tonight’s topics

- Review of key themes
  - human-computer interaction
  - the human in the equation
  - the computer in the equation
  - design methods and techniques
  - supporting the design process
  - ensuring success via evaluation
- Demonstrating your understanding
  - a few words about the exam

what is HCI

- Designing computer systems that support people so they can carry out their activities productively and safely...
- Neither the study of humans, nor the study of technology, but the bridging between the two...

what is usability

- A usable application is one that allows its users to focus on their tasks, not on the application...
- A usable interface becomes transparent to the user

goals of HCI

- Understand factors influencing use of technology
  - psychological, ergonomic, organisational, social
- Utilise tools and techniques to help designers create suitable systems
- Ultimately produce highly usable, efficient, effective, and safe systems

review – what is HCI

what is HCI

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attributes of usable systems

- Necessary
- Safe
- Appropriate
- Simple
- Clear
- Powerful
- Consistent
- Flexible

from the human perspective

human considerations

- Cognitive processes
- Perception
- Attention, memory, cognitive load theory
- Knowledge and mental models
- Interface metaphors and models
- The act of learning
- Working in context
- Problem solving
- Experts and novices

cognitive processes

- Theories of human information processing were the initial basis of HCI
- Information was assumed to be processed as a sequential set of steps

HCI must look further

- Today these theories are used mainly for predicting behaviour in the crudest sense
  - need to take into account usage context, not just procedural steps

perception

- Optimising for human visual perception is clearly important in user interface design
  - readability in general
  - graphical coding of quantitative data
  - visual coding with icons
  - use of colour for identifying tasks and information
human memory

- Memory is limited - the more that the information is processed (not just input) the more likely it will be remembered

  data -> information -> knowledge -> wisdom

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classic memory & attention

- The magical number 7±2
- Gestalt factors
  - context plays a huge part in what people perceive

THE CHT

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cognitive load theory

- Huge long-term memory is used to store vast amounts of information over long periods of time
- Limited working memory (WM) used to process current information, not for long term storage
- Surface vs Deep learning
- Takes time, iteration, review

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traditional theory of memory

- Input or stimuli 
  - Sensory store
  - Loss from sensory store
  - Short-term memory store
  - Loss from short-term memory store
  - Long-term memory store
  - Decay, interference, loss of strength in long-term memory store

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implications for HCI

- The more meaningful the names and icons are, the more likely they will be remembered
- Recognition is easier than recall
- Completing tasks involves combining information in the head with knowledge of the world
- GUIs can reduce the amount of knowledge required about the interface, recognise the “command”

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cognitive load theory

- *Schemas* allow us to bypass the limitations of WM by chunking large amounts of information together into a single unit
- *Automation* also helps to reduce the burden on WM by allowing us to process information with minimal use of our limited WM capacity
- Schema acquisition and automation are the two most important components of learning
- Schemas are important for your study technique!
cognitive load theory

- split attention
- redundancy effect
- modality effect

knowledge and mental models

- Mental models enable users to generate descriptions and explanations about systems - can make predictions about how it will work (mental models = schemas)

memory

- Human memory capability helps explain a range of reasons why systems fail, how people can rapidly adopt or learn new systems
- We can use the understanding of human memory capability to inform our design process

matching the models

[Diagram of matching models]

metaphors

- Analogies based on familiar knowledge to help users understand new systems
- Metaphors combine a familiar domain with the system structure to make a concrete system image

<table>
<thead>
<tr>
<th>Metaphor</th>
<th>Application area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop</td>
<td>Operating system</td>
</tr>
<tr>
<td>Ledger sheet</td>
<td>Spreadsheet</td>
</tr>
<tr>
<td>Files</td>
<td>File storage</td>
</tr>
<tr>
<td>Rooms</td>
<td>Multimedia</td>
</tr>
<tr>
<td>Multi-agent</td>
<td>CSCW</td>
</tr>
</tbody>
</table>

learning

- Learning is an active process - easiest through doing and following examples
- Active learning involves using analogies, making errors and trying to explain the system’s behaviour
- Experts have superior chunking skills than novices
learning - continued

- Learning can be promoted through minimalist instruction, and encouraging users to explore the system
  - reduce chances to make errors through good user interface design and initially restricting ability of advanced functions
- Users with different levels of knowledge are likely to have different user interface needs

implications for HCI

<table>
<thead>
<tr>
<th>Experience with other applications</th>
<th>Assumes new application works like others</th>
<th>May confuse this application with others</th>
<th>Wants several ways to accomplish tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs very obvious task flow</td>
<td>May need to re-learn application with each use</td>
<td>Wants shortcuts to complete tasks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experience with this application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice/Infrequent</td>
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</tbody>
</table>

working in context

- Most work does not happen in isolation - hence, need to consider communication and interactive processes
  - group communication has different properties
- Computer-mediated processes can help, but are still not as effective as face-to-face communication
  - new protocols must be established
  - work practices must be reflected

organisational aspects

- Organisations are extremely complex
- The impact of technology on organisations is both positive and negative
  - de-skill and potentially control workers
  - provide tools for enriching work
- Imperative to consider distribution of work and impact to organisation when introducing new technology

problem solving

- Problem solving space – includes the initial state, the goal state, and problem solving operators.
- General problem solving strategies – e.g. means-ends analysis, analogies
- Importance of prior knowledge to problem solving

problem solving

- Importance of appropriate problem representation:
  - Problem difficult to represent in solvable form
  - Functional fixedness
  - Unwarranted assumptions
  - Set effect
problem solving

- Other reasons why problems may be difficult to solve:
  - Goal state is inadequately defined
  - Problem solving space is too large
  - Lack of prior knowledge
  - Memory limitations

scientific methodology

- Scientific method can be applied
  - Hypothesis
  - Develop methodology
  - Select participants
  - Conduct experiment
  - Analyse data
  - Discuss and summarise data
  - Draw conclusions
  - Formulate a new hypothesis

scientific methodology

Benefits of the scientific methodology

- Reliability
- Validity
- Consistency
- Level of significant

Scientific methodology requires

- Control of extraneous factors
- Control of bias
- Representative sample

scientific approach

- Through the assignment process, we walked through the process of practical user interface development, it wasn't very scientific

- We introduced scientific methodology and illustrated the role it plays in validating new techniques - eg. DateLens

- How do we objectively construct studies that take a scientific approach?

novices vs experts

- Interaction between knowledge level and instructional presentation mode

- Practical applications of expert / novice differences:
  - Software can be designed with different modes or versions for novices and experts - e.g. short-cuts for experts, different levels of skill selection in games

novices vs experts

- Difference between expert and novice problem solvers:
  - Pattern learning in experts - experts have superior chunking skills
  - Problem representation and categorisation - novices use surface features, experts use deeper principles
  - Problem solving strategies - novices use means-ends analysis, experts use schema based problem solving
applying memory research to HCI

Design interfaces that:

• are more attention grabbing (as appropriate)
• are more memorable
• are easier to make sense of and to use and take into account users’ schemas or mental models
• use consistent terminology and layout
• do not overload our limited working memories
• present information in an appropriate context
• use retrieval ‘cues’ to aid recall

other user considerations

• Accessibility and universal access
• Designing for an international audience
• Occupational health and safety

support of universal access

• Consider use of different input and output devices and styles
  • special needs users with hearing impairment, vision impairment, physical limitations
• Consider availability of technology
  • slower connection speeds, older browsers, lower screen resolution, limited plug-ins
• Consider different intellectual levels

accessibility

• What are the legal implications of not considering accessibility or universal access requirements?
• What do you need to do as part of the user centred design process?
• Considered the case of blind users and the use of screen reader and validation tools

internationalisation & localisation

• Need to consider the audience
• Need to design to support the potential differences
  • character set / keyboard
  • text direction
  • language / words / spelling
  • size of words
  • metaphors
  • use of images / icons / colour
  • date / time / calendars / currency / units of measure
• Need to consider how to localise the interface

occupational health and safety issues

• Workstation design
• Keyboard design
• Mouse design
• Vision and lighting
• Screen factors and readability
• Use of sound
• Job design
from the technology perspective

technology considerations

- Input
- Output
- Interaction styles
- Windowing systems
- Performance support
- Design for universal access

standard input devices

- Keyboards
- Chorded keyboards
- Pointing devices - cursor keys, mouse, trackball, joystick
- Touchscreens
- 3D trackers
- Speech

implications for HCI

- Choice and method of use of input device is a key factor to success of a system
- Need to consider the physiological and psychological characteristics of users
  - age and skill
- Must be appropriate for the task
  - drawing requires continuous motion
- Must be suitable for the environment
  - mouse requires surface

output styles

- Simple visual output
  - text, data
- Complex visual output
  - graphics, animation
- Audio output
  - sounds, music
- Tactile output
  - Braille screen-readers

implications for HCI

- Poorly chosen output mappings are likely to be ineffective
- Mapping must:
  - match how users think of the problem
  - be consistent
  - be natural
  - work in the environment
interaction styles

- Menu-driven interaction
- Question-and-answer
- Function key interaction
- Voice-based interaction
- Graphical
- Form fill-in
- Command-line
- Natural language

implications for HCI

- Match between users' needs and interaction style is critical to usability
- Often the decision is obvious:
  - necessary functionality
  - usability goals
  - cost targets for hardware and software
- Questions to ask:
  - who are the users?
  - how will they access the system?
  - how much training is expected?

implications for HCI

- Enable people to work together in a productive manner
- Same/Different Time/Place
- Factors:
  - Social protocols
  - Nature of the work
  - Technology support
- Involves communication between people

basic concepts of GUIs

- Dimming of unavailable items
- Object/action paradigm
- Default keys
- Explicit destruction
- Standard terminology (e.g., OK/Cancel)
- Selection mechanisms (e.g., double clicking)
- Direct manipulation

GUIs

- human interface guidelines is a great source of information
- tools are maturing to help guide you to producing interfaces that comply with the guidelines

design methods and techniques
predicting and measuring performance

- **GOMS**
  - Goals – what the user wishes to achieve
  - Operators – cognitive actions and processes required to satisfy the goal
  - Methods – the sequence of steps required
  - Selection rules – to determine which method to choose when there are alternatives
- **Keystroke level model**
  - Predicts performance by using standard timings for performing particular aspects of key tapping, pointing, homing, and mentally preparing
- **Fitts’ Law**
  - Predicts the time to reach a target (the bigger the target, the better)

the value of quantification

- Does not require user testing
- Useful for developing predictive models of performance
- Useful in situations where it’s difficult to carry out testing
- Very good for comparative evaluation of different systems

quantification or UCD?

- Quantitative techniques are predictive (hence perhaps a good first step) however, they are not a substitute for user centred design
- Main drawback is that they assume that all users have the same cognitive skills

quantification informs design

- Aware of the low level interaction and how each step contributes to the overall efficiencies
- Appreciate the impacts to help inform how you go about designing systems
- Now that you know Fitt’s law what will you consider when you are designing small buttons?

general HCI methodology

![General HCI Methodology Diagram](human-computer-interaction.png)

proved user-centred design process

![User-Centred Design Process](human-computer-interaction.png)
reducing design and development costs

requirements gathering

- Stakeholder interviews
- Field studies
- Focus groups
- Task analysis
- Business strategy review
- Marketing material review

outcome of analysis

- Understand needs of users
  - functionality
  - high-level tasks to be completed
  - context of use
- Understand needs of the ‘business’
  - goal of the system
- Understand needs to the developers
  - tools, constraints

why use activity scenarios?

- Provides a snapshot of the critical points of user interaction
- Keeps context in which the tasks are carried out
  - by including other elements such as phone calls, forms, interruptions…
- Helps to get into the ‘user’s shoes’
- Provides a means to envisage workflow

scenarios in the design process

- Analysis
  - envisage a series of activities based on knowledge of user environment, user requirements, common practices & workflow
- Design
  - provide context for brainstorming leading to mock-ups and prototypes
- Evaluation
  - baseline against which to compare results
  - presents task context in walkthroughs
scenarios

- What is a scenario?
- How do you go about writing scenarios?
- When do you use scenarios?
- Who uses scenarios?

design process

- Tools and techniques informing design
  - affinity diagramming
  - requirements, usability goals, business goals
- Use of paper mock-ups to iterate on design
- Collaborative design process to collect user input in a meaningful way

paper based design

- Paper is quick and easy to create
- Easily corrected and annotated
- Allows all stakeholders to participate

think well beyond the visuals

- Dialog & Experience
  - How do I interact with the application?
  - What are the controls?

usability evaluation techniques

- Assessing how well an application meets users’ needs
- An opportunity to increase user understanding, efficiency, and satisfaction

collecting user opinions

- Storyboard reviews
- Usability walkthroughs
- Documentation reviews
- Focus groups
- Opinion surveys/Questionnaires
expert reviews

- Heuristic evaluations
- Compliance audits
- Inspections

observing user performance

- Site visits
- Usability testing

usability walkthrough plan

- How do you prepare and plan a usability walkthrough?
- What steps are involved?
- What are the outcomes?
- What do you do with the data?
- What is the difference between a commercial approach and scientific?

user involvement throughout

<table>
<thead>
<tr>
<th>Functional Specification</th>
<th>user opinions</th>
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<tbody>
<tr>
<td>Paper Mock-Up</td>
<td>user opinions +</td>
</tr>
<tr>
<td>Electronic Mock-Up</td>
<td>user opinions +</td>
</tr>
<tr>
<td>Application Prototype</td>
<td>expert reviews</td>
</tr>
<tr>
<td>Alpha/Beta Code</td>
<td>user performance</td>
</tr>
<tr>
<td>Deployed Application</td>
<td>expert reviews</td>
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</table>

ethics

- How does ethics affect the way that we conduct user centred activities?
- What issues do you need to disclose to participants?

assignments

- Museum visit
  - Demonstrate the importance of visiting the site
  - Observation, diaries, heuristic evaluation
- Design
  - Work together as a group
  - Interview real users, discover how real users think
  - Gather requirements, develop paper-based mock-ups
  - Presentation
assignments

• Evaluation
  • Iterate
  • Consolidate
  • Evaluate with real users
  • Refine

• Close to a real-world design example
  without the coding

design diaries

• One place to keep your thoughts and ideas
• Dated
• Can review ideas
• Solve problems
• Paper based
• Take it anywhere
• Reflect

laboratories/tutorials

• Heuristic Evaluation
• Observation
• Affinity Diagramming
• Universal Access
• Collaboration
• Interface Builder

future

• Career opportunities
  • Non-Developer
  • Developer
• Other courses
  • COMP4511 User Interface Design and Construction
• Thesis A/B
  • Chemistry, Music, NIDA, COFA, PHM, Other
• Postgraduate - CSE / NICTA Multimodal

UNSW Surveys

• Instructions will be e-mailed

Electronic survey

• Teaching/course evaluations to be done electronically
• We want to improve HCI in our next iteration and need your help
• Will e-mail out a request to fill out an electronic web-based survey form
• Specifically about the subject content, allows you to add comments
demonstrating that knowledge on the final exam

- Time allowed: **3 hours**.
- The are **3** multi-part questions of **UNEQUAL** value.
- **ALL** questions are **COMPULSORY**.
- Candidates may bring: Drawing instruments or rules.
- Do not write your answers on the examination paper.

- Questions 1 and 2 involve **short essay** style answers. Each must be answered in **INK** in **SEPARATE** writing books.
  - Eight parts per question
- Question 3 consists of **40** multiple choice questions (only one answer). These must be answered in **PENCIL** on the **GENERALISED ANSWER SHEET**.

- You understand and can apply the user centred design methodology
- You understand when and how to apply the design techniques
- Provide examples to support your reasoning
- Sketch examples
- We assume that you have read the prescribed text

- Sample exam available from the class web site
- Demonstrates the style of the exam questions

- This course has concentrated on making software development a success from the perspective of people, process, and their productivity
  - what is usability and why it is important
  - key attributes of human behaviour and perception that influence the use of applications
  - characteristics of highly usable applications
  - designing for usability - an iterative, user-centred approach

consultation

- CHIL Lab
- Mon, Tue, Thu 2-3pm
- Wed 5-7pm
if you've learned one thing…

• As a developer, you are not your user
• It is necessary to take the users' perspective in everything you do…