Mental Models, Metaphor and Design

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Handouts
http://www.syntagm.co.uk/design/articles.htm

Mental Models

- Psychological representations of real, hypothetical, or imaginary situations
- First postulated by the Scottish psychologist Kenneth Craik (1943)

> *The mind constructs 'small-scale models' of reality to anticipate events, to reason, and to underlie explanation.*

- Their structure corresponds to the structure of what they represent

Mental Models

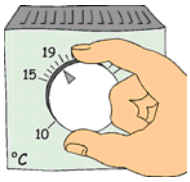
- Users acquire mental models through…
  - Interaction
  - Explanation
- Two types of model
  - Functional – knowing what to do but not *why* (e.g. shutting down PC before switching off)
  - Structural – understanding the components and their relationships (*why*)
- Structural models allow us to solve problems

Mental Models - Example

- The heating has just come on but the room is cold. The room thermostat is set where you normally have it (higher than the current temperature)
- Do you…
  1. Turn it up hoping that the room will heat faster?
  2. Leave it where it is and just wait?

Mental Models

- A room thermostat is not like a tap (valve)



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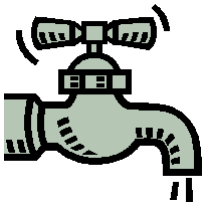
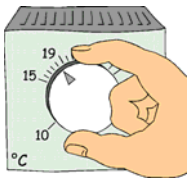


Mental Models

- A room thermostat is like a switch



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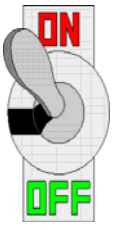
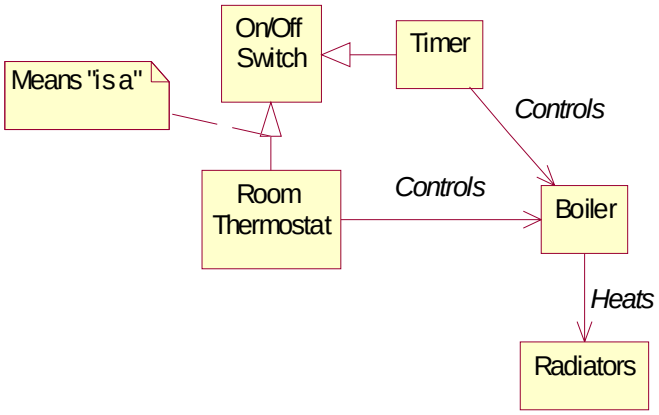


Mental Models - Notation

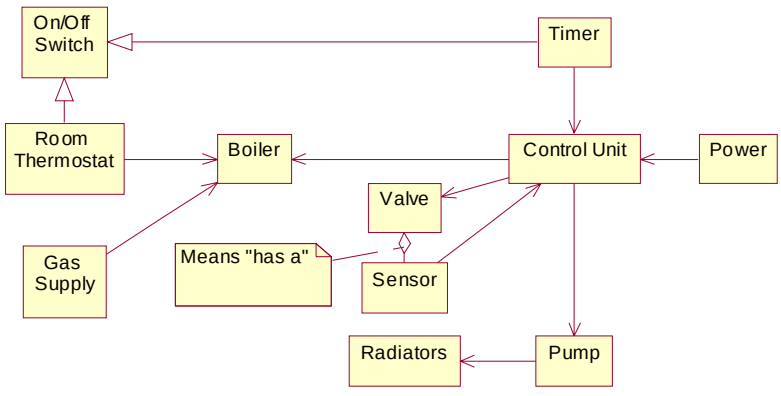
- Primarily entities and their relationships



User's mental model of central heating system in UML Class Diagram Notation

Mental Models – Whose?

- Different roles need different models



Engineer's mental model of central heating system

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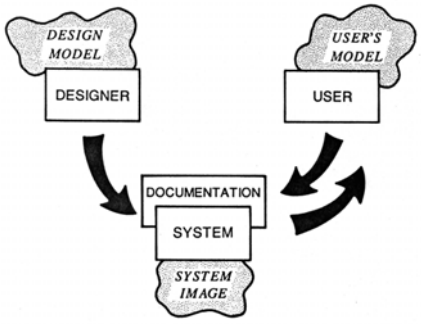
Mental Models – Whose?

- Designers and users models for an interactive system (Don Norman in *User-Centered System Design*)



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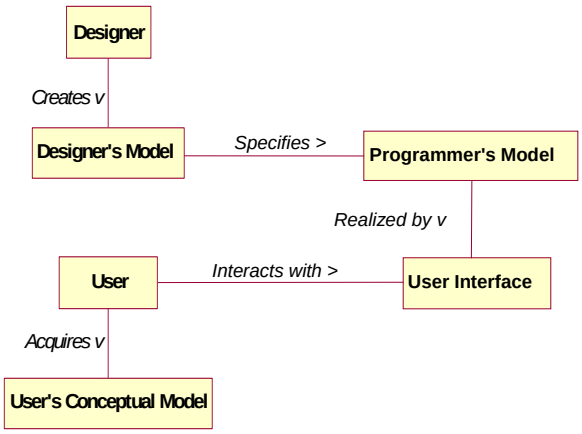
Mental Models – Whose?



Three models from OVID

Conceptual Models

- To…
  - Distinguish between the various models
  - And reflect that mental models are not directly under our control
- …we will call the mental model we want users to acquire the users' conceptual model (or just conceptual model)

Conceptual Models

- How can users acquire the 'right' mental model?
  - Training
  - Documentation, guides or online help
  - Interaction with the system
- In systems for general use (e.g. e-commerce), interaction is usually the only realistic approach

Conceptual Design

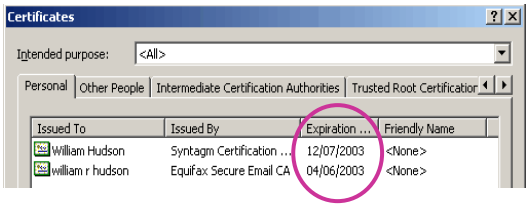
- To create a system that will be easy to use, the conceptual model must be…
  - Deliberately designed
  - Simple enough to be understood through interaction
  - Appropriate to users' tasks
- Use familiar concepts and terms
- Provide adequate feedback
- Be consistent (especially with users' expectations)

Example – Inappropriate Concept

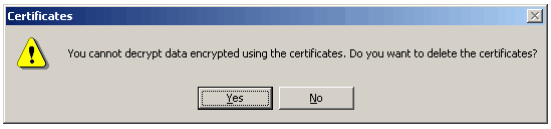
- Expiry date
  - What are common examples of expiry dates?
  - What action(s) do you associate with expiry dates?

Example – Inappropriate Concept

- Secure email certificates have expiry dates



- *But* discarding a certificate means loosing access to all email encrypted with it



Example – Inappropriate Concept

- Security certificates are more like insurance policies than foods or drugs
- Renewal date would have been a better concept

Benefits of Conceptual Models

- Provide an opportunity for innovation and simplification
- Define concepts and terms to for UI
- Framework for implementation
  - 'Core' model is elaborated
  - 'Views' and other UI components added
- Basis for OO development
- Control over 'feature bloat'

Reverse Engineering

- Conceptual models can be 'reverse engineered' from existing applications or web sites
- Expert review or with users
- Three step process:
  - Visual inspection (can use screen shots)
  - Interaction with controls (but no navigation)
  - Unrestricted use
- Alternatively, a user's conceptual model can be elicited following use of the system

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Reverse Engineering

- Major concepts and relationships should be apparent from visual inspection
- Primary results are entities and relationships (operations and attributes at a more detailed level)
- Users' conceptual models can be compared with designers'
- Careful questioning of users might be necessary to validate results (e.g. 'what would happen if…')

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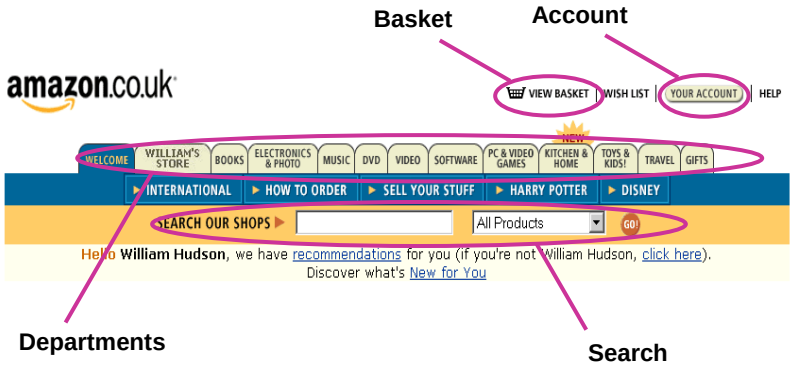
Reverse Engineering

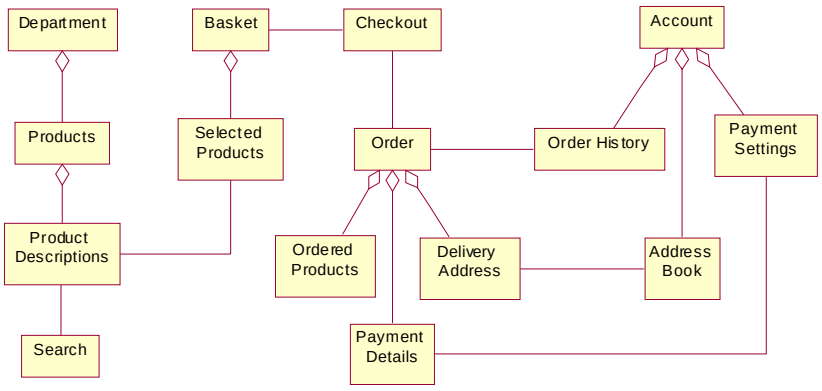


Entities from visual inspection of Amazon site

Reverse Engineering

- Entities
  - Usually nouns
  - Frequently gleaned from navigation (e.g. menus, tabs, links)
  - Can be other UI components (e.g. panels, popups, dialogs)
- Relationships
  - Need not be named
  - Gleaned from visual relationships
  - More reliant on interaction

Reverse Engineering



Reverse-engineered conceptual mode for Amazon site

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Metaphor

- Metaphors makes use of existing conceptual models
- Do not have to be literal or visual, but they can provide a source of images
  - Desktop metaphor: inbox, folder
  - Piggly Wiggly metaphor: shopping basket, checkout
- Relationships of interest need to be related in some way: ‘systemic’ (e.g. we are not interested in the size of shopping baskets)

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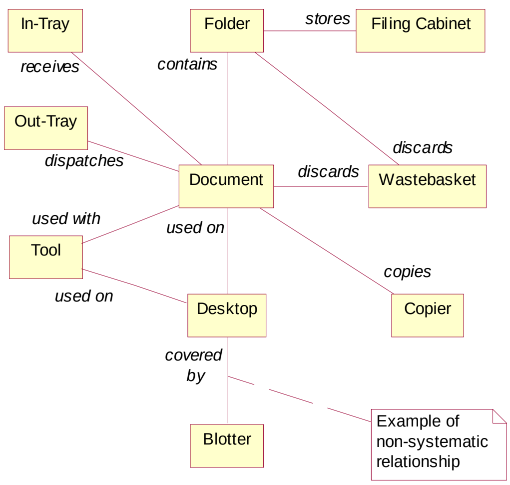
Myths About Metaphors

- Easy to learn, difficult to use
  - Difficulty usually comes from visual metaphors, e.g. Microsoft’s Bob UI

Myths About Metaphors

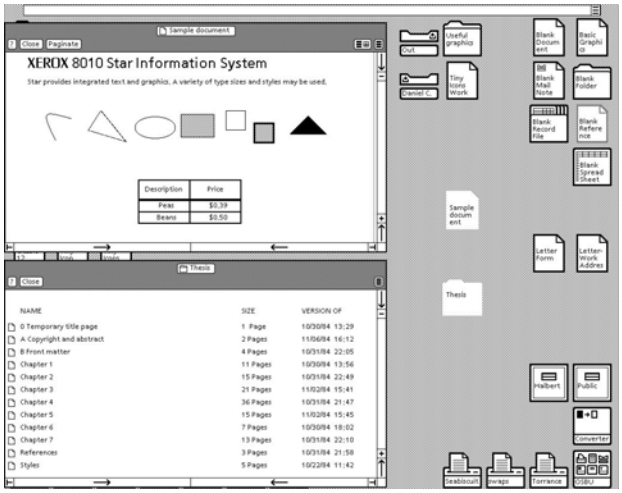
- Too limiting
  - Only when taken literally or visually
- Windows desktop proves metaphor is bad
  - *Broken* metaphors are bad
  - Windows bears little resemblance to 'real' desktop metaphor

Desktop Metaphor



'Real' desktop metaphor is closer to Xerox Star than Windows

Desktop Metaphor



Xerox Star desktop from http://www.acypher.com

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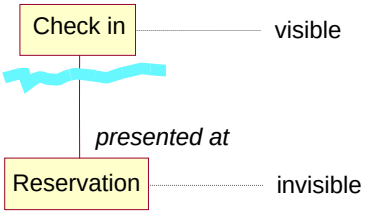
Other Aspects of Metaphor

- Metaphor can be used at different levels
  - High level: desktop, shopping
  - Low level: scissors for ‘cut’, renewal date
- Iceberg model of metaphor
  - Some terms have hidden relationships



Design Exercise

- Offset mortgages
  - Cash savings used to reduce mortgage payments
  - Can be a single account with a large overdraft
  - Sometimes mortgage and savings presented separately
  - Customers uncomfortable with large overdraft and lack of separate accounts

Design Exercise

- Consider metaphors that might be appropriate for managing money and allowing greater flexibility (what did people use to do before everyone had a bank account?)

Design Exercise (Solution)

- People used to put money into different containers:
  - Jars
  - Tins
  - Socks
  - Mattresses
  - Bags
  - Envelopes

Design Exercise

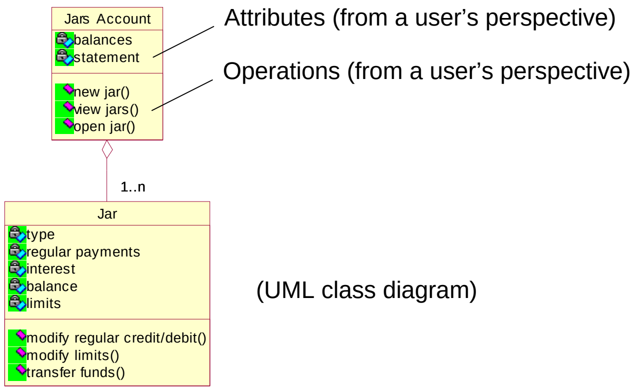
- What are the basic operations that can be performed on these containers?
- What extensions could we make for a web implementation?

Design Exercise (Solution)

- Basic operations
  - Create/destroy
  - View balance (count money)
  - Add funds
  - Remove funds
- Extensions
  - Automatic interest calculation
  - Regular credits or debits
  - Limits (e.g. when enough funds for holiday, boat)

Design Exercise (Solution)

- Conceptual model for ‘Jars’ account



(UML class diagram)

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You Are Here

- Contextual enquiry
- Abstract use cases
- *Conceptual design*
- Concrete use cases
- Paper prototyping + usability testing
- Visual design + usability testing
- Implementation + usability testing

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Further Reading

- http://cognet.mit.edu/MITECS/Entry/johnson-laird
  - Mental models
- http://www.syntagm.co.uk/design/articles.htm
  - Hudson, William (2000), 'Why Metaphor is a Double-Edged Sword' in *interactions,* May/June 2000, ACM Press
  - Hudson, William (2001), 'Towards Unified Models in User Centered and Object Oriented Design' in *Object Modeling and User Interface Design*, van Harmelen, Mark (Ed.), Addison Wesley
  - Hudson, William (2002), 'Crossing the Wireless Chasm' in *SIGCHI Bulletin*, Nov/Dec 2002, ACM Press
  - Hudson, William (2003), 'Elegance, Simplicity, Flexibility and Change: Resisting Design Erosion', in *SIGCHI Bulletin*, Mar/Apr 2002, ACM Press
- http://www.syntagm.co.uk/design/casestudies.htm
  - Brief case studies on metaphor and conceptual modelling