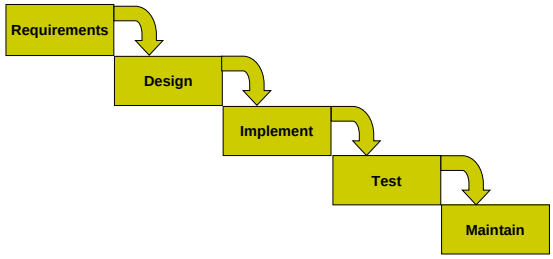
Understanding Users

The Design process
From an individual cognitive perspective
From an organisational and social perspective
From an art and design perspective

‘Proper’ interface design: the design process

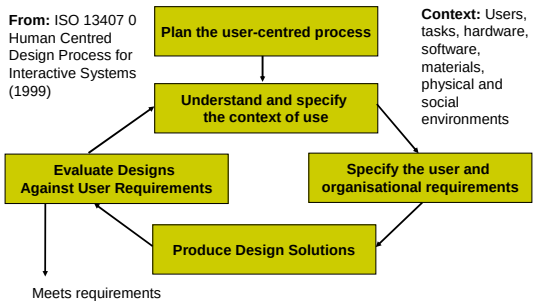
- Three key activities
  - Understand user requirements (various methods)
  - Prototype & build the interface (programming environments software tools)
  - Evaluate & refine (expert reviews, usability testing and experiments)
- But these may be interwoven through ‘iterative design’

The Traditional Waterfall Model of Systems Design



The Human Centred Design Cycle

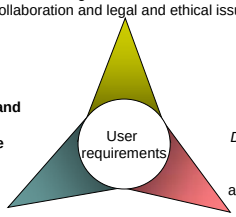
From: ISO 13407 0 Human Centred Design Process for Interactive Systems (1999)



Context: Users, tasks, hardware, software, materials, physical and social environments

Different perspectives on design

Social and organisational perspective
Draws on sociology and management
Focuses on organisational fit, environment, collaboration and legal and ethical issues



Individual and cognitive perspective
Draws on psychology
Focuses on individual capabilities, task performance and dialogue

Design perspective
Draws on art and design
Considers aesthetic, cultural and marketing aspects of interaction design

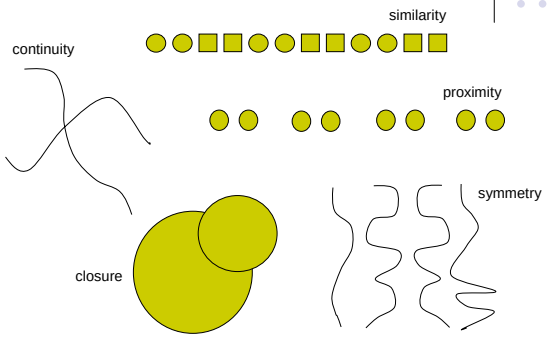
The individual cognitive perspective

- Cognitive capabilities
- Task analysis
- The Keystroke level model
- Fitt's Law

Capabilities of Human Beings - Perception

- Cognitive psychology tells us a great deal about how we interpret information from our senses
- Relevant here is Gestalt Psychology – we use five principles to organise what we see into a meaningful whole
  - Proximity
  - Similarity
  - Symmetry
  - Continuity
  - Closure

What do you see?



Design implications from Gestalt Psychology

- Proximity – group related items close together and separate unrelated ones
- Alignment – place related items along an imaginary line. Align items of equal importance and indent subordinate ones
- Consistency – make related items look the same
- Contrast – make unrelated items look different

Human capabilities - memory

- Hierarchical model of memory
  - Sensory memory – buffer for sensory data that is mostly thrown away
  - Short term memory – limited amount of information for 30 seconds to two minutes
  - Long-term memory – virtually unlimited, but takes effort
- Chunking – users can remember seven plus or minus two chunks of information
  - www.bestbookbuys.com is three chunks
- It is much easier to recognise information than to recall it
- Interruptions
  - Resuming a task after an interruption relies in short term memory
  - A delay of more than 8-10 seconds will cause an interruption

Design implications arising from human memory

- Minimise load on short term memory by
  - Relying on recognition rather than recall
  - Helping users chunk information
- Cope with interruptions by
  - Keep delays below the critical threshold
  - Warning users about how long delays will be
  - Providing memory aids to help resume tasks after interruptions

Task Analysis

- Methods for analysing the fine details of tasks that people carry out when using a system
- Generates a hierarchical model of tasks and subtasks
  - High-level user-oriented tasks near the top
  - Lower-level system-oriented tasks at the bottom
- Feeds into design in areas such as
  - Menu systems
  - Dialogue boxes
  - Sequences of screens
  - Handling errors

Key components of a task analysis

- Establish the underlying hierarchy of tasks and sub-tasks
- E.g., use an email system
  - Send message
  - Read message
  - Reply to message
  - Forward message
  - Save Message
  - Keep address book
    - Start a new address book
    - Add someone to the address book
      - Enter name
      - Enter address

        etc
    - Change information about someone
    - Remove someone from the address book

- Establish the ideal sequence of tasks
- Establish different users' preferences
  - User 'Fred Bloggs'
    - Write letter
    - Get envelope
    - Address envelope
    - Put stamp on envelope
    - Put letter in envelope
  - User 'Freda Bloggs'
    - Get envelope
    - Address envelope
    - Write letter
    - Put letter in envelope
    - Put stamp on envelope

- Document other key task related data
  - Frequency of each task
  - Time to complete
  - Difficulty of each task
  - Criticality of each task- essential or optional
  - Who does this task
  - What will they need to know in order to do it
  - How will they learn this?
  - What can go wrong
    - Problems and errors that can arise with each (sub)task
    - What to do about them

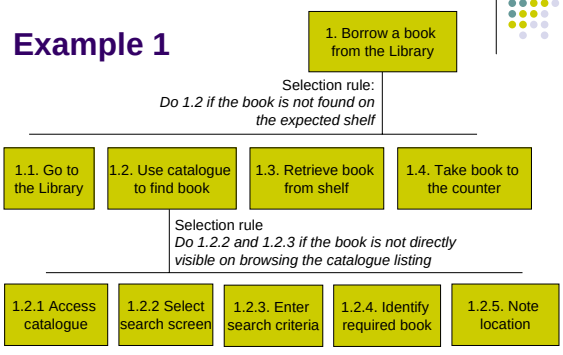
The process of task analysis

- Task elicitation
  - Interviews
  - Direct observation
  - 'Think aloud'
  - Analysing system logs (for refining an existing system)
- Task representation
  - Indented text lists
  - Tables
  - Diagrams
  - Pseudo language
- Discuss with users and refine
- Discuss with designers to identify specific design consequences

GOMS

- Model human problem solving strategies in terms of a hierarchy of:
  - GOALS - user's overall goals and memory points
  - OPERATORS – the basic actions that the interface supports (select menu item, press button)
  - METHODS - different routes to achieving a goal
  - SELECTION- rules to say which method a given user will select under particular circumstances

Example 1



Example 2

GOAL: ICONIZE-WINDOW
[select GOAL: USE-CLOSE-METHOD
MOVE-MOUSE-TO-WINDOW-HEADER
POP-UP-MENU
CLICK-OVER-CLOSE-OPTION
GOAL: USE-L7-METHOD
PRESS-L7-KEY]

User Sam:
Rule 1: Use the CLOSE-METHOD unless another rule applies
Rule 2: If the application is 'blocks' use the L7-METHOD

User and task requirements:
cognitive models - keystroke level model

- Predict performance times for common operations based on knowledge of human motor system
- 7 basic operators
  - K - keystroking - actually striking keys
  - B - pressing a mouse button
  - P - pointing, moving the mouse at a target
  - H - homing - switching the hand between mouse and keyboard
  - D - drawing lines using the mouse
  - M - mentally preparing for physical action
  - R - system response (may be ignored)

M-operators in KLM

- Initiating a task – pause while user considers what should be done
- Making a strategy decision – which option to take?
- Remembering something – e.g., a filename
- Finding something on the screen (here the location is not well known)
- Verifying that what has been done or is about to be done is correct

Typical KLM times

Operator	Remarks	Time (s)
K	Press key	
	good typist (90 wpm)	0.12
	average typist (40 wpm)	0.28
	non-typist	1.20
B	Mouse button press	
	down or up	0.10
	click	0.20
P	Point with mouse	
	Specific movement	Fitts' law
	Average movement	1.10
H	Home hands to/from keyboard	0.40
D	Drawing	domain dependent
M	Mentally prepare	1.20
R	Response from system	measure

Example of KLM

- Deleting a file from the desktop on a Mac
- Method 1: drag to the wastebasket
- Operator sequence:
  - Initiate the deletion (M)
  - Find the file icon (M)
  - Point to file icon (P)
  - Press and hold mouse button (B)
  - Drag file icon to wastebasket (P)
  - Release mouse button (B)
- Total predicted time = 2M + 2P + 2B = 4.8 secs

Example of KLM

- Deleting a file from the desktop on a Mac
- Method 2: using an accelerator key
- Operator sequence:
  - Initiate the deletion (M)
  - Find the file icon (M)
  - Point to the file icon (P)
  - Click – i.e., press and release mouse button (BB)
  - Move hand to keyboard (H)
  - Press 'Apple' and 'Delete' keys (KK)
  - Move hand back to mouse (H)
- Total predicted time = 1P + 2B +2 + 2KM +2H = 5.1 seconds

Fitts' Law

- Predicts the time taken to move a pointer to hit a target on the screen
- Movement time = $a + b \log_2 (\text{distance} / \text{size} + 1)$
  - distance is distance to the target on the screen
  - size is size of the target on the screen
  - a and b are empirically determined constants that differ for different devices – typically 50 and 150 respectively
  - time is in milliseconds