MUNI   **HCI** LAB

PV182
Human Computer Interaction

Lecture 1
Introduction to Human-Computer Interaction

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Fotis Liarokapis

- PhD in Computer Engineering
  – University of Sussex, UK
- MSc in Computer Graphics and Virtual Environments
  – University of Hull, UK
- BSc in Computer Systems Engineering
  – University of Sussex, UK

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My Research

- Research areas:
  – Virtual Reality
  – Augmented Reality
  – Brain-computer Interfaces
  – Procedural Modeling
  – Serious Games

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Contact Details

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- Office Location:
  – C411
- Office Hour:
  – Wednesday 13:00 to 14:00

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Course Details

- Lectures
  – Every Monday
  – Time: 12:00 to 13:50
  – Location: A318

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Course Objectives

- The course deals with basics of human-computer interaction
- It is focused on psychological and physiological aspects of interface design, graphical user interface design and its usability assessment

Learning Outcomes

- After finishing the course students
  - Will be able to evaluate existing screen designs
  - Will practice in developing human-computer interfaces with respect to a usability
  - Will be able to assess the usability of SW products
  - Will understand the usability issues of products in general
  - Will gain practical knowledge of designing process based on in-depth knowledge of high and low level models of human-computer interaction

Indicative Syllabus

- Introduction to human computer interaction. Task-centred system design
- High level models of human-computer behaviour
- User-centred design and prototyping
- Evaluating interfaces with users
- Evaluation - controlled experiments
- Design of everyday things
- Representations, visual variables, metaphors and direct manipulation
- Evaluation based on cognitive models
- Graphical screen design
- Physical user interfaces
- Heuristic evaluation of interfaces

Teaching Methods

- Delivery of the material will be based on
  - Expositional lectures
  - Reinforced by computer demonstrations of the application of the material
  - Video demonstrations

Labs

- Critical to your success in assignments
  - Elaboration of details
  - Learn specific skills
  - Discuss intermediate results
  - Class feedback on assignment milestones

Assessment Methods

- Project is split in 5 HWA solved mostly in a lab using specialized software
  - Steps include a design of interface for a specific purpose: from a paper prototype to complete GUI design
  - Every step is graded 0-10 points
  - Points exceeding limit 20 are added as bonus to the grading of a written exam
- Written exam
 - 5 questions, 90 minutes

Plagiarism and Cheating

- If you use an external resource cite it clearly!
- Don't do things that would be considered dishonest... if in doubt ask
- Cheating earns you:
  - Fail in the class
  - Getting reported to the University
  - No exceptions

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Literature

- MULLET, Kevin and Darrell SANO. Designing visual interfaces : communication oriented techniques. Englewood Cliffs, NJ: SunSoft Press, 1995. xv, 273. ISBN 0133033899.
- PREECE, Jenny. Human computer interaction. Harlow: Addison-Wesley, 1994. xxxviii, 7. ISBN 0-201-62769-8
- DIX Alan, FINLAY Janet E., ABOWD Gregory D., BEALE Russell, Human-Computer Interaction (3rd Edition), Pearson Education Ltd, 2004. ISBN-10: 0130461091

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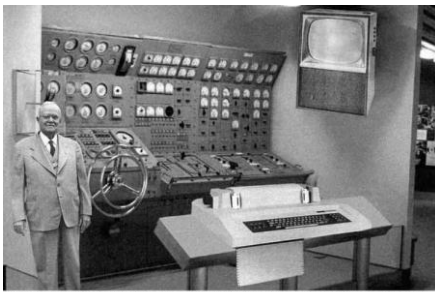
History of HCI

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RAND's vision of the Future

Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 50 years from now scientific progress is expected to solve these problems. With teletype interface and the Fortran language, the computer will be easy to use.

http://www.imageshack.us/ (original source unknown)

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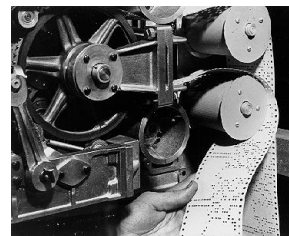- With teletype interface and the Fortran language, the computer will be easy to use

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Eniac (1943)

- A general view of the ENIAC, the world's first all electronic numerical integrator and computer
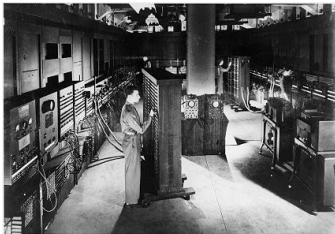
From IBM Archives

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Mark I (1944)

- The Mark I paper tape readers

From Harvard University Cruft Photo Laboratory

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'As We May Think' (1945)

- Vannevar Bush identified the information storage and retrieval problem:
  - New knowledge does not reach the people who could benefit from it
- Desired for a sort of collective memory machine with his concept of the memex that would make knowledge more accessible
  - Memex was the hypothetical proto-hypertext system

Vannevar Bush

https://en.wikipedia.org/wiki/As_We_May_Think

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Bush's Memex

- Conceiving Hypertext and the World Wide Web
  - A device where individuals stores all personal books, records, communications etc
  - Items retrieved rapidly through indexing, keywords, cross references,...
  - Can annotate text with margin notes, comments...
  - Can construct and save a trail (chain of links) through the material
  - Acts as an external memory!

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Bush's Memex .

- Bush's Memex based on microfilm records!
  - Not implemented
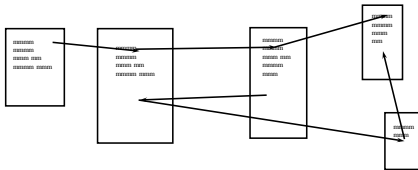
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Ball Tracker System (1946)

- Ralph Benjamin invented a ball tracker system called the roller ball in 1946
  - Invented as part of a post-World War II-era radar plotting system named Comprehensive Display System (CDS)
  - Kept as a military secret for a few years!
  - Only fully implemented as a usable device by the Canadian navy some years later in its Digital Automated Tracking and Radar system (DATAR)

https://arcadeblogger.com/2016/07/29/the-secret-history-of-the-arcade-trackball/

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IBM SSEC (1948)

- IBM Selective Sequence Electronic Calculator (SSEC) was an electromechanical computer built by IBM
  - Design started in late 1944
  - Operated from January 1948 to 1952

From IBM Archives

https://en.wikipedia.org/wiki/IBM_SSEC

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DATAR (1952-1953)

- The DATAR was a method of giving all ships within a particular fleet a "single view" of their operational status
  - Collated information provided by sensors placed on board of each vessel

https://arcadeblogger.com/2016/07/29/the-secret-history-of-the-arcade-trackball/

DATAR (1952-1953) .

- The trackball could be used by operators of the system to manage and upload this data to the main DATAR mainframe for processing and regurgitation back to each ship
  - The actual hardware used to display this information was adapted from a radar screen

https://arcadeblogger.com/2016/07/29/the-secret-history-of-the-arcade-trackball/

J.C.R. Licklider (1960)

- Outlined "man-computer symbiosis"

"The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today."

IBM 7030 - Stretch (1961-62)

- The IBM 7030, also known as Stretch, was IBM's first transistorized supercomputer
- Fastest computer in the world from 1961 until 1964
  - The first CDC 6600 became operational in 1964

https://en.wikipedia.org/wiki/IBM_7030_Stretch

SketchPad (1963)

- Ivan Sutherland's SketchPad-1963 PhD
- Sophisticated drawing package
- Many ideas/concepts now found in today's interfaces

http://accad.osu.edu/~waynec/history/images/ivan-sutherland.jpg

SketchPad Concepts (1963)

- Hierarchical structures:
  - Defined pictures and sub-pictures
- Object-oriented programming:
  - Master picture with instances
- Constraints:
  - Details which the system maintains through changes
- Icons:
  - Small pictures that represent more complex items

- Copying:
  - Pictures and constraints
- Input techniques:
  - Efficient use of light pen
- World coordinates
  - Separation of screen from drawing coordinates
- Recursive operations
  - Applied to children of hierarchical objects

First Mouse Prototype (1964)

- Bill English joined ARC, where he helped Engelbart build the first mouse prototype
- Early models had a cord attached to the rear part of the device which looked like a tail
  - This resembled to the common mouse

Bill English   Douglas Engelbart

Douglas Engelbart holding the first computer mouse

https://en.wikipedia.org/wiki/Computer_mouse

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Xerox Alto (1973)

- The Xerox Alto was the first computer designed from its inception to support an operating system based on a graphical user interface (GUI)
  - Later using the desktop metaphor

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The Xerox Alto Mouse (1973)

- The first mouse driven GUI computer
- Featured:
  - A three button mouse
  - Utilised a steel ball

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ALTAIR 8800 (1974)

- The Altair 8800 is a microcomputer designed in 1974 by MITS
  - Based on the Intel 8080 CPU

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Xerox Star 8010 (1981)

- First commercial personal computer designed for 'business professionals'
  - Introductory price : $16,500 (equivalent to $43,467 in 2016)
  - Discontinued: 1985
- Incorporated various technologies that have since become standard in personal computers
  - i.e. a bitmapped display, a window-based graphical user interface, icons, folders, mouse (two-button), Ethernet networking, file servers, print servers, and e-mail

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Apple Lisa (1983)

- Based upon many ideas in the Star
  - Predecessor of Macintosh
  - Somewhat cheaper ($10,000)
  - Commercial failure

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Macintosh 128K (1984)

- Succeeded because:
  - Aggressive pricing ($2500)
  - Learnt from mistakes of Lisa and corrected them - ideas now "mature"
  - Market now ready for them
  - Developer's toolkit encouraged 3rd party non-Apple software
  - Interface guidelines encouraged consistency between applications
  - Domination in desktop publishing because of affordable laser printer and excellent graphics

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Logitech Wireless Mouse (1991)

- In 1991, Logitech released the first wireless mouse:
  - Logitech's Cordless MouseMan
- Before released:
  - 1982: a 3-button mouse in
  - 1990: introduced the MouseMan Left, MouseMan Right and MouseMan Large

https://github.com/Gouthamve/Evolution-of-a-mouse/blob/master/README.md

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Logitech MX-1000 (2004)

- In 2004, Logitech MX-1000 introduced the first optical mouse with Laser baser tracking
  - Made the mouse experience a lot smoother

https://github.com/Gouthamve/Evolution-of-a-mouse/blob/master/README.md

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Magic Mouse (2009)

- Apple released the Magic Mouse in 2009
- Minimalist design
- Multi-touch pad

https://github.com/Gouthamve/Evolution-of-a-mouse/blob/master/README.md

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Other Events

- MIT Architecture Machine Group
  - Nicholas Negroponte (1969-1980+) with many innovative inventions:
    - wall sized displays
    - use of video disks
    - use of artificial intelligence in interfaces (idea of agents)
    - speech recognition merged with pointing
    - speech production
    - multimedia hypertext
    - ....
- ACM SIGCHI (1982)
  - special interest group on computer-human interaction
  - conferences draw between 2000-3000 people
- HCI Journals
  - Int J Man Machine Studies (1969)
  - many others since 1982

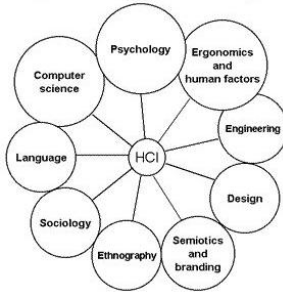## HCI LAB

Introduction to HCI

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Definition

- "*Human–computer interaction (commonly referred to as HCI) researches the design and use of computer technology, focused on the interfaces between people (users) and computers. Researchers in the field of HCI both observe the ways in which humans interact with computers and design technologies that let humans As a field of research, human-computer interaction is situated at the intersection of computer science, behavioral sciences, design, media studies, and several other fields of study.*"

https://en.wikipedia.org/wiki/Human%E2%80%93computer_interaction

The Field of HCI

https://www.pinterest.com/pin/388998486545084172/

What is HCI?

- Human-Computer Interaction

Advanced HCI?

HCI Importance

- Cheaper/available computers/workstations meant people more important than machines
- Excellent interface ideas modeled after human needs instead of system needs (user centered design)
- Evolution of ideas into products through several generations
  - Pioneer systems developed innovative designs, but often commercially unviable
  - Settler systems incorporated (many years later) well-researched designs
- People no longer willing to accept products with poor interfaces

HCI Discipline

A discipline concerned with the:

design **implementation** **evaluation**
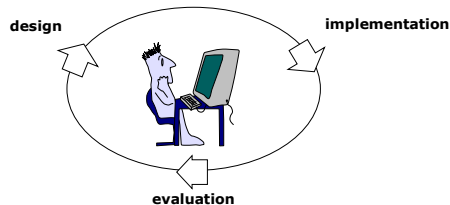
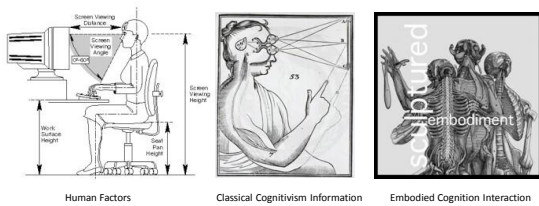of interactive computing systems for human use

HCI Discipline Definition

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

Association for Computing Machinery (ACM)

Three paradigms of HCI

- The Three Paradigms of HCI Harrison, Tatar and Sengers, CHI 2007

Human Factors Classical Cognitivism Information Embodied Cognition Interaction

Three paradigms of HCI .

|	1st HCI Paradigm Human Factors Engineering	2nd HCI Paradigm Classical Cognitivism Information	3rd HCI Paradigm Embodied Cognition Interaction
Metaphor of Interaction	Interaction as Man-Machine Coupling	Interaction as Information Transfer	Interaction as Phenomenologically Situated
Central Goal for Interaction	Optimise fit between man and machine	Optimise accuracy and Efficiency of Information Transfer	Support of Situation Action in the World
Typical Questions of Interest	How can we fix specific problems that arise in Interaction?	What mismatches arise in communication between humans and computers? How can we accurately model what people do? How can improve the efficiency of HCI?	What existing situated activities should we support? How do users appropriate technology? How can we support interaction with constraining it by what a computer can do/understand? What is the wider context roles, politics and values?

Three paradigms of HCI ..

|	1st HCI Paradigm Human Factors Engineering	2nd HCI Paradigm Classical Cognitivism Information	3rd HCI Paradigm Embodied Cognition Interaction
Appropriate Disciplines for Interaction	Engineering, Programming, Ergonomics	Laboratory and Theoretical Behavioural Science	Ethnography, Action Research Ethnomethodology, Interaction Design, User Centred Design
Desirable Methodologies	Cool Hacks	Verifiable Quantitative design and evaluation methods that can be applied regardless of context	A palette of situated design and evaluation strategies
Legitimate kinds of Knowledge	Pragmatic Objective Details	Objective facts and models with general applicability	Thick Description of Context and Stakeholder Concerns.
How do you know something is True?	You Tried it out and it worked	You confirm of refute your hypothesis based on a statistical analysis of the evidence	You argue about the relationship between your data and what you seek to understand

Three paradigms of HCI …

	1st HCI Paradigm Human Factors Engineering	2nd HCI Paradigm Classical Cognitivism Information	3rd HCI Paradigm Embodied Cognition Interaction
Values	Reduce errors and make it work. Ad Hoc is OK. Cool Hacks that exploit a specific instance are desired	Optimisation. Strive for Objective, Abstract, Quantitative, Generalizable Knowledge wherever possible. Principled evaluation is *a priori* better than ad hoc, since design can be structured to suite this paradigm. Structured Design better than un-structured. Reduce Ambiguity. Top Down View of Knowledge.	Construction of meaning is intrinsic to and unfolds from interaction. What goes on around systems is more interesting than what's happening at the interface. "Zensign" - what you don't build is as important and what you do build. Goal is to grapple with the full complexity around the system.Knowledge can not just be a powerful abstraction but can be embedded in the world as hidden context and tacit skill which is revealed through engagement

Which HCI Paradigm is Correct?

- The key question is not which of the paradigms is "correct" but what different perspectives, strengths, weaknesses, insights and tools they offer and when they are appropriate to apply

Classical Cognitive Information Epoc   Embodied/Situated Interaction Epoc
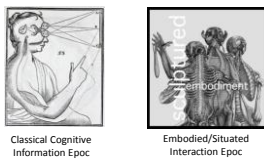
An interface design process
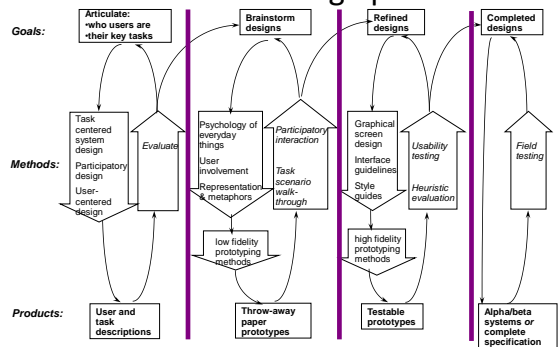
Why Interface Design Process?

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- 63% of large software projects go over cost
- Managers gave four usability-related reasons
  - Users requested changes
  - Overlooked tasks
  - Users did not understand their own requirements
  - Insufficient user-developer communication and understanding
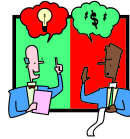
Why Interface Design Process? .

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- Usability engineering is software engineering
  - Pay a little now, or pay a lot later!
  - Far too easy to jump into detailed design that is:
    - founded on incorrect requirements
    - has inappropriate dialogue flow
    - is not easily used
    - is never tested until it is too late

Foundations for designing interfaces

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- Understanding users and their tasks
  - Task-centered system design
    - How to develop task examples
    - How to evaluate designs through a task-centered walk-through

Foundations for designing interfaces .

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- Designing with the user
  - User centered design and prototyping
    - methods for designing with the user
    - low and medium fidelity prototyping
  - Evaluating interfaces with users
    - the role of evaluation in interface design
    - how to observe people using systems to detect interface problems

Foundations for designing interfaces ..

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- Designing visual interfaces
  - Design of everyday things
    - What makes visual design work?
  - Beyond screen design
    - Representations and metaphors
  - Graphical screen design
    - The placement of interface components on a screen

Foundations for designing interfaces …

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- Principles for design
  - Design principles, guidelines, and usability heuristics
    - Using guidelines to design and discover usability problems

Computer

Computer

• What is a computer?

Nowadays Many Mediums

• Mobile and Social Media
• Social Computing
• Virtual and Augmented Reality
• Ubiquitous Computing
• Tangible Computing
• Brain-Computer Interfaces

Mobile and Social Media

• Smart Phones
• Apps vs HTML5
• Location Based Services (LBS)
• Communication and Content Creation
• A post PC era of phones and tablets?
• Constantly changing interactions, social context and place.
• Twitter, Facebook, Foursquare, Google Maps

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Social Computing

• Computer Supported Collaborative Working (CSCW)
• Beyond immediate interaction to a web of surrounding relations
• Ethnography, Ethnomethodology
• Actual Practices

Virtual and Augmented Reality

• Virtual Worlds - Simulation, immersion
• Second Life, Massive Multi-player Online Role Playing Games MMORPG
• Virtual Reality - A separate virtual place
• HeadMounted Displays, Caves
• Augmented Reality - The Real World Plus
• Tablets, Phones, Google Glasses
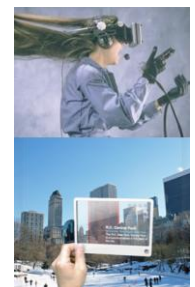
Ubiquitous Computing

- Computers omni-present but "invisible"
- Computers escape from the desktop and disappear
- Wireless, Wearable, Small, Embedded
- RFID tags,
- Micro-controllers, Speckled computing, Machine to Machine
- Internet of Things (IoT)

Tangible Computing

- Physical Interface
- Use of Embodied skills
- Rich tactile and proprioceptive feedback
- Physical affordances and constraints of the physical world

Ishii and Ullmer, CHI 97.
Tangible Bits: Towards Seamless Interfaces
Between People, Bits and Atoms

Brain-Computer Interfaces

- BCI is a direct communication pathway between an enhanced or wired brain and an external device
  - Research on BCIs began in the 1970s at the University of California, Los Angeles (UCLA)
  - More to come …

Conclusions

- HCI is one of the most important disciplines of Computing and Engineering
- Traditional HCI is changing
  - What will be the new technology that will dominate?

Questions

Acknowledgements

- Prof. Ing. Jiří Sochor