

CS408 Short Notes Mid term

Lec 1 to18

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Lecture 1 Introduction to Human Computer Interaction – Part I

Definition of HCI (Human-Computer Interaction)

“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”.

Role of HCI

Human designed the interfaces we hate human continue to use dysfunctional machines even as the awkward interfaces strain their eyes, ache their backs, and ruin their wrist tendons. HCI plays a role to bridge up the gape between the interfaces of machines and human understanding.

Lecture 2 Introductions to Human-Computer Interaction – Part II

Feature Shock

Every digital device has more features than its manual counterpart, but manual devices easier to use. Hi-tech companies add more features to improve product becomes complicated.

Human verses Computer

Human species

Human beings are the most interesting and fascinating specie on planet. They are the most complex living being on the earth. It has very much diversity in its nature. It is intelligent in its deeds. Human beings think and decide according to their own will. Yes, they are free in nature.

Software Apartheid

Apartheid

Racial segregation specifically a policy of segregation and political and economic discrimination against non-European groups in the Republic of South Africa

Software Apartheid

Institutionalizing obnoxious behavior and obscure interactions of software-based products

- “Acceptable levels of quality for software engineers are far lower than are those for traditional engineering disciplines”
- “Software-based products not INHERENTLY hard to use Wrong process is used to develop them”

Software Engineering and HCI

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There is a basic fundamental difference between the approaches taken by software engineers and human-computer interaction specialists. Human-computer interface specialists are user-centered and software engineers are system-centered. Software engineering methodologies are good at modeling certain aspects of the problem domain. Formal methods have been developed to represent data, architectural, and procedural aspects of a software system.

Lecture 3 Introductions to Human-Computer Interaction – Part III

Effect of Bad Tools

Not only are computers taking over the cockpit of jet airliners, they are taking over the passenger cabin, too, behaving in that same obstinate, perverse way that is so easy to recognize and so hard to use. Modern jet planes have in-flight entertainment (IFE) systems that deliver movies and music to airline passengers.

An Industry in Denial

We are a world awash in high-tech tools. Computers dominate the workplace and our homes, and vehicles are filling up with silicon-powered gadgets. All of these computerized devices are wildly sophisticated and powerful, but every one of them is dauntingly difficult and confusing to use.

The high-tech industry is in denial of a simple fact that every person with a cell phone or a word processor can clearly see our computerized tools are hard to use. The technologists who create software and high-tech gadgets are satisfied with their efforts. The software engineers who create them have tried as hard as they can to make them easy to use and they have made some minor progress.

Techno-Rage

Technological Frustration: Techno-Rage could describe the frustration or anger that people experience when dealing with technology-related issues. This could range from software glitches and hardware malfunctions to the challenges of adapting to rapidly advancing technologies. It reflects the emotional response to the sometimes complex and unpredictable nature of modern technology.

Musical Genre: "Techno-Rage" could also be interpreted as a term related to music, specifically a sub-genre or style within the broader category of techno music. In this context, it might imply a more aggressive, intense, or high-energy

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form of techno, possibly characterized by harder beats, distorted sounds, and an overall more "rageful" or intense atmosphere.

Computer rage

There is a technology-based scourge afoot...maybe. It's not a virus; it's not a denial of service attack; it's computer rage, and according to the latest reports, it is out to destroy the physical health, the emotional stability, and if left unchallenged, the economic strength of whatever population it strikes.

70% swear at PCs

The study by the National Opinion Poll and the software company Symantec, found that nearly half of all computer users had become angry at some time. Almost a third of people had physically attacked a computer, 67% experienced frustration, exasperation and anger and more than 70% swore at their machines.

Success Criteria in the New Economy

The successful professional for the twenty-first century is either a business savvy technologist or a technology-savvy businessperson.

Here are some facts and figures:

Users can only find information 42% of the time

Jared Spool

62% of web shoppers give up looking for the item they want to buy online

Zona Research

50% of the potential sales from a site are lost because people cannot find the item they are looking for

Forrester Research

40% of the users who do not return to a site do so because their first visit resulted in a negative experience

Forrester Research

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80% of software lifecycle costs occur after the product is released, in the maintenance phase - of that work, 80 % is due to unmet or unforeseen user requirements; only 20 % is due to bugs or reliability problems.

IEEE Software

Around 63% of software projects exceed their cost estimates. The top four reasons for this are:

- Frequent requests for changes from users
- Overlooked tasks
- Users' lack of understanding of their own requirements
- Insufficient user-analyst communication and understanding

Communications of the ACM

BOO.com, a \$204m startup fails

BBC News

Poor commercial web sites will kill 80% of Fortune 500 companies within a decade

Jakob Nielsen

So all above given facts reveals that the product with the bad user experience deserve to die!

Computer + Information

What do you get when you cross a computer with information?

In 2000, the Olympic Games were held in Sydney. Before the Olympic Games could begin, a lawsuit was filed against the Olympic Committee. The case was called Bruce Lindsay Maguire vs Sydney Organizing Committee for the Olympics Games (SOCOG) On 7 June 1999 the complainant.

Lecture 4 Goals & Evolution of Human Computer Interaction

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Definition of HCI

“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”.

Goals of HCI

The primary objective of HCI is to design systems that make them accessible, usable, efficient, and safe for anyone and everyone. This implies that people with a wide range of capabilities, expertise, and knowledge can easily use HCI-designed systems. It also encompasses people with disabilities.

Usability goals

To recap, usability is generally regarded as ensuring that interactive products are easy to learn, effective to use, and enjoyable from user perspective. It involves optimizing the interactions people have with interactive product to enable them to carry out their activities at work, school, and in their everyday life. More specifically, usability is broken down into the following goals:

- Effective to use (effectiveness)
- Efficient to use (efficiency)
- Safe to use(safety)
- Have good utility (utility)
- Easy to learn (learnability)
- Easy to remember how to use (memorability)

Effectiveness VS Efficiency

Effectiveness

It is a very general goal and refers to how good a system at doing what it is supposed to do.

Efficiency

It refers to the way a system supports users in carrying out their tasks.

Safety

It involves protecting the users from dangerous conditions and undesirable situations. In relation to the first ergonomics aspect, it refers to the external conditions where people work.

Preventing user VS providing users

Preventing user

Preventing the user from making serious error by reducing the risk of wrong keys/buttons being mistakenly activated (an example is not placing the quit or delete-file command right next to the save command on a menu.)

Providing users

Providing users with various means of recovery should they make errors. Save interactive systems should engender confidence and allow the users the opportunity to explore the interface to carry out new operations.

Utility

It refers to the extent to which the system provides the right kind of functionality so that user can do what they need or want to do.

Learnability

It refers to how easy a system is to learn to use. It is well known that people do not like spending a long time learning how to use a system. They want to get started straight away and become competent at carrying out tasks without too much effort. This is especially so for interactive products intended for everyday use (for example interactive TV, email) and those used only infrequently (for example, video conferencing) to certain extent, people are prepared to spend longer learning more complex system that provide a wider range of functionality (for example web authoring tools, word processors) in these situations, CD ROM and online tutorials can help by providing interactive step by step material with hands-on exercises.

Memorability

It refers to how easy a system is to remember how to use, once learned. This is especially important for interactive systems that are used infrequently. If users haven't used a system or an operation for a few months or longer, they should be able to remember or at least rapidly be reminded how to use it. "Don't make me THINK, is the key to a usable product"

User experience goals

The realization that new technologies are offering increasing opportunity for supporting people in their everyday lives has led researchers and practitioners to consider further goals. The emergence of technologies in diversity of application areas has brought about a much wider set of concerns. As well as focusing primarily on improving efficiency and productivity at work, interaction design is increasingly concerning itself with creating systems that are:

- Satisfying
- Enjoyable
- Fun
- Entertaining
- Helpful
- Motivating
- Aesthetically pleasing
- Supportive of creativity
- Rewarding
- Emotionally fulfilling



Evolution of HCI

The main topics that make up the discipline of HCI All HCI takes place within a social and organizational context. Different kinds of applications are required for different purposes and care is needed to divide tasks between humans and machines, making sure that those activities and routine are allocated to machines.

Dynabook

Alan Kay designed the first object-oriented programming language in the 1970s. Called Smalltalk, the programs were the basis for what is now known as windows technology the ability to open more than one program at a time on a personal computer.

Star

The Xerox Star was born out of PARC's creative ferment, designing an integrated system that would bring PARC's new hardware and software ideas into a commercially viable product for use in office environments. The Star drew on the ideas that had been developed, and went further in integrating them and in designing for a class of users who were far less technically knowledgeable than the engineers who had been both the creators and the prime users of many PARC systems (one of PARC's favorite mottoes was "Build what you use, use what you build.")

Direct manipulation

The core concept that distinguished Star (and other Alto programs) from the conventional computer interfaces of their time was the use of a bitmapped screen to present the user with direct visual representations of objects. In the Star's desktop metaphor, documents, printers, folders, collections of folders (file drawers and cabinets), in and out boxes, and other familiar office objects were depicted on the screen.

WYSIWYG (what you see is what you get)

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In previously available programs for producing sophisticated graphical output such as drawings or page layout with multiple fonts the user created and edited a representation that looked like a programming language, and then compiled the resulting program into a visible form. Alto programs pioneered a new style that Star unified, in which the user works directly with the desired form, through direct manipulation.

Consistency of commands

Because a single development group developed all Star applications in a unified way, it was possible to adhere to a coherent and consistent design language. The Star keyboard embodied a set of generic commands, which were used in a consistent way across all applications: Move, Copy, Delete, Open, Show Properties, and Same.

The Apple Lisa was a personal computer designed and manufactured by Apple Computer, released on January 19, 1983. It was one of the first personal computers to feature a graphical user interface (GUI) and a mouse, and it was also the first computer to use the Motorola 68000 microprocessor. Despite its innovative features, the Lisa was a commercial failure, selling only about 100,000 units before being discontinued in 1986.

Here are some of the key features of the Apple Lisa:

- Graphical user interface (GUI) with a mouse
- Motorola 68000 microprocessor
- 12-inch monochrome monitor
- 512 KB of RAM
- Two 5.25-inch floppy disk drives
- Optional hard drive
- LisaOffice suite of applications, including a word processor, spreadsheet, and database

Lecture 5 Discipline of Human Computer Interaction

Quality

Let us firstly look at a general definition of quality.

- Quality is conformance to specifications (British Defense Industries Quality Assurance Panel)
- Quality is conformance to requirements (Philip Crosby)
- Quality is fitness for purpose or use (Juran)
- Quality is a predictable degree of uniformity and dependability, at low cost and suited to the market (Edward Deming)
- Quality is synonymous with customer needs and expectations (R J Mortiboys)

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- Quality is meeting the (stated) requirements of the customer- now and in the future (Mike Robinson)
- Quality is the total composite product and service characteristics of marketing, engineering, manufacturing and maintenance through which the product and service in use will meet the expectations by the customer (Armand Feigenbaum)
- Totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs (ISO 8402: 1994)

What is a Product?

A product is any item or service you sell to serve a customer's need or want. They can be physical or virtual. Physical products include durable goods (like cars, furniture, and computers) and nondurable goods (like food and beverages).

Software Quality

The extent to which a software product exhibits these characteristics

- Functionality
- Reliability
- Usability
- Efficiency
- Maintainability
- Portability

Software QA Teams

- Only test requirements
- Customers and users

The Dual Nature of Usability

- Usability is both
- Strategic
- Tactical

Interdisciplinary Nature of HCI

HCI is a large interdisciplinary area emerging as 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) Industrial design (interactive products).

HCI concerned with:

- Joint performance of tasks by humans and machines
- Structure of communication between human and machine
- Human capabilities to use machines
- Algorithms and programming of interfaces
- Engineering concerns in designing and building interfaces
- Process of design, specification and implementation
- Design trade-offs

Various aspects

- Science
- Human capabilities to use machines
- Engineering
- Building interfaces
- Design
- Design tradeoffs

Case Study – Ticketing System

A small ticketing agency has many shops distributed throughout the country. It feels the need to install an efficient ticketing system for survival. Manual Issuing Procedure

- Call airlines to check for vacant seats
- Check with customer if the available seat is suitable
- Then ticket is written out manually
- Customer receipts and itinerary
- Accounting for issued tickets every two weeks

Case Study Ticketing System Research

The research on existing ticketing systems reveals computers always going wrong, lack of trust in computers, staff unable to understand messages.

The Result

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Sales figures had dropped and were disappointing a large number of sales staff had left.

Ticketing System Recommendations

- Immediate booking via Internet
- Automatic print-out of tickets, itineraries and receipts
- Direct connection between booking system and accounting system
- Elimination of booking forms
- Layout of the agency needs to be changed for staff to operate computers
- Staff training
- Changes to job design
- Support to older staff during period of change
- Changes to employment conditions must be examined
- Staff relationship with other non-techi staff members (Technology Power)

Interdisciplinary Nature of HCI

HCI is understanding the Complex Relationship between Human and Computers, Two Distinct “Species” ,Successful Integration is dependent upon the a better understanding of both Species, Hence HCI borrows and establishes its roots in Disciplines concerned with both, HCI has roots in many disciplines, HCI is interdisciplinary in nature.

Interdisciplinary Nature of HCI (Human Side)

- Cognitive Psychology
- Social Organizational Psychology
- Ergonomics and human Factors
- Linguistics
- Philosophy
- Sociology
- Anthropology

Cognitive Psychology

Understanding human behavior and mental processes

- Human information processing
- See
- Feel

- Touch
- Smell
- Taste
- How much information can be processed and remembered

Social Organizational Psychology

Studying nature and causes of human behavior in social context, Four core concerns;

- Influence of one individual on another person's attitude and behavior
- Impact of a group on its member's attitude and behavior
- Impact of a member on group's activities and structure
- Relationship between the structure and activities of different groups
- Informs designers how computers affect working practices

Ergonomics or Human Factors

To define and design tools and various artifacts for different work, leisure and domestic environment to suit the capacities and capabilities of users. Ergonomist translates the above information from the above mentioned sciences into context of design of products. Increase feelings of comfort and satisfaction

Concerns

- Hardware design
- Radiation from VDUs
- Repetitive Strain Injury (RPI)

Linguistics

- Scientific study of languages
- Command-object (delete „report“ OR „report“ delete)
- Understanding structure (syntax) and meaning (semantics)
- HCI goal is to develop natural language interfaces

Philosophy, Sociology and Anthropology

- Contribution in the sense of Soft Sciences for HCI
- Considers introduction of IT in society
- Ethnography involves observing people
- Cognitive psychology tries to predict
- Computer Supported Cooperative Writing

Interdisciplinary Nature of HCI Computer Side

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- Computer Science
- Artificial Intelligence
- Engineering
- Design

Other Disciplines

Computer Science

Provides knowledge about capability of technology developing techniques to support software design, development and maintenance.

Artificial Intelligence

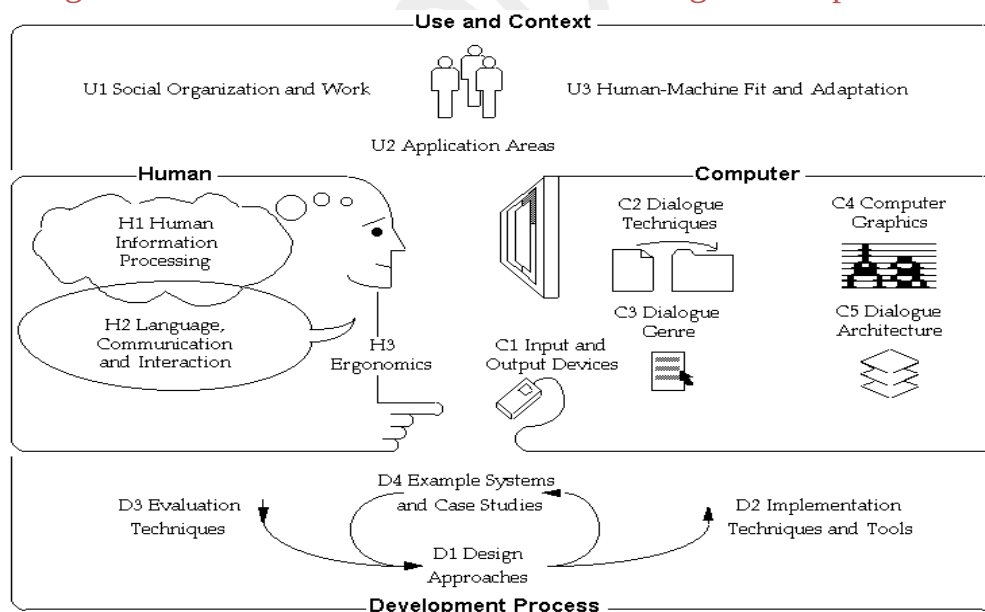
Intelligent Computing concerned with simulating human behavior HCI – development of expert and tutoring systems.

Engineering

Engineering takes finding of sciences and utilizes them in the production of artifacts.

Design

Design contributes creative skills and knowledge to this process.



Lecture 6 Cognitive Frameworks

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Cognitive Frameworks

Cognitive Framework It includes the positive and freewill aspects of human behavior.

Cognitive Psychology

Psychology is concerned primarily with understanding human behavior and the mental processes that underlie it. To account for human behavior, cognitive psychology has adopted the notion of information processing.

Cognition

The dominant framework that has characterized HCI has been cognitive. Let us define cognition first Cognition is what goes on in our heads when we carry out our everyday activities. In general, cognition refers to the processes by which we become acquainted with things or, in other words. Process by which we became acquainted with things or in other words gain knowledge:

- Understanding
- Remembering
- Reasoning
- Attending
- Creating a new idea

How Humans and Computers interact with one another in terms of knowledge transmitted by them.

Modes of Cognition

Norman (1993) distinguishes between two general modes:

1. Experiential cognition
2. Reflective cognition

Experiential cognition

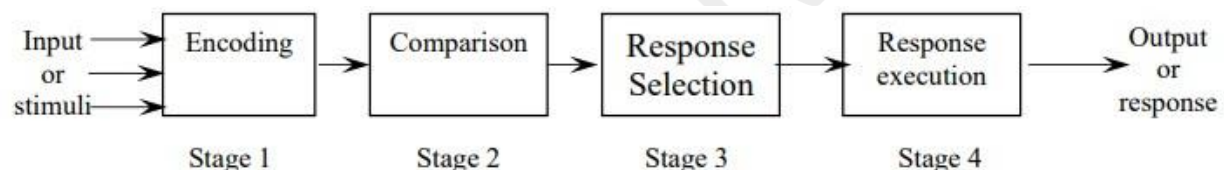
It is the state of mind in which we perceive, act, and react to events around us effectively and effortlessly. It requires reaching a certain level of expertise and engagement.

Reflective cognition

Reflective cognition involves thinking, comparing, and decision-making. This kind of cognition is what leads to new ideas and creativity. Examples include designing, learning, and writing a book.

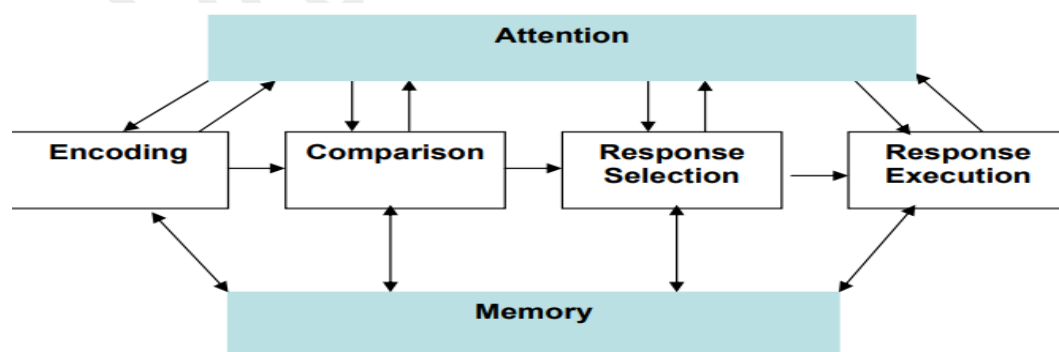
Information processing

One of the many other approaches to conceptualizing how the mind works has been to use metaphors and analogies. A number of comparisons have been made, including conceptualizing the mind as a reservoir, a telephone network, and a digital computer. One prevalent metaphor from cognitive psychology is the idea that the mind is an information processor. During the 1960s and 1970s the main paradigm in cognitive psychology was to characterize humans as information processors; everything that is sensed (sight, hearing, touch, smell, and taste) was considered to be information, which the mind processes. Information is thought to enter and exit the mind through a series of ordered processing stages.



Extending the human information processing model

Two main extensions of the basic information-processing model are the inclusion of the processes of attention and memory.



Human processor model

Human processor model or MHP (Model Human Processor) is a cognitive modeling method developed by Stuart K. Card, Thomas P. Moran, & Allen Newell (1983) used to calculate how long it takes to perform a certain task. Other cognitive modeling methods include parallel design, GOMS, and keystroke-level model (KLM).

GOMS

Card et al. have abstracted a further family of models, known as GOMS (goals, operations, methods and selection rules) that translate the qualitative descriptions into quantitative measures.

Goals

These are the user's goals, describing what the user wants to achieve. Further, in GOMS the goals are taken to represent a „memory point“ for the user, from which he can evaluate what should be done and to which he may return should any errors occur.

Operators

These are the lowest level of analysis. They are the basic actions that the user must perform in order to use the system. They may affect the system (e.g., press the „X“ key) or only the user's mental state (e.g., read the dialogue box).

Methods

As we have already noted, there are typically several ways in which a goal can be split into sub goals.

Selection

Selection means of choosing between competing methods recently, attention has focused on explaining:

- **Knowledge Representation** Models how knowledge is represented
- **Mental Models** How mental models (these refer to representation people construct in their mind of themselves, others, objects and the environment to help them know what to do in current and future situations) develop and are used in HCI

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- **User Interaction Learning** Models how user learns to interact and become experienced in using computer system.

Diff Conceptual Models VS Interface Metaphor

Conceptual Models

Conceptual models are (these are the various ways in which systems are understood by different people) to help designers develop appropriate interfaces.

Interface Metaphor

Interface metaphors are (these are GUIs that consists of electronic counterparts to physical objects in the real world) to match the knowledge requirements of users.

Recent development in cognitive psychology

With the development of computing, the activity of brain has been characterized as a series of programmed steps using the computer as a metaphor. Concept such as buffers, memory stores and storage systems, together with the type of process that act upon them (such as parallel verses serial, top-down verses down-up) provided psychologist with a mean of developing more advanced models of information processing, which was appealing because such models could be tested.

Computational Approaches

Computational approaches are very necessary and useful resources in the process of drug development. The goal of drug development is to identify a chemical compound that can fit in a specific cavity of a target protein both geometrically and chemically.

Connectionist Approaches

The connectionism approach in cognitive science is a method of studying human cognition with the help of mathematical models that are known as Artificial Neural Networks or Connectionist Networks. They usually happen to be extremely interconnected processing units that resemble neurons.

External Cognition:

This refers to the idea of utilizing external tools, objects, or resources to aid cognitive processes. Instead of relying solely on internal mental processes, individuals or systems extend their cognitive abilities by incorporating external elements. Examples include using pen and paper, calculators, or digital devices to augment memory, problem-solving, and decision-making.

Annotating and cognitive tracing

Another way in which we externalize our cognitions is by modifying representations to reflect changes that are taking place that we wish to mark. For example, people often cross things off in to-do list to show that they have been completed.

Information Visualization

A general cognitive principle for interaction design based on the external cognition approach is to provide external representations at the interface that reduce memory load and facilitate computational offloading.

Distributed cognition

Distributed cognition is a theory of human cognition that describes how information processing is dispersed across people and their workplace, their technologies, and their social organization and how information processing evolves over time.

Lecture 7 Human Input-Output Channels – Part I

Input Output channels

A person's interaction with the outside world occurs through information being received and sent input and output. In an interaction with a computer the user receives information that is output by the computer, and responds by providing input to the computer the user's output becomes the computer's input and vice versa. Input in human is mainly through the senses and output through the motor control of the effectors. There are five major senses:

- Sight
- Hearing
- Touch
- Taste

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- Smell

Of these first three are the most important to HCI. Taste and smell do not currently play a significant role in HCI, and it is not clear whether they could be exploited at all in general computer systems.

Similarly there are a number of effectors:

- Limbs
- Fingers
- Eyes
- Head
- Vocal system

Vision Human

Vision is a highly complex activity with range of physical and perceptual limitations, yet it is the primary source of information for the average person. We can roughly divide visual perception into two stages:

- the physical reception of the stimulus from outside world,
- The processing and interpretation of that stimulus.

The human eye

Vision begins with light. The eye is a mechanism for receiving light and transforming it into electrical energy. Light is reflected from objects in the world and their image is focused upside down on the back of the eye. The receptors in the eye transform it into electrical signals, which are passed to brain.

Rods

Rods are highly sensitive to light and therefore allow us to see under a low level of illumination.

There are approximately 120 million rods per eye, which are mainly situated towards the edges of the retina. Rods therefore dominate peripheral vision.

Cones

Cones are the second type of receptor in the eye. They are less sensitive to light than the rods and can therefore tolerate more light. There are three types of cone, each sensitive to a different wavelength of light. This allows color vision. The eye has approximately 6 million cones, mainly concentrated on the fovea.

Fovea

Fovea is a small area of the retina on which images are fixated.

Blind spot

Everyone has a spot in the retina where the optic nerve connects. In this area, there are no light sensitive cells, so this part of your retina cannot see. We call this the blind spot.

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Nerve cells

The retina also has specialized nerve cells called ganglion cells. There are two types:

- **X-cells**
these are concentrated in the fovea and are responsible for the early detection of pattern.
- **Y-cells**
these are more widely distributed in the retina and are responsible for the early detection of movement. The distribution of these cells means that, while we may not be able to detect changes in pattern in peripheral vision, we can perceive movement.

Visual perception

Visual perception refers to the brain's ability to make sense of what the eyes see. This is not the same as visual acuity which refers to how clearly a person sees (for example “20/20 vision”). A person can have 20/20 vision and still have problems with visual perceptual processing.

Perceiving size and depth

Imagine you are standing on a hilltop. Beside you on the summit you can see rocks, sheep and a small tree. On the hillside is a farmhouse with outbuilding and farm vehicles. Someone is on the track, walking toward the summit.

Example: Visual angle indicates how much of the field of view is taken by the object. The visual angle measurement is given in either degrees or minutes of arc, where 1 degree is equivalent to 60 minutes of arc, and 1 minute of arc to 60 seconds of arc.

Visual acuity

Visual acuity (VA) is a measure of the ability of the eye to distinguish shapes and the details of objects at a given distance.

Example: A person with normal vision can detect a single line if it has a visual angle of 0.5 seconds of arc. Spaces between lines can be detected at 30 seconds to 1 minute of visual arc. These represent the limits of human visual perception.

Law of size constancy

Size constancy refers to the fact that our perceptions of the size of objects are relatively constant despite the fact that the size of objects on the retina vary greatly with distance.

Perceiving brightness

A second step of visual perception is the perception of brightness. Brightness is in fact a subjective reaction to level of light. It is affected by luminance, which is the amount of light emitted by an object.

Perceiving color

A third factor that we need to consider is perception of color. Color is usually regarded as being made up of three components:

- hue
- intensity
- saturation

Hue

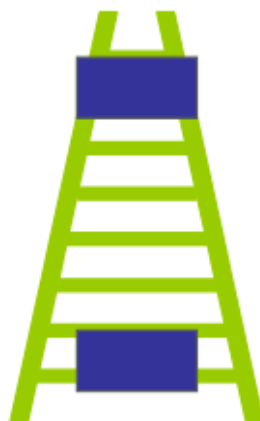
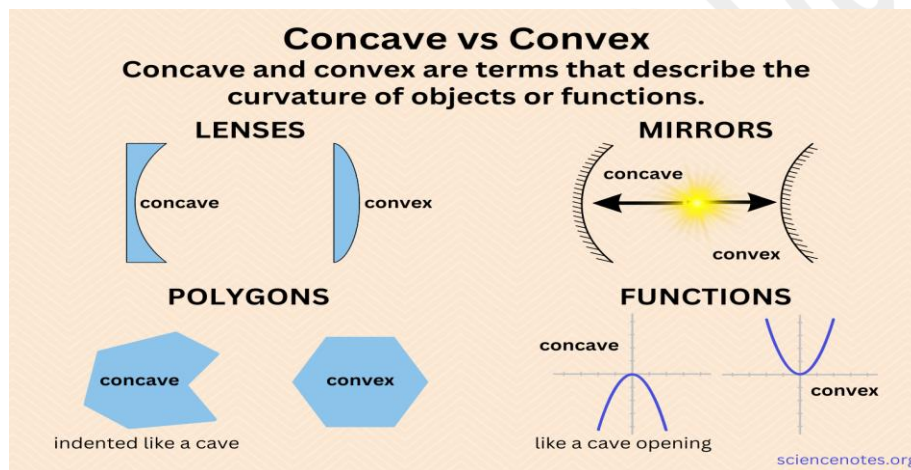
Hue is determined by the spectral wavelength of the light. Blues have short wavelength, greens medium and reds long. Approximately 150 different hues can be discriminated by the average person.

Intensity

„Intensity is the brightness of the color.

Saturation

Saturation is the amount of whiteness in the colors.



A similar illusion is the Ponzo illusion.

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Lecture 8 Human Input-Output Channels Part II

Color Theory

Color theory encompasses a multitude of definitions, concepts and design applications. All the information would fill several encyclopedias. As an introduction, here are a few basic concepts. A color circle, based on red, yellow and blue, is traditional in the field of art. Sir Isaac Newton developed the first circular diagram of colors in 1666.

PRIMARY COLORS

In traditional color theory, these are the 3 pigment colors that cannot be mixed or formed by any combination of other colors. All other colors are derived from these 3 hues. PRIMARY COLORS are Red, yellow and blue.

Secondary Colors

These are the colors formed by mixing the primary colors. SECONDARY COLORS are Green, orange and purple.

Tertiary colors

These are the colors formed by mixing one primary and one secondary color. TERTIARY COLORS are Yellow-orange, red-orange, red-purple, blue-purple, blue-green and yellow-green.

Color Harmony

Harmony can be defined as a pleasing arrangement of parts, whether it be music, poetry, color, or even an ice cream sundae. Extreme unity leads to under-stimulation, extreme complexity leads to overstimulation. Harmony is a dynamic equilibrium.

Some Formulas for Color Harmony

There are many theories for harmony. The following illustrations and descriptions present some basic formulas.

Analogous colors

Analogous colors are any three colors, which are side by side on a 12 part color wheel, such as yellow-green, yellow, and yellow-orange. Usually one of the three colors predominates.

Complementary colors

Complementary colors are any two colors, which are directly opposite each other, such as red and green and red-purple and yellow-green. There are several variations of yellow-green in the leaves and several variations of red-purple in the orchid. These opposing colors create maximum contrast and maximum stability.

Natural harmony

Nature provides a perfect departure point for color harmony. In the illustration above, red yellow and green create a harmonious design, regardless of whether this combination fits into a technical formula for color harmony.

Color Context

Central to color-in-context theory is the idea that color carries different meanings in different contexts and, therefore, has different implications for feelings, thoughts, and actions in different contexts.

Guidelines

- Opponent colors go well together (red & green) or (yellow & blue)
- Pick non-adjacent colors on the hue circle
- Size of detectable changes in color varies. For example, it is hard to detect changes in reds, purples, & greens and easier to detect changes in yellows & blue greens
- Older users need higher brightness levels to distinguish colors
- Hard to focus on edges created by color alone, therefore, use both brightness & color differences
- Avoid red & green in the periphery due to lack of RG cones there, as yellows & blues work in periphery
- Avoid pure blue for text, lines, & small shapes.
- Blue makes a fine background color

- Avoid adjacent colors that differ only in blue
- Avoid single-color distinctions but mixtures of colors should differ in 2 or 3 colors., 2 colors shouldn't differ only by amount of red

Accurate color discrimination is at $\pm 60^\circ$ degree of straight head position. Limit of color awareness is $\pm 90^\circ$ degree of straight head position

Stereopsis

Stereopsis is the computation of depth information from views acquired simultaneously from different points in space. 3D vision, binocular vision and stereopsis all mean the same thing that remarkable power of the visual sense to give an immediate perception of depth on the basis of the difference in points of view of the two eyes. It exists in those animals with overlapping optical fields, acting as a range finder for objects within reach. There are many clues to depth, but stereopsis is the most reliable and overrides all others. The sensation can be excited by presenting a different, properly prepared, view to each eye. The pair of views is called a stereopair or stereogram, and many different ways have been devised to present them to the eye.

The word stereopsis was coined from the Greek *στερεος*, solid or firm, and *οψις*, look or appearance. Since terms derived from Greek are often used in this field, it may be useful to have a brief discussion. Single and double vision are called *haplopia* and *diplopia*, respectively, from *ἁπλους* (haplous) and *διπλους* (diplous), which mean "single" and "double".

Stereopsis is the direct sensing of the distance of an object by comparing the images received by the two eyes. This is possible only when the eyes of a creature look in the same direction, and have overlapping fields. The placing of the two eyes this way gives up the opportunity of a wide field of view obtained with eyes on the sides of the head. Predators find it best to have eyes in front prey to have them on the sides. Stereopsis yields benefits for close work, such as fighting for cats and hand work for humans. Note that normal binocular vision is single, so that the two images have been fused by the brain. There is no evidence that the image resulting from the many simple eyes of an insect is not also fused in a similar way.

Although we have two eyes, we usually have only one visual world, which is a remarkable and important fact calling for explanation. Stereopsis gives a reliable

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distance clue as far away as 450 metres, Helmholtz estimated. The fineness of the comparison that must be made by the visual system is remarkable.

The brain regards this fused image as the real one, the others as mere ghosts. This skill is called free fusion, and requires considerable practice to acquire. In free fusion, both the convergence of the eyes, and their distance accommodation, are inconsistent with the actual location of the image, and must be overridden by stereopsis. It shows, incidentally, that convergence of the optic axes is not a strong depth clue. By the use of a stereoscope, one can achieve fusion without diverging the eyes, or focusing on a close object with the eyes so diverged, so no practice or skill is required. A stereoscope mainly changes the directions in which the two images are seen so that they can both be fixated by normally converged eyes. The two images are called a stereo pair.

Hearing

Hearing, or auditory perception, is the ability to perceive sounds through an organ, such as an ear, by detecting vibrations as periodic changes in the pressure of a surrounding medium.

The human ear

Hearing begins with vibrations in the air or sound waves. The ear receives these vibrations and transmits them, through various stages, to the auditory nerves. The ear comprises three sections commonly known as the outer ear, middle ear and inner ear.

Processing sound

Sound has a number of characteristics, which we can differentiate.

Pitch

Pitch is the frequency of the sound. A low frequency produces a low pitch, a high frequency, a high pitch.

Loudness

Loudness is proportional to the amplitude of the sound; the frequency remains constant.

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Timber

Timber related to the type of the sound Sounds may have the same pitch and loudness but be made by different instruments and so vary in timber.

Sound characteristics

Audible range is 20 Hz to 15 KHz. Human ear can distinguish between changes less than 1.5 Hz but less accurate at higher frequencies. Different frequencies trigger neuron activity causing nerve impulses.

Touch

The third sense is touch or haptic perception. Although this sense is often viewed as less important than sight or hearing, imagine life without it. Touch provides us with vital information about our environment.

Haptic perception involves sensors in the skin as well as the hand and arm. The movement that accompanies hands-on exploration involves different types of mechanoreceptors in the skin (involving deformation, thermo reception, and vibration of the skin), as well as receptors in the muscles, tendons, and joints involved in movement of the object (Verry, 1998). These different receptors contribute to a neural synthesis that interprets position, movement, and mechanical skin inputs. Druyan (1997) argues that this combination of kinesthetic and sensory perception creates particularly strong neural pathways in the brain.

Haptics vs Visual

The science learner, kinesthetic allows the individual to explore concepts related to location, range, speed, acceleration, tension, and friction. Haptics enables the learner to identify hardness, density, size, outline, shape, texture, oiliness, wetness, and dampness (involving both temperature and pressure sensations) (Druyan, 1997; Schiffman, 1976)

- When haptics is compared to vision in the perception of objects, vision typically is superior with a number of important exceptions.
- Visual perception is rapid and more holistic allowing the learner to take in a great deal of information at one time.

Haptic Learning

Haptic learning plays an important role in a number of different learning environments. Students with visual impairments depend on haptics for learning through the use of Braille as well as other strategies.

Movement

Movement generally refers to the act of changing physical position or location. It involves the displacement of an object or a person from one place to another. Movement can occur in various forms and scales, ranging from the simple motion of body parts, such as walking or waving, to the complex motions of celestial bodies in space.

Movement time is dependent largely on the physical characteristics of the subjects: their age and fitness, for example. Reaction time varies according to the sensory channel through which the stimulus is received. A person can react to an auditory signal in approximately 150ms, to a visual signal in 200ms and to pain in 700ms.

Movement perception

Motion perception is an important aspect of daily visual experience. It involves a substantial network of regions that contribute to different functions such as perceiving object motion, self-motion, the guidance of eye and hand movements, and the perception of the form of moving two- and three-dimensional objects.

Lecture 9 Cognitive Processes - Part I

Human Computer Interaction, so that after studying this you will be able to:

Attention

Attention is the process of selecting things to concentrate on, at a point in time, from the range of possibilities available.

Williams James says, “Everyone knows what attention is. It is the taking possession of mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought... it requires withdrawal from some things in order to deal effectively with others.”

Information presentation

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An informational presentation is common request in business and industry. It's the verbal and visual equivalent of a written report. Information sharing is part of any business or organization. Informative presentations serve to present specific information for specific audiences for specific goals or functions.

Models of Attention

There are two models of attention: *f*

- Focused attention
- Divided attention

Focused Attention VS Divided attention

Focused Attention

Focused attention, the ability to respond discretely to specific visual, auditory, or tactile stimuli, is considered the simplest form of attention. Sustained attention is the ability to maintain a consistent behavioral response over the course of an ongoing activity.

Divided attention

Divided attention is the ability to pay attention to two tasks at once such as cooking a meal while talking to a friend or driving a car and talking to a passenger at the same time neither activity is stopped in order to carry out the other activity.

Voluntary attention

A further property of attention is that can be voluntary, as when we make a conscious effort to change our attention.

Involuntary attention

Involuntary attention in this contribution refers to the processes of attending that are not elicited by intentions but by certain outside events.

Focusing attention at the interface

To enhance user attention and focus in UI design:

- Embrace minimalism with a clean, uncluttered layout.
- Maintain consistency in UI elements for ease of use.
- Utilize strategic contrast and color to highlight key features.
- Choose legible fonts and appropriate sizing for readability.

Structuring Information

Information structure helps explain why people say things in different ways. Speakers constantly make choices about how to phrase their utterances. For example, a speaker might say The aardvark chased the squirrel, The squirrel was chased by the aardvark, or What was chased by the aardvark was the squirrel.

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Memory Model

It is generally agreed that there are three types of memory or memory functions sensory buffers, short-term memory or working memory and long-term memory. It is also called the multi-store model of memory.

Characteristics of multi-store model

Characteristics of the multi-store model of memory are the various types of memory stores. These are

- **Sensory store modality-specific**, hold information for a very brief period of time (a few tenth of a second),
- **Short-term memory store** holds limited information for a short period of time (a few seconds),
- **Permanent long-term** memory store hold information indefinitely. Let's us have a detailed look of this model.
- **Sensory memory** the sensory memories act as buffer for stimuli received through the senses. A sensory memory exists for each sensory channel iconic memory for visual stimuli, echoic memory for aural stimuli and haptic memory for touch.
- **Short term memory** Short-term memory or working memory acts as a scratch pad for temporary recall of information. It is used to store information which is only required fleetingly.

Recency effect

In experiments where subjects were able to recall words freely, evidence shows that recall of the last words presented is better than recall of those in the middle. This is known as recency effect.

Primacy effect

„Better recall for items at the beginning of the list (because these items have been rehearsed more frequently than other items and thus have a greater chance of being placed in LTM).“

Long Term Memory

If short-term memory is our working memory or „scratch-pad“, long-term memory is our main resource. Here we store factual information, experiential knowledge, and procedural rules of behavior- in fact, everything that we know. It differs from short-term memory in a number of significant ways.

Long-term memory structure

There are two types of long-term memory episodic memory and semantic memory.

Episodic memory

Episodic memory represents our memory of events and experiences in a serial form. It is from this memory that we can reconstruct the actual events that took place at a given period of our lives.

Semantic memory

Semantic memory is structured record of facts, concepts and skills that we have acquired. The information in semantic memory is derived from that in our episodic memory, such that we can learn new facts or concepts from our experience.

Model for the way in which semantic memory is structured is as a network. Items are associated to each other in classes, and may inherit attributes from parent classes. This model is known as a semantic network. Semantic networks represent the associations and relationship between single items in memory. However, they do not allow us to model the representation of more complex objects or events, which are perhaps composed of a number of items of activities.

Revised Memory Model

According to revised memory model working memory is a subset of LTM.

- Some other characteristics are as under:
- Items are semantically linked.
- Items in working memory are activated.
- Activation is supplied from other linked chunks and from sensory input.

Lecture 10 Cognitive Processes - Part II

Procedural

According to declarative learning we try to find the facts about something. For example, using a computer-based application to understand a given topic. Jack Carroll and his colleagues have written extensively about how to design interfaces to help learners develop computer-based skills. A main observation is that people find it very hard to learn by following sets of instructions in a manual.

GUI and direct manipulation interface are good environments for supporting this kind of learning by supporting exploratory interaction and importantly allowing users to „undo“ their actions, i.e., return to a previous state if they make a mistake by clicking on the wrong option.

Dynalinking

The process of linking and manipulating multimedia representations at the interface is called dynalinking.

Reading, Speaking and Listening

These three forms of language processing have both similar and different properties. One similarity is that the meaning of sentences or phrases is the same regardless of the mode in which it is conveyed.

- Written language is permanent while listening is transient. It is possible to reread information if not understood the first time round.

- Reading can be quicker than speaking or listening, as written text can be rapidly scanned in ways not possible when listening to serially presented spoken works.
- Listening require less cognitive effort than reading or speaking. Children, especially, often prefer to listen to narratives provided in multimedia or web-based learning material than to read the equivalent text online.
- Written language tends to be grammatical while spoken language is often ungrammatical.
- There are marked differences between people in their ability to use language. Some people prefer reading to listening, while others prefer listening.
- Dyslexics have difficulties understanding and recognizing written words, making it hard for them to write grammatical sentences and spell correctly.
- People who are hard of hearing or hart of seeing are also restricted in the way they can process language.

Incorporating Language Processing in applications

Many applications have been developed either to capitalize on people's reading writing and listening skills, or to support or replace them where they lack or have difficulty with them. Natural language processing can bring value to any business wanting to leverage unstructured data. The applications triggered by NLP models include sentiment analysis, summarization, machine translation, query answering and many more.

Design Implications

In engineering and design circles, implications for design are often concrete suggestions of features, design solutions, and plans for action.

Problem Solving, Planning, Reasoning and Decision making

Problem solving, planning, reasoning and decision-making are all cognitive processes involving reflective cognition. They include thinking about what to do, what the options are, and what the consequences might be of carrying out a given action.

Reasoning

Reasoning is the process by which we use the knowledge we have to draw conclusions or infer something new about the domain of interest. There are a number of different types of reasoning:

- Deductive reasoning
- Inductive reasoning
- Abdicative reasoning

Deductive reasoning

Deductive reasoning derives the logically necessary conclusion from the given premises.

Inductive reasoning

Induction is generalizing from cases we have seen to infer information about cases we have not seen.

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Abdicative reasoning

The third type of reasoning is abduction. Abduction reasons from a fact to the action or state that caused it. This is the method we use to derive explanations for the events we observe.

Gestalt theory

Gestalt psychologists were answering the claim, made by behaviorists, that problem solving is a matter of reproducing known responses or trial and error. This explanation was considered by the Gestalt school to be insufficient to account for human problem solving behavior.

Problem space theory

Newell and Simon proposed that problem solving centers on the problem space. The problem space comprises problem states, and problem solving involves generating these states using legal state transition operators.

An important feature of Newell and Simon's model is that it operates within the constraints of the human processing system, and so searching the problem space is limited by capacity of short-term memory, and the speed at which information can be retrieved.

Analogy in problem solving

A third element of problem solving is the use of analogy. Here we are interested in how people solve novel problems. One suggestion is that this is done by mapping knowledge relating to a similar known domain to the new problem-called analogical mapping. Similarities between the known domain and the new one are noted and operators from the known domain are transferred to the new one.

Skill acquisition

The entire problem solving that we have considered so far has concentrated on handling unfamiliar problems. However, for much of the time, the problems that we face are not completely new. Instead, we gradually acquire skill in a particular domain area.

Lecture 11 The Psychology of Actions

Mental model

A well-known in the context of HCI, is provided by Donald Norman: „the model people have of themselves, others, the environment, and the things with which they interact. People form mental models through experience, training and instruction“.

Fact the term mental model was first developed in the early 1640s by Kenneth Craik. He proposed that thinking „...models, or parallels reality“: „If the organism carries a “small-scale model” of external reality and of its own possible actions

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within its head, it is able to try out various alternatives, conclude which is the best of them, react to future situations before they arise, utilize the knowledge of past events in dealing with the present and future, and in every way to react in a much fuller, safer, and more competent manner to emergencies which face it."

Within cognitive psychology the term mental model has since been explicated by Johnson-Laird (1983, 1988) with respect to its structure and function in human reasoning and language understanding. He argues that mental models are either analogical representations or a combination of analogical and prepositional representations. They are distinct from, but related to images. A mental model represents the relative position of a set of objects in an analogical manner that parallels the structure of the state of objects in the world. An image also does this, but more specifically in terms of view of a particular model.

Theories about thermostats

There are two commonly held folk theories about thermostats: the timer theory and the valve theory.

Timer theory

The timer theory proposes that the thermostat simply controls the relative proportion of time that the device stays on. Set the thermostat midway, and the device is on about half the time set it all the way up and the device is on all the time hence, to heat or cool something most quickly, set the thermostat so that the device is on all the time.

valve theory

The valve theory proposes that the thermostat controls how much heat comes out of the device. Turn the thermostat all the way up, and you get maximum heating or cooling.

Thermostats work by switching on

Mechanical thermostats regulate heat thanks to the expansion of their internal metallic strips. This strip carries electricity through the connected circuit, switching on the heating. As the strip heats up, one of the metals expands enough to open the circuit and switch off the heating, cooling the room down. To regulate

this mechanism on your thermostat, use the temperature dial that you can adjust to the preferred temperature. This sets the point for the circuit to switch off and on.

Why do people use erroneous mental models?

Mental models guide your perception and behavior. They are the thinking tools that you use to understand life, make decisions, and solve problems. Users may use erroneous mental models due to prior experiences, incomplete information, or misunderstandings about how a product works. This can lead to confusion, frustration, and difficulty using the product effectively.

Self-blaming

Self-blame is a cognitive process in which an individual attributes the occurrence of a stressful event to oneself. The direction of blame often has implications for individuals' emotions and behaviors during and following stressful situations.

Reason for self-blaming

Learned helplessness

The phenomenon called learned helplessness might help explain the self-blame. In psychology, learned helplessness is a state that occurs after a person has experienced a stressful situation repeatedly. They believe that they are unable to control or change the situation, so they do not try, even when opportunities for change are available.

Taught helplessness

Badly designed objects constructed so as to lead to misunderstanding faulty mental models, and poor feedback, no wonder people feel guilty when they have trouble using objects, especially when they perceive that nobody else is having the same problems. The problem is that once failure starts, it soon generalizes by self-blame to all technology.

The nature of human thought and explanation

The nature of human thought and explanation is a complex and fascinating subject that encompasses various aspects of cognition, perception, and communication.

The nature of human thought and explanation is multifaceted, involving cognitive,

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linguistic, social, and cultural dimensions. The interplay of these factors contributes to the richness and diversity of human cognition.

Three Mile Island Nuclear Power Plant

The Three Mile Island nuclear power plant, operators pushed a button to close a valve; the valve had been opened (properly) to allow excess water to escape from the nuclear core. In fact, the valve was deficient, so it didn't close. But a light on the control panel indicated that the valve position was closed.

Lockheed L-1011

Similarly many airline accidents happened just due to misinterpretations. Consider flight crew of the Lockheed L-1011 flying from Miami, Florida, to Nassau, Bahamas. The plane was over the Atlantic Ocean, about 110 miles from Miami, when the low oil pressure light for one of the three engines went on. The crew turned off the engine and turned around to go back to Miami. Eight minutes later, the low-pressure lights for the remaining two engines also went on, and the instruments showed zero oil pressure and quantity in all three engines.

How people do things

You check to see that your goal was made. So there are four different things to consider:

- the goal, what is done to the world,
- the world itself,
- The check of the world.

The action itself has two major aspects:

- Doing something and checking.
- Call these executions and evaluation

Goals do not state precisely what to do here and how to move, what to pick up. To lead to actions goals must be transformed into specific statements of what is to be done, statements that are called intentions. A goal is something to be achieved, often vaguely stated.

Action Cycle

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Human action has two aspects, execution and evaluation.

- Execution involves doing something.
- Evaluation is the comparison of what happened in the world with what we wanted to happen.

Stages of Execution

Start at the top with the goal, the state that is to be achieved. The action sequence is still a mental event noting happens until it is executed, performed upon the world.

Stages of Evaluation

Evaluation starts with our perception of the world. This perception must then be interpreted according to our expectations and then compared with respect to both our intentions and our goals.

Seven stages of action

The stages of execution (intentions, action sequence, and execution) are coupled with the stages of evaluation (perception, interpretation, and evaluation), with goals common to both stages.

Errors

Human capability for interpreting and manipulating information is quite impressive. We do make mistake. Whenever we try to learn a new skill, be it skiing, typing, cooking or playing chess, we are bound to make mistakes.

A classification of errors

There are various types of errors. Norman has categorized them into two main types, slips and mistakes:

Mistakes

Mistakes occur through conscious deliberation. An incorrect action is taken based on an incorrect decision.

Slips

Slips are unintentional. They happen by accident, such as making typos by pressing the wrong key or selecting wrong menu item by overshooting. The most frequent errors are slips, especially in well-learned behavior.

Lecture 12 Design Principles

Conceptual Model

(David Liddle) say to “The most important thing to design is the user’s conceptual model. Everything else should be subordinated to making that model clear, obvious, and substantial. That is almost exactly the opposite of how most software is designed.”

Conceptual Models and Designers

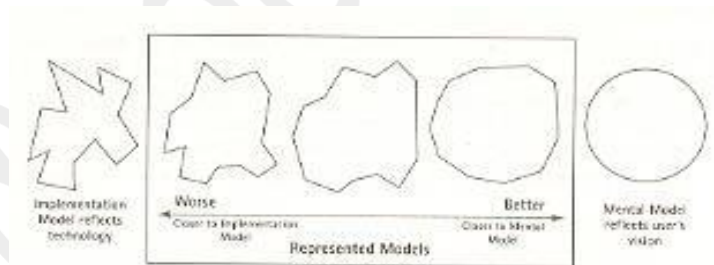
- Designer does not talk directly with user Communication via SYSTEM IMAGE.
- If SYSTEM IMAGE does not make DESIGN MODEL clear and consistent, then user will have wrong USER MODEL.

Fallacy of Designers

Designers expect USER MODEL to be the same as the DESIGN MODEL.

What Designers Should Aim For

Designers should aim to understand how each of these design principles actually impacts their work. Studying how other designers have implemented these ideas to structure their own designs is also an incredibly valuable tool in learning to create better designs.



Gulfs of Execution and Evaluation

The Gulf of Execution

The gulf of execution is the degree to which the interaction possibilities of an artifact, a computer system or likewise correspond to the intentions of the person and what that person perceives is possible to do with the artifact/application/etc.

The Gulf of Evaluation

The degree to which the system or artifact provides representations that can be directly perceived and interpreted in terms of the expectations and intentions of the user.

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The Seven Stages of Action as Design aids

The seven stages of action are:

Goal → plan → specify → perform → perceive → interpret → compare.

These steps carry the user across the gulfs of both execution and evaluation. The first stage, “goal,” sets the standard that will be used later to determine if the action was successful.

Design Principles

Design principles are fundamental concepts and guidelines that help designers create effective and aesthetically pleasing designs. A number of design principles have been promoted. Here we briefly describe the most common ones:

Visibility → Affordance → Constraints → Mapping → Consistency → Feedback

Visibility

When functions are “out of sight,” it makes them more difficult to find and know how to use. Norman describes the controls of a car to emphasize this point. The controls for different operations are clearly visible (e.g., indicator, headlights, horn, and hazard warning lights), indicating what can be done. The relationship between the way the controls have been positioned in the car and what they do makes it easy for the driver to find the appropriate control for the task at hand.

Affordance

Affordance is a term used to refer to an attribute of an object that allows people to know how to use it. There are two kinds of affordance:

- Perceived
- Real

Real

Physical objects are said to have real affordances, like grasping, that are perceptually obvious and do not have to be learned.

Perceived

User interfaces that are screen-based are virtual and do not make sense to try to design for real affordances at the interface except when designing physical devices, like control consoles, where affordances like pulling and pressing are helpful in guiding the user to know what to do.

Constraints

There are various ways this can be achieved. A common design practice in graphical user interfaces is to deactivate certain menu options by shading them, thereby restricting the user to only actions permissible at that stage of the activity.

Physical constraints

Physical constraints refer to the way physical objects restrict the movement of things. For example, the way an external disk can be placed into a disk drive is physically constrained by its shape and size, so that it can be inserted in only one way.

Logical constraints

Logical constraints rely on people's understanding of the way the world works. They rely on people's common-sense reasoning about actions and their consequences. Picking up a physical marble and placing it in another location on the phone would be expected by most people to trigger something else to happen.

Culture constraints

Culture constraints rely on learned conventions, like the use of red for warning, the use of certain kinds of signals for danger, and the use of the smiley face to represent happy emotions.

Mapping

This refers to the relationship between controls and their effects in the world. Nearly all artifacts need some kind of mapping between controls and effects, whether it is a flashlight, car, power plant, or cockpit.

Consistency

This refers to designing interfaces to have similar operations and use similar elements for achieving similar tasks. In particular, a consistent interface is one that follows rules, such as using the same operation to select all objects.

Feedback

Related to the concept of visibility is feedback. This is best illustrated by an analogy to what everyday life would be like without it. Imagine trying to play a guitar, slice bread using knife, or write a pen if none of the actions produced any effect for several seconds.

Lecture 13 the Computer

Input devices

In computing, an input device is a piece of equipment used to provide data and control signals to an information processing system, such as a computer or information appliance. Examples of input devices include keyboards, mouse, scanners, cameras, joysticks, and microphones.

Text entry devices

Keyboard:

A traditional input device featuring keys for entering alphanumeric characters, symbols, and commands. Keyboards can be physical or virtual, and they are one of the most common text entry methods.

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QWERTY Keyboard:

The standard keyboard layout used in most English-speaking countries. Named after the arrangement of its first six letters, it is widely adopted and found on computers, laptops, and many other devices.

Dvorak Keyboard:

An alternative keyboard layout designed for increased typing efficiency by placing commonly used letters on the home row, minimizing finger movement. It is an alternative to the QWERTY layout.

Chord Keyboards:

Chorded keyboards require users to press multiple keys simultaneously to input characters or commands. Each combination of keys represents a specific character or action. These keyboards are designed to be compact and efficient.

Phone Pad and T9 Entry:

Found on mobile phones, phone pads typically have a numeric keypad with letters assigned to each number. T9 (Text on 9 keys) is a predictive text entry system where users press keys multiple times to cycle through letters, allowing faster text entry on numeric keypads.

Handwriting Recognition:

Allows users to input text by writing characters with a stylus or finger on a touchscreen or graphics tablet. The system translates the written input into digital text.

Speech Recognition:

Technology that converts spoken words into text. Users can dictate text, and the system processes the speech to generate written content. Speech recognition is used for hands-free operation and accessibility.

Positioning, Pointing and Drawing

Pointing devices are input devices that can be used to specify a point or path in a one-, two- or three-dimensional space and, like keyboards, their characteristics have to be considered in relation to design needs.

Mouse:

A pointing device with buttons for controlling the cursor on a computer screen. Users move the mouse on a flat surface and the cursor responds accordingly.

Touchpad:

A touch-sensitive surface typically found on laptops. Users control the cursor by moving their fingers on the touchpad. It often includes additional functionalities like tapping and multi-finger gestures.

Trackball:

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A stationary device with a ball on its upper surface. Users rotate the ball with their fingers or palm to move the cursor. Trackballs offer an alternative to traditional mice and can be more comfortable for some users.

Joystick:

An input device often used in gaming or aviation simulations. Joysticks consist of a lever that can be tilted in different directions, allowing users precise control over the movement of an object on the screen.

Touchscreen:

A display screen that can detect and respond to touch. Users interact with the device by directly touching the screen, eliminating the need for a separate input device like a mouse or keyboard.

Eye Gaze:

An input method that tracks the movement of a user's eyes to control the cursor or make selections on a screen. Eye gaze technology is often used for accessibility, especially for individuals with limited mobility.

Cursor keys

Arrow keys are a set of four directional keys typically found on computer keyboards. They are named for the arrows or directional symbols typically engraved on them. The four cursor keys include Home, PgUp,



End, PgDn.

Display devices

Cathode Ray Tube (CRT):

A technology that was once prevalent in older computer monitors and television sets. CRT displays use electron beams to generate images on a phosphorescent screen. However, they have largely been replaced by newer technologies due to their bulkier design and energy consumption.

Liquid Crystal Display (LCD):

A flat-panel display technology widely used in computer monitors, televisions, and various portable devices. LCDs use liquid crystals sandwiched between two layers of glass or plastic to modulate light and produce images. They are known for their thin profile and energy efficiency.

Digital Paper:

A display technology designed to mimic the appearance of traditional paper. Devices using digital paper, such as e-readers, use electronic ink (e-ink) displays. E-ink displays are reflective and offer good visibility even in bright light, making them suitable for reading.

Physical Controls and Sensors:

Physical controls and sensors refer to the input devices and sensors used to interact with electronic devices. This includes buttons, switches, knobs, and touch-sensitive surfaces that allow users to control functions or provide input to a device. Sensors can include accelerometers, gyroscopes, and other detectors that respond to physical movements.

Sound Output:

Sound output refers to the technology used to produce audio from electronic devices. This can include speakers integrated into devices like computers, smartphones, and televisions. Sound can also be output through headphones, external speakers, or other audio output devices.

Touch, feel and smell

Sense of touch and feel is also used for feedback tactile feedback has its own importance and is being used in many interactive devices. We usually feel textures when we move our fingers over a surface. Technology for this is just beginning to become available.

Physical controls

A desktop computer has to serve many functions and do has generic keys and controls that can be used for a variety of purpose. In contrast, these dedicated controls panes have been designed for a particular device and for a single use. This is why they differ so much.

Environment and bio sensing

Environmental pollutants can be monitored using specific biosensors. The detection principle must be based on a suitable physical/chemical transducer integrated with a compatible biological or biomimetic element that reversibly binds the analytic.

Lecture 14 Interaction

The terms of Interaction

Domain

A domain defines an area of expertise and knowledge in some real-world activity. Some examples of domains are graphic design, authoring and process control in a factory.

Task

Tasks are the operation to manipulate the concepts of a domain. A goal is the desired output from a performed task.

Goal

A related goal would be to produce a solid red triangle centered on the canvas. So, goal is ultimate result, which you want to achieve after performing some specific tasks.

Donald Norman's Model

In which user chooses a goal, formulate a plan of action, which is then executed at the computer interface. When the plan or part of the plan has been executed, the user observes the computer interface to evaluate the result of the execution plan, and to determine further actions.

The two major parts, execution and evaluation, of interactive cycle are further subdivided into seven stages, where each stage is an activity of the user. The seven stages of action are: goal, plan, specify, perform, perceive, interpret, compare.

Gulf of execution and evaluation

Norman also describes the two gulfs, which represent the problems that are caused by some interfaces to their users.

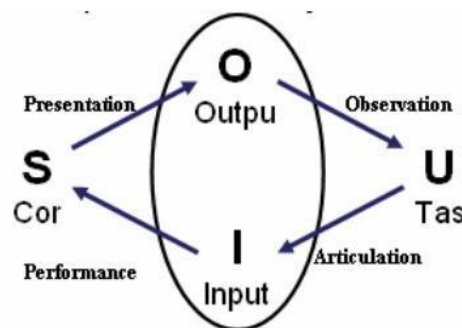
Gulf of execution

Gulf of execution is the difference between the user's formulation of the actions to reach the goal and the actions allowed by the system. The interface should therefore aim to reduce this gulf of execution.

Gulf of evaluation

The gulf of evaluation is the distance between the physical presentation of the system state and the expectation of the user. If the user can readily evaluate the presentation in terms of his goal, the gulf of evaluation is small. The more effort that is required on the part of the user to interpret the presentation, the less effective the interaction.

The interaction framework

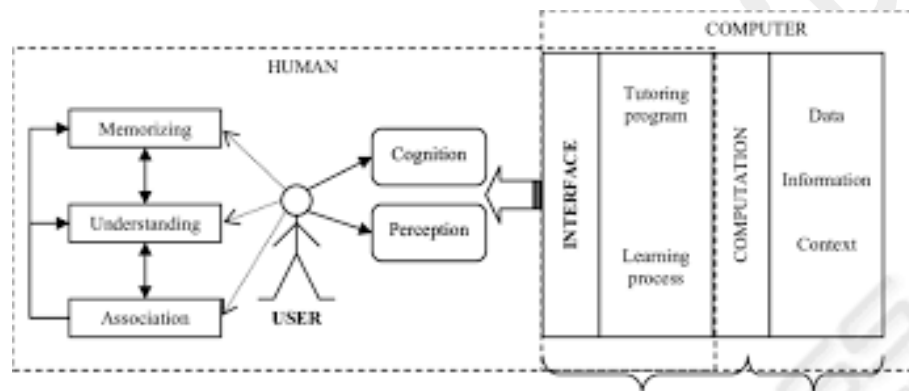


The interaction framework breaks the system into four main components. The nodes represent the four major components in an interactive system the System, the User, the Input and the Output. The system and user are each described by means of a language that can express concepts relevant in the domain of

the application. The system's language is referred as the core language and the user's language is referred as the task language.

There are four steps in the interactive cycle, each corresponding to a translation from one component to another, as shown by the labeled arcs in figure. The user begins the interactive cycle with the formulation of a goal and a task to achieve that goal. The only way the user can manipulate the machine is through the input, and so the task must be articulated within the input language, the input language is translated into the core language as operations to be performed by the system.

Frameworks and HCI



The ACM SIGCHI Curriculum Development Group presents a framework and uses it to place different areas that relate to HCI. The field of ergonomics addresses issues on the user side of the interface, covering input and output, as well as the user's immediate context. Dialog design and interface styles can be placed particularly along the input branch of the framework, addressing both articulation and performance.

Ergonomics

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Physical aspects of Interface are as follow:

- Arrangement of controls and displays
- The physical environment
- Health issues
- Use of colors

Arrangement of controls and displays

Arrangement of controls and displays To enhance performance, display sections and controls should be grouped logically. A logical arrangement will allow the user to access them rapidly. The logic of arrangement depends on the application and the domain.

Industrial Interface

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This is a connection between networks over which the control of all connected devices is managed. All data between the devices but also with the control is exchanged through this interface. So, one can say that the interface is the connection that enables the communication between systems.

Glass interfaces vs. dials and knobs

Glass Interfaces:

Glass interfaces typically refer to touchscreens or digital displays that allow users to interact directly with the displayed content. This can include smartphones, tablets, and touch-enabled monitors.

Dials and Knobs:

Dials and knobs refer to physical controls that users can turn or manipulate. They are often found on devices such as audio equipment, thermostats, or control panels.

What is direct and indirect manipulation?

Direct Manipulation:

Direct manipulation refers to a user interface design approach where users interact with graphical objects or elements on the screen in a physical and immediate way. Users can manipulate objects directly using gestures, such as clicking, dragging, dropping, or resizing. Direct manipulation is often favored for its immediacy and user-friendly nature, making it accessible to a wide range of users, including those with less technical expertise.

Indirect Manipulation:

Indirect manipulation involves interacting with objects or elements through intermediary tools or commands rather than directly manipulating them on the screen. Users typically use commands or tools to operate on objects. Indirect manipulation can offer more complex and powerful operations but may have a steeper learning curve and might be better suited for users with specific expertise or those who prefer more abstract interactions.

The physical environment of the interaction

We live through our senses. They rely on stimulation from the tasks we are focused on; people around us but also the physical environment. We breathe air and its quality affects the olfactory system; temperature is felt by thermo receptors in the skin; sound enters our ears; the visual scene is beheld by our eyes.

Health issues

Perhaps we do not immediately think of computer use as a hazardous activity but we should bear in mind possible consequences of our designs on the health and safety of users. Leaving aside the obvious safety risks of poorly designed safety-critical systems. Again these are factors in the physical environment that directly affect the quality of the interaction and the users' performance:

Physical position

Users should be able to reach all controls comfortably and see all displays. Users should not be expected to stand for long periods and, if sitting, should be provided with back support.

Temperature

Users can adapt to slight changes in temperature without adverse effect, extremes of hot or cold will affect performance and, in excessive cases, health.

Lighting

The lighting level will again depend on the work environment. However, adequate lighting should be provided to allow users to see the computer screen without discomfort or eyestrain. The light source should also be positioned to avoid glare affecting the display.

Noise

Excessive noise can be harmful to health, causing the user pain, and in acute cases, loss of hearing. Noise level should be maintained at a comfortable level in the work environment.

Time

The time users spend using the system should also be controlled.

The use of color

Ergonomics has a close relationship to human psychology in that it is also concerned with the perceptual limitations of humans. For example, the use of color in displays is an ergonomics issue. The human visual system has some limitations with regard to color, including the number of colors that are distinguishable and the relatively low blue acuity.

Interaction styles

Interaction is communication between computer and human (user). For a successful enjoyable communication interface style has its own importance. There are a number of common interface styles including Command line interface, Menus, Natural language.

Command line interface

Command line interface was the first interactive dialog style to be commonly used and, in spite of the availability of menu-driven interface, it is still widely used. Command line interface are powerful in that they offer direct access to system functionality, and can be combined to apply a number of tools to the same data.

Menu

In the menu-driven interface, the set of options available to the user is displayed on the screen and selected using the mouse, or numeric or alphabetic keys. Since the options are visible they are less demanding of the user, relying on recognition rather than recall. Such systems either can be purely text based, with the menu options being presented as numbered choices, or may have a graphical component

in which the menu appears within a rectangular box and choices are made, perhaps by typing the initial letter of the desired selection, or by entering the associated number, or by moving around the menu with the arrow keys. This is restricted form of a full WIMP system.

Natural Language

Perhaps the most attractive means of communicating with computers, at least at first glance, is by natural language. Users unable to remember a command or lost in a hierarchy of menus, may long for the computer that is able to understand instructions expressed in everyday words.

Question/answer and query dialog

Question and answer dialog is a simple mechanism for providing input to an application in a specific domain. The user is asked a series of questions and so is led through the interaction step by step.

Form-fills and spreadsheets

Form-filling interfaces are used primarily for data entry but can be useful in data retrieval applications. The formula can involve the value of other cells. Now days MS Excel is used widely In past VISICALC and Lotus 123 had been used.

The WIMP Interfaces

Currently many common environments for interactive computing are examples of the WIMP interface style, often simply called windowing systems. WIMP stands for windows, icons, menus, and pointers, and is default interface style for the majority of interactive computer systems.

Point and Click interface

In most multimedia systems and in web browsers, virtually all actions take only a single click of the mouse button. You may point at a city on a map and when you click a window opens, showing you tourist information about the city.

Three-dimensional interfaces

There is an increasing use of three-dimensional effects in user interfaces. The most obvious example is virtual reality, but VR is only part of a range of 3D techniques available to the interface designer. The simplest technique is where ordinary WIMP elements, buttons, scroll bars, etc. 3D appearance using shading, giving the appearance of being sculpted out of stone.

Lecture 15 Interaction Paradigms

The WIMP Interfaces

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In human-computer interaction, WIMP stands for "windows, icons, menus, pointer", denoting a style of interaction using these elements of the user interface. Other expansions are sometimes used, such as substituting "mouse" and "mice" for menus, or "pull-down menu" and "pointing" for pointer.

Windows

Windows are areas of the screen that behave as if they were independent terminals in their own right. A window can usually contain text or graphics, and can be moved or resized. More than one window can be on a screen at once, allowing separate tasks to be visible at the same time. Users can direct their attention to the different windows as they switch from one thread of work to another.

Icons

Windows can be closed and lost forever, or they can be shrunk to some much reduced representation. A small picture is used to represent a closed window, and this representation is known as an icon. By allowing icons, many windows can be available on the screen at the same time, ready to be expanded to their full size by clicking on the icon. Shrinking a window to its icon is known as iconifying the window.

Pointers

The Pointer is an important component of the WIMP interface, since the interaction style required by WIMP relies very much on pointing and selecting things such as icons. The mouse provides an input device capable of such tasks, although joysticks and trackballs are other alternatives. The user is presented with a cursor on the screen that is controlled by the input device.

Menus

A menu presents a choice of operations or services that can be performed by the system at a given time. Our ability to recall information is inferior to our ability to recognize it from some visual cue. Menus provide information cues in the form of an ordered list of operations that can be scanned. The pointing device is used to indicate the desired option. As the pointer moves to the position of a menu item, the item is usually highlighted to indicate that it is the potential candidate for selection. The main menu can be visible to the user all the time, as a menu bar and submenus can be pulled down or across from it upon request. Menu bars are often placed at the top of the screen or at the top of each window.

Pull-down menus are dragged down from the title at the top of the screen, by moving the mouse pointer into the title bar area and pressing the button. Fall-down menus are similar, except that the menu automatically appears when the mouse pointer enters the title bar, without the user having to press the button.

The major problems with menus in general are deciding what items to include and how to group those items. Including too many items makes menus too long or creates too many of them, whereas grouping causes problems in that items that relate to the same topic need to come under the same heading, yet many items could be grouped under more than one heading.

Keyboard accelerators

Menus often offer keyboard accelerators, key combinations that have the same effect as selecting the menu item. This allows more expert users, familiar with the system, to manipulate things without moving off the keyboard, which is often faster.

Buttons

Buttons are individual and isolated regions within display that can be selected by the user to invoke specific operations. These regions are referred to as buttons because they are purposely made to resemble the push buttons you would find on a control panel. „Pushing“ the button invokes a command, the meaning of which is usually indicated by a textual label or a small icon.

Check boxes

If a set of options is not mutually exclusive, such as font characteristics like bold, italic and underlining, and then a set of toggle buttons can be used to indicate the on/off status of the options. This type of collection of buttons is sometimes referred to as check boxes.

Toolbars

Many systems have a collection of small buttons, each with icons, placed at the top or side of the window and offering commonly used functions. The function of this toolbar is similar to a menu bar, but as the icons are smaller than the equivalent text more functions can be simultaneously displayed.

Palettes

Palettes are a mechanism for making the set of possible modes and the active mode visible to the user. A palette is usually a collection of icons that are reminiscent of the purpose of the various modes.

Dialog boxes

Dialog boxes are information windows used by the system to bring the user's attention to some important information, possibly an error or a warning used to prevent a possible error

Interaction Paradigms

An interaction paradigm is a model or pattern of human computer interaction that encompasses all aspects of interaction, including physical, virtual, perceptual, and cognitive.

Time sharing

In the 1940s and 1950s, the significant advances in computing consisted of new hardware technologies. Mechanical relays were replaced by vacuum electron tubes. Tubes were replaced by transistors and transistors by integrated chips, all of which meant that the amount of sheer computing power was increasing by orders of magnitude.

By the 1960s it was becoming apparent that the explosion of growth in computing power would be wasted if there was not an equivalent explosion of ideas about how to channel that power. One of the leading advocates of research into human-centered applications of computer technology was J.C.R Licklider, who became the director of the Information Processing Techniques Office of the US

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Department of Defense's Advanced Research Agency (ARPA). It was Licklider's goal to finance various research centers across the United States in order to encourage new ideas about how best to apply the burgeoning computing technology.

Video display units

As early as the mid-1950s researchers were experimenting with the possibility of presenting and manipulating information from a computer in the form of images on a video display unit (VDU). It was not until 1962, however, when a young graduate student at the Massachusetts Institute of Technology (MIT), Ivan Sutherland, astonished the established computer science community with the Sketchpad program, that the capabilities of visual images were realized.

Sketchpad demonstrated two important ideas

- Computers could be used for more than just data processing. They could extend the user's ability to abstract away from some levels of detail, visualizing and manipulating different representations of the same information.
- Secondly, Sutherland's efforts demonstrated how important the contribution of one creative mind could be to the entire history of computing.

Programming toolkits

Douglas Engelbart's ambition since the early 1950s was to use computer technology as a means of complementing human problem-solving activity. Engelbart's idea as a graduate student at the University of California at Berkeley was to use the computer to teach humans.

Personal computing

Programming toolkits provide a means for those with substantial computing skills to increase their productivity greatly. But Engelbart's vision was not exclusive to the computer literate. The decade of the 1970s saw the emergence of computing power aimed at the masses, computer literate or not. One of the first demonstrations that the powerful tools of the hacker could be made accessible to the computer novice was a graphics programming language for children called LOGO.

Window systems and the WIMP interface

With the advent and immense commercial success of personal computing, the emphasis for increasing the usability of computing technology focused on addressing the single user who engaged in a dialog with the computer in order to complete some work. Humans are able to think about more than one thing at a time, and in accomplishing some piece of work, they frequently interrupt their current train of thought to pursue some other related piece of work.

The metaphor

Metaphor is used quite successfully to teach new concepts in terms of ones, which are already understood. It is no surprise that this general teaching mechanism has been successful in introducing computer novices to relatively foreign interaction techniques. Metaphor is used to describe the functionality of

many interaction widgets, such as windows, menus, buttons and palettes. Tremendous commercial successes in computing have arisen directly from a judicious choice of metaphor.

Direct Manipulation

In the early 1980s as the price of fast and high-quality graphics hardware was steadily decreasing, designers were beginning to see that their products were gaining popularity as their visual content increased. As long as the user-system command line prompt computing was going to stay within the minority population of the hackers who reveled in the challenge of complexity.

He highlights the following features of a direct manipulation interface.

- Visibility of the objects of interest
- Incremental action at the interface with rapid feedback on all actions
- Reversibility of all actions, so that users are encouraged to explore without severe penalties
- Syntactic correctness of all actions, so that every user action is a legal operation
- Replacement of complex command language with actions to manipulate directly the visible objects.

Language versus action

Whereas it is true that direct manipulation interface make some tasks easier to perform correctly, it is equally true that some tasks are more difficult, if not impossible. Contrary to popular wisdom, it is not generally true that action speak louder than words. The image, projected for direct manipulation was of the interface as a replacement for the underlying system as the world of interest to the user.

Hypertext

In 1945, Vannevar Bush, then the highest-ranking scientific administrator in the US war effort, published an article entitled „As We May Think“ in The Atlantic Monthly. Bush was in charge of over 6000 scientists who had greatly pushed back the frontiers of scientific knowledge during the Second World War.

An unsuccessful attempt to create a machine language equivalent of the memex on early 1960s computer hardware led Nelson on a lifelong quest to produce Xanadu, a potentially revolutionary worldwide publishing and information retrieval system based on the idea of interconnected, non-linear text and other media forms. A traditional paper is read from beginning to end, in a linear fashion.

Multi-modality

Multimodality refers to the interplay between different representational modes, for instance, between images and written/spoken word. Multimodal representations mediate the sociocultural ways in which these modes are combined in the communication process (Kress & Van Leeuwen 2001, p. 20).

Computer-supported cooperative work

Another development in computing in the 1960s was the establishment of the first computer networks, which allowed communication between separate machines. Personal computing was all about providing individuals with enough computing power so that they were liberated from dumb terminals, which operated on time-sharing systems.

It is interesting to note that as computer networks become widespread, individuals retained their powerful workstations but now wanted to reconnect themselves to the rest of the workstations in their immediate working environment, and even throughout the world. One result of this reconnection was the emergence of collaboration between individuals via the computer called computer supported cooperative work, or CSCW.

The World Wide Web

Probably the most significant recent development interactive computing is the World Wide Web, often referred to as just the web, or WWW. The web is built on top of the Internet, and offers an easy to use, predominantly graphical interface to information, hiding the underlying complexities of transmission protocols, addresses and remote access to data.

Ubiquitous computing

In the late 1980s, a group of researchers at Xerox PARC led by Mark Weiser initiated a research program with the goal of moving human-computer interaction away from the desktop and out into our everyday lives Weiser observed.

Sensor-based and context-aware interaction

The yard-scale, foot-scale and inch-scale computers are all still clearly embodied devices with which we interact, whether or not we consider them „computers“. There are an increasing number of proposed and existing technologies that embed computation even deeper, but unobtrusively, into day-to-day life.

Lecture 16 HCI Process and Models

Software product

The extent to which a software product exhibits these characteristics

- Functionality
- Reliability
- Usability
- Efficiency
- Maintainability
- Portability

In fact, we can understand the nature of usability in two aspects

- Strategic

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- Tactical

Strategic aspect guides us to think about user interface idioms –in other words, the way in which the user and the idiom interact.

Tactical aspects give us hints and tips about using and creating user interface idioms, like dialog boxes and pushbuttons.

Ignorance about users

It is a sad truth that the digital technology industry doesn't have a good understanding of what it takes to make users happy. In fact, most technology products get built without much understanding of the users.

Conflict of Interest

A second problem affects the ability of vendors and manufacturers to make users happy. There is an important conflict of interest in the world of digital product development the people who build the products programmers are usually also the people who design them. Programmers are often required to choose between ease of coding and ease of use.

How can you achieve success?

The third reason that digital technology industry isn't cranking out successful products is that it has no reliable process for doing so. Or, to be more accurate, it doesn't have a complete process for doing so. Engineering departments follow or should follow rigorous engineering methods that ensure the feasibility and quality of the technology.

Evolution of Software Development Process

Software Evolution is a term which refers to the process of developing software initially, then timely updating it for various reasons, i.e., to add new features or to remove obsolete functionalities etc.

Originally programmers did it all

In the early days of software industry smart programmers dreamed up useful software, wrote and even tested it on their own. But as their businesses grew, the software business and software business and software products became more complicated.

Managers brought order

Inevitably, professional managers were brought in. Good product managers understand the market and competitors. They define software product by creating requirements documents. Often, however, requirements are little more than a list of features and managers find themselves having to give up features in order to meet schedule.

Testing and design became separate steps

Testing became a separate discipline and separate step in the process. In the move from command-line to graphical user interface, design and usability also became involved in the process, though often only at the end, and often only affecting visual presentation.

Design must precede the programming effort

A goal directed design approach to software development means that all decisions proceed from a format definition of the user and his or her goals. Definition of the user and user goals is the responsibility of the designer, thus design must precede programming.

Design

Design, according to industrial designer Victor Papanek, is the conscious and intuitive effort to impose meaningful order. Cooper proposes a somewhat detailed definition:

- Understanding the user's wants, needs, motivations, and contexts
- Understanding business, technical, and domain requirements and constraints
- Translating this knowledge into plans for artifacts whose form content, and behavior is useful, usable and desirable, as well as economically viable and technically feasible.

Three dimensions of designs

The act of designing, as previously defined, is a function of 3 dimensions: thinking, doing, and environment. Their interplay and notice the underlining assumption that a human-centered (or design-driven) culture is a function of mindsets and environment;

$$C=f(M/E)$$

Definition interaction design

Simply put, interaction design is the definition and design of the behavior of artifacts, environment, and systems, as well as the formal elements that communicate that behavior. Unlike, a traditional design discipline, whose focus has historically been on form and, more recently, on content and meaning, interaction design, seeks first to plan and describe.

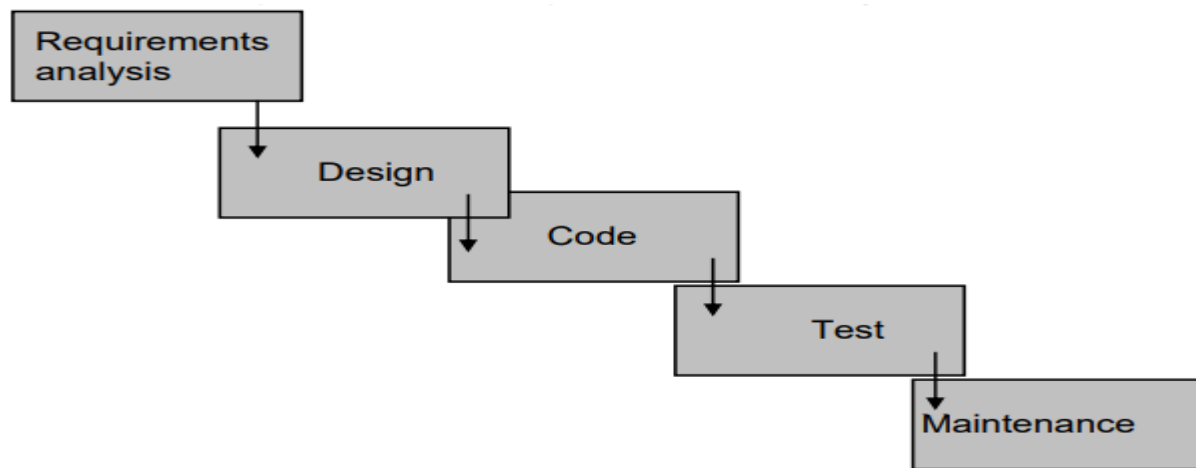
Lecture 17. HCI Process and Methodologies

Lifecycle models

The term lifecycle model is used to represent a model that captures a set of activities and how they are related. Sophisticated models also incorporate a description of when and how to move from one activity to the next and a description of the deliverables for each activity. The reason such models are popular is that they allow developers, and particularly managers, to get an overall view of the development effort so that progress can be tracked, deliverables specified, resources allocated, targets set, and so on.

The design of software systems

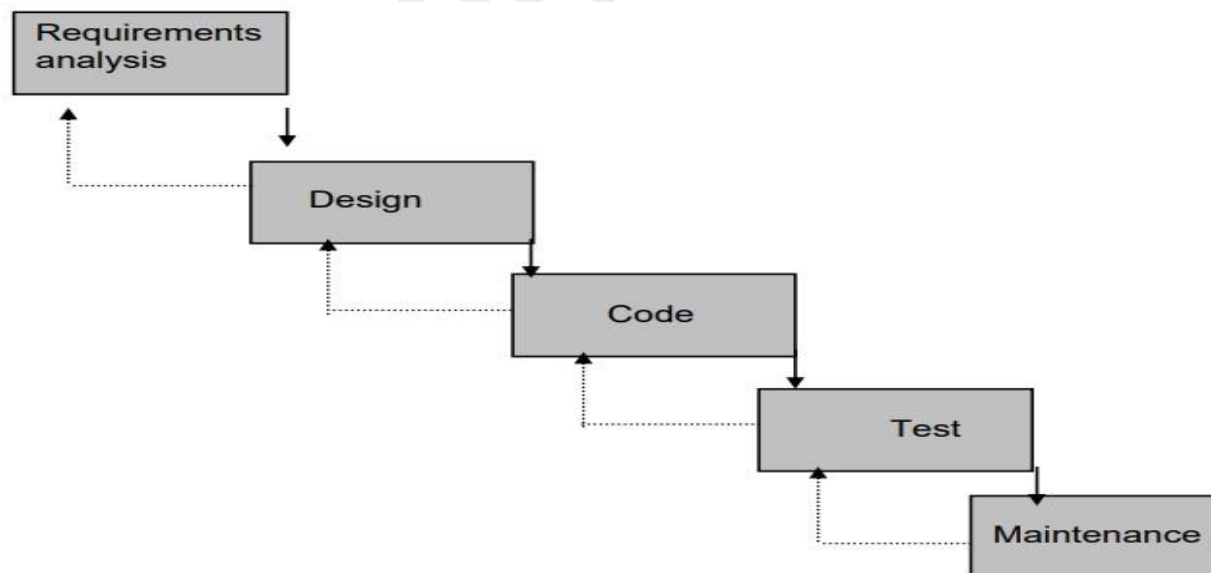
The traditional view of software engineering characterizes the development of software as consisting of number of processes and representations that are produced in an essentially linear fashion. This is often called waterfall model, because the output of each process „tumbles down“ neatly to the next activity.



The waterfall lifecycle was the first model generally known in software engineering and forms the basis of many lifecycle in use today. This is basically a linear model in which each step must be completed before the next step can be started.

Flaws of waterfall model

One of the main flaws with this approach is that requirements change over time, as businesses and the environment in which they operate change rapidly. This means that it does not make sense to freeze requirements for months, or maybe years while design and implementation are completed.

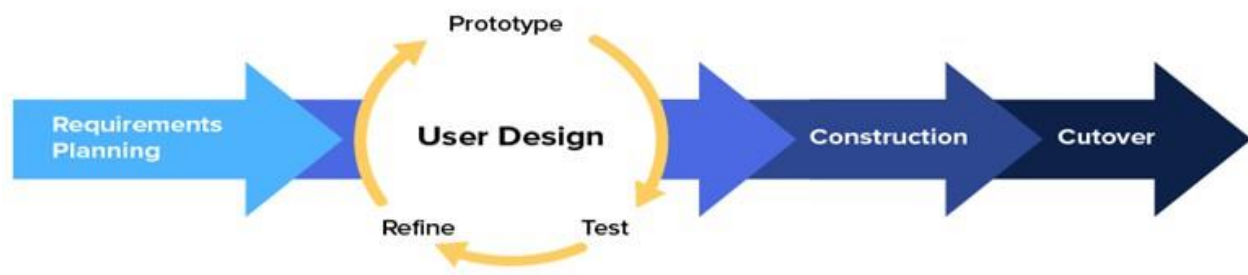


The spiral lifecycle model

For many years, the waterfall formed the basis of most software developments, but in 1988 Barry Boehm suggested the spiral model of software development. Two features of the spiral model are immediately clear from figure: risk analysis and prototyping.

Rapid Application Development (RAD)

During the 1990s the drive to focus upon users became stronger and resulted in a number of new approaches to development. The Rapid Application Development (RAD) approach attempts to take a user-centered view and to minimize the risk caused by requirements changing during the course of the project.



Two key features of a RAD project are:

- **Time-limited cycles of approximately** six months, at the end of which a system or partial system must be delivered. This is called time-boxing. In effect, this breaks down a large project into many smaller projects that can deliver product incrementally, and enhance flexibility in terms of the development techniques used and the maintainability of the final system.
- **JAD (Joint Application Development) workshops** in which users and developers come together to thrash out the requirements of the system. These are intensive requirements-gathering sessions in which difficult issues are faced and decisions are made. Representatives from each identified stakeholder group should be involved in each workshop so that all the relevant views can be heard.

DSDM (Dynamic Systems Development Method)

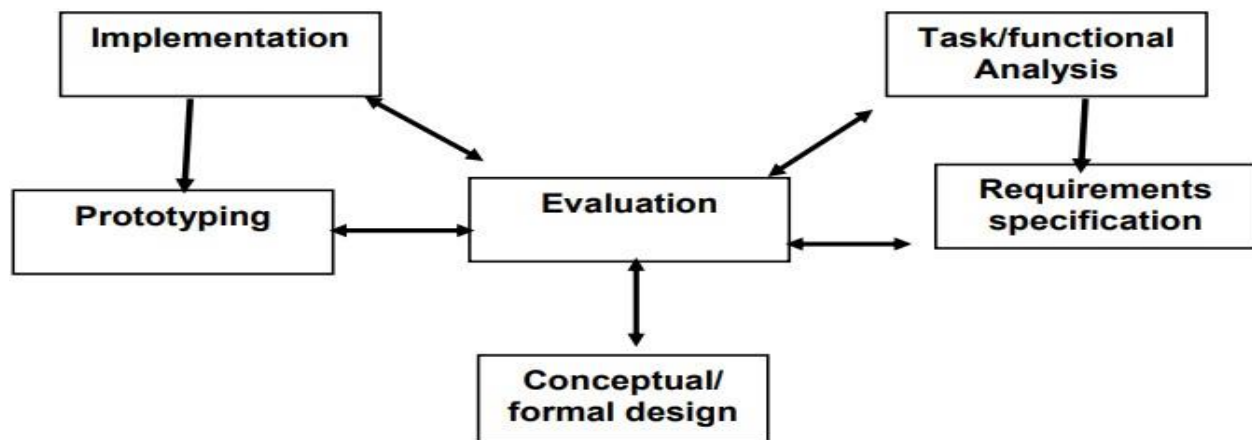
A basic RAD lifecycle has five phases (as shown in figure): project set-up, JAD workshops, iterative design and build, engineer and test final prototype, implementation review. The popularity of RAD has led to the emergence of an industry-standard RAD based method called DSDM (Dynamic Systems Development Method).

Lifecycle models in HCI

Interaction design has emerged in the field of HCI. Fewer lifecycle models have arisen from this field than from software engineering and, as you would expect, they have a stronger tradition of user focus.

The Star Lifecycle model

Involved in software engineering were looking for alternatives to the waterfall lifecycle, so too were people involved in HCI looking for alternative ways to support the design of interfaces. In 1989, the Star lifecycle model was proposed by Hartson and Hix .



They identified two different modes of activity

- analytic mode
- synthetic mode

The former is characterized by such notions as top-down, organizing, judicial, and formal, working from the systems view towards the user's view the latter is characterized by such notions as bottom-up, free-thinking, creative and adhoc, working from the user's view towards the systems view. Interface designers served in software designers.

Analytic Thinking:

Analytic thinking involves breaking down a problem or situation into its individual components to understand it more thoroughly. It often relies on logical reasoning, critical analysis, and a focus on details. Analytic thinkers tend to emphasize precision and accuracy in their examination of information.

Synthetic Thinking:

Synthetic thinking involves integrating various elements or pieces of information to form a cohesive whole or a new understanding. It's a more holistic approach that looks at the big picture, connections, and relationships between different components. Synthetic thinkers often emphasize creativity and innovation in their problem-solving.

The Usability engineering lifecycle

The Usability Engineering lifecycle was proposed by Deborah Mayhew in 1999. Many people have written about usability engineering, and as Mayhew herself says, "I did not invent the concept of a Usability Engineering Lifecycle. Nor did I invent any of the Usability Engineering tasks included in lifecycle....".

The Goal-Directed Design Process

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Goal-directed design focuses on the rationale and motivation of the developers in a particular project, rather than building it off small tasks and functional details. The basis of goal-directed design is in analyzing data and conducting comprehensive research to assess user behaviors, habits, and goals.

Bridging the gap

The role of design in the development process needs to be change we need to start thinking about design in new ways, and start thinking differently about how product decisions are made.

Design as product definition

Design has, unfortunately, become a limiting term in the technology industry. Design, when properly deployed identifies user requirements and defines a detailed plan for the behavior and appearance of products. In other words, design provides true product definition, based on goals of users, needs of business, and constraints of technology.

Designers as researchers

If design is to become product definition, designers need to take on broader roles than that assumed in traditional design, particularly when the object of this design is complex, interactive systems. One of the problems with the current development process is that roles in the process are overspecialized Researchers perform research, and designers perform design.

Lecture 18 Goal-Directed Design Methodologies

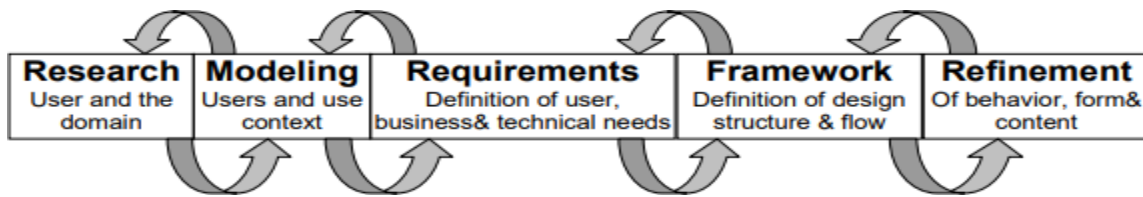
Goal-Directed Design Model

Goal-directed design is an approach founded by Alan Cooper, which he described in his book that first came out in 1995. The technique's intention is to understand the essence of users' needs and their behavior, to eventually create a product whose interface and pursuit satisfy those requirements.

A process overview

Goal-Directed Design combines techniques of ethnography, stakeholder interviews, market research, product/literature reviews, detailed user model, scenario-based design, and a core set of interaction principles and patterns. It provides solutions that meet the needs and goals of users, while also addressing business/organizational and technical imperatives. This process can be roughly divided into five phases:

- Research
- Modeling
- Requirements Definition
- Framework Definition
- Refinement



Research

The research phase employs ethnographic field study techniques (observation and contextual interviews) to provide qualitative data about potential and/or actual users of the product. It also includes competitive product audits, reviews of market research and technology white papers, as well as one-on-one interviews with stakeholders, developers, subject matter experts (SMEs), and technology experts as suits the particular domain.

Modeling

During the modeling phase, usage and workflow patterns discovered through analysis of the field research and interviews are synthesized into domain and user models. Domain models can include information flow and workflow diagrams. User models, or personas, are detailed composite user archetypes that represent distinct groupings of behavior patterns, goals, and motivations observed and identified during the research phase.

Possible user persona type designations include:

- **Primary:** the persona's needs are sufficiently unique to require a distinct interface form and behavior
- **Secondary:** primary interface serves the needs of the persona with a minor modification or addition
- **Supplement:** the persona's needs are fully satisfied by a primary interface
- **Served:** the persona is not an actual user of the product, but is indirectly affected by it and its use
- **Negative:** the persona is created as an explicit, rhetorical example of whom not to design for

Framework definition

In the framework definition phase, teams synthesize an interaction framework by employing two other critical methodological tools in conjunction with context scenarios. The first is a set of general interaction design principles that, like their visual design counterparts, provide guidance in determining appropriate system behavior in a variety of contexts

Refinement

The refinement phase proceeds similarly to the framework definition phase, but with greater focus on task coherence, using key path and validation scenarios focused on storyboarding paths through the interface in high detail. The culmination of the refinement phase is the detailed documentation of the design, a form and behavior specification, delivered in either paper or interactive media as context dictates.

Goals, not features, are key to product success

Programmers and engineers people who are intrigued by technology share a strong tendency to think about products in terms of functions and features.

Types of users

Most users are neither beginners nor experts instead they are intermediates. The experience level of people performing an activity requiring knowledge or skill, if we graph number of people against skill level, a relatively small number of beginners are on the left side, a few experts are on the right, and the majority intermediate users are in the center.

Optimizing for intermediates

Let's contrast our bell curve of intermediates with the way that software is developed. Programmers qualify as experts in the software they code because they have to explore every possible use case, no matter how obscure and unlikely, to create program code to handle it. Their natural tendency is to design implementation model software with every possible option given equal emphasis in the interaction, which they, as experts, have no problem understanding.

What perpetual intermediates need

Perpetual intermediates need access to tools. They don't need scope and purpose explained to them because they already know these things. Tooltips are the perfect perpetual intermediate idiom. Tooltips say nothing about scope and purpose and meaning they only state function in the briefest of idioms, consuming the least amount of video space in the process.