People-Oriented Computing

- Computer science is a broad field that has ever increasing impact on our lives and our world.
- Humans shape the direction of computing as individuals, as groups and as a collective society.
- Computing in turn shapes how we work, how we engage with friends and family, how society functions.

Interaction and Interaction Paradigms

Communication as Interaction

Important questions:

- How do we communicate and why ? We communicate verbally, or via body language (non-verbal, for example hand gestures). We communicate because we want to exchange informations, humans are curious, we also communicate to learn from others, we also work in groups to achieve things.
- What is language ? Language is a tool that we have to communicate
- What else do we use to communicate ?
- What do we need in order to communicate?

Communication as Interaction means:

- Ability, and channels of expressing intent, state or information
- Ability, and channels of receiving input
- Enough shared understanding to interpret what is being communicated and respond appropriately

➔ With humans, abilities develop naturally and structures have evolved over a long time

Interaction Paradigms

Are successful approaches to interactive systems, that have helped make it easier to use technology.

Time Sharing

Means a single computer could support multiple users at once. So programming became an interactive activity. But this gave rise to the hacker who could create increasingly complex programs (the hacker is a person who makes complex programs, not the one we know today who hacks security of banks, etc.). It created a shift from programming as pre-planned set of instructions for a computer to an exchange between programmer and computer. (=Collaboration between human and computer)

Hardware advances in the 1940s and 1950s and let to a massive increase in computing power:

Mechanical relays -> vacuum electron tubes -> transistors -> integrated chips

Time sharing(1950s-1960s)

Batch session :

-Previous approach

Individual programmers submitted complete jobs on punched cards or paper tape to an operator.

The operator ran individual jobs on a computer →slow way of programming

Video Display Units (→visual) (1950s-1960s)→Data represented visually, it was intuitive for humans.

There was early research in video display units in the 1950s for displaying images for military purposes. In 1962 Ivan Sutherlands Sketchpad program, developed at MIT, led to a breakthrough:

- Allowed data to be represented Visually, abstracted, manipulated and changed
- Enabled truly visual interaction
- A more human way of interacting with data
- Computer adapting to humans way of thinking rather than vice versa

Programming Toolkits (1960s)

The previous thinking was that computers are complex technology that can only be used by a few experts and specialists. Douglas Engelbart had a vision: To enable humans to use computers to learn. He created programming tools that allow people to create complex programs more easily. You can now combine small programming components to create larger ones (=bootstrapping).

Personal Computing (1970s-1980s)

It is the notion of computing for the masses. There was no need for substantial computing skills in order to benefit from computers (people can benefit from computers without any required skill).

Seymour Papert created a programming language for children called LOGO :

- Demonstrated that powerful tools for hackers could be used by novices
- Made use of a graphical “turtle” that could be commanded to draw shapes through simple English-based phrases: e.g. ‘turn left’, ’forward’
- Illustrated that ease of use makes a system more powerful

Personal Computing

Alan Kay believed the future of computing was small, powerful machines dedicated to single users – personal computers. This was a shift away from mainframe computing and time sharing. With other PARC (Palo Alto Research Center) researchers, created Smalltalk, a simple but powerful, visually based programming environment especially for personal computing. Kay also conceived of the Dynabook in the 1970 s, a handheld personal computer for children.

Windows and WIMP (1980s)

The advent of personal computing led to a focus on increased usability of single-user interaction with computers. Previous interfaces were command-line based. Now we got increased support for engaging in multiple tasks at once, with human in control. Multiple threads of interaction were supported in conventional command line interfaces and became complicated and difficult to manage. Window-based systems are supported through physical and logical separation of tasks.

The Xerox Star computer introduced the first commercial WIMP interface. Had an interface based on Windows, Icons, Menus and Pointers (=WIMP)

Interface Metaphors

Metaphors hep people learn new concepts by putting them in terms of known concepts

➔ e.g. LOGO’s metaphor of a turtle dragging its tail in the dirt

Metaphors applied to computer interactions make unfamiliar concepts familiar and reduce the perception of complexity or difficulty.

A metaphor represents complex and hard topics in easier ways to understand (more intuitive).

Window and WIMP interfaces make extensive use of real- world metaphors:

- Windows
- Buttons
- Menus
- Palettes

Xerox Star and successors made use of an office desktop metaphor :

- Desktop
- Folders
- Trash Can
- Etc.

Metaphors are naturally limited as it is not possible to completely map one set of concepts onto another. But watch out : Mismatches and false expectations can occur (Folders within Folders, Dragging media into trash to eject)

Direct Manipulation (1980s)

Traditional command line interfaces provided very limited feedback in interactions. Advancement in displays allowed for rapid audio and visual feedback with every interaction.

Direct Manipulation

Rapid feedback facilitated an interaction technique called direct manipulation. It creates the illusion of operating directly on data and objects, rather than giving commands to a computer. (Keyboard shortcuts are not Direct Manipulation).
Features of direct manipulation are :

- Visibility of all objects of interest
- Incremental action at the interface with rapid feedback on all actions
- Reversibility of all actions so that users can explore without severe penalties
- Syntactic correctness of all actions so that possible action is a legal operation
- Replacement of complex command languages with actions to manipulate visible objects directly

The first commercial success of a direct manipulation interface was the Apple Macintosh computer (1984). It made files and directory structure visible to the user. Operations such as moving files between directories were mirrored in an action on a visible document that could be picked up and dragged. It was impossible to formulate a syntactically incorrect command. In addition there were continual visual feedbacks provided while the operation was being carried out.

Hypertext (1940s-1960s)

In 1945 Vannevar Bush published ‘As we may think’. The article was in response to the proliferation of scientific knowledge produced during WWII and the challenges of keeping track of the growing body of scientific literature. Bush believed that keeping abreast of the increasing flow of information was crucial for progress.

Hypertext

‘As we may think’ proposed an innovative future for information storage and retrieval to improve human capacity of knowledge access. The proposed ‘memex’ apparats was a desk with the ability to produce and store massive amounts of photographic copies of documents. Memex could keep track of links between parts of different documents, created an interconnected mesh of date, similar to information storage in the human brain. This was a revolutionary idea to store not only information between associations among information. The memex was never built.

Multi-Modality

It enables the use of multiple channels of human communication means of interact. It allows people to engage in multiple tasks simultaneously. Conventional computer systems with keyboard, pointing device, visual display and audio output are inherently multimodal. However, genuinely multimodal systems rely more heavily on simultaneous or flexible use of multiple communication channels.

Interaction Paradigms (Part 2) Computer-

Supported cooperative work

The advent of computer networks began in the 1960s, by enabling computers to communicate with each other.

Networks facilitated collaboration among individuals using computers resulting in CSCW (=Computer-Supported Cooperative Work) systems.

A transition started to happen from systems for individual use to systems for group and organizational use. CSCW systems allowed for interaction between humans via computers and need to support the needs of multiple users. Email is a good example of a CSCW system. Subsequent computer-based communication tools and social media platform origin from this paradigm.

It's easier for humas to communicate with each other through computers.

The World Wide Web (1990s)

The internet refers to a collection of computers linked by data connections. Although the internet had been in existence since the 1960s there were no interfaces to make it easily usable and accessible.

The first browsers were text-based browsers.

The World Wide Web

In 1989, Tim Berners-Lee started the World Wide Web project as a way to facilitate distribution of scientific data over the internet. The WWW provides access to information on the internet through standard protocols, notations and addressing systems. The first WWW browser (1991) was text based.

The WWW was a revolutionary paradigm. It lowered the barrier for access to the internet and for creating and publishing information. This lead to the rapid growth and increased value of internet. Increased access to internet led to increase in computer purchases and use (=Snowball-Effect)
The World Wide Web it’s a tool to access the internet
WWW has been an interaction advancement.

Agent-Based Interfaces

Is a departure from direct manipulation. It creates the illusion of someone working on your behalf to perform a task. It can perform repetitive tasks, respond to events and learn from user actions. We’ve got now the illusion of an agent working with us. We’re the one actively engaging with data. And this is the opposite of command line bases. Agents can be simple actors that follow commands or intelligent and proactive. An early example was Eager, a cat icon, that would observe HyperCard programmers and suggest next actions.(needs to be useful and not annoying !). Siri, Alexa, Google assistant are great example of an useful agent and agent interaction.

Ubiquitous Computing (1990s-2000s)→It’s the reality we are living now

Researchers at Xerox PARC attempted to move computing ‘off the desktop’ and into everyday life. This was a big push : Individual Computer which does personal stuff. In 1991 Mark Weiser wrote ‘The computer for the 21st century’ which introduced the vision of Ubiquitous Computing. This made computing seamless with everyday activities (since then the computer wasn’t an everyday activity). Computing would be available at different scales from handheld to wall-size displays. It also refers to a shift in computer to human ratios:

1950: Many Humans one computer

1970-1980: one computer to one human

1990s-present: many computers to one human. (almost every human now has more than one computing device (e.g. smartphone, computer, tablet)

Sensor-based and context-aware interaction

Context-aware computing (computer knows who’s using it, they’re understanding) extends the notion of ubiquitous computing. More invisibility and seamlessness of computing with everyday life came up. The information was now gathered from people’s activities through sensing and context. The sensed information is used by systems to provide functionality and support for human activities. But there were still some unsolved problems : Privacy (gathered information, how to use) and systems that act based on collected data using artificial intelligence may also make poor decisions or act in ways that are undesirable (e.g. the System provides the wrong interaction).

Augmented/Virtual Reality

Augmented Reality : Combines physical world and digital content. But it requires knowledge of environment. (QR codes, IR sensors)

Virtual Reality replaces physical world with digital world. It is a ‘full immersion’ and recognizes gesture and senses your full body.

Lecture 2

Humans and Interactive Systems

Interactive system

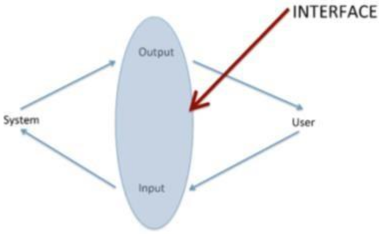
The traditionally purpose is to aid a user in accomplishing a goal within application domain. A domain is an area of expertise and knowledge in a real world activity, which consists of concepts. A task is an operation to manipulate concepts within a domain. And least a goal is a desired output from a task or sequence of tasks.

An Interaction Framework

It has four major components:

- The system
- The user
- The input
- The output

Every system has its own language. Same as every user has its own language. Users can manipulate the system only through the input. And the state of the system can only be communicated to the user through the output.

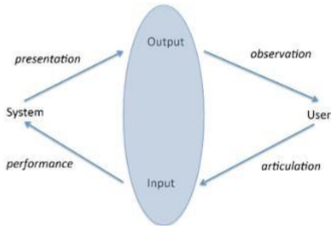


The Interface

The interface of an interactive system can be thought of as the combination of the input provided by the user and the output provided by the system. Interface serves as the “translator” between the system and the user (If the user and the system want to communicate they need the interface).

The user needs to be able to articulate his goals and tasks in the input language specified by the interface. nput needs to be translated into stimuli for the system upon which the system can perform. New state of the system must be presented as output as specified by the interface. And in addition the output needs to be observed and interpreted by the user.

For a system-centric formulation, an interaction framework focuses what comes into and out of the system. On the other hand the people-centric view would consider a human receiving input from a system and providing output to it.



Look slide 35 lecture 2 for an example!

Input-Output Channels

Human-centric models of interaction

- The Model Human Processor(Card, Moran, Newell):

It considers the human as an input-output machine that processes physical stimuli and produces a physical response.

- The 7-Stage Model of Interaction (Don Norman):

It conceives of interaction in two human-centric phases of execution and evaluation in the world.

Human Input and Output

Inputs to humans occur primarily through the five senses (vision, hearing, touch, smell, taste). And human output occurs through motor control of effectors/physical action (limbs, head, eyes, vocal system, fingers)

In an interactive system other input than the five senses are still rare. On the other hand output (output is the way humas respond to the screen) is traditionally finger and hand movement (keyboard, touchscreens..). There are now also other outputs increasingly being used (head-movement, voice commands etc.) which depends on technological progress.

Vison as Input

There are two stages of vision:

- The physical reception of stimulus from the outside world (as example light..)
- And processing and interpretation of the stimulus.

Vision: Receiving Stimulus

The light is reflected by objects in the world and forms an image which is received by the eye. The image is focused(cornea and lens) upside- down on the back of the eye (retina). Photoreceptors transform the stimulus into electrical signals which are transmitted to the brain. (slide 44 lect. 2 example)

The retina has two types of photoreceptors:

- The rods (120 Million per eye):

Which is concentrated in the periphery of the retina and which is highly sensitive to light and permit vision in low light situations. But they’re unable to resolve fine details.

- The cones (6 million per eye):

Which are more light tolerant/less light sensitive. There are three types, each sensitivity to a different wavelength. It allows for color vision (RGB) and is concentrated on fovea (center of retina) where images are focused.

Perceiving Size and Depth

The size of an image on the retina is specified as a visual angle. Objects of the same size at different distances have different visual angles.

If two objects of different sizes at are at the same distance, the larger object will have a larger visual angle. If two objects of the same size are at a different distance, the closer object will have a larger visual angle. The visual angle indicates how much of the field of view is taken up by the object. An object does not appear to become smaller as it moves further away even though its visual angle becomes smaller. The depth perception makes uses of cues:

- Position relative to other objects
- Size relative to other objects
- Familiarity

Perceiving Brightness

Brightness is a subjective response to levels of light. It is affected by luminance – the measurable amount of light emitted by an object. The contrast is a function of luminance of an object in relation to the luminance of its background. The visual system can compensate for changes in brightness. The rods predominate in low-light conditions,, they provide less detail. The visual acuity increases with increased luminance. When things re bright the cones take over and allow for more detailed vision.

Perceiving Color

Color has three components:

- Hue: The wavelength of the light (short for blue, long for red)
- Intensity: The brightness of the color
- Saturation: The amount of whiteness in the color

Humans can perceive around 7 million different colors but generally can only identify about 10. There are three types of cones for perceiving color, corresponding to red, green, and blue. Cones are concentrated in the fovea so color vision is best in the center of the field vision. Blue cones are the last frequently occurring, which makes blue acuity lower.

Visual Processing
Is known as transformation and interpretation of a complete image from light that is provided onto the retina. It compensates for image movement (we move and we do not stay still all the time) on the retina and changes in luminescence and color. (=object stays the same). It also resolves ambiguity based on expectations and experience. It compensates also for incomplete information and it can overcompensate sometimes.

Reading
Is an especially important aspect of visual perception and processing in interactive systems. Perception and processing is not strictly serial. The eye fixates and then jumps in the text, and it makes regressions while reading (e.g. the paragraph of a book is not read continuously but the eye jumps forward). Words are recognized as whole shapes rather than letter by letter! So manipulations to word shape can slow reading speed and reduce accuracy.

Hearing
Is generally regarded as the second most important sense to people with typical sensory abilities. Is a continuous channel of input (we can't turn our hearing off, e.g. if there is noise around we can't avoid it, we will hear it anyway because it enters through our ears; we can't decide what we are listening to, the sound just comes in)

Hearing: Receiving Stimulus
The soundwaves pass through the outer ear auditory canal. The waves vibrate the tympanic membrane, these vibrate the ossicles and the ossicles vibrate the cochlea. Vibration is transferred to cochlea liquid. The cochlea liquid vibrations bend the inner ear cilia and the cilia releases chemical transmitter which causes impulses in auditory nerve.

Hearing Processing Sound
Sound has key characteristics: The pitch, which is the frequency of sound, the loudness which is the amplitude of sound and the timbre which is the type of sound. Auditory system performs some filtering of sound. It is filtering out background noise and focuses on important information. As example the Cocktail Party Effect: illustrates the ability to selectively hear sounds that are highly relevant (es. Qualcuno che urla il mio nome lo sento subito).

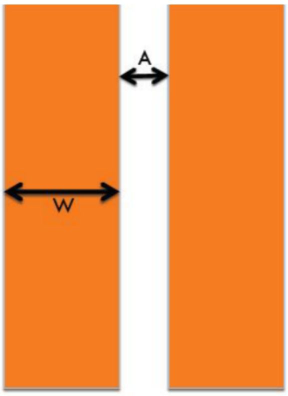
Touch
Is an important input channel in interaction though it is generally impoverished in digital interfaces compared to visual and auditory. The human sense of touch is not localized, though as interface output it is mostly localized to hands and fingers.

Movement: Human Output
Most human output used by interactive systems is articulated through movement. The external stimulus is received by sensory receptors and transmitted to brain. The brain processes the information and generates a response. The appropriate muscles are told to articulate the response (motoric response). And the entire process can be divided into reaction time and movement time.

Fitts's Law for Physical Modelling
Movement is proportional to distance and target size.
'If it's hard, it's the system and not you'

Fitts Law Demo
Tap back and forth between the two rectangles as quickly as you can!

Fitts Law Basics
The movement time is proportional to the index of Difficulty (ID) of a selection task. This means the harder the selection task, the longer it will take. The movement time for a well- rehearsed selection task increases as the distance A to the target increases and decreases as the size of the target W increases.



Index of Difficulty

The difficulty of a selection task can be calculated as: ID = $\log_2(2A/W)$, A = distance between targets, W = Target width

How MT (Movement Time) is determined

Empirical measurements establishes constants a and b. They are different for different devices and different ways a device is used.

Applying Fitts Law

Is used for predicting performance on low-level physical actions. It is for automatic tasks and actions and for tasks with minimal cognition, where you don't have to think about them.

Applying Fitts's Law is useful for early interface testing, comparing alternative interface layouts.

Human Memory

Human Memory

Humans are more than processors that take a stimulus and produce a response. Real interaction involves knowledge, reasoning, cognition and experience. And here the memory plays a critical role. Human memory stores information needed for activity (Factual, procedural and experiential knowledge). And there are three general types of memory: Sensory, short-term/working and long-term memory (most of the working memory gets forgotten).

Sensory Memory

Serves as buffer for incoming sensory input:

- Iconic memory: for visual stimuli
- Echoic memory: for aural stimuli
- Haptic memory: for touch stimuli

It decays quickly, you don't hold it forever. Most information is filtered out and lost. And some information is transferred to short-term memory by focus or attention.

Short-term Memory

The working memory is a temporary storage for information that is currently being used. It can be accessed rapidly but also decays rapidly and it has limited capacity (from 5 to nine units e.g. words, numbers). Information can be chunked-combined into larger units, thus is increasing our memory capacity. Patterns and meaningful chunks also aid memory (e.g. 7 words in your native language vs 7 words in a language you don't know very good).

Short-term Memory subject to recency effects. It may have different channels or different types of information and may transfer information to long-term memory through repetition or rehearsal.

Long-term Memory

Main repository for memory. It stores factual, experiential and procedural knowledge. It has potentially unlimited capacities and has a slow access time. And there's a slow decay, forgetting occurs slowly. There are two types of long-term memory:

- Episodic: memory of events and experiments in a serial form
- Semantic: structured record of facts, concepts and skills, structured as a network

Long-term Memory Acquisition

The more time spent learning the more will be learned (=total-time hypothesis). Learning is more effective if it is distributed over time (=Distribution of practice effect). And meaningful information can be learned more easily. It can be more easily integrated into the semantic network of memory.

Lecture 3

What is information visualization and why is it important?

With so much information…

- How do we understand and make sense of data?
- How do we extract meaning and value from data?
- How do we communicate data?
- How can we use date to gain new insights and knowledge?

Information Visualization

The use of computer-supported, interactive visual representations of abstract data to amplify cognition.

Why visualize data?

To record and analyze information, to present and communicate information and to discover new information and gain insight.

Information vs. Scientific Visualization

Information Visualization:

- Abstract data with no physical correspondence.
- Free mapping of date to 2D or 3D space.

Scientific Visualization:

-Scientific data, corresponding to physical phenomena

- Fixed positions in space for visualizations.

Key Challenges in InfoVis

Creating meaningful and useful mappings of abstract data onto 2D or 3D space. It represents an extremely large sets of data in a finite amount of space. And is representing diverse types and forms of data within visualization.

Classic visualization Examples: Successes and Failures

Slides 17-32 lecture 3

"There are right ways and wrong ways to show data; there are displays that reveal the truth and displays that do not. And, if the matter is an important one, then getting the displays of evidence right or wrong can possibly have momentous consequences.''

Visual thinking and perception

What can we see easily?

How does the designer ensure that all visual queries can be effectively and rapidly served?

How can we use semantically meaningful graphic objects to create designs with the right amount of salience?

Take perceptual laws of visual distinctness and pattern processing into account

Pre-attentive Processing

Psychologist Anne Treisman studied visual search to understand what makes some patterns easy to find. For some combinations of targets (the thing you are looking for, you are searching) and distracters (all the other objects), the time to respond was independent of the number of distractors – indicative of pre-attentive processing. (non cambia quanti distracters ci sono, se l'oggetto che cerco è facile da visualizzare il tempo che ci metto a individuarlo rimane circa lo stesso per ogni numero di distracters presenti).

Se non è pre-attentive, più distractors ci sono più ci metto a individuare l'oggetto che cerco e che si distingue da tutti gli altri.

Conjunction of features is generally slow because you have to search for two features serially. (es. Cerca i triangoli tra le figure di color rosso→prima devo individuare il colore e poi la forma (in questo caso il triangolo)

Gestalt Laws

Germany psychologists Max Westheimer, Kurt Koffka, and Wolfgang Kohler from the Gestalt school of psychology undertook to understand how people perceive patterns (1935)

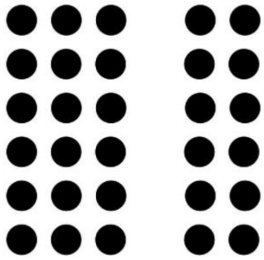
The resulting laws they created serve as valuable principles for displaying information

- Proximity
- Similarity
- Connectedness
- Continuity
- Symmetry
- Closure

Principle 1: Proximity

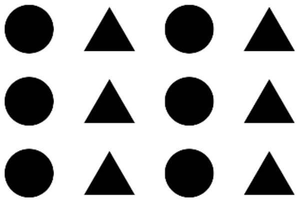
The principle of proximity states that things that are close together appear to be more related than things that are spaced farther apart.

Examples of the proximity principle



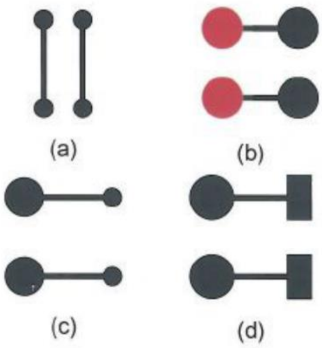
Principle 2: Similarity

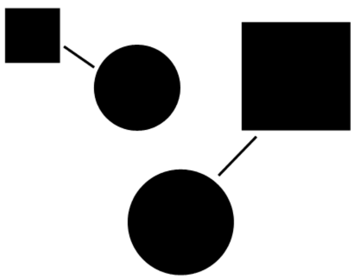
The principle of similarity states that when things appear to be similar to each other, we group them together. And we also tend to think they have the same function.



Principle 3: Connectedness

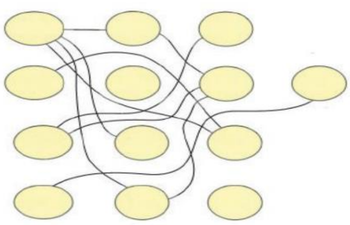
It refers to the fact that elements that are connected by uniform visual properties are perceived as being more related than elements that are not connected.





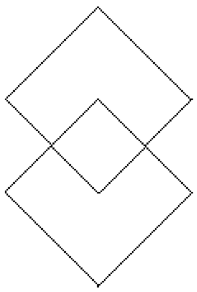
Principle 4: Continuity

The principle of continuity states that elements that are arranged on a line or curve are perceived to be more related than elements not on the line or curve.



Principle 5: Symmetry

The law of Symmetry states that elements that are symmetrical to each other tend to be perceived as a unified group. Similar to the law of similarity, this rule suggests that objects that are symmetrical to each other will be more likely grouped together than non-symmetrical objects.



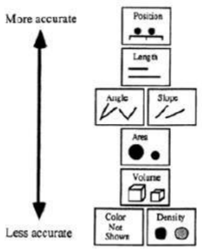
Principle 6: Closure

The principle of closure states that when we look at a complex arrangement of visual elements, we tend to look for a single, recognizable pattern.

In other words, when you see an image that has missing parts, your brain will fill in the blanks and make a complete image so you can still recognize the pattern.

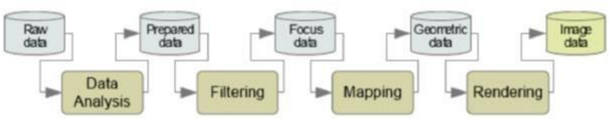
Elementary Graphical Perception

Cleveland and McGill tested ten graphical elements for accuracy of perception:



Guidelines for visualization

The visualization pipeline



Infovis Principles from Edward Tufte

-Graphical Excellence: How revealing is the visualization?

-Graphical Integrity. How truthful is the visualization?

-Data Graphics: How effectively are graphics used in the visualization?

Tuftes Principles of Graphical Excellence

Graphical excellence

The well-designed presentation of interesting data, is a matter of substance, statistics and design. It consists of complex ideas communicated with clarity, precision and efficiency. It gives the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space. It is nearly always multivariate and tells the truth about data.

Tuftes Principles of Graphical Integrity

Graphical integrity

The representation of numbers should be directly proportional to the numerical quantities represented. Clear, detailed and thorough labelling should be used to prevent distortion and ambiguity. It shows data variation and not design variation. The graphics also shouldn't quote data out of context. And the number of information-carrying dimensions depicted should not exceed the dimensions of the data.

Tuftes Principles of Data Graphics

Data Graphics

Above all else show the data

-Maximize the data-ink ratio

-Erase non-data-ink

-Erase redundant data-ink

-Revise and edit

-Upper-case words violate Tufte's principle of friendly Data Graphics.

The friendly data graphic (Tufte)

Words are spelled out, avoid elaborated encoding. The words run from left to right and little messages should help to explain data. The words should be spelled out. Labels are placed on the graphics, so no legends are required. Graphics attract viewers, they provoke curiosity and colors, if used, are chosen so that the color-deficient and color-blind can make sense of the graphic. The type needs to be clear, precise and modest and the type is lower case, with serifs.

Smallest effective Difference

In designing information…the idea is to use just notable differences, visual elements that make clear a difference but no more – contrasts that are definite, effective and minimal. (=Tufte 1997)

Pictures, Symbols or Words

Pictorial icons are used for pedagogical purposes in infographics (only when a canonical or culturally defined image is available). Symbols are used when a large number of data points must be represented. Words are directly on charts where the number of symbolic objects in each category is few and space is available.

Pitfalls

Means:

Selecting the wrong data (structure), filtering out important data, failed understanding of the types of things that need to be shown, selecting the wrong representation and choosing the wrong presentation format.

Concluding Thoughts

Information is powerful and abundant. Information alone is not effective for discovering and communicating ideas, trends and insights. The basic understanding of visualization is beneficial to anyone who deals with data or communication.

Lecture 4

Design in Interaction

A basic distinction

Usability versus usefulness:

-Usability: Is a system or object easy to use?

-Usefulness: Does a system or object serve a function that is valuable to me?

Usability and Usefulness are different for the people looking at the object (per me un oggetto può essere utile, mentre per un’altra persona no; per me l’oggetto può sembrare facile da usare, mentre per un'altra persona no→è soggettivo)

Don Norman wrote a book called “The Design of Everyday Things”, this book covers many ideas in a fairly short book and provides many examples of design concepts, but offers relatively few examples of digital systems and interfaces

Fundamentals Ideas

Everything that is not fully created in nature has being designed. Someone made decisions about how things should look or operate, how procedures and services should work etc. and that design may be carefully thought through or informal and haphazard.

Design

Is a relatively new field of study and considers how things work, who they are controlled and how people interact with them.

Why is design important?

-It affects the human experience.

-Poorly designed systems and products waste money, time, resources and crate frustration.

-Bad designs can have negative, even dangerous effects (e.g. Therac-25: released radiations, with a bug the Therac-25 released too much dose (100x the intended dose)   and 4 people died)

Three fields of design

Industrial-design: Focuses on function and appearance of products and systems, often physical→Properties of systems or of products.

Interaction-design: Focuses on how people interact with technology, in particularly understanding how to use it.

Experience-design: Focuses on quality and enjoyment of experience, particularly of services, environments and

events. What do we want people to get out of it? E.g. Do we want it to be educational?

Human-centered design

Is an approach and not a field of design. It makes human capabilities and behavior central, and designs to accommodate. It focuses on communication between the person and the system. Human-centered design can be applied to almost any type of design (including software design).

Design principles and concepts

Conceptual Models

A (usually simplified) explanation of how something works. It is not necessarily an accurate reflection of the actual workings of the system and it is not necessarily complete. Conceptual models of the same system can differ from person to person (l'idea che un umano ha in testa di come qualcosa funzioni cambia da persona a persona).

Conceptual Models: Mental Models

Mental models are conceptual models that people have in their minds of a system. They are often developed from experience:

-Inferred from the system itself, from learning from others, through interaction with the system and from instructions or manuals.

Designers Conceptual Model

Represents the designers understanding of the system and is usually fairly complete, detailed and accurate.

User's Conceptual Model

It varies from person to person and varies in completeness and correctness.

It is based on experience and it is influenced by the system image.

System Image

It's the total information that is available to the user:

- Appearance of the system
- Instructions
- Information from salespeople and advertisement
- Articles about products
- Products website etc..

Essentially, *it's all of the information that can be communicated to the user.*

<u>Problems of the System Image</u>

It can be incomplete or contradictory. It can also foster good or poor conceptual model for user and they are the only means through which the designer can communicate with the user (sono l'unico mezzo attraverso cui il designer può communicare con l'utente).

What does good design do?

Good design facilitates the communication of the designers conceptual mode via the system image to the user.
It enables the user to develop a good conceptual model.
If the design provides a good system image, then the user should be able to develop a good conceptual model. If the design is complete and provides a good system image, then it is enough to allow the user to use the system correctly and efficiently.

Fundamental Design Principles

For Norman Donald: Discoverability in a systems design is what allows a user to develop a good conceptual model of the systems.
Discoverability means the extent to which the design allows the user to discover what it does, how it works and what operations are possible.

Discoverability

How easy it is to use an object. Discoverability is bad if it is not clear how to use that object, and it is good if the object is easy to use/it's clear how to use it.

What concepts can be applied to yield good discoverability in a system?

-Affordances, Signifiers, Constraints, Mapping and Feedback

Affordances

An affordance is the relationship between an object and a person (or other entity). It determines how the object could possibly be used. It depends on both the properties of an object and the capabilities of the person. Affordances need to be perceivable to be effective.

Signifiers

Signifiers are any perceivable indicator that communicates an appropriate behavior to a person. While affordances communicate what is possible, signifiers communicate what to do /what is possible to do. They can be deliberate in design and e.g. sign indicating (e.g. how many minutes till next tram).
Signifiers can also be unintentional, as example the presence of people waiting at a tram stop. They are important in design for fostering discoverability, but they can also be misleading, poor or superfluous. Perceived affordances often serve as signifiers but not all signifiers are affordances.
Signifiers are simple objects or systems that should be self-explanatory:

- Signifiers should not require signage or 'added-on' signifiers
- Signifiers should not require additional instructions or manuals to operate.

Constraints
They are clues that help you discover what to do by putting limits on the set of possible actions. constraints are especially useful for helping people to determine proper course of action in new situations. Types of constraints are: Physical, cultural, semantic, and logical

Physical Constraints

They are physical limitations to possible operations (e.g. physical key) and they are more effective when they are easy to see and interpret.

Physical constraints can prevent actions before it happens rather than when it is in progress
They are often lacking because of legacy systems

-The need for backwards compatibility prevents addition of new physical constraints.

Alternative to adding physical constraints is to make devices or objects that are not orientation sensitive (e.g. many modern keys, USB-C). They are forcing functions (form of physical constraint that impedes a sequence of actions)

-failure at one stage prevents the next step, e.g. needing physical key to unlock door and start ignition before driving.

There are three types of forcing functions: Interlock, lock in and lock out.
An interlock forces actions to take place in a particular sequence (examples: ordering processes, setup wizards, etc.)
Lock-ins keep an operation active preventing it from being ended prematurely.
Lock-outs prevent an unwanted event from occurring, or prevents someone from entering a space or state that is dangerous.

Cultural Constraints
Cultures have embedded guidelines and cues for acceptable behavior. Cultural Constraints in design prevent incorrect actions by relying on culturally understood cues and expectations. They are not universally interpretable and are likely to change over time.

Semantic Constraints
Semantic Constraints prevent incorrect actions by relying on the meaning of the situation. They are "common sense" actions. (E.g. Dragging file onto a printer icon rather than onto trash can icon to print it).
Like cultural constraints, semantic constraints can also change over time (e.g. seats facing forwards, inwards or in the center)
Semantic Constraints are more universal than cultural constraints.

Logical Constraints
They are constraints that apply because no other option exists or makes sense. They do not rely on cultural or semantic information, or pose physical limitations.
Natural mappings employ logical constraints.

Mapping
Mapping refers to the relationship between two sets of elements, frequently devices and their controls. Mappings that take advantage of spatial relationships are called natural mappings (in general, natural mappings promote the deign).
Natural Mappings are especially valuable for fostering discoverability and good conceptual models.
Good mappings lead to immediate understanding and are easy to remember. Natural Mapping can also take advantage of Gestalt principles: related controls should be grouped together and controls should be placed close to the item being controlled.

Natural Mappings in Digital Systems
There are many examples of input devices: Touchscreens, Touch pads, Mouse, Joystick etc. Natural mappings often don't apply because data (often) doesn't have a meaningful spatial organization. Digital interfaces can offer high potential for controlling real world elements using natural mappings (e.g. tablet to control lights).

Feedback
Feedback is the communication of the outcome of an action. Humans have numerous mechanisms for perceiving and receiving feedback (visual, auditory, and touch sensors). Even a simple task requires feedback (e.g. picking up a glass: without tactile feedback you don't know where to position your hand or how much pressure to apply.
The lack of feedback or impoverished feedback makes tasks more difficult or disconcerting (e.g. typing on a physical keyboard versus a soft keyboard without haptic feedback mechanism).
Feedback must be immediate. Long delays are disconcerting and may cause users to abandon the system. It must be informative – impoverished feedback is confusing, frustrating and distracting. All actions should be confirmed in an unobtrusive manner. Prioritized feedback should indicate the importance of information.

Feedback in Digital Systems
WIMP interfaces offer continuous visible feedback. Physical keyboards offer effective haptic feedback. Progress bars or

confirmation messages are also feedback.
Feedback in Digital Systems progresses you to the next step or screen.

To sum up

Donald Normans central insight about what makes for good design:

- Discoverability in a systems design is what allows a user to develop a good conceptual model of the system.
- To foster good discoverability, concepts of affordances, signifiers, constraints, feedback and mapping should be applied.

Interaction Models

What is a model?

It is a constructed representation intended to help understand and reason about the world, or some phenomenon in the world: It is abstracted and simplifies, generalized, and not necessarily reflective of how the world actually works.

Purpose of Interaction Models

There are many potential uses: They predict human performances, understand the interactions and interaction cycles. They explain physical and cognitive processes and examine individual parts of the interaction. They diagnose breakdowns and examine mappings between user language and system language.

Interaction Models

Are tools for modeling and thinking about how humans interact with objects or systems. Different models enable different types of thought, tasks and explanations.

Consider maps…

What kind of maps would be helpful for

- Understanding the spatial relationships between countries or continents?
- Talking about changes in elevation in given terrain?
- Learning about the public transit systems or different large cities?
- Designing a new public transit system for a municipality?
- Figuring out how long it will take to get to a friends house?

Keyboard-Level Model (KLM)

Adding Cognition into Models

Not all human tasks involve no cognition. Even making a simple decision about how to accomplish a task or what the next step should be involves some mental processing. KLM is a simple model that begins to incorporate mental processes.

Keystroke-Level Models

Is developed by Card et al. in 1983. Is another way of doing physical modelling and decompose tasks into low-level elements with time values. It calculates predictions for total execution time and is the best for automated behaviour.

K = striking keys

B = pressing a mouse button

P = pointing (dragging a pointer to a target)

H = homing (switching the hand between the mouse and keyboard)

D = drawing lines using the mouse

M = mentally preparing for a physical action

R = system response time

It calculates time required for individual generic actions and decompose tasks into individual actions. It calculates the total time for a task as a sum of the time for each action and can be used for comparing alternate ways of executing a task. It does not take time for cognition into amount. How long will it take to insert the word ‘not’ into the following sentence using Microsoft word:

- Running through the streets naked is normal

To change to:

- Running through the street naked is not normal.

1. Select what method to use (M)
2. Move cursor to appropriate point in sentence (H+P+P1)
3. Move hands to home position on keys (H)
4. Mentally prepare (M)
5. Type ‘n’ + ‘o’ + ‘t’ + space (K+K+K+K)

➔ 1.35 + .40 + 1.1 + .20 + 1.35 +.22 +.22 +.22 +.22 = 5.68 seconds

Keystroke-Level Model Limitations

Can be used for comparing alternate ways of executing a task. Does not take time for deeper cognition into account. There is limited capacity for tasks that require complicated decisions or cognition. Cards et al. formulation assumes conventional keyboard, mouse and display; does not cover modern input devices and channels (but could be extended to).

GOMS Model

GOMS Model

Was developed in the early 1980s by Card, Moran and Newell. It stands for **G**oals, **O**perators, **M**ethods and **S**election rules. And it attempts to model the knowledge and cognitive processes involved when users interact with

system. The Goals refer to a particular state the user wants to achieve (e.g. find a website on interaction

design).

The operators refer to the cognitive processes and physical actions that need to be performed in order to attain goals (e.g. decide on which search engine to use, think up and then enter keywords into the search engine). The difference between goals and operators: Goals are obtained and operators are executed.

The Methods are learned procedures for accomplishing the goals. It consists of the exact sequence of steps required (type in keywords in a Google search box and press the search button)

The selection rules are used to determine which method to select when there is more than one available for a given stage of task (once keywords have been entered into a search engine entry field, you can press the return click or click on the 'search' button using a mouse or pointer. Selection rule determines which of the methods to use in this instance)

Short-cut:

- **Goals**: refer to a particular state the user wants to achieve
- **Operators**: refer to the cognitive processes and physical actions that need to be performed in order to attain those goals
- **Methods**: learned procedures for accomplishing the goals
- **Selection rules**: used to determine which method to select when more than one is available for a given stage of a task

GOMS Example: Slides 46-48 lecture 5

Vending Machine Example:

Goal: purchase an item from the vending machine

-Operators: Step-by-step procedure to achieve the goal.

-Method: pay for item using coins, pay for item using credit/debit card, pay for item using twint, etc.

-Selection rules: Different possibilities to achieve the goal.

Seven-Stage Model of Interaction

Language in Interaction

The system language is what the system understands, expects and communicates.
The user language is what the person understands, expects and communicates.

Modeling Interaction with a System

This goes beyond just the human actions and choices. It models the dialogue between the system and the user. And it is broader than just commands and outputs.

Seven-Stage Model; Execution

Once a goal is formulated, the next steps are:

- Forming the intention: What does the person want to do in this step?
- Specifying an action: What are the exact steps the person decides to take to address the intention?
- Executing the action: Actually doing the steps that have been chose, thus acting upon the world.

Seven-Stage Model: Evaluation

Once the world has responded/changed:

- Perceiving the state of the world: The person must physically perceive the current state of the world, whether changed or unchanged (see, hear, feel,etc.)
- Interpreting the state of world: The person must figure out what the perceived changes mean (what just happened?)
- Evaluating the outcome: The person must come to a conclusion about whether the original goal has been addressed.

Intention has to be one step closer/further to the goal.

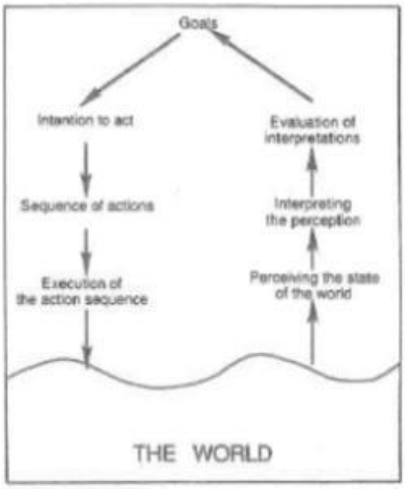
The intention cannot be the same as the goal.

Perception has to do with feelings (no perception if subject is deaf, blind)

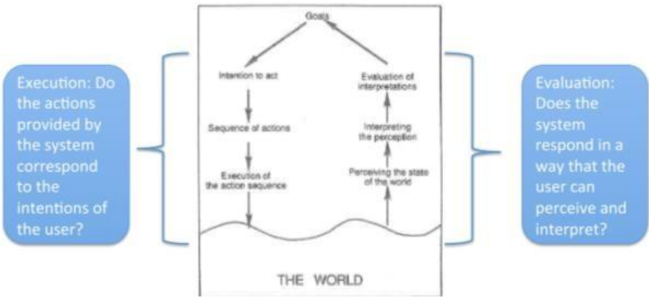
Interpretation has to do with using brain and cognition.

E.g. if I want to make the room brighter the intention cannot be ‘make the room brighter’, because we have to move on step closer to the goal, so the intention can be for example ‘turn on the light, open the curtains, etc.’

Putting it All Together



The Gulfs of Execution and Evaluation



Examples for seven stage model: slides 61-64 lecture 5

Explaining Breakdowns

Where do problems occur? Breakdowns can occur at any stage in the cycle and a breakdown at one stage usually prevents correct execution of some or all later stages.

Examples for this: slides 66-69, lecture 5

Bridging the Gulfs

The **Gulf of Execution** is small, when the actions provided by the system match the intention of the user and when the actions can be executed without extra effort.

The **Gulf of Evaluation** is small, when the system provides information about its state that can be easily accessed and interpreted. The systems state matches the way the user thinks about the system.

You need to provide good discoverability to enable the user to develop a good conceptual model:

- Make use of natural mappings
- Provide clear feedback
- Make use of constraints
- Provide perceivable affordances, meaningful signifiers

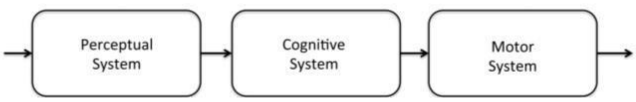
Using the Seven-Stage Model

Identify where problems occur in the cycle (provides a basic checklist). Is a design to make the gulf as small as possible and helps breaking down a design problem into smaller pieces.

Model Human Processor

The Model Human Processor

There are three systems: The perceptual, cognitive and motor. Each system has processor and memory. Each system has principles of operation (= rules on how they work)



The MHP is not meant to explain how the human brain works. It is intended to help understand, predict and calculate human performance in interaction.

MHP Perceptual System

Creates internal representation of physical sensations (stores temporary information buffers (auditory Image Store)) and transfers information in buffers into working memory (short-term).

MHP Perceptual Processor

-Cycle Time: is the time between when stimulus is presented and when it is available in buffers.
-Multiple similar stimuli can combine during one cycle.
-The principle is as following: The cycle time varies inversely with stimulus intensity.

MHP Cognitive System

It connects inputs from Perceptual System to outputs of Motor System. It handles learning, remembering and problem solving and includes working memory (WM/STM) and long-term memory (LTM)

MHP Cognitive Processor

- Recognize-act cycle: contents of WM trigger actions in LTM which modify WM
- Principle: CP cycle time is shorter when greater effort is induced by task or information. Cycle time diminishes with practice.

MHP Motor System

Thought is translated into physical(muscular) actions. The motor system corrections require cycles of perceptual and cognitive systems.

Quick Synopsis of Models

Model	What it represents	Features
Fitts's Law	Automated physical actions	- Predictive of performance - Quantitative - Assumes no cognition
KLM	Interaction sequences with a computer system	- Predictive of performance - Quantitative - Takes low-level mental processes into account
GOMS	Tasks, processes, and associated knowledge	- Accounts for decisions - Represents knowledge about tasks - Low and higher level processes
MHP	Human Input, Cognitive Processing and Output	- Perceptual, Cognitive, and Motor systems - Includes rules - Accounts for memory
Seven-Stage Model	Tasks and interactions including human and world/system	- Accounts for cognitive processes and decision making - Helps identify breakdowns

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Lecture 6

Description of an Interaction Design (As a career)

Go over this (Lecture 6) on your own not worthy enough to sum up, there's only some information about our profs background and stuff like this(many statistics and pictures)…but I'd recommend to read it though!

Lecture 7

Computer-Supported Cooperative Work

CSCW Background and History

Computing for Individuals vs. Groups

The focus thus far has been on interaction between individual human and computer systems. But much of our current technology goes beyond a closed interaction between an individual and a technology – how does technology connect humans?

Computer-Supported Cooperative Work (CSCW)

It's a field of research concerned with understanding social interaction and technologies supporting social interaction in groups, organizations and communities.

CSCW Definitions

'In its most general form, CSCW examines the possibilities and effects of technological support for humans, involved in collaborative group communication and work processes'

– Bowers and Benford 1991

CSCW is "computer-assisted coordinated activity such as communication and problem solving carried out by a group of collaborative individuals"

– Greif 1988

‘CSCW is a generic term which combines the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques’

– Ellis 1991

CSCW

It has dual focuses: The technology in software and hardware and the groupwork and social phenomena. It is the understanding of socio-technical aspects of work in groups and organizations:

- What is the nature of cooperative Work carried out in groups as opposed to by individuals?
- What are the various roles and relationships in organizations, and how do these affect and influence the work?
- What are the challenges to cooperative

work?[1]

Are technologies to support group work and processes:

- How can computing technology be applied to support and enhance cooperative work and organizations?
- How should such technologies be designed to support the diverse roles and needs in groups and organizations?

It presents day computing technologies. This means it makes ample use of social features. In addition these technologies are seldom purely for individual use and often blur the distinction between work and leisure. Now if (nearly) all software supports social interaction, what does CSCW do? It gives a core understanding of group processes and work. And it gives an explicit understanding of technology support for collaboration. This is parallel to the notion that everything artificial is designed, but there is still a need to understand design.

Rough Boundaries of Traditional CSCW

Rough Boundaries of Social Computing/Social Media

Groupware

Refers to the technical systems that arise from CSCW research and development.

‘Computer-based systems that support groups of people engaged in a common task/goal and that provide an interface to a shared environment’ – Ellis, 1991

‘Software designed to run over a network in support of the activities of a group or organization. These activities can occupy any of several combinations of same/different place and same/different time.’ – Olson & Olson, 2002

Early CSCW Efforts

It was placed heavy emphasis on facilitating synchronous and remote communication. The biggest goal of CSCW was to simulate being there or face-to-face communication (e.g. Holodeck). They focused extensively on improving the experience of videoconferencing to create the illusion of colocation. But videoconferencing with more than two people becomes challenging, it is hard for participants to keep track of eye glaze and deixis (pointing). Olson and Olson (2000) identified several key reasons why videoconferencing experience can’t match face-to-face:

- Difficulty of establishing common ground (awareness of other people)
- Different time zones
- Cultural differences

At the same time as research focused on videoconferencing, other tools were proving to be successful for supporting group work (Wikipedia and Instant messaging)

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[1] What makes CSCW difficult?

'Beyond Being There'

They were trying to move the focus away from trying to simulate face-to-face interaction, including asynchronous communication (→not much to do face-to-face), anonymous communication and automatic archiving of communication. The principle was: The goal should be to support the functions of collocation rather than the form (Bob Kraut)

CSCW Technologies, A Sampling

Classes of CSCW Technologies

- Computer-mediated communication: Systems that support the direct communication between participants.
- Meeting and decision support systems: Systems that capture common understanding
- Shared applications and artifacts: Systems that support participant interaction with shared work objects – the artifacts of work
- Awareness applications: Systems that promote awareness of individual and group status

Computer-Mediated Communication

Are systems that support direct communication; they usually support remote communication and can be asynchronous (often text based) or synchronous.

Asynchronous CMC

Is the oldest form of CMC , here some primary examples: Email, Online Forums etc.

Synchronous CMC

Can support synchronous communication (though many can also be used asynchronously), a few examples would be: Instant messaging/chat (WhatsApp), video conferencing and virtual collaborative environments (Virtual reality, virtual worlds)

Conferencing Tools – Voice and Video

Is a support for real time meetings via high bandwidth connections. They sometimes allow for sharing of artifacts as example shared documents, agendas, slides and electronic whiteboards. But there are still difficulties with quality, interaction and turn-taking.

Meeting and Decision Support Systems

Participants in shared work must establish a common understanding about tasks to be performed. The work often involves generating and recording ideas (research, design tasks, management meetings and brainstorming sessions) The system can support the idea generation and idea and decision recording.

Meeting Support

It may imposes structure on the process of the meeting and brainstorming and voting processes (e.g. Klicker during lectures). It also may provide support for group decision making (prioritization of projects, tracking of arguments). In addition it may supports shared editing of documents or artifacts and may provide shared surfaces (electronic whiteboards and shared tabletops).

Meeting and Decision Support Systems: Argumentation Tools

Argumentation Tools record arguments used to arrive at a decision and often support asynchronous co-located teams (Wikipedia change tracking, comments in shared document editors)

Meeting and Decision Support Systems: Meeting Rooms

Meeting rooms support face-to-face groups in brainstorming and management meetings.

Meeting and Decision Support Systems: Shared Surfaces

Shared surfaces can be used for synchronous remote or collocated collaboration.

Shared Applications and Artifacts

Are systems in which the focus of sharing is the participants work domain(shared computers used in work and shared documents used in work)

Shared Applications and Artifacts: Shared Editors

Shared editors are editing applications (for text or other data) that are collaboration aware. They can be used synchronously or asynchronously (e.g. version control software, shared document editors and change tracking).

Shared Applications and Artifacts: Shared Calendars

They support viewing and editing of calendars among group or organization members. It provides an awareness among group members. It met its early resistance in organizations in 1980s but has since become widespread.

Shared Applications and Artifacts: Workflow
Supports coordination of sequential steps of activities among team members working on a particular task (routing a travel reimbursement voucher from traveler to approving party to accounts payable bank). It may also allows for work monitoring and management (bug tracking system, code repositories).

Shared Applications and Artifacts: Information Repositories
Is a system build for knowledge sharing among groups. It aims to capture knowledge that can be reused by others (standard procedures, training, document templates)

- ➔ Lotus Notes Domino, Wikipedia

Awareness
Is an attempt to recreate aspects of face-to-face awareness among people who are distribute or remote (who is around, what people are doing, what activities are going on). Video walls attempt to connect two remote spaces through video link. And micro level awareness cues, such as status indicators on messaging clients.

CSCW Frameworks and Conceptualizations

CSCW Time/Space Matrix

	Same time synchronous	Different time asynchronous
Same place colocated	**Face-to-face interactions**	**Continuous task**
Different place remote	**Remote interactions**	**Communication + coordination**

CSCW Time/Space Matrix Traditional Communication

	Same time synchronous	Different time asynchronous
Same place colocated	**Face-to-face meetings**	**Post-its**
Different place remote	**Telephone**	**Letters (Snail Mail)**

CSCW Time/Space Matrix
Where do the following technologies belong?

- OLAT forums
- Google Hangouts/Skype calls
- Shared electronic whiteboard
- Automatic recording of meeting minutes

	Same time sychronous	Different time asynchronous
Same place colocated	**Face-to-face interactions**	**Continuous task**
Different place remote	**Remote interactions**	**Communication + coordination**

CSCW Time/Space Groupware Matrix

	Same time sychronous	Different time asynchronous
Same place colocated	**Face-to-face interactions** decision rooms, single display groupware, shared tables, wall displays, roomware	**Continuous task** team rooms, large public displays, shift work groupware, project management
Different place remote	**Remote interactions** video conferencing, instant messaging chats, virtual worlds, shared screens, multi-user editors	**Communication + coordination** email, online forums, blogs, group calendars, version control, wikis

CSCW Time/Space Matrix
It considers groupware in terms of temporal and spatial parameters of use and it does not classify based on intended functions or purpose.

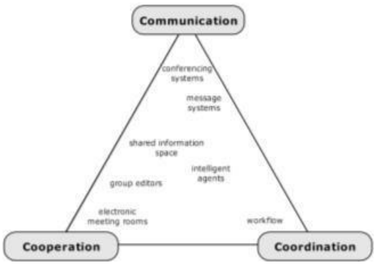
Groupware 3C Model
It considers three dimensions of support and classifies groupware in space based combinations of dimensions.

Communication: is the tools primary purpose to provide channels of communication among group members?

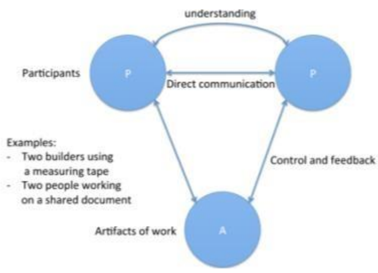
Cooperation: is the tools primary purpose to support collaborative activities?

Coordination: is the tools primary purpose to facilitate the organization of joint work activities?

All these technologies might fall in: Instant messaging, workflow management systems, shared electronic whiteboard, shared document editing and group calendars.



Cooperative Work Framework
Is also known as People-Artifact Framework. It is based on the entities involved in cooperative work (Participants in the work and things upon which they work (Artifacts)). The Participants are engaged in common work and they interact with shared tools and products to do the work. The participants communicate with each other as they work – direct communication. (Face-to-Face, writing letters, leaving messages etc… and communication serves to establish shared understanding of the task). They also interact with tools and work objects to perform the job (flow control from participants to artifacts and flow of feedback from artifacts to participants).



Barriers to CSCW Success

Challenges to CSCW
Despite the ubiquity of CSCW tools in the workplace, many challenges still exist and a lot of potential is not yet fulfilled:

- Collaborative surfaces and other meeting room technologies are not fully realized
- Remote collaboration still impoverished compared to co-located
- Many failed systems, means that it is expensive for organizations in terms of time and resources.

In addition groups and organizations are complex and dynamic. So it is complicated to model in comparison to individual interaction. Furthermore embody structures, hierarchies and social rules are often not always explicit.

Challenge to CSCW: capturing Requirements
When CSCW systems are introduced into an organization without a full understanding of how all people will be affected, problems can arise (introduction of shared calendaring systems in hierarchical organizations). It’s important that the technology should be deployed only to organizations if it’s done with an understanding of the context of use.

Understanding Stakeholders
The end users of technology are not the only people who are affected by the introduction of the technology. Stakeholders are anyone who is affected by the success or failure of a system:
Example: Airline creates a system that allows associated travel agents to sell flights directly to the public

- Primary stakeholders: end user of the system – travel agency staff, airline booking staff.
- Secondary stakeholders: people who do not directly use the system but receive output from it or provide input to it – customers, airline management.
- Tertiary stakeholders: not in the first two categories but directly affected by success or failure (someone whose profits increase or decrease as a result of the systems success) – competitors, civil aviation authorities, airline sharolders.
- Facilitating stakeholders: People who are involved with the system design, development or maintenance of the system, it’s the design team, IT department staff.

Example for Stakeholders Understanding slide 70 lecture 7!

A Good CSCW design aims to address the needs of as many stakeholders as possible, but stakeholders needs are often in conflict with each other! Important: The stakeholder priority diminishes as you go down the categories.

Disparity in Work and Benefit

Groupware applications often require additional work from individuals who do not perceive a direct benefit from the use of the application (e.g. maintenance of shared calendars, systems for voice annotation of documents).

Critical Mass

The groupware may not enlist the critical mass of users required to be useful or can fail because it is never in any one individuals advantage to use it. In addition early adopters may abandon the system before the critical mass is reached (document editing software, meeting scheduling systems and project management applications).

Disruption of Social Processes

Groupware can lead to activity that violates social taboos, threatens existing political structures or otherwise demotivates users crucial to its success (automatic meeting scheduling replacing scheduling through secretary).

Exception Handling

Groupware may not accommodate the wide range of exception handling and improvisation that characterizes much group activity. (workflow management systems that require procedures be followed in a particular sequence)

Unobtrusive Accessibility

Are features that support group processes and which are used relatively infrequently, requiring unobtrusive accessibility and integration with more heavily used features (features for collaborative editing of graphics integrated into single-user editing software).

Difficulty of Evaluation

Obstacles to meaningful, generalizable analysis and evaluation of groupware prevents us from learning from experience. Groups interactions unfold over days or weeks, rather than hours. And the evaluation often requires high level skills and resources. In addition it needs to consider multiple skakeholder groups.

Failure of Intuition

Intuitions in product developed environments are especially poor for multiuser applications, resulting in bad management decisions and error-prone design processes. Decision-makers in organizations are often drawn to applications that benefits management and underestimate work cots to others.

The Adoption Process

Groupware requires more careful implementation (introduction) in the workplace than product developers have confronted (individual use document authoring software vs. groupware for team of nurses).

Lecture 8

CSCW Challenges

Challenges for CSCW

Despite the ubiquity of CSCW tools in the workplace, many challenges still exist and a lot of potential is not yet fulfilled:

- Collaborative surfaces and other meeting room technologies not fully realized
- Remote collaboration still impoverished compared to co-located
- Many failed systems – expensive for organizations in terms of time and resources

It is difficult to model and analyze groups and also difficult to predict effects on all parties. Many groups of stakeholders are affected and there is a disparity between work and benefit. It is difficult to attain critical mass and there are effects on social processes and norms. There is also obtrusiveness of social features and the failure of intuition. There is a difficulty of evaluation.

Methods for informing CSCW Technologies

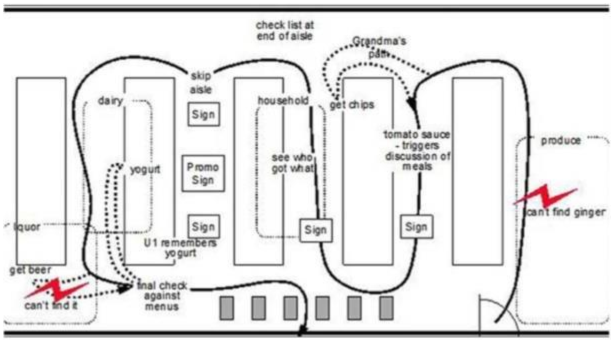
How to Address Challenges to CSCW?

Creating and understanding CSCW technologies requires complex approaches. The methods should be appropriate for understanding complex groups and organizations. Methods should involve multiple stakeholder groups and should provide input to other decision makers.

Ethnographic Methods

Focuses on studying work practice in situations. It is based on the premise that work can only be understood if it is observed while it is happening (Asking people what they do will not yield the whole truth). Is a detailed recording of interactions among people and between people and the environment. It takes an unbiased view and open-ended view of the situation (Goal is to describe the situation, not look for solutions).

Contextual Inquiry



Based on similar ideas as ethnographic inquiry but geared towards interpretation and system design. Investigator studies work in situations, takes apprentice role to learn about new users work. It makes use of observation and interviews.

It develops models to represent knowledge about the work environment:

- Task models: specify required steps for work tasks
- Physical model: represents physical work environment and its impact on practice
- Flow model: shows lines of coordination and communication between people
- Cultural model: reflects influences of work culture and policy including official and unofficial codes of behaviour and expectations
- Artifact model: describes structure and use of artifacts within work processes.

➔ Data is interpreted and used to shape design!

Participatory Design Method

Philosophy that encompasses entire design cycle. The users are not only involved as subjects or consultants, more as members of design team and active collaborators . They are treated as experts in the domain.

It can entail many processes, including:

- Brainstorming: involving participants in pooling ideas an informal and unstructured process
- Storyboarding: creating representation of users day-to-day activities
- Workshops: focused activities to fill in missing knowledge and allow for mutual inquiry between designers and users
- Pencil and paper exercises: Creation and discussion of designs with low overhead and low risk

Ubiquitous Computing

Technology and Societies

There are profound changes in recent decade:

- Ubiquity of devices
- Abundance of data being collected and generated
- Concerns about data access and privacy
- Expectations about connectedness and communication
- Impact on work and study expectations / social relationships
- Expectations regarding access to information
- Blurring of work and free time

Concept was introduced in 1991 article ‘The Computer for the 21 st century’ by Mark Weiser from Xerox PARC ➐ “The most profound technologies are those that disappear, They weave themselves into the fabric of everyday life until they are indistinguishable from it.”

“The Computer for the 21st Century”

Introduced a revolutionary vision for computing, computing now happens at different scales: Pads, Tabs, Boards.
Is the third wave of computing - high ratio of devices to human

Weiser focused not only on new technologies but on the impact of ubicomp on the human experience.

> *"Machines that fit the human environment instead of forcing humans to enter theirs will make using a computer as refreshing as a walk in the woods."*
>
> *"We wanted to put computing back in its place, to reposition it into the environmental background, to concentrate on human-to-human interfaces and less on human-to-computer ones."*

Ubiquitous Computing

Is often referred to as "off -the-desktop" computing – a move away from interaction with a single workstation:

- Mobile Devices
- Large interactive screens
- Alternative means of interaction including voice, vision, gestures
- Interactive environments
- Sensor-based interactions

Ubiquitous Computing: computing is made to appear anytime and everywhere. In contrast to desktop computing, ubiquitous computing can occur using any device, in any location, and in any format. A user interacts with the computer, which can exist in many different forms: laptop computers, tablets, smartphones.

Directions for Ubiquitous Computing

Ubiquitous Computing

What is necessary to realize the human-centered vision of ubicomp?

Defining the appropriate physical interaction experience, discovering general application features and theories for designing and evaluating the human experience within ubicomp.

Defining Appropriate Physical Interaction Experience

There are new approaches to input and output: implicit input, multi-scale and distributed output and seamless integration of physical and virtual worlds.

Implicit Input

Input technologies are becoming increasingly diverse, and along with it increasingly implicit. Natural interactions with the environment ca provide sufficient interaction to a variety of services without explicit user interaction:

- Interfaces that recognize when people are present in the room and respond
- Surfaces (tables or whiteboards) that automatically capture work done on them
- Fitness trackers that collect data about your activities

(smartwatch, smart mat fitness trainer)

Multi-scale and Distributed Output

Ubiquitous computing requires novel output technologies and techniques. Output technology design needs to move beyond visual displays and consider form and aesthetic appeal. Ambient display, displays of varying scales and audio output are part of it.

➔ Real time snowboard training

Seamless Integration of Physical and Virtual Worlds

Ubicomp attempts to merge computational artifacts with physical artifacts by merging the two worlds. The input can be merged by incorporating physical objects and digital objects (tangible interfaces). Output can be merged by overlaying digital information on the real world (augmented reality)

Ikea Place App (2017)

Discovering General Application Features

Functions that support daily activity:

- Context-aware computing
- Automated capture and access
- Continuous interaction

Context-aware Computing

Using implicitly sensed context from physical and electronic environment to determine the correct behaviour of a service. It is intended to make interactions with services more seamless and less distracting from everyday activities:

- Cars that recognize the driver and adjust the environment to him/her
- Smart thermostat systems that learn your schedule and adjust the heat in your home accordingly

Context-aware computing can make use of different types of information:

- (where) location of people
- (Who) identity of people
- (When) Routines or time spent
- (What) sensing of specific activities – often requires interpretation
- (Why) Reasons or other context, mood, heart rate etc.)

Automated Capture and Access

Human recording and retrieval of information is generally inefficient, incomplete and error prone, especially when there are multiple relevant streams of data. Information from events are automatedly recorded, and are regarded as both valuable and dangerous. Computational tools can remove or reduce the burden of recording and organizing information.

It focuses on preservation and recording of live experiences for review or access by user in the future as well as access interfaces : Classroom activities, meetings, special events etc.

Vannevar Bushs idea for the Memex was an early example of a capture and access technology for textual artifacts and other documents.

Continuous Interaction

Providing continuous interaction moves computing from localized tools to constant, ubiquitous presence. It focuses on informal daily activities (rather than goal-oriented tasks) e.g. Fitness trackers, notifications on a smart watch.

Informal daily activities present new challenges for design:

- Rarely have a clear beginning or end point so design cannot assume common starting point or closure
- Interruptions should be expected
- Multiple Activities operate concurrently and may need to be loosely coordinated
- May consists of a number of subtasks that are loosely bundled

Understanding Interaction in Ubicomp

As with CSCW, understanding ubicomp interaction is more complicated than understanding interactions between a single user and a single machine. Various models methods are applicable to ubicomp, including:

- Activity Theory
- Situated Action
- Distributed Cognition
- Ethnography
- Cultural Probes

Knowledge in the World

Traditional models of cognition and interaction focus on internal cognition:

- Three independent units for sensing, cognition and motor activity, each with its own memory

Complexity of ubicomp systems lends itself to models that consider both “knowledge in the head” and “knowledge in the world”.

Activity Theory

Is a descriptive theory that recognizes traditional concepts such as goals, actions and operations. Treats goals and actions as fluid based on the changing state of the world rather than a priori plans. It emphasizes the transformational properties of objects that carry knowledge and traditions. Ubicomp systems informed by activity theory would focus on transformational properties of artifacts and fluid execution of actions and operations.

Situated Action

Theory that rejects the notion of pre-planned goals as the motivation for action (the idea is that people don’t have pre-planned goals). It emphasizes the improvisational nature of human behaviour based on the changing world. Ubicomp systems informed by situated action would emphasize improvisation and seek to add useful knowledge to the world to shape actions. Evaluation of systems would emphasize real-time observation and reject post-hoc explanation.

Distributed Cognition

Theory that de-emphasizes internal human cognition. Treats humans as a part of a larger system in which the knowledge is distributed among the components, including humans and objects. Objects themselves act as triggers for action and reflect the state of the system. Ubicomp systems informed by distributed cognition would focus on larger system goals rather than individual interactions or appliances and focus on how information is encoded in objects and transmitted.

Ethnography

Descriptive approach based in anthropology that focuses on observation of everyday practices in situations. It recognizes that peoples conscious conceptions of what they do are incomplete and inaccurate. Is valuable for gaining rich understanding of settings and practices. And is used to inspire design rather than as a way of finding solutions.
Tries to describe a situation as objectively as possible. Ethnography is derived from anthropology.

Cultural Probes

Developed by Gaver as a way of gathering rich data from people without the intrusion of observation. Small packages of items with guidelines for use designed to provoke and record comments given to people to use in their own environments (drawing pads, single-use cameras, voice recorders etc.). Is used to understand what is significant for the people in the environment and to convey aspects of the environments culture to designers.

Evaluation of Ubicomp Systems

Evaluation of Ubicomp systems is also more challenging than evaluation of single user/single machine interactions:

- Ubicomp often relies on cutting edge or novel technology that are not yet reliable and robust
- Hard to test systems in real world deployments
- Often long-term use in 'living laboratories' or real world settings are necessary to understand their real impact

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Lecture 9

Technologies and the Home

Domestic Technologies

Are originally conceived of as the application of technologies in the home, often with the intention to increase efficiency or reduce work. But in actuality the reduction of work is questionable, because the access to technologies has also changed expectations (increased adoption of washing machines for clothes led to societal shift in expectations for cleanliness of clothes so workload did not decrease).

Domestic environments are extremely diverse and challenging to understand. The questions go beyond technology to society, culture, politics and psychology. Technologies that prescribe procedures or practices are generally undesirable.

Domestic Technologies and Ubiquitous Computing

Is an extremely broad field that considers many aspects pf the home, including:

- Efficiency
- Safety
- Entertainment
- Communication
- Comfort
- Coordination
- Health and wellness etc.

The "Smart" Home

A term, frequently used to refer to homes augmented with technology or a home of the future(sensors, actuators, cameras, microphones, displays, speakers, robots etc.)

Today's modern homes are already filled with smart technologies:

- Audio and visual entertainment technology that can be controlled from a mobile phone
- Voice controlled agents
- Smart thermostats
- Ubiquitous high-speed wireless internet
- Sensor-activated lights

Definitions of a "smart" Home

Domestic environments, in which we are surrounded by interconnected technologies that are more or less responsive to our presence and actions – Edwards & Grinter 2001

A home that adapts to inhabitants – Brush et al 2011

Homes that cleverly support their inhabitants – Mennicken et al 2014

➔ All definitions have a strong emphasis on the inhabitants of the home. The inhabitance of the home is put central. How does the home relate to the people living in it?

The strictest definitions include intelligence (Homes learn about inhabitants implicitly, Homes respond to inhabitants activities, Homes adapt and develop behaviors based on inhabitants activities. And less strict definitions involve some automation (possibly rule based, not as intelligent).

Early forays into smart home research

"Living Laboratories"

Early smart homes were research laboratories designed in the form of a living space. But the infrastructure for smart homes was expensive and difficult to deploy in real homes; test systems instead of built in laboratories. The new technologies could be tested and demonstrated and experiments could be run.

Example

MIT's House_n (2002 ca) was a one-bedroom apartment with sensing technology placed in nearly every part of the home. Applications were built atop sensors using information collected from them. This allowed studies of behaviours, testing of new technologies and learning about what can be sensed in a home.

Digital Family Portrait

Georgia Tech Aware Home project (2001). It focuses on aging in place and promotes the lightweight communication of wellness status of senior adults to their adult children. It Is intended to support privacy in communication and daily awareness.

Is an influential idea because of emphasis on wellness and privacy. It represented a move away from the notion of smart homes as focused on efficiency and automation.

Challenges for the design of smart home technologies

Challenges for smart homes

The foundational 2001 work by Grinter and Edwards laid out key challenges for the future of smart homes.

Challenge One: The "accidentally" smart home

Pervasive infrastructure for ubiquitous computing does no exist in most homes. Houses require specific outfitting for ubicomp technologies. And homes which are intentionally built as smart homes must be upgraded to support new technologies creating problems of interoperability between systems.

Challenge Two: Impromptu Interoperability

The ability to interconnect between systems and devices with little or no advance planning will often be desirable. It is not easy to predict what future services or devices will need to connect with each other. If people cannot predict or know which services can interconnect, it will lead to frustration and poor interaction witch the home

Challenge Three: No systems administrator

Increasing complexity of computing technology in the home leads to need for increasing knowledge to administer and maintain. You cannot expect that all homes will have a systems administrations expert (just as homes usually do not have an electrical or plumbing expert). The challenge is to design technologies that require no on-site expert to maintain.

Challenge Four: Designing for domestic use

There is a lack of understanding of domestic environments to inform the design of smart home technology. Real technology use can differ greatly from its intended use, a classic example: Initial vendors of the telephone did not regard it as having a social function. Predicting the ways in which technology will affect and disrupt the home environment is extremely challenging so studies of routines and practices are necessary.

Challenge Five: Social Implications of aware home technologies

Technologies in homes have important social implications. The privacy is the key concern because man systems rely on collecting data and context. Machines for automating work may change expectations and shift the burden of work without reducing work. Also the increased access to media and communication has changed the activities of children and the responsibilities of parents. Technologies alter routines in ways that cannot be predicted and have a massive impact on the home and society.

Challenge Six: Reliability

Reliability becomes increasingly challenging when systems are embedded in the home environment. It can be also unwieldy to patch or upgrade devices in the field. If systems are interconnected, designers also need to take care, that a failure in one component dos not bring down the rest of the systems. Evidence of this challenge in the transition from conventional phones and televisions to digital counterparts????

Challenge Seven: Inference in the presence of Ambiguity

Systems that attempt to understand what the inhabitants are doing have long been a goal but have met with mixed success in reality. How smart should a home be? How much inference is required for a smart home to be successful? How to fix incorrect interpretations? The challenge is to figure out what functions of the home are only possible through inference, what can be achieved with limited inference and what requires an "oracle"

Addressing barriers to smart home success

Studies of Smart Homes

Commercially available home automation systems, DIY (do it yourself/fai da te) home automation and uses of smart appliances.

Home Automation Study (2011) + Roomba Study (2007)

Slides at the end of lecture 9

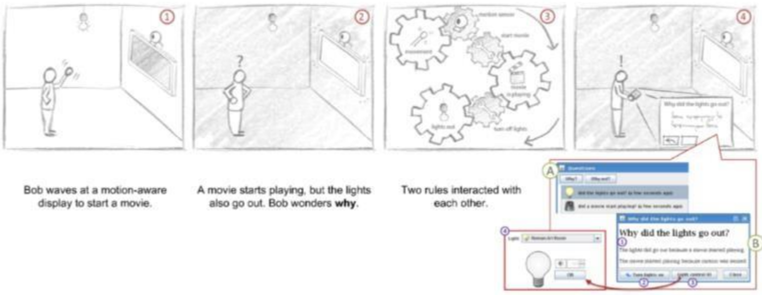
Facilitating the Smart Home Experience

Smart homes present clear challenges for inhabitants. In addition complexity of the technology pose limitations for value and functionality. Steps towards solutions may include:

- Interfaces to help people understand what is going on in their homes
- Interfaces to help people program the functionalities in their homes easily

PervasiveCrystal

IS a system designed by Vermeulen et al and keeps track of recent events in smart homes. It presents list of available "why" or "why not" questions depending on recent events. It automatically generates responses by linking smart home events to triggers. And it allows us to "teach" the system by invoking undo or fine grained control to adjust system behaviour.



Jigsaw Puzzle Interface

Interface for end-user programming by Humble et al. It provided a simple interface for specifying the behaviours of technologies in the home, i.e., programming with little programming knowledge. It identified three types of "transformers":

- Physical to digital transformers: turn physical events into digital events
- Digital to physical transformers: transforms digital information to drive a physical device
- Digital transformers: act upon digital information and effect digital information to allow for more complex behavior

CAMP Interface

Created by Truong et al and offered a simple interface for end-user programming of smart home technologies, specifically for capture and access purposes. It relied on magnetic poetry metaphor, and required little to no programming skill.

Quick summary

Domestic environments present unique challenges for technology design.

Technologies need to consider untraditional approaches for input and output

Smart homes pose barriers for intelligibility, maintenance and configuration.

Domestic technologies can have unpredictable disruptive effects on homes, families and society.

Universal Design: A very brief introduction

Universal Design

Designing with the goal of making things as widely useful and usable as possible:

- Accommodate the widest array of abilities possible
- Accommodate the widest range of conditions possible

- Optimize for equal utility for all (to the extent possible)
- Not just for elderly and people with impairments but also for gender culture etc.

Lecture 11

Is Gender important in Computing?

Computing and Gender Issues

- Gender imbalance in IT field
- Gender and computing in education
- Portrayal of gender in digital content
- **Gender and computing use**

A few notes on gender

Most research thus far has focused on gender difference between male and female:

- Gender is equated with biological sex in most cases
- Nascent work on technologies to include transgender and other gender identities

Generalizations about gender are generalizations:

- Describe gender tendencies based on empirical research
- Not universal

Is computing technology inherently gendered?

If technology is not designed for a specific gender, then its gender-neutral or even if technology is not designed for a specific gender, it nevertheless embodies gender biases.

Females and males engage with computer differently

Gender HCI/Gender computing

Is a field of study concerned with gender and the use of computing technologies:

- How does gender affect how people perceive and use computing technology?
- How can/should gender be taken into account in software engineering and technology design?

Why should you care about gender computing?

- Design can be gendered unintentionally
- Universal usability – fixing problems for a specific segment of the population can improve a system for everyone
- Software users and consumer are equally distributed across genders – why design for only half of your customers?

Who's smarter: Males or Females?

Revisiting CSCW

Workplace activities typically involve communication, coordination and collaboration – group processes and activities

CSCW software supports more effective group processes by supporting interaction between group members

Good software should not disadvantage some members of a group or organization

How smart is a group?

How evaluate intelligence of a group?

- How would you measure it?
- What factors would you look for?

Collective Intelligence

Is a metric that measures a groups intelligence based on how well they solve collaborative tasks

Collective Intelligence Study

Groups were scored to yield a measure of their collective intelligence:

- Performance on tasks did not correlate to average intelligence of group members
- Performance of tasks did not correlate to maximum individual intelligence in the group
- Group cohesion, group motivation and group satisfaction were also not predictors of performance

Three significant factors affecting collective Intelligence:

- Average social sensitivity of group members
- Lower variance in turn taking (→groups with few dominating members = lower collective intelligence)
- The proportion of females in a group (→higher percentage of women = higher collective intelligence
-

Gender Differences in Computing

Gender Differences in Computing

Many known differences have been studied and found:

- Perceptual differences
- Attitude differences
- Behavioural differences
- Performance differences

➔ Suggests that technology design should take these into account to be maximally inclusive (maximally effective)

Perceptual Differences

Research indicates that males perform better than women on spatial navigation tasks. Studies have shown that differences are greater when navigating virtual environments:

➔ Females build less accurate conceptual models of the space, possibly due to:

- Differences in spatial ability
- Lower proficiency with virtual environment interfaces

Field of View Experiment

Conducted by researchers at Microsoft. Males and females were given navigation tasks on a flight simulator and tasks were performed on a standard display and a special extra wide display(Extra wide display provided more visual context of the space being navigated).

As expected males performed better than females with standard display. Also as expected, performance overall was superior with wider display. But, performance gap was eliminated with wider display ➔ Females and males performed equally well on tasks, female performance benefited more dramatically from wide display than male performance.

Optical Flow Experiment

Conducted by researchers at Microsoft. Evaluated the effects of providing optical flow cues on navigating virtual environments.

Participants were led trained on paths, allowed to practice and then tested. Method encouraged spatial rather than symbolic learning paths.

Males performed better than females without optical flow cues. Both genders performed better with optical flow cues and female performance increased more dramatically with optical flow cues, equal performance on forward tests.

Implications for Universal Design

Changes to technology design (optical flow cues, wider field of vision)

- Benefit males and females
- Narrow the gap between male and female performance
- No detrimental effects to any performance

Attitude Difference: Self-Efficacy

Self-Efficacy: a person's self-judgment about his or her own ability to carry out a task to achieve a goal, self efficacy can affect:

- Use of cognitive strategies
- Amount of effort
- Strategies for dealing with obstacles
- Performance outcome

Much research has shown that women have lower self-efficacy than men regarding computer-related abilities. Females also exhibit higher risk aversion when interacting with computers .

Problem Solving Study

Considered problem-solving software (spreadsheet software with familiar and new features for helping to test and debug formulas). Some new features were introduced, others were not. And participants were asked to test the formulas and debug incorrect ones.

As expected females had substantially lower self-efficacy than males and females were slower to try new features and less likely to adopt them for repeated use.

Males and females exhibited no difference in performance regarding bug fixing, but females introduced more new bugs into the spreadsheets that did not get fixed

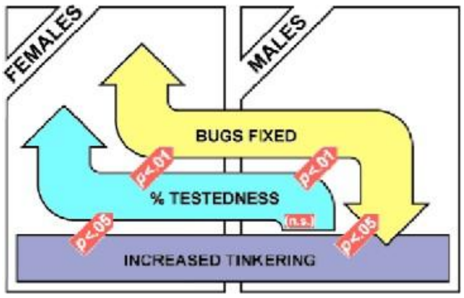
➔ Females edited formulas by hand – the only way to introduce new bugs – instead of using the new problem-solving features

Females voiced hesitation over learning new features – 'afraid it would take too long', but learned new features as well as males – no difference in ability

➔ Females had disproportionately low self-efficacy, preventing them from using beneficial features – inaccurate self-assessment became a self-fulfilling prophecy.

Outcome: Higher frequency of tinkering among women correspondence to higher effectiveness (more formulas tested and fixed). And higher frequency of tinkering among women corresponded to better understanding

Outcome: Higher frequency of tinkering among males did not correspond to number of formulas tested. Higher frequency of tinkering among males correlated negatively with number of bug fixes. And tinkering did not predict males understanding.



What is the difference between male tinkering and female tinkering?

- Males repeatedly tinkered on the same cell when cost was low (ineffective for learning)

➔ Repeated tinkering negatively affected understanding

- Females had significantly more pauses

➔ Allowed for reflection

➔ Better understanding, more efficient testing, more bugs fixed

Behavior Difference: Tinkering

Tinkering: Playful experimentation while using software

It has educational benefits:

- Can lead to better understanding of a system
- Can lead to greater comfort with a system

Educational research indicates that tinkering is a strategy more commonly adopted by males.

Implication for universal Design

Even spreadsheet software is not gender neutral. How to design software that encourages female tinkering and prevents overtinkering by males? Tools that promote effective tinkering would improve performance by both males and females.

Addressing gender inclusiveness issues in software

Is software inherently gendered?

Females and males have different capabilities

Females and males have different attitudes towards technology

➔ These capabilities and attitudes affect how they use technology and their performance with it

Can gender-inclusive software be designed to help optimize performance for all genders while minimizing disadvantages to a specific gender?

Towards gender-inclusive Software

First need to be able to identify gender-inclusiveness problems, but how?

GenderMag

Method designed by Oregon State University researchers

GenderMag: Gender-Inclusiveness Magnifier

➔ Allows software developers to identify gender-inclusiveness issues in their software quickly and inexpensively. And it can be applied during design and development, or as evaluation

It considers five known facets of gender differences:

- Motivation: females are motivated by what they can accomplish with technology, males by enjoyment of technology
- Information processing style: Females process new information comprehensively, males process information as it comes

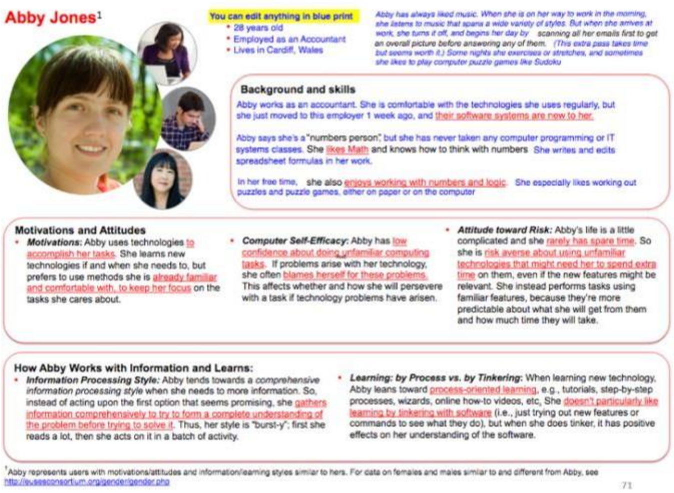
- Computer self-efficacy: Females often have lower computer self-efficacy
- Risk aversion: Females tend to be more risk averse than males in decision making
- Tinkering: Females are less likely to playfully experiment than males with software features, are more likely to reflect during the thinking process.

The important insight:

To create software that is gender-inclusive, you have to create software that accommodates differences in these facet values.

GenderMag Personas

GenderMag provides four archetypes – personas intended to serve as representative members of segments the user population. (Abby, Patricia, Patrick, Tim)



Abby, Patricia, Patrick and Tim:

Live in the same place, work at the same company, have the same job, have the same level of comfort with mathematics and are equally comfortable with the technology they use regularly.

➔ Differ only in aspects related to the five facer values

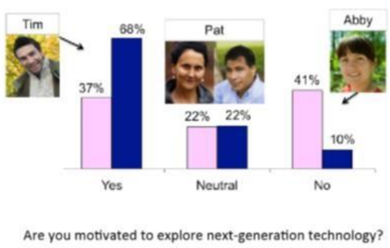
Abby: exhibits facet values most frequently seen in females

Tim: exhibits facet values most frequently seen in males

Patricia/Patrick: exhibit common facet values different from those of Tim or Abby

➔ These two are identical in facet values.

Example: Motivation Facet Values



Cognitive Walkthrough

The well-established Cognitive Walkthrough method for identifying usability issues:

- Evaluators are given a use case with a goal, subgoals and a script of actions to achieve the goal
- At each action, evaluators identify potential usability issues by answering a set of questions about that action

Example Script
Goal: Project slides for a lecture

Subgoal nr 1: Connect laptop to projection system

- Action nr 1: Plug HDMI dongle into monitor port
- Action nr 2: Plug HDMI cable into HDMI dongle

Subgoal nr 2: Set laptop as input device to projector

- Action nr1: Touch ‘Video Quellen’ on projection control device
- Etc.

Using GenderMag
GenderMag builds on the Cognitive Walkthrough method

At each subgoal, evaluators assess:

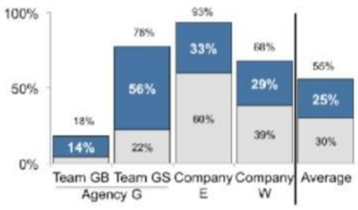
- Will <persona> have formed this sub-goal as a step to their overall goal? Why?

At each action, evaluators assess:

1. Will <persona> know what to do at this step? Why?
2. If <persona> does the right thing, will s/he know that s/he did the right thing and is making progress towards the goal? Why?

Explanations for each question can be justified by referring to the persona and its facet value

GenderMag Field Trial Findings



Issues found as a percentage of user actions and subgoals evaluated.
Dark blue indicates gender-inclusiveness issues, light gray other issues

GenderMag Field Trial

Examples of issues and justifications (Abby persona):

Action: click <button>
“I don’t even know why you would hit that... she doesn’t tinker so she’s going to be hesitant to just push buttons and see what they do.”

Action: enter <value> in <field>
“She avoids troublesome features... It’s not intuitive... She tends to blame herself...”

Gender Inclusiveness
Gender-inclusiveness issues are issues that are related to one or more of the known facets:

- If an issue arises that such that success of use is related to a facet, then it is subsequently going to affect gender inclusiveness

Why should YOU care about gender computing?
- Design can be gendered unintentionally
- Universal usability – fixing problems for a specific segment of the population can improve a system for everyone

- Software users and consumers are equally distributed across genders – why design for only half of your customers?
- We know gender-inclusiveness issues can be identified so it should be possible to address them

Lecture 12

Computing for Health and Wellness

Computing and Health

Computing is revolutionizing healthcare on many fronts, e.g. Advances in medical imaging, Cloud computing for data storage and access, Big data for health research , Medical informatics for health information systems, Computer-aided diagnosis, Telemedicine etc.

Pervasive Healthcare

Refers to the set of technologies designed to seamlessly integrate health education, interventions, and monitoring technology into our everyday lives, regardless of space and time.
Interactive systems in support of healthcare, can increase coverage and quality of care. Increasing area of focus in both research and industry.
Offers solution including application and mechanisms to: -ease recording, tracking and monitoring of health information, -allows communication, collaboration and coordination among stakeholders, -encourages clinical adherence and disease prevention.
Supports nomadic work of clinicians and integration of digital and physical worlds and enables the development of novel medical devices.
Builds upon Mark Weiser's vision and the field of ubiquitous computing: -Takes advantage of the increasing availability of heterogeneous interconnected devices, -employs approaches including: Context-Aware Computing, Automated Capture and Access, Artificial Intelligence and Wearable and Embedded sensing, -"Anytime and anywhere" healthcare.
Pervasive Healthcare has impact on a variety of stakeholders, including patients, healthcare providers, family members, other caretakers.
Most systems involve multiple stakeholders (e.g., a patient captures her heart rate, later reviewed by her relatives and healthcare providers)
Primary stakeholder is the person who primarily interacts with and benefits from the system.

Human-Centered Model of Healthcare

Preventive Care

It targets behavior and lifestyle choices (e.g. smoking, diet, inactivity) to prevent disease or injury, rather than treating or curing them.
Many chronic diseases and premature deaths are linked to common preventable risk factors.
Preventive care reduces burden on hospitals and healthcare sectors

Hospital Care

Supports the coordination and collaboration to care for patients. Technology for managing and sharing health information and supporting decision-making.
Making hospital workflows more efficient to improve patient care and reduce costs.

Chronic Care

Considers impairments or deviations from the norm that last three or more months. It's most common among elderly people, but affects all ages. Prevalence of chronic diseases is growing, straining healthcare workers, family member, pharmaceutical industry, medical technology, and insurers.

Personal Informatics and Wellness Management for Preventative Care

Preventative Care

-… (leggi sopra)
As life expectancy increases, prevention of chronic illnesses becomes a greater priority. Preventative care programs encourage healthy behaviors in attempt to reduce healthcare costs on a large scale. Preventive Care has its focus on issues such as medication compliance, health monitoring and documenting, and social health issues.
Its goals is to prevent cognitive decline, and maintain physical and psychological well being.

Preventive Care Technologies

Automated and selected capture and access, the technologies are persuasive and self-monitoring. There is a social support for health.

Automated and Selective Capture and Access

Takes advantage of computing to record relevant health information. Makes information available and accessible to important stakeholders and can use fully-automated capture of information (e.g., activity trackers) or user-triggered capture of information

Estrellita

It's a selective capture and access system for parents of premature infants. It allows sharing of relevant health information with health providers, relatives, and friends.
Parents update baby's health information and flag points of concern and professionals can access and analyze data.
Parents and professionals can communicate via the system

Foodprint

Supports lightweight photo-based food journaling via mobile app and supports communication between patients and experts based on eating goals. Foodprint allows for visualizations to support reflection on eating habits.

Persuasive Technologies and Self Monitoring

Technologies encourage people to take responsibility for setting health goals or making positive changes in behavior. Many commercial applications and devices available are for fitness and wellness. Persuasive games can be used to discourage unhealthy behaviors or encourage healthy behaviors

Focus on behaviors such as exercise, diet, smoking, alcohol consumption, physical activity, leisure activity.

UbiFit Garden

It has been designed to encourage regular physical activity through aesthetic images.
Made use of sensors on mobile phone to infer levels of physical activity.
New physical activities were represented on a visualization of a garden.
Lack of physical activity could lead to death of garden.

Quitty

It's a mobile application to support smoking cessation. It serves as continuous interaction support for ongoing task and tailors messaging to cessation progress.

Detecting Mood Disorders

Using data collected from mobile phones and wearable devices to detect potential mood disorders and predict changes in mood (e.g. social anxiety, seasonal affective disorder)

Social Health

A research shows that social ties and social integration are beneficial in maintaining physical and psychological well-being
Virtual communities can support communication among patients, or between patients and clinicians and this can lead to reduced stress, social satisfaction, increased access to information, and increased communication.

pHealthNet

It's a virtual community to support communication between patients and specialists. It aimed at promoting healthy lifestyle for people with chronic degenerative diseases to prevent further disease.

Spaceship Launch

It leverages FitBit data. Social "exergame" targeted at low-income families to encourage physical activity.
It is based on the idea that children often don't see parents modeling physical activity

Pervasive Computing for Hospital Care

-… (leggi sopra)
Healthcare is often slower than other industries in adopting new information technologies. Hospitals are deploying technologies to improve patient care, reduce costs, and prevent errors.
Hospital work conditions are substantially different from typical office conditions: Hospital work demands close coordination and collaboration among specialists distributed over space and time. The clinicians continuously move around the space to access people, knowledge, and resources (e.g., seeing patients, accessing clinical information such as patient records or medical images)
Information is often distributed in different locations

Technology Approaches for Supporting Hospital Care

Primary goal is to make information available and allow people to access relevant information when and where they need it.
<u>Technology approaches for Supporting Hospital Care</u>
-Context-Aware Services and Awareness
-Pervasive Groupware and Collaboration Support
-Record-keeping and Note Taking
- Handling Multiple Activities and Supporting Rapid Context Switching

Context-Aware Services and Awareness

Make use of computing to collect context information to determine how a system should behave.
Focus on keeping clinicians aware of current situation and work status and providing information where and when it is relevant.

FlowerBlink

Ambient display and wearable bracelet to help monitor ADL, specifically patient urination.
Patient urination triggers blinking light on nurse's bracelet that indicates which patient is urinating.
Ambient display has flowers that blink when patient is urinating or has a full urine bag, flowers display location of each patient.

Pervasive Groupware and Collaboration Support

It supports collaboration between colleagues for patient care and can support cross-department or even cross-hospital interaction.
It can enable synchronous or asynchronous meetings and shared access to medical information.

ABC (Activity-Based Computing)

Project supported teleconferences between clinicians that allowed them to physically "roam" while engaged.
Organized by "activity" rather than by application or document. It transferred user sessions and ongoing tasks among appropriate devices as clinicians move in the space, it provided shared display for activities and last but not least it allowed activities to be shared among participants .It also helps with context switching and it is organized by activity rather than by application or document.
Activity-Based-Computing (ABC) consolidates several functions into a single system, reducing the need o switch between systems while engaged in an activity (e.g. helps Hospital Work while clinicians switch from an activity to another).

Record-Keeping and Note-taking

Supports recording of data with minimal interference to the ability to engage in an activity or interaction.
It is challenging because clinician activities often require the use of both hands so they cannot use them to record information. It often uses automated capture and access approaches.
Activity Theater
It enables automatic capture of relevant events during a health procedure. The events can be captured as audio notes, pictures, or video clips and are saved to a palette; items from the palette can be used to create necessary documents. The system is activated by voice.

Handling Multiple Activities and Context Switching

Hospital work is highly fragmented: clinicians switch activities every 90 seconds on average.
Hospital work requires switching between several systems frequently, and there are many interruptions.

Chronic Care Management Technologies

Chronic Care Management

--… (leggi sopra)

Focuses on health conditions or diseases with long-term effects (e.g. Cancer, asthma, diabetes, high blood pressure, Alzheimer's, autism, affective disorders)

It often requires a variety of pharmaceutical and behavioral interventions to monitor and maintain patient health over time.

Remote patient monitoring is often more desirable than hospital care.

Chronic conditions can lead to lower perceived quality of life and self-care abilities.

It can lead to the need for regular assistance for performance of Activities of Daily Living (ADL) (e.g., feeding, bathing, or dressing oneself, walking, etc.).

The extensive support from caregivers can help, but also hamper independence, engagement in society, and self-image

Caregivers can experience strain and decreased quality of life as well.

Technology Approaches for Supporting Chronic Care

Focus on supporting ADLs, self management, communication with health providers, and caregiver support

Technology Approaches for Supporting Chronic Care

-Pervasive Monitoring

-Social Connectedness and Communication Support

-Assisted Navigation and Wayfinding Support

- Prompting and Reminders

Pervasive Monitoring

It consists of monitoring systems that can track basic metabolic and behavior information (Vital signs, activities, social interactions, sleep patterns, etc.)

It often makes use of wearable or embedded sensors.

CareLog

It's a capture and access application to help caregivers assess the behaviors of children with autism.

Uses audio and video buffers and selective (manually triggered) archiving of significant incidents.

Provides access to information and analytic tools for behavior assessment.

Monarca

It focuses on management of affective disorder, especially bipolar disorder. It uses manual and automated collection of information by patient. It communicated information to caretakers and clinicians and it allows for self-reflection and analysis.

Monarca serves multiple purposes: collection of vital data; provides clinician with access to more data; helps patient learn about condition and patterns; supports prediction of mood.

Visualization for Glucose Monitoring

It offers support for patients with Type II diabetes. It consists of a study of various information visualizations of glucose information. It varied context information, text, symbols, colors to help patients better understand and manage the disease.

Social Connectedness and Communication Support

Strong social networks may enhance quality of life for people with chronic illnesses ○ Improves health ○ Reduces chances of developing cognitive decline ○ Prevents earlier death. But people with chronic conditions experience additional challenges in accessing and maintaining social networks, increasing isolation.

Digital Family Portrait

It supports lightweight awareness between senior adult and adult children and provides indications of older adult's activity levels without explicit information. It is intended to encourage communication between family members without feelings of being "watched".

Assisted Navigation and Wayfinding Support

Mobility can be a substantial challenge for people with chronic illnesses and cognitive disabilities. Regards problems with working, driving, walking, or taking transit and problems with orientation indoors or outdoors.

The Technologies can help support navigation of environments.

Robotic Walker

It is a walking support device that includes a robot to physically guide elderly patients in assisted living facilities.

It uses artificial intelligence to help with path planning, tracking other people, and preventing collision.

It includes a touch interface for receiving commands from the individual.

It shows simple directions (e.g., arrows) on a display.

Prompting and Reminders

Aimed at assisting cognition for people with cognitive disabilities, memory impairment, or attention problems.

Provide guidance and management services to remind people how to execute activities.

Caregivers (assistenti) are often overburdened and stressed, so systems provide additional support.

COACH

It has been designed to assist people with severe dementia who have difficulties remembering the proper sequence of ADLs (e.g. COACH uses video camera to observe user as she attempts to wash hands). The video image is analyzed to identify current steps (e.g., turning on water, using soap). COACH provides recorded verbal prompt if a problem is recognized.

ADLs = activity of daily living (attività di vità quotidiana, termine utilizzato nella sanità per la cura personale).

Success and Challenges for Pervasive Healthcare

How to Assess Success? With improved health metrics, improved quality of life, less time in hospital, fewer readmissions to hospital, more/better information for clinicians, better understanding of own health, more independence, low burden, greater efficiency, etc.

Ongoing Challenges for Pervasive Health
Challenges: Privacy of sensitive health information; reliability of sensor-based technologies; overhead of introducing new systems and reluctance to move from analog to digital technologies; difficulties of testing and evaluating the effects of technologies on health and wellness; burden and adherence for users of systems.
Development and Evaluation
Many approaches from CSW and UbiComp are appropriate (Participatory Design, Contextual Inquiry, Distributed Cognition, Activity Theory, etc.) but concrete measures of effectiveness remain a challenge.
Evaluation of Health Technologies
It is difficult to measure behavior change and it is also difficult to measure effects of social factors.
-Ethical challenges of deploying experimental technologies that affect health
-Long-term empirical studies with measurable results are challenging deploy (legal and safety compliance or cooperation of health organizations).
Technology and Sustainability
Environmental Sustainability
Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Two negative effects of ubiquitous computing are energy/resource consumption and electronic waste.
Technological Efficiency != Sustainability
"Jevons Paradox" → Example with coal: increasing the efficiency of coal power system wasn't going to affect an overall reduction of coal, the technology became more efficient. E.g. when fuel is more available/efficient people drive more.
"Jevons Paradox": Technological improvements increase the efficiency with which a resource is used; total consumption of that resource may increase rather than decrease.
E-waste: trash produced by the disposal of electronic devices. Switzerland has the #3 highest rate of electronics disposal per capita (2019).
Obsolescence and Planned Obsolescence
Rapid advancements in technology lead to technology obsolescence and frequent replacement of devices.
Planned Obsolescence
It's the intentional design or engineering of technologies to become obsolete (e.g. software designed to run on new devices, circuits designed to lose performance over time).
Energy Consumption and E-waste
They are complex problems without easy solutions, no one is responsible. The advances in computer science have contributed greatly to these problems. There is a very real impact of computing on society (political, environmental, health, social).
Design and Engineering
Engineering technologies for efficiency alone is not enough to achieve sustainability. There is a need to consider design, and how people interact with technologies. Two questions: How can design lead to more sustainable technology use? How can technologies themselves promote sustainable behaviors and practices?
Sustainable HCI
New-ish field of research in computing (since ~2007) which considers the relationship between humans and technology in the context of sustainability.
Two high level approaches:
-Sustainability in design: asks how technologies can be designed so that their use is sustainable.
-Sustainability through design: asks how technology can support sustainable behaviors or lifestyles.
Sustainability in Design
Sustainable Interaction Design
It's the perspective that sustainability can and should be a first-class focus of design, like robustness, usability, etc.
Blevis, the man who proposed the sustainable interaction design, defines design as an act of choosing among or informing choices of future ways of being.
Blevis's Rubric
Blevis's rubric is a rubric for understanding and assessing the sustainability of particular instances of design in terms of use, reuse, and disposal. This rubric is approximately ordered from greatest to least negative impact /from most damaging to most beneficial).
Elements of Blevis's Rubric: -Disposal, Salvage, Recycling, remanufacturing for reuse, reuse as is, achieving longevity of use, sharing maximal use, achieving for maximal use, sharing for maximal use, achieving heirloom status, finding wholesome alternatives to use, active repair of misuse.
Disposal: Does the design cause the disposal of physical material, directly or indirectly and even if the primary material of the design is digital material?
Examples: Any single use technologies (cameras, phones), almost all devices eventually, printing software that has default cover pages
Salvage: Does the design enable the recovery of previously discarded physical material, directly or indirectly and even if the primary material of the design is digital material?
E.g., Technologies that run on waste oil, printers that can accept used paper
Recycling: Does the design make use of recycled physical materials or provide for the future recycling of physical materials, directly or indirectly and even if the primary material of the design is digital material?
E.g., Devices made of recycled or recyclable plastics, devices designed to be easily separated into component materials, applications that inform you of where you can recycle materials.
Remanufacturing for Reuse: Does the design provide for the renewal of physical material for reuse or updated use, directly or indirectly and even if the primary material of the design is digital material?
Examples: Phones with replaceable exteriors, software upgrades to update older devices
Reuse as is: Does the design provide for the transfer of ownership, directly or indirectly and even if the primary material of the design is

digital material?
E.g., Devices that are easy to wipe of old data and allow for “new user” configuration experience, websites for people to sell or give away used items.
Achieving longevity of use: Does the design allow for long term use of physical materials by a single owner without transfer of ownership, directly or indirectly and even if the primary material of the design is digital material?
E.g., Physically robust e-book reader that allows for regular upgrading of software and content, online community that lets you “brag” about how long you have kept a device
Sharing for maximal use: Does the design allow for use of physical materials by many people as a construct of dynamic ownership, directly or indirectly and even if the primary material of the design is digital material?
E.g., car-sharing, bike sharing, or ride sharing websites and apps, shared payment devices in stores
Achieving Heirloom Status: Does the design create artifice of long-lived appeal that motivates preservation such that transfer of ownership preserves quality of experience, directly or indirectly and even if the primary material of the design is digital material?
E.g., vintage game consoles, collector websites for rare electronics
Finding Wholesome Alternatives to use: Does the design eliminate the need for use of physical resources, while still preserving or even ameliorating qualities of life in a manner that is sensitive to and scaffolds human motivations and desires?
E.g., activity tracking apps on phones that reduce the need for separate tracking devices, digital readers that alleviate the need for paper
Active Repair of Misuse: Is the design specifically targeted at repairing the harmful effects of unsustainable use, substituting sustainable use in its place?
E.g., apps that encourage and reward walking instead of driving, devices that generate and harness kinetic energy from everyday activities

Blevis’s Principles for Design

Linking invention and disposal; promoting renewal and reuse; promoting quality and equality; de-coupling ownership and identity; using natural models and reflection.

Linking Invention and Disposal

“Any design of new objects or systems with embedded materials of information technologies is incomplete without a corresponding account of what will become of the objects or systems that are displaced or obsoleted by such inventions.”
When designing a product or technology, it is as important to design what happens after it is out of use as it is to design how it will be used. It is also important to consider what happens to other technologies or products as a result (e.g. products that are replaced by the new one)
Why is this a concern for designers of digital content? -Software drives physical aspects, e.g. demand for new hardware, premature disposal of physical materials; -New hardware prompts the invention of new software
Take-back and recycling programs are insufficient given the rate of consumption
What alternatives can be designed that change the way we use and discard things? (Incentives for shared use , modularity or upgrade-ability, construction from enduring materials)

Promoting Renewal and Reuse

“The design of objects or systems with embedded materials of information technologies implies the need to first and foremost consider the possibilities for renewal and reuse of existing objects or systems from the perspective of sustainability.”
How can digital material (i.e. software) promote renewal and reuse?
It’s the use of software to upgrade and renew older devices (E.g. upgrading maps and directions on an older GPS device, upgrading an older vehicle through the addition of a GPS device)
It’s also the use of technologies to promote renewal and reuse (E.g. freecycle.org – community based services that promote exchange and distribution of unwanted items, websites for refurbishing and reselling computer equipment).

Promoting Quality and Equality

Looking at what can motivate people to reuse as is, achieve longevity of use, share for maximal use, and achieve heirloom status for objects

De-coupling Ownership and Identity

Concerns issues of fashion, security and privacy, and sense of self in the construct of identity.
These motivate relationship to objects of consumption. -Hinder possibilities for sharing for maximal use.

Using Natural Models and Reflection

Promoting imitation of use of resources in nature and the design method for doing so ○ Connected to achieving longevity of use, sharing for maximal use, achieving heirloom status, finding wholesome alternatives to use, and active repair of misuse.

Cradle to Cradle Design

It’s an alternate perspective on how things should be designed
A counterargument to “doing less harm,” using fewer resources, or making do with less
argues against the tenets of “reduce, reuse, recycle and regulate” and against “cradle to grave” design (life cycle of product, we gave to think of a more cyclic approach).
The Cradle to Cradle design considers the “cherry tree” metaphor. Tree produces thousands of blossoms with the “goal” that one pit might grow a new tree.
The Cradle to Cradle design conceives of design in terms of “nutrient flows” – all materials are nutrients that should go back into the system. There are two closed loop “metabolisms” :Biological metabolism – for biological nutrients; components that can biodegrade or be safely thrown away to be consumed again and Technical metabolism – for technical materials that can be reused in the same form (e.g., metals and high-quality plastics).
Cradle to Cradle design is complicated to apply to technology design but it’s promising. It echoes Blevis’s rubric about use of natural models and active repair of misuse.

Eco-Feedback Technologies

It is a primary focus of technology development for promoting sustainable actions.
They are technologies that present feedback about individual or group behavior with the intention of reducing environmental impact.
Ambient Awareness technologies: they sit in the background of the consciousness and make use of “calm computing” approaches.
Ambient Awareness is intended to create awareness of the environment or behaviors.

Persuasive Technologies

It is the predominant genre of sustainable HCI technologies. They are systems that attempt to convince users to behave more sustainably and they vary in terms of whether the persuasion is passive or active. It also varies in terms of whether the user is intended to be conscious of the persuasion or not.

Pervasive and Participatory Sensing

Sensors are increasingly being used to monitor and report on environmental conditions (e.g. air quality displays on highways)

Participatory sensing involves non-experts in the collection of data.

Intended to help collectively create a rich set of data and to empower and inform non-experts.

Spectacle Computing

-Workshops teach citizens of a community to assemble sensor-augmented balloons to collect data about air pollutants

-Citizens deploy balloons in public places to monitor air quality and inform the public

-Balloons invite curiosity and engagement

Criticism of Sustainable Human Computer Interaction (HCI)

Focus on Consumer vs. Focus on Designer

Affecting consumer or end-user behavior is limited in impact. Consumers may be motivated to change practices but technologies need to allow for more sustainable behaviors

It the ongoing work on how to motivate and support designers in incorporating sustainability into technology systems and products.

Sustainability and Profitability

It's the value of durable goods. There is a shift from physical objects to services, software, content. Reclaiming materials can save money.

Sustainability is an Ongoing Problem

Technologies and approaches presented are all problematic and unlikely to yield complete solutions. The many proposed solutions potentially create new problems

Problems of environmental sustainability, and negative environmental effects of ubiquitous computing cannot be solved by informatics alone.

The solutions are difficult to test and evaluate.

Ethics and Computing

What is Computer Ethics? Ethical problems aggravated, transformed or created by computer technology.

It's the analysis of the nature and social impact of computer technology and the corresponding formulation and justification of policies for the ethical use of such technology.

1940s and 1950s: Norbert Wiener drew several insights about the potential ethical impact of information systems (computer might be able to sense information, machines could be built to perform complicated tasks)

He identified key ethical questions for computing and predicated a second industrial revolution.

1960s: Donn Parker developed the first code of professional conduct.

1970s: Walter Maner begins to use the term "computer ethics". He developed university-level courses on computer ethics and published the starter kit in computer ethics which contains materials and advice for universities to implement computer ethics courses.

1980s: Social and ethical impacts of computing become public issues (computer-enabled crime, disasters caused by computer failures, etc.)

The first international conference on computer ethics takes place, bringing together computer professionals, philosophers, etc.)

Topics in Computer Ethics: Computer in the Workplace, computer crime, privacy and anonymity, intellectual property, professional responsibility & globalization

Computers in the Workplace

Computers can potentially replace people in jobs or reduce their need. Computing also creates new jobs. Computers can radically alter the nature and responsibilities of a job.

Computer Crime

It's the proliferation of fraud, viruses, spying, hacking. New policy and approaches needed to handle security and computer crime.

Privacy and Anonymity

Computers and networks can gather, store, search, compare and share personal information. People can no longer keep information fully confidential. There is a lack of transparency about who has access to personal information.

Intellectual Property

It consists of challenges concerning ownership of software and media. There is a strong financial interest in protection of software and other intellectual property.

Professional Responsibility & Globalization

Global networks and conglomerates connect people and information worldwide.

It affects global laws, global business, global education, global information flows.

There is an increasing digital divide between rich and poor nations.

Ethics Codes

Organizations and groups attempt to define codes of conduct and ethics that members should follow. It is impossible to cover all ethical issues. The ethical codes mirror some legal policy but they are not laws.

Examples of ethical codes: code of fair information practices, computer ethics institute, association for computing machinery

Study Ethics: entails collecting data about people.

Purpose of study ethics; protect study participants, protect data, protect an organization.

The participant has a right to be informed (procedures, use of information collected, risks, procedures)

Informed Consent

Provide the potential participant with enough information that they understand what they are agreeing to.

Its purpose is to provide a high-level description of the research activity. It is also to make the participant comfortable with the study and data collection.

The procedure of informed consent is to provide a description of what the participant will be required to do. It is also to provide a description of what the researcher will be doing (e.g. taking notes, recording audio, etc.)
Right to withdraw: participants should not be coerced into participating and should not be penalized for withdrawing.

Overall guidelines of Study Ethics

Minimize risks to participants, collect only as much personal information as necessary, inform participants about their participations and data use, provide incentives that are proportional to effort, allow participants to withdraw.