Usability

3. Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?

4. Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

5. Satisfaction: How pleasant is it to use the design?

Usability

One of the key concepts in HCI.

It is concerned with making systems easy to learn and use

A Usable system is:

- **Easy to learn**
- **Easy to remember how to use**
- **Effective to use**
- **Efficient to use**
- **Safe to use**
- **Enjoyable to use**

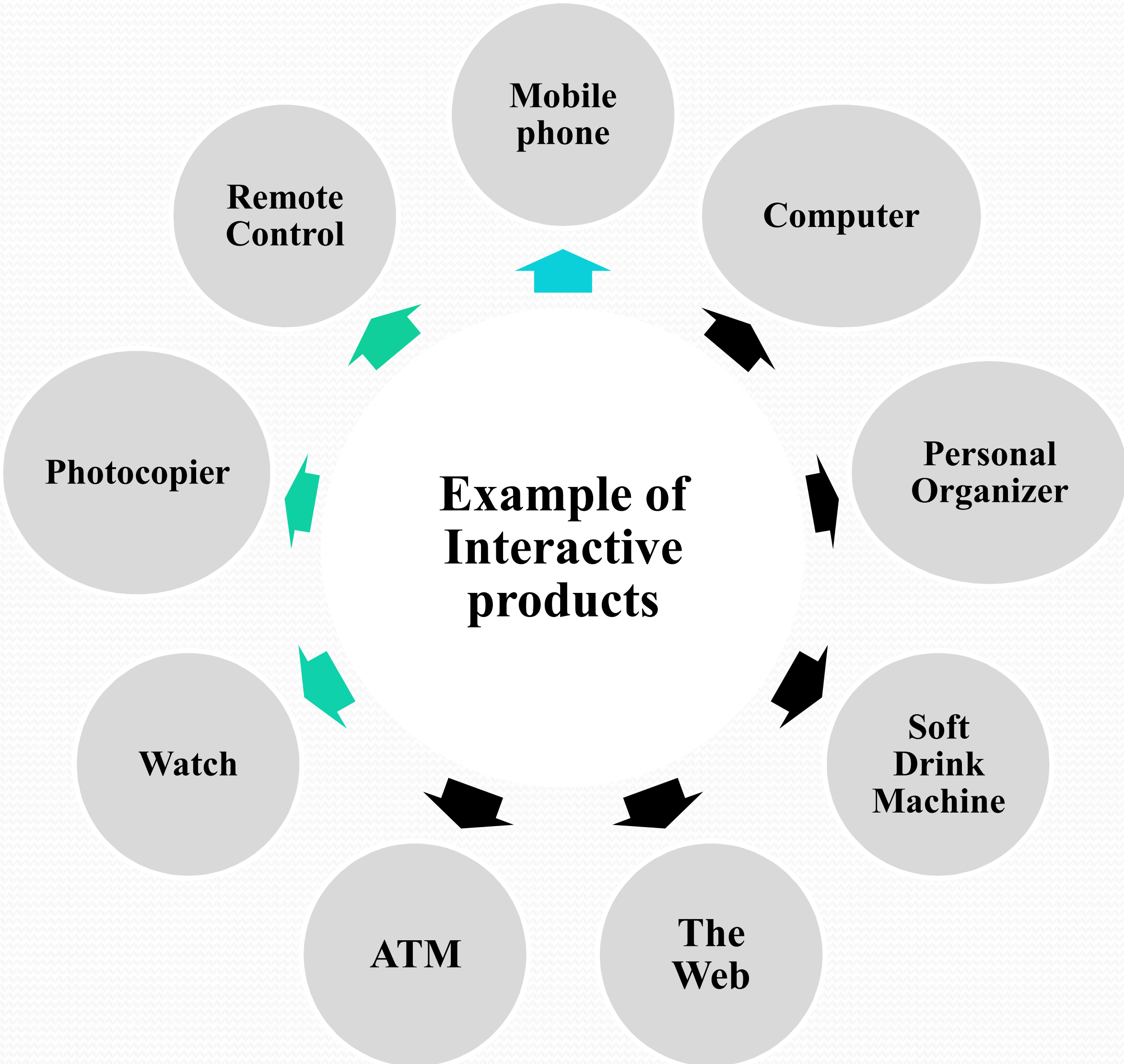
Why is Usability Important

Many everyday systems and products seemed to be designed with little regard to usability.

This leads to:

- Frustration
- Wasted time
- Errors

Why Usability is Important?



How many systems are easy, effortless, and enjoyable to use?

Why is Usability Important?

Improving usability can

- Increase productivity of users
- Reduce costs (support, efficiency)
- Increase sales/revenue (web shop)
- Enhance customer loyalty
- Win new customers