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Conceptual Design

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References
Focus on Design

- What is wanted
- Analysis
- Design
- Prototype
- Implement and deploy

How do we actually do the design?
- Temptation: start sketching windows, menus and buttons...
- But we can do better by starting from thinking about the user experience we want to provide.
Focus on Design

- How do we actually *do* the design?
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Focus on Design

How do we actually *do* the design?

Temptation: start sketching windows, menus and buttons...

But we can do better by starting from thinking about the *user experience* we want to provide.
A **conceptual model** is the designer’s intended mental model for the user of the system: a set of ideas about how it is organized and operates.

Norman (1986) called this the *design model*:
Advantages of a Conceptual Model

- A conceptual model
  - is a starting point for interaction design
  - should help the user “figure it out”
- It helps design team:
  - Not to become narrowly focused early on
  - Ask questions about how the conceptual model will be understood by users
  - Establish a set of common terms they all understand and agree upon (a standard lexicon for the project)
  - Reduce the chance of misunderstandings and confusion arising later on

See Johnson and Henderson (2002) for more motivation and methodology.
The conceptual model should specify:

- **metaphors** or **analogies** used, if any
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Objects in the Conceptual Model

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- the **relationships** between concepts, e.g.
  - attributes has-a
  - specialisations is-a
  - containment contains
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- the **relationships** between concepts, e.g.
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  - specialisations is-a
  - containment contains
- the **mappings** between concepts and task domain
Actions in the Conceptual Model

The conceptual model should also specify/discuss:

- the functions performed and by whom: **task allocation**
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Outputs of Task Analysis can inform object and action analysis for conceptual model.
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Example conceptual model (sketch)

Online library

**metaphor** information is organised as a physical card catalogue
## Online library

**metaphor** information is organised as a physical card catalogue

**concepts** *item, book, periodical, issue, DVD, shelf-mark, user account, librarian, …*
Example conceptual model (sketch)

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**object relationships** a book is a type of item; periodicals contain issues
Example conceptual model (sketch)

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metaphor  information is organised as a physical card catalogue

categories  item, book, periodical, issue, DVD, shelf-mark, user account, librarian, ...

object relationships  a book is a type of item; periodicals contain issues

mappings  item corresponds to a physical object; shelf-mark to its physical location
<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metaphor</td>
<td>Information is organised as a physical card catalogue</td>
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<td>Concepts</td>
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</tr>
<tr>
<td>Mappings</td>
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<td>Functions</td>
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**mappings** *item* corresponds to a physical object; *shelf-mark* to its physical location

**functions** *issue item, return item, search item*

**function relationships** issue before return for same item; for different items, in parallel, …

**data** new items added by typing data
Metaphors

- Interface metaphors combine familiar knowledge with new knowledge in a way that will help the user understand the product.
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  - make learning easier
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- Three steps to consider:
  1. understand functionality
  2. identify potential problem areas
  3. generate metaphors
Classic example: Visicalc (1979)

- Ledger sheet analogy
- Interaction and computation

[See http://www.bricklin.com]
Classic example: The Xerox Star

Issues with interface metaphors

- A metaphor can have a big impact so should be carefully considered:
  - How much structure does it provide?
  - How much is relevant to the problem?
  - Is it easy to represent?
  - How extensible is it?

Problems:
- Break conventional or cultural rules
- Constrain designers in problem space
- Conflict with design principles
- Forces user into one mode of understanding
- May transfer over bad design
- May limit imagination for new conceptual model
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Infamous failure: Microsoft Bob (1995)

[See http://toastytech.com/guis/bob.html]
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- We may have lots or little choice:
  - a new special-purpose physical product, with our own choice of input/output features
  - new I/O mechanisms for existing device
  - new usage of existing mechanisms
  - standard device (e.g., PC) with standard mechanisms

Recall cognitive and psychological design influences from earlier lectures, used to inform physical design (human motor function, affordances, natural mappings, etc).

However physical I/O controls are realised, we will want to choose the:

- interaction modes for using inputs
- presentation methods for using outputs
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**exploration** user moves through physical or virtual environment

Other possibilities and higher-level classifications exist, e.g., we may interact by learning, problem solving, socializing, searching, ...
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Instructing

- **Examples:**
  - Shell command line interpreters for operating systems
  - Menu and key-driven GUI shells for OSes and applications
  - VCRs, hi-fis, alarm clocks, vending machines, etc.
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- **Advantages:**
  - Quick and efficient
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- **Disadvantages:**
  - Hard to learn
  - Seldom standardised
  - May be overly specific
Vending machines
Conversing

Examples:

- Help facilities (Microsoft’s Office Assistant paper clip, Bob)
- Search engines (http://www.ask.com, although Jeeves has now retired)
- Phone services (voice recognition query answering/navigation)
- Virtual shopping or support assistants

Advantages

- No special knowledge required; onus on system to understand user

Disadvantages:

- Limited scope of understandability
- Dialogue can become one-sided and cumbersome
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Manipulation

- Shneiderman (1983) coined the term **Direct Manipulation** (DM).
- Digital objects should allow interaction analogous to how physical objects are manipulated
- Core DM principles:
  - Continuous representation of objects and actions
  - Physical **actions and button pressing** instead of issuing commands with complex syntax
  - Rapid **reversible** actions with immediate feedback on object of interest
- Examples:
  - desktop files metaphor in OSes and applications
  - also true manipulable objects: physical objects with sensors (e.g. Wii controller)
Issues around DM

- Advantages of direct manipulation include:
  - Novices can learn the basic functionality quickly
  - Intermittent users can retain operational concepts over time
  - Error messages rarely needed
  - Users can immediately see if their actions are furthering their goals and if not do something else
  - Users experience less anxiety; gain confidence and feel in control

- But there are drawbacks, e.g.:
  - Some people take the metaphor of direct manipulation too literally
  - Not all tasks can be described by objects and not all actions can be done directly
  - Some tasks are better achieved through delegating rather than manipulating e.g., spell checking
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Exploring

- **Examples:**
  - 3D desktop **virtual worlds** where people navigate using mouse around different parts to socialize (e.g., Second Life)
  - **CAVEs** (Computer Automatic Virtual Environment) where users navigate by moving whole body, arms, and head
  - physical **context-aware environments**, embedded with sensors, that present digital information to users at appropriate places and times (e.g. cell phone tourism, smart home)
  - Currently rather specialised, will be more important in future with rise of ubiquitous computing.
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Exercise: Interface for Robot Cleaner

Design an interface for controlling a robot vacuum cleaner.

1. Extend and deepen the task analysis for house cleaning given in the previous lecture, to consider:
   - individual tasks that performed by the robot
   - interactions necessary to control the robot
2. Propose a suitable conceptual model
3. Consider the physical design of the system
4. ... and interaction modes that would be appropriate for different tasks.
5. Justify your choices.
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Further reading: Dix et al, Chapters 6, 7, 8, 18.