Formal Methods for Interactive Systems

Part 1 — Motivations and History

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Motivation — Example

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Example: but ...

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[Dix et al. 98]

Alan Dix, Janet Finaly, Gregory Abowd, Russel Beale.

Human-Computer Interaction.

Prentice Hall, 2nd Edition, 1998.

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Design logic does not take the user into account!

Example: poor usability!

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Design logic does not address user's capabilities and limitations

Why Poor Usability

- User friendly and easy to use

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User-centered Design

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Study of Human Being

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- study of the mind (perception, thinking and learning) and behaviour of the human being (Psychology) and related experiments
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Positive Assumptions $\Longrightarrow$

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Negative Assumptions

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- explicit assumptions on user's physical and cognitive limitations and environmental and social constraints (Ergonomics, Cognitive Science and Sociology)

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Separate HCI Design $\Longrightarrow$

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Integrated HCI Design

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- interface developed integrally with the rest of the system (SE) to support tasks people want to do and forgive careless mistakes

Improving Usability

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Multidisciplinary Approach

Contribution from many disciplines:

- Software Engineering

- Psychology (Social, Cognitive, Personality, Industrial and Engineering Psychology)

- Ergonomics

- Cognitive Science

- Sociology

Wide Range of Expertise

- Psychology and Cognitive Science to give knowledge of the user's perceptual, cognitive and problem-solving skills

- Ergonomics for the user's physical capabilities

- Sociology to help understandig the wider context of the interaction

- Computer Science and Software Engineering to be able to build the necessary technology

- Business to be able to market the built technology

- Graphic Design to produce an effective interface presentation

- Technical Writing to produce the manuals

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In practice people tend to take a strong stance on one side or another

Interdisciplinary Research

Multidisciplinary Research Centres:

- UCL Interaction Centre

  (University College London, London, UK)

  http://www.uclic.ucl.ac.uk/

- Key Centre for Human Factors and Applied Cognitive Psychology

  (University of Queensland, Brisbane, Australia)

  http://www.humanfactors.uq.edu.au/

- NASA Human Systems Integration Division

  (NASA Ames Research Centre, USA)

  http://hsi.arc.nasa.gov/

  - HCI Group: http://hci.arc.nasa.gov/

History of HCI

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  early 20th century in factories
  emphasis on manual tasks

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- 1949
  Ergonomic Research Society

- 1982
  Conference on Human Factors in Computing,
  Gaithersburg
  HCI as a professional community

Def of HCI (ACM)

the discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them

[ACM special interest Group on Computer-Human Interaction Curriculum Development Group, 1992]

Def of HCI (Dix et al.)

the study of people, computer technology
and the ways these influence each other

[Dix et al. 98]

Requirements and Goal of HCI

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Requirements of HCI

- computer technology
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- computer technology

- the people who interact with it

Goal of HCI

- usability $\Longrightarrow$ to prevent user errors

Consequences of Human Errors

may just be temporary inconvenience or annoyance in interactive systems such as

- word processors
- VCR, DVD
- radio, CD, AC

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distract the driver

$\Longrightarrow$ may cause human errors in driving

$\Longrightarrow$ it's unsafe!!!

Catastrophic Effects

Human errors may cause

- safety violations in domains such as chemical and nuclear plants, air traffic control, trasporation systems, health systems

- security violations in domains such as e-commerce, e-voting, defence

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- safety violations in domains such as chemical and nuclear plants, air traffic control, trasporation systems, health systems

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$\implies$ need to use formal methods

National Standards

used to deal with safety and security issues
without mentioning HCI aspects

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$\Longrightarrow$ human error appears in many accident
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Recently national health and safety standards are starting to explicitly include usability

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Recently national health and safety standards
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Example
EC directive 90/270/EEC

Appendix

Social Sciences

Study of people.

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have slightly different perspectives and emphases in their study of people.

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  - think,
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  - feel;
- behaviour — how people
  - act,
  - interact with others and
  - understand themselves.

Def. of Cognitive Psychology

Cognitive Psychology is the field of Psychology that aims at studying how people

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Examples

- Why do people remember some facts but forget others?

- How do people think when they play chess or solve everyday problems?

Def. of Sociology

Sociology is a Social Science that aims at studying groups of individuals, such as groups of people

- in various kinds of works or

- having different incomes.

Ergonomics

Ergonomics is a Multidisciplinary Science that aims at studying how a workplace and the equipment used there can be best designed for confort, efficiency, safety and productivity.

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We speak about *Human Factors* when we include cognitive issues.

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Examples

- Why are people attached to each other, and why do people like and even love one another?

- Why are people sometimes generous and helpful, and why are they sometimes not?

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Examples

- Why are some people highly sociable, whereas others seem to prefer just the company of very few other people?

- What makes some people high conscientious and others less so?

Def. of Industrial Psychology

Industrial Psychology is the field of Psychology applied to

- decision making, and
- hiring

in institutional settings, such as

- workplaces, and
- businesses.

Def. of Engineering Psychology

Engineering Psychology is the field of
Psychology that

- deals with human-machine interaction, and

- aim to make interactive systems more
  user-friendly.