CSE 4849 / CSE 4885
Human Computer Interaction (HCI)
Lecture 1: Introduction to HCI

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Introduction

- What happens when a human and a computer system interact to perform a task?
- Tasks - write document, calculate budget, solve equation, learn about Cox's Bazar, drive home, make a reservation, land a plane and so on so forth.
- For each of the above cases, user cares about the interface, not the code or the hardware details.
- But instead, User wants **flawless performance**, **learning the usage from the interface itself**, want the tasks to be done **securely**, **quick**, **enjoying the task**, **not distracted by other unnecessary tasks**, wants to do the tasks as they are **used to doing it in daily life**.

What is HCI?

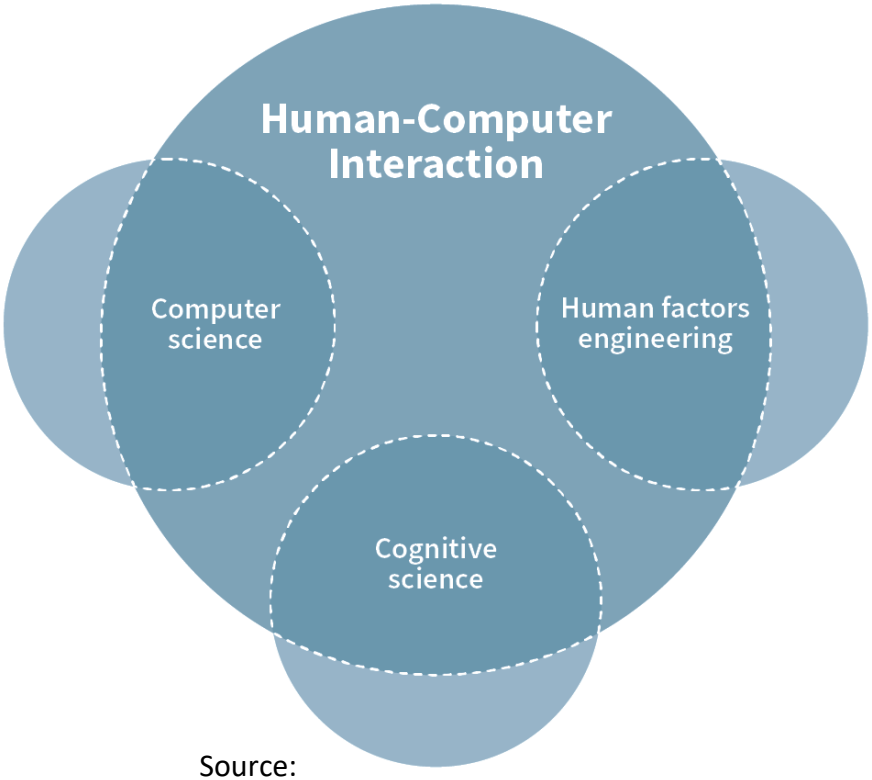
Physical Work → Cognitive Interaction

- The term HCI has only been in widespread use since the early 1980s.
- Systematic study of human performance (e.g. **efficiency**, accuracy) began in the earnest at the beginning of the last century (1900's) in **factories**, with an emphasis on manual tasks.
- The second World War (**WWII**) provided the driving force for **studying the interaction between humans and machines** (e.g. aircraft cockpit, weapons). This leads to the formation of Ergonomics Research Society in 1949.
- Traditionally, ergonomics have concerned primarily with the physical characteristics of machines and systems (e.g. layout of controls, visibility of instruments), and how these affects human performance.
- Human factors incorporate these issues, and more cognitive issues (e.g. memory, attention, decision making) as well.

"HCI evolved from solving physical interaction problems to solving cognitive and interactive design problems."

What is HCI?

- *HCI gives the ground for the researchers to study the interaction between people and computers, concerning themselves with **physical, psychological and theoretical** aspects of this process.*
- *HCI blends the concepts of **computer science**, **cognitive science** and **human factor engineering** to devise interactive solutions of real-life problems*



Source:
Interaction Design Foundation
interaction-design.org

What is HCI? …

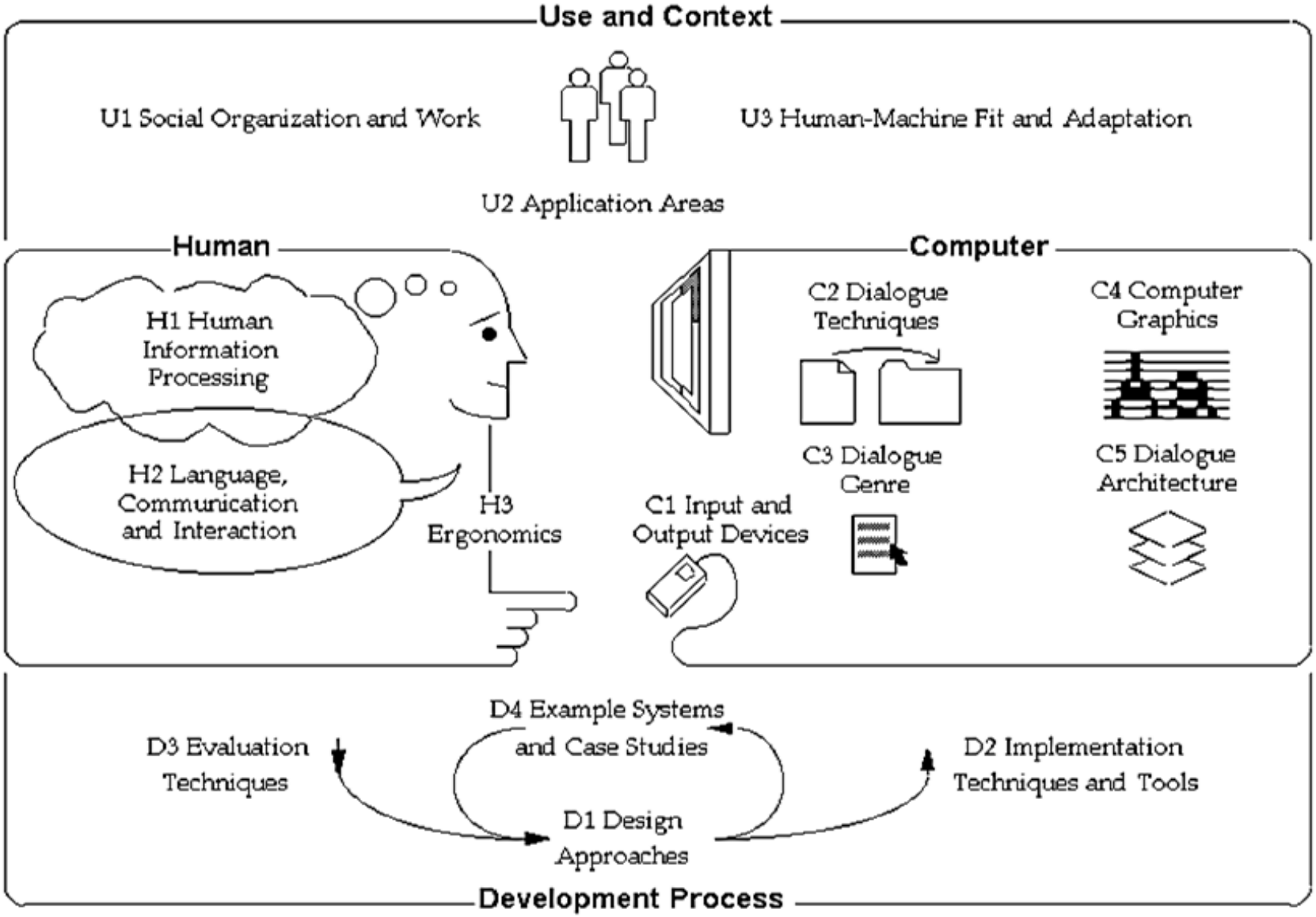
HCI do not necessarily envisage a single user with desktop computer. In the context of HCI;

- User means – an individual user, a group of users working together, or a sequence of users in an organization, each dealing with some part of the task or process.
- Computer means – any technology ranging from the general desktop computer to a large-scale computer system, a process control system or an embedded system. The system may include non-computerized parts, including other people.
- Interaction means – any communication between a user and computer, be it direct or indirect.
  - Direct interaction involves a dialog with feedback and control throughout the performance of the task.
  - Indirect interaction may involve batch processing or intelligent sensors controlling the environment.

What is HCI?

- HCI is *"Concerned with the design, implementation and evaluation of interactive computing systems for human use and with the study of major phenomena surrounding them"* (ACM SIGCHI, 1992)
- As a science and practice HCI has two goals:
  1. Designing better technology
  2. Understanding the nature of the relationship between humans and technology

Interrelated aspects of HCI



You know now

- The HCI discipline includes the study of:
  - The use and context of computers
  - Human characteristics
  - Computer system and interface architecture
  - The development process
- HCI is worth studying because it aligns both human interests and economic interests

HCI How?

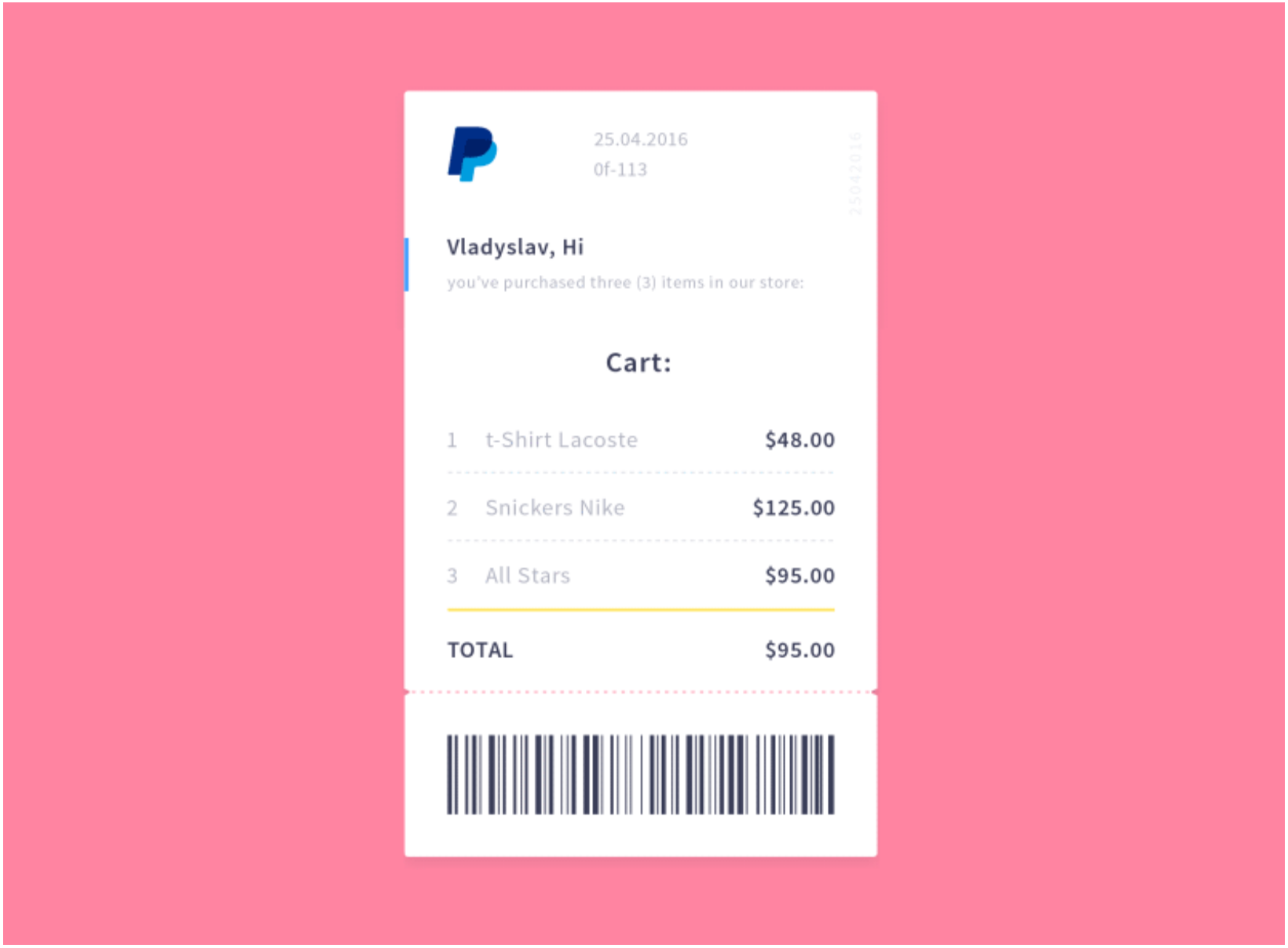
- How do we improve interfaces?
  1. Educate software professionals
  2. Draw upon fast accumulating body of knowledge regarding H-C interface design
  3. Integrate UI design methods and techniques into standard software development methodologies now in place

Why HCI?

- iPhone VS Samsung
- Pros:
  - It feels good in the hand.
  - “Thin and light”
  - Image quality is perfect and there is little or no noise even in a low-light environment
  - The smooth design ensures an elegant appearance and offers a thick frame layout.
  - Smooth ecosystem integration
- Cons:
  - Low battery
  - High price

Samsung
S24 ultra 5G

iPhone 16
pro Max


25.04.2016
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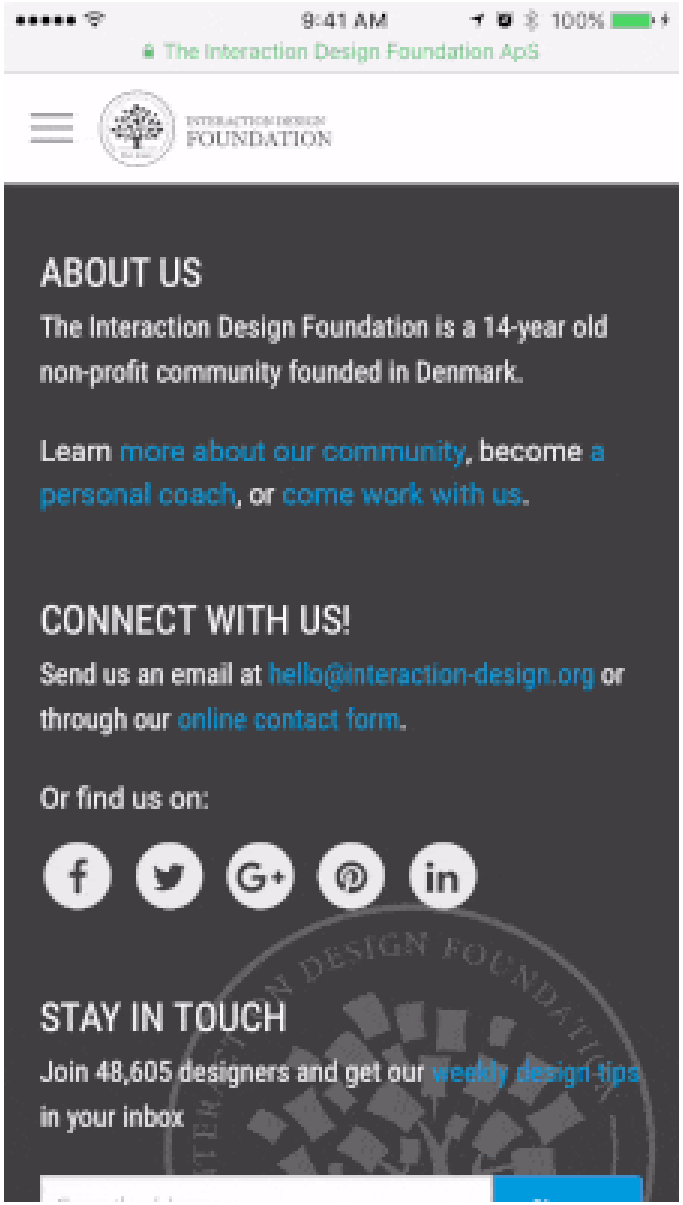
Vladyslav, Hi
you've purchased three (3) items in our store:
Cart:
1 t-Shirt Lacoste $48.00
2 Snickers Nike $125.00
3 All Stars $95.00
TOTAL $95.00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The Interaction Design Foundation ApS
INTERACTION DESIGN FOUNDATION
ABOUT US
The Interaction Design Foundation is a 14-year old non-profit community founded in Denmark.
Learn more about our community, become a personal coach, or come work with us.
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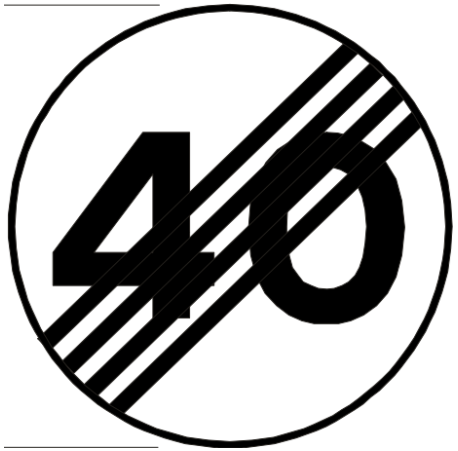
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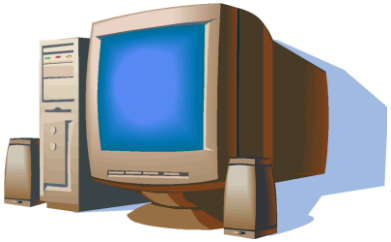
Interfaces in the Real World

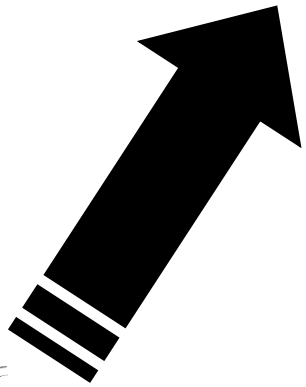
- Not just computers!
  - Wristwatch
  - Phone
  - Copier
  - Car
  - Plane cockpit
  - Airline reservation
  - Air traffic control
  - Running shoes

Why we will tackle



There is a mismatch between the developer's mental model and the user's mental model

The system image is poorly communicating the developer's mental model to the user



You can't blame the user!

Why HCI? …

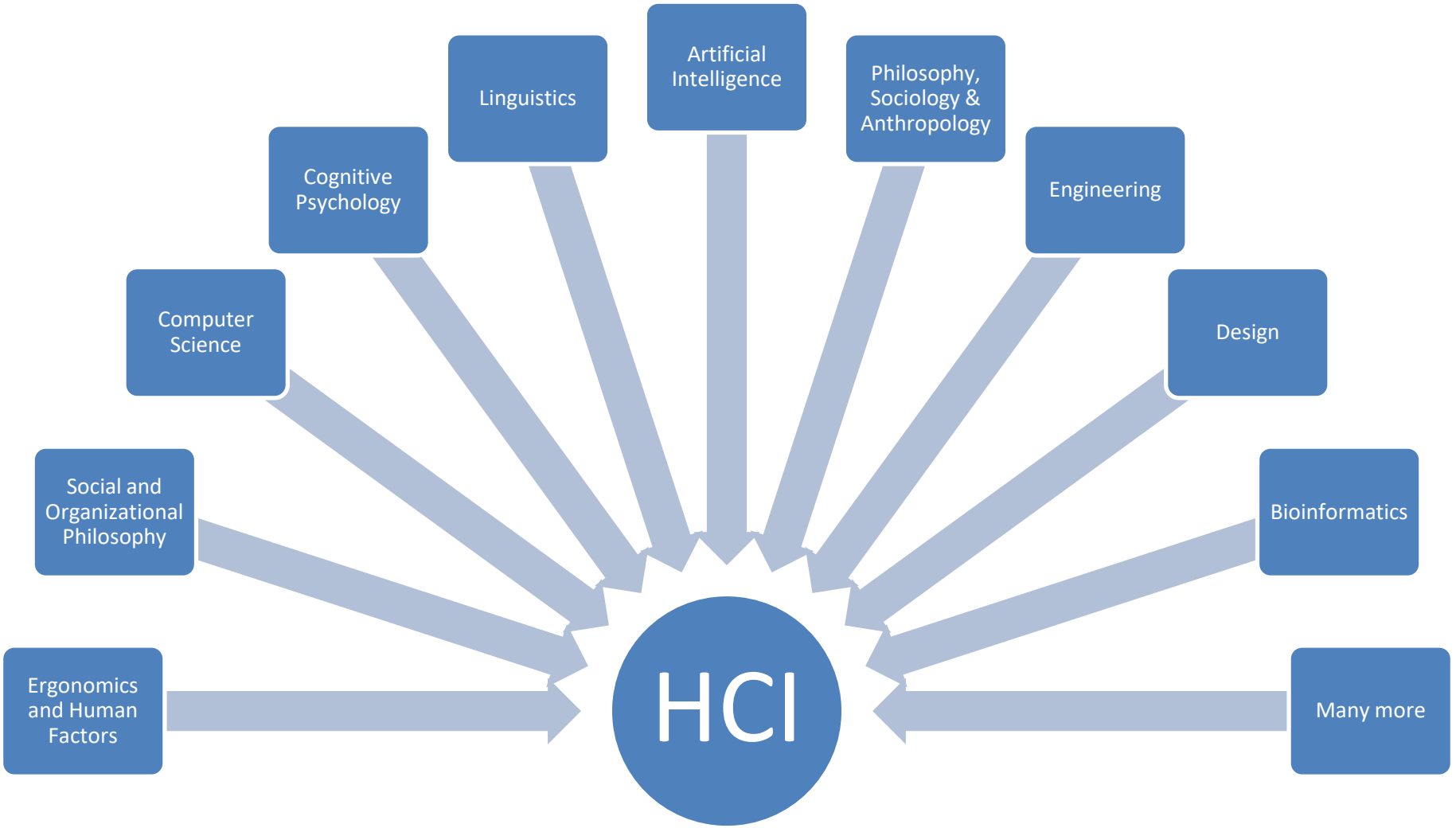
- “Programmers aren’t evil. They work hard to make their software easy to use.
- Unfortunately, their frame of reference is themselves, so they only make it easy to use for other software engineers, not for normal human beings.”

How Users Really Feel

Factors in HCI

Organisation Factors Training, job design, politics, roles, work organisation		**Environmental Factors** Noise, heating, lighting, ventilation
Health and Safety Factors	**The User** Cognitive processes and capabilities Motivation, enjoyment, satisfaction, personality, experience	**Comfort Factors** Seating, equipment, layout.
User Interface Input devices, output devices, dialogue structures, use of colour, icons, commands, navigation, graphics, natural language, user support, multimedia,		
Task Factors Easy, complex, novel, task allocation, monitoring, skills		
Constraints Cost, timescales, budgets, staff, equipment, buildings		
System Functionality Hardware, software, application		
Productivity Factors Increase output, increase quality, decrease costs, decrease errors, increase innovation		

Disciplines contributing to HCI



Disciplines contributing to HCI…

- **Computer Science**
  - Technology
  - Software design, development & maintenance
  - User Interface Management Systems (UIMS) & User Interface Development Environments (UIDE)
  - prototyping tools
  - Graphics
- **Cognitive Psychology**
  - Information processing
  - Capabilities
  - Limitations
  - Cooperative working
  - Performance prediction
- **Social Psychology**
  - Social & organizational structures

Disciplines contributing to HCI…

- **Ergonomics/human factors**
  - Hardware design
  - Display readability
- **Linguistics**
  - Natural language interfaces
- **Artificial intelligence**
  - Intelligent software
- **Philosophy, sociology & anthropology**
  - Computer supported cooperative work (CSCW)
- **Engineering & design**
  - Graphic design
  - Engineering principles

Typical topics in HCI

- **Human cognition**
  - Perception; visual/auditory cognition; ecological interfaces; motion cognition; memory and attention; meaning and representation; learning; language understanding; mental models and metaphors
- **Designing for collaboration & communication**
  - Information visualization; online communities; dialog models; presentation styles; group dynamics; groupware and discussion-ware

Typical topics in HCI…

- **Understanding how interfaces/technology affect users**
  - Ergonomics; safety-critical systems; work environments; social and behavioral impact (individual and group); diversity and the digital divide
- **User-centered approaches to interaction design**
  - Identify needs and establish requirements; integrate users into design, prototyping and construction phases

Typical topics in HCI…

- **Usability evaluation**
  - Observing users; testing and modeling users; expert evaluations
- **Interaction styles**
  - Direct manipulation; Virtual environnements; menus and forms; commands and natural language; hands-free input; heads-up displays
- **Interaction devices**
  - Keyboard, pointing devices, speech I/O, image and video I/O, other sensory devices, mobile devices

Physical Variation

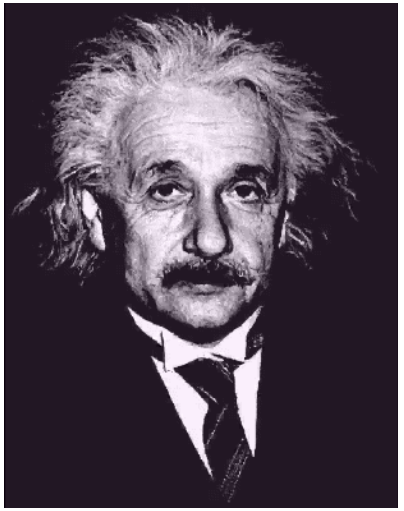
- Ability
  - Disabled (elderly, handicapped, vision, ambidexterity, ability to see in stereo [SUTHERLAND])
  - Speed
  - Color deficiency
- Workspace (science of ***ergonomics***)
  - Size
  - Design
- Lots of prior research

Physical Variation

- Field of **anthropometry**
  - Measures of what is 5-95% for weight, height, etc. (static and dynamic)
  - Large variance reminds us there is great ‘variety’
  - Name some devices that this would affect.
    - note most keyboards are the same
    - screen brightness varies considerably
    - chair height, back height, display angle
- Multi-modal interfaces
    - Audio
    - Touch screens

Cognitive and Perceptual Variation

- Bloom's Taxonomy
  - knowledge, comprehension, application, analysis, synthesis, evaluation
- Memory
  - short-term and working
  - long-term and semantic
- Problem solving and reasoning
- Decision making
- Language and communication



Cognitive Variation

(Learners differ in how deeply they process and solve problems)

Student Type	Cognitive Profile	Java Example Task	Bloom's Level
Student A	Good memorizer	Remembers Java syntax for loops	Remembering
Student B	Good explainer	Can explain difference between class and object	Understanding
Student C	Logical thinker	Applies loops to solve pattern problems	Applying
Student D	Problem-solver	Breaks a big task into methods	Analyzing
Student E	Critical thinker	Evaluates which sorting algorithm is best in a scenario	Evaluating
Student F	Inventive/creative	Designs a small text-based game using classes and arrays	Creating

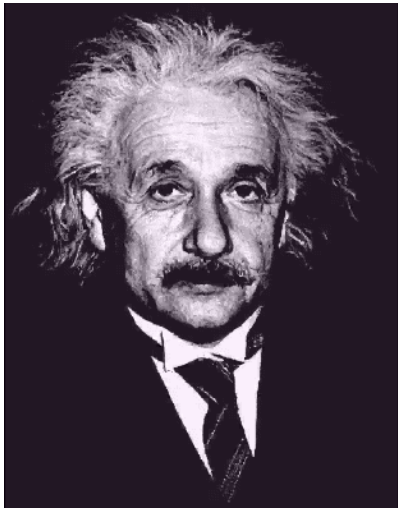
Perceptual Variation

(Learners differ in how they best receive/engage with content)

Learner Type	Preferred Mode	Example in Java Learning
Visual	Diagrams, code flowcharts	Uses flowcharts to visualize if-else or loop logic
Auditory	Listening/talking	Learns through video lectures or pair programming talks
Kinesthetic	Hands-on doing	Learns by typing code, debugging, and running tests
Read/Write	Text, documentation	Reads Java docs and books; writes summaries and notes

Cognitive and Perceptual Variation

- Language and communication
- Search, imagery, sensory memory
- Learning, skill development, knowledge acquisition
- Confounding factors:
  - Fatigue
  - Cognitive load
  - Background
  - Boredom
  - Fear
  - Drugs/alcohol



Personality variations

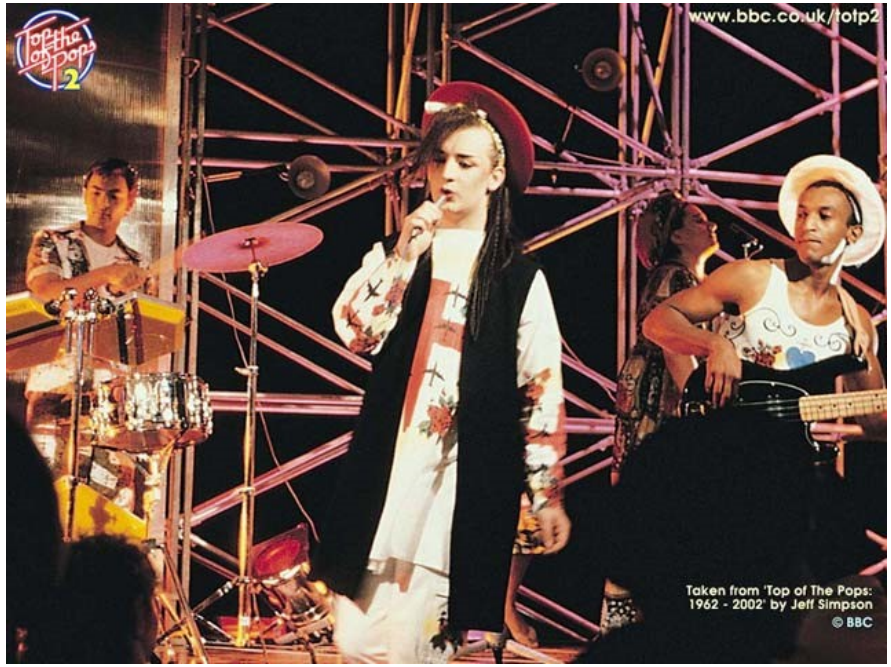
- Computer anxiety
- Gender
  - Which games do women like?
  - Pac-man, Donkey Kong, Tetris
  - Why? (Hypotheses: less violent, quieter soundtracks, fully visible playing fields, softer colors, personality, closure/completeness)
  - Can we measure this?
- What current games are for women?
- Style, pace, top-down/bottom-up, visual/audio learners, dense vs. sparse data

Personality variations

- No simple taxonomy of user personality types. Ex. Myers-Briggs Type Indicator
  - Extrovert vs. introvert
  - Sensing vs. intuition
  - Perceptive vs. judging
  - Feeling vs. thinking
- Weak link between personality types and interfaces
- Think about your application, and see if user personality is important!
  - Fighter jets vs. search engines

Cultural and International Diversity

- Language
- Date / Time conventions
- Weights and Measures
- Left-to-right
- Telephone #s and addresses
- Names, titles, salutations
- SSN, ID, passport
- Sorting
- Icons, buttons, colors
- Etiquette
- Evaluation:
  - Local experts/usability studies



Users with Disabilities

- Federal law to ensure access to IT, including computers and web sites. (1998 Amendment to Rehabilitation Act)
- Disabilities
  - Vision
    - Blind (bill-reader)
    - low-vision
    - color-blind
  - Hearing
    - Deaf
    - Limited hearing
  - Mobility
  - Learning
    - Dyslexia
    - Attention deficient, hemisphere specific, etc.
- Keyboard and mouse alternatives
- Color coding
- Font-size

Users with Disabilities

- Contrast
- Text descriptors for web images
- Screen magnification
- Text to Speech (TTS) – JAWS (web pages)
  - Check email on the road, in bright sunshine, riding a bike
- Speech Recognition
- Head mounted optical mice

Users with Disabilities

- Eye Gaze control
- Learning what helps those with disabilities affects everyone
  - Present procedures, directions, and instructions accessible to even poor readers
  - Design feedback sequences that explain the reason for error and help put users on the right track
  - Reinforcement techniques with other devices
- Good target area for a final project!

Elderly

- Reduced
  - Motor skills
  - Perception
  - Vision, hearing, touch, mobility
  - Speed
  - Memory
- Other needs
  - Technology experience is varied (How many grandmothers use email? mothers?)
  - Uninformed on how technology could help them
  - Practice skills (hand-eye, problem solving, etc.)
- Touch screens, larger fonts, louder sounds

Children

- Technology saviness?
- Age changes much:
  - Physical dexterity
    - (double-clicking, click and drag, and small targets)
  - Attention span
  - (vaguely) Intelligence
- Varied backgrounds (socio-economic)
- Goals
  - Educational acceleration
  - Socialization with peers
  - Psychological - improve self-image, self-confidence
  - Creativity – art, music, etc. exploration

Children

- Teenagers are a special group
  - Next generation
  - Beta test new interfaces, trends
  - Cell phones, text messages, simulations, fantasy games, virtual worlds
- Requires Safety
- They
  - Like exploring (easy to reset state)
  - Don’t mind making mistakes
  - Like familiar characters and repetition (ever had to babysit a kid with an Ice Age DVD?)
  - Don’t like patronizing comments, inappropriate humor
- Design: Focus groups

Accommodating Hardware and Software Diversity

- Support a wide range of hardware and software platforms
- Software and hardware evolution
  - OS, application, browsers, capabilities
  - backward compatibility is a good goal
- Three major technical challenges are:
  - Producing satisfying and effective Internet interaction (broadband vs. dial-up & wireless)
  - Enabling web services from large to small (size and resolution)
  - Support easy maintenance of or automatic conversion to multiple languages

Summary

- Human-computer interaction studies a human and a machine in communication.
- HCI draws supporting knowledge on the machine side, the human side, and the interaction side.
- **On machine side**
  - Techniques in computer graphics, operating systems, programming languages, algorithms and development environments are relevant

Summary…

- **On human side**
  - Communication theory, graphics and industrial design discipline, linguistic, social sciences, cognitive, psychology and human performance (AI) are relevant
- **On interaction side**
  - Engineering and design methods are relevant