What is design?

Administration

- **Next class: Flex tutorial**

- **Homework #0 set today!**

Questions about the class?

- **Forum access**
- **ACM digital library access**
- **Online readings**

What is <u>design</u>?

From dictionary.com

http://dictionary.reference.com/search?q=design

"To conceive or fashion in the mind; invent"

...

"The purposeful or inventive arrangement of parts or details"

From CMU design department:

What is <u>design</u>?

From dictionary.com

http://dictionary.reference.com/search?q=design

"To conceive or fashion in the mind; invent"

…

"The pu ntive **arrange** details"

Design is the art
that humanizes our environment
through visual communication
and the construction of all the products
that help us in our daily lives

From CMU design department:

What is design?

From Jodi Forlizzi:

"The human power of conceiving, planning and making all the products that serve human beings in the accomplishment of their individual and collective purposes."

Design vs. Art

- **What's the difference?**

  - **Often hard to distinguish**
  - **Traditional distinction: both visually satisfying, but design should have practical purpose**
  - **Design often entails working out form or structure of something by creating plans**
  - **Art is concerned with creation of something beautiful or significant in some way**

What is design?

Norman (p. 158)

"Design is the successive application of constraints until only a unique product is left"

Key: *constraints = tradeoffs*

Design is ...

- **Creative**
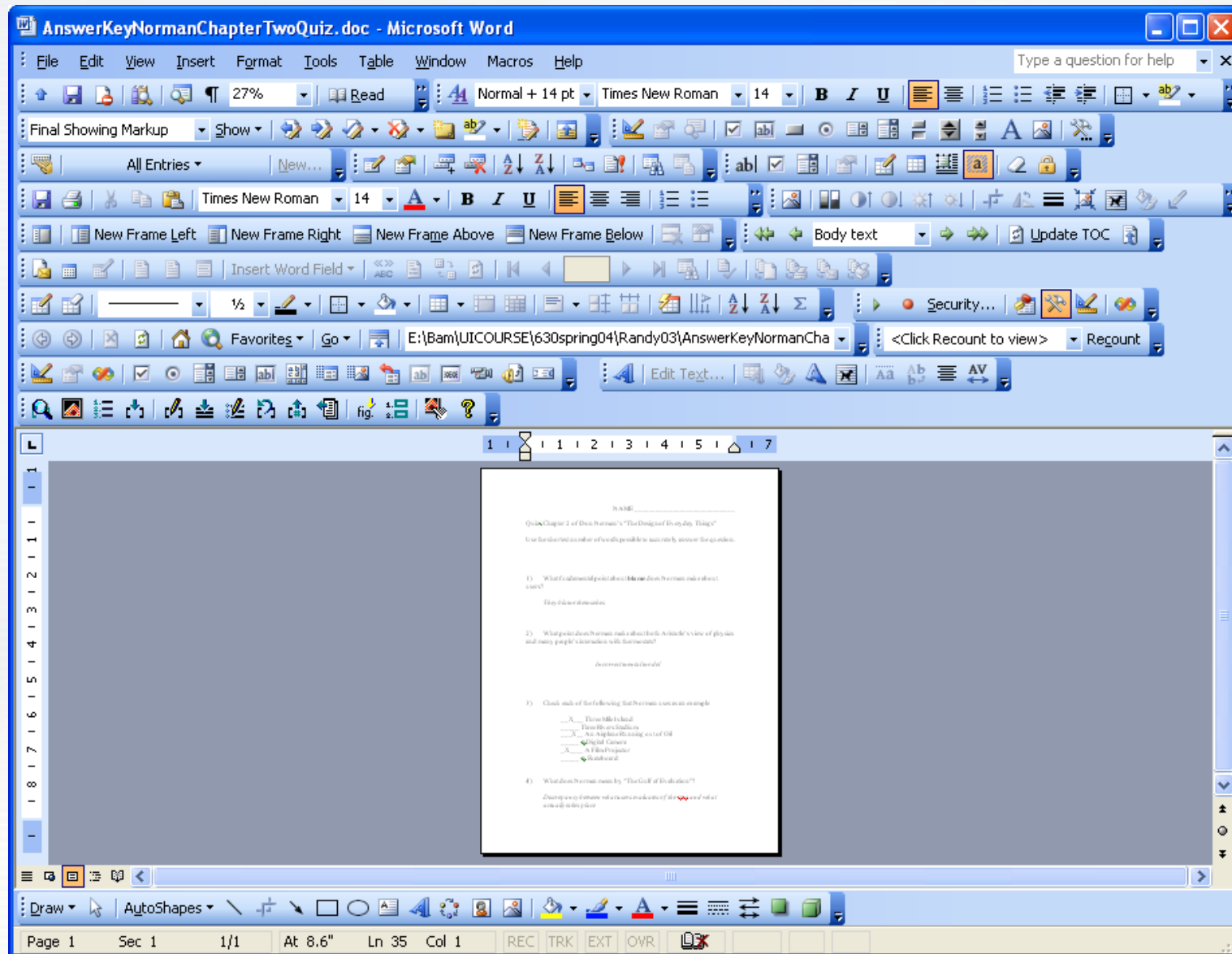- **Informed**
- **Respectful**
- **Responsible**

Complexities

April 8, 1991

Complexities

Complexities

12

Bad design vs. good design

- ### What's the difference?

- ### Properties of good design?

Examples of good and bad design

- **Not amenable to hard definition, but can get at via examples**

- **Lots in Norman DOET book**
  - **Door handles**
  - **Light switches**
  - **Faucets**

- **Assignment #0**
  - **Physical/computer products (not web pages)**

Some typical properties / issues to look at (mostly from Norman)

- **Good conceptual model**
- **Visibility**
- **Natural Mappings**
- **Affordances**
- **Constraints**
- **Taking into account errors**
- **Aesthetics and desirability**
- **Design in the real world**

Encourage Accurate User Model

p. 16: Conceptual Model
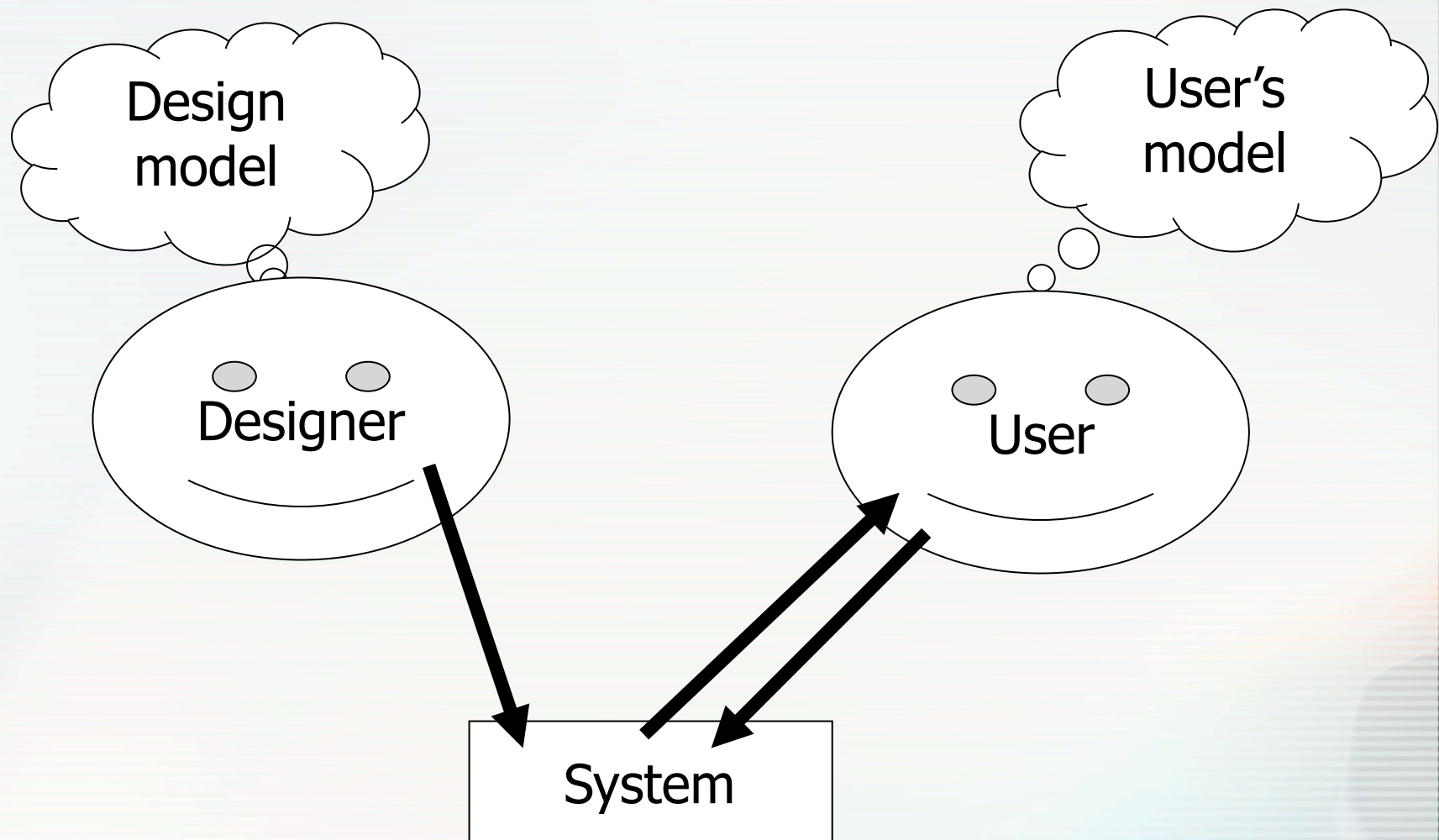
Conceptual model

- **Users form mental models**
  - **Users <u>always</u> form model of how things work**
    - **Human nature to create explanations**
    - **Just a question of good models (functional and predictive) or not so good**
  - **You had better have a plan for the model you want (a "conceptual model") or you will get something more random**

  - ➤**Use everything you have at your disposal to instill and reinforce your conceptual model**

Getting the right mental model induced in the user

- **Simpler models are easier**
  - **See Norman refrigerator & freezer example**

- **Revealing the state of the system and its operations critical**
  - *Visibility* **of system status / state**
  - **Natural** *mappings* **for actions**
  - *Feedback* **(visibility of change)**

People Create Explanations

People will invent explanations for pretty much all observed behavior
- **Even if unrelated or unintentional**
  - **Coincidences**
    - **"It crashed the last time I did this"**
  - **Observed differences**
    - ➤ **Consistency is important**
- **Even if it's too complex to understand how it really works**
  - **Inconsistent models**
  - **Superstitions**
 - **Naïve models (e.g., involving "magic")**

Visibility

➢ **Critical to provide accurate and appropriate visibility and feedback**
  – **Both for avoiding errors and mental model formation**

Incorrect Assessments

- **Three Mile Island (1979)**
  – **Incorrect meaning of indicator light valve closed when leaking**
- **Aegis: Ascent vs. Decent**

Norman's Gulfs

- **Gulf of Evaluation**
- **Gulf of Execution**
- **7 Stages**
  - **Form goal**
  - **Form intention**
  - **Specify action**
  - **Execute action**
  - **Perceive state**
  - **Interpret state**
  - **Evaluate outcome**
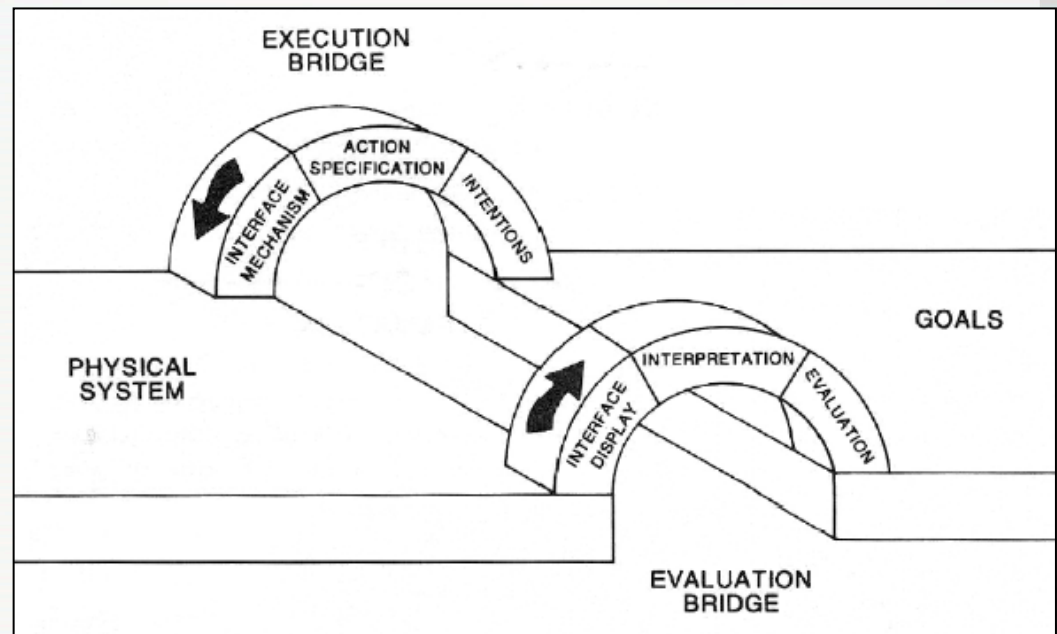
Important properties of people: Memory (more later)

Recognition (working from world) vs. recall (working from memory)
a critical difference between novice and expert

"Remembering things" clearly critical to learning and performance

Distinct kinds of memory

- **Short term (working) memory**
  - Capacity of ~ 7 ± 2 chunks
  - Decays quickly
  - Must pass through STM to be processed
- **Long term memory**
  - Essentially infinite capacity
  - Lasts indefinitely
    (but recall may become hard)

Distinct kinds of memory

Illustrations (STM)

4 2 8 9 5

Distinct kinds of memory

Illustrations (STM)

What were those numbers?

Distinct kinds of memory

Illustrations (STM)

0 3 9 4 5 9 1 6 5 7 8 6

Distinct kinds of memory

Illustrations (STM: limited capacity)

What were those numbers?

Distinct kinds of memory

Illustrations (STM: Decay)

What was the first set of numbers?

Distinct kinds of memory

Illustrations (Chunking)

9 1 1   7 4 7   1 2 3   U M A

Distinct kinds of memory

Illustrations (Chunking)

What were those numbers and letters?

Distinct kinds of memory

Illustrations (LTM)

What did you have for breakfast 3 days ago?
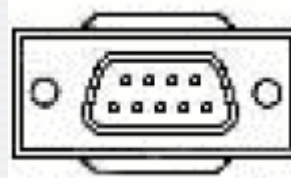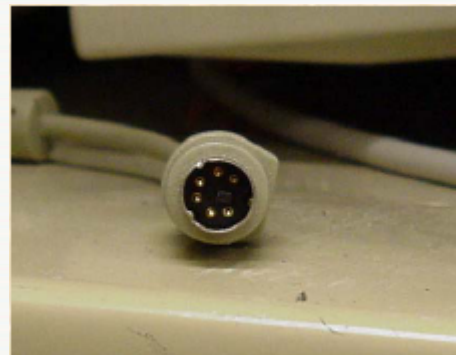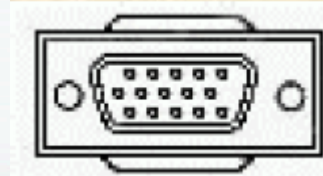
Easier to remember things...

- **That have**
  - **Symbolic meaning**

  - **Patterns or rules**
  - **Explanations**
    - **Control-C = <u>C</u>opy**
    - **Control-V = Paste?**
    - **Control-Shift-D = ???**
  - **Consistency**

Constraints

- **Physical Constraints**
  - Door handles
  - Mac vs. PC plugs; USB

Affordances

"Perceived and actual properties of the thing, primarily those fundamental properties that determine how the thing could possibly be used." (Norman p.9)

- **–"When affordances are taken advantage of, the user knows what to do just by looking"**

Affordance

Example:
- Small ridges typically found on knobs
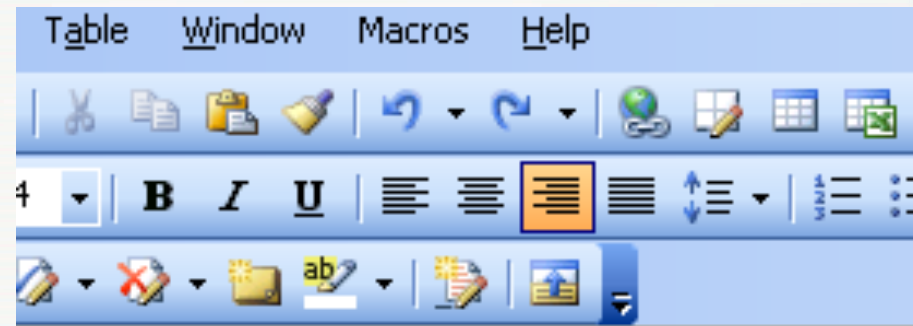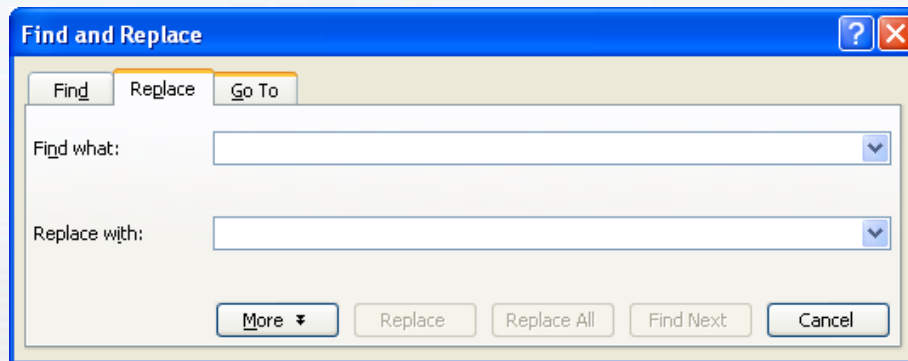

Increases friction → Affords grip

Analogs in the virtual world

- **Interactors (AKA interactive components, widgets, controls) provide analogs of affordances and constraints on screen**

Widget Design

- **Try to make it obvious what to do with the widget**
- **3-D Buttons "afford" "pushing"**
  - **Where are the buttons?**

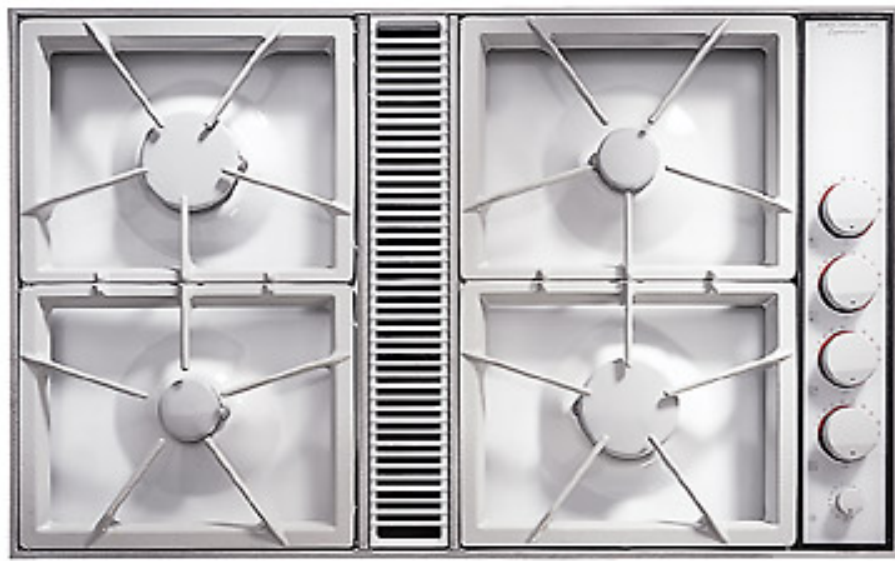- **Scroll wheel affords turning, *not* pushing**

Constraints (cont.)

- **Semantic constraints**
  - **Meaning of operation implies certain limits**
- **Cultural constraints**
  - **(Consistency)**
  - **Turn a knob clockwise or CCW**
- **Logical constraints**
  - **Switches to lights, knobs to burners**
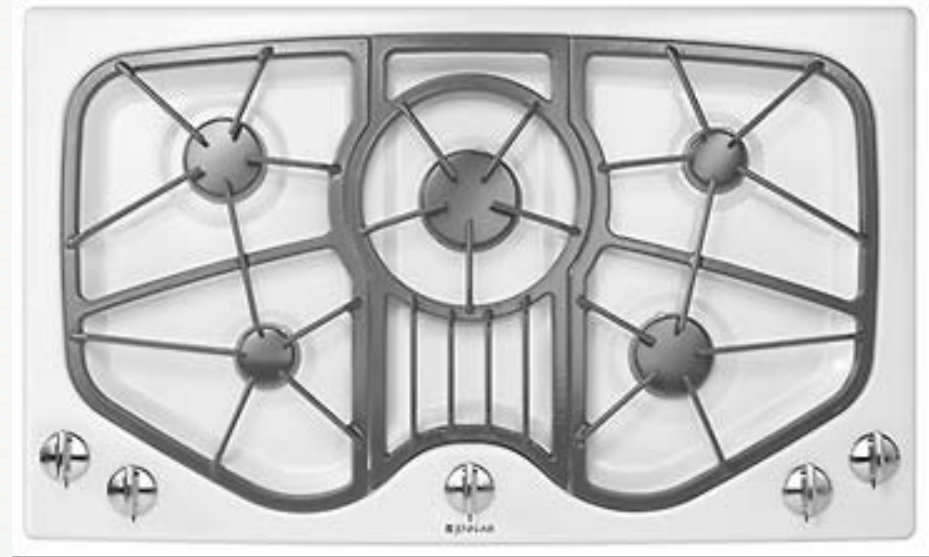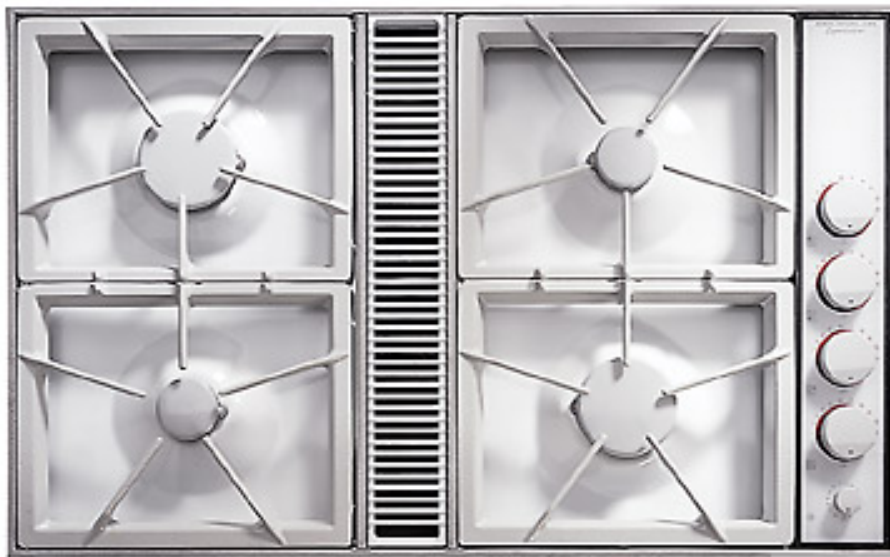 - ➢ **Natural mappings**

Natural mappings

- **Mappings (relationships between parts) evident from observation**

Natural mappings

- **Mappings (relationships between parts) evident from observation**

Natural Mappings

- **"Taking advantage of physical analogies and cultural standards"**
  - **Leads to immediate understanding**
- **Which way to turn a knob, which light switch to use, automobile window adjustments**

Taking errors into account

- **Errors are an inevitable part of being human**
  - ➢ **Part of what should be considered normal, expected, *valid* input**
    - **Have to handle it (and handle it well)**

Errors

•**Slips**
- – **Typos**
- – **Hitting the wrong menu item**
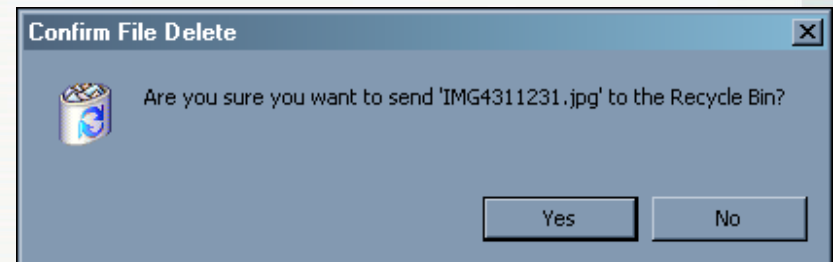- – **Drag and drop to wrong place**

Very common → had better not have big negative consequences

•**Mode errors**
- – **Digital watch**

•**Confirmations don't help (much)**
- – **Confirms operation more than parameters**
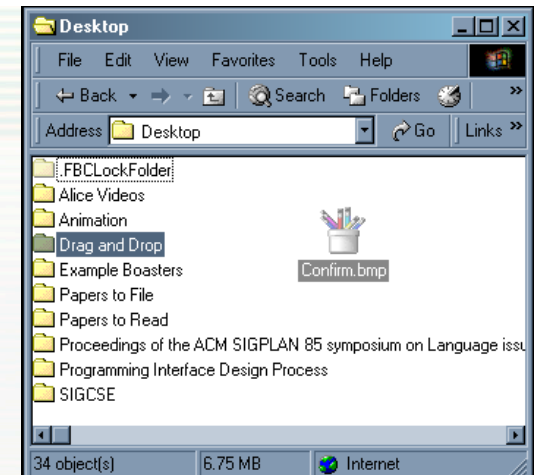
Designing to minimize errors

- **Reduce opportunities for errors**
  - **Selection rather than fill-in**
  - **"Forcing functions"**
    - **Physical constraints**
    - **Lockouts**
      - **But often annoying**

Depart:

[   ] Anytime ▾

Return:

mm/dd/yy Anytime ▾

Depart

⊙ Feb ▾ 11 ▾ ▦

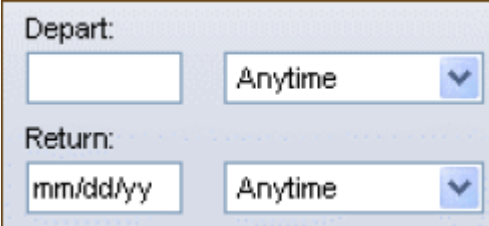# Designing to minimize errors

- **Reduce severity of errors**
  - **Cancel and undo**

OmniApp 7.0 Critical Error

You have caused the database to lose referential integrity! (E50276)

Beat Me Some More   I'm Guilty
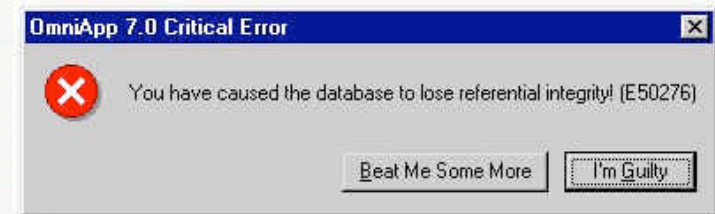
- **Make errors more obvious**
  - **Good feedback**
  - **Uncaught or misunderstood errors tend to quickly lead to malformed mental models**

Aesthetics and desirability

- **Beyond usability**
  - **"Useful, Usable, Desirable"**
    - **Useful   you can get the job done**
    - **Usable   without too much pain**
    - **Desirable   you *WANT* it**
- **Good Visual Design (look)**
- **Good Industrial/Product Design (form; feel)**

Aside: Art vs. Design

From science and engineering perspective can seem quite similar (both concerned with aesthetics)

- Design involves working out form or structure by creating plans and solving problems
- Art is concerned with creating something evocative
- Traditional distinction: Design centrally serves practical purposes, Art typically doesn't

Design in the real world

- **Lots of practical considerations and tradeoffs that may not seem to relate directly to the product**

- **But still need to address them to be successful**

Tradeoffs and tensions

- **Time-to-market vs. good design**
- **Cost**
- **Uniqueness**
- **Legal considerations**
- **Market forces**
  - **Can't sell the next version if it doesn't have "more" than the last**

Other real world considerations

- **Client isn't the user**

- **Occasionally usability is *not* desired**
  - **Uncomfortable chairs to discourage lingering**
  - **First class vs. coach**

That all tells us about what kind of things to look for in good and bad design

- some notion of how to evaluate designs or prospective designs

But it doesn't really tell you much about how to DO design

- Need processes, tools, methods
- Somewhat more the domain of IID

How to integrate design into the software development process

- **Topic of another lecture…**

Support for design process

- **Can take many forms**
  - –**Can support individual designers**
  - –**Can support teams of designers**
  - –**Can be as simple as support for pen and paper**
  - –**Can be complex**

Support for what?

- **Individual design tasks**
- **Managing production**
- **Results coordination**
- **Integration of individual pieces into a coherent whole**

Forms of support

- **Software support**
  - **For prototype creation**
  - **Screen layouts**
  - **For brainstorming**
  - **Envisioning designs**
  - **Etc.**

Support for individual designers

- **How do designers work?**

- **Ethnographic studies of designers resulted in some significant discoveries**

How do designers work? Designer experience

- **Novices concentrate on superficial elements**

- **Experts take a "deeper" view**

- **Experts in a particular application domain exhibit better performance**

* **Some differences in performance between novice and expert can be mitigated by the provision of appropriate support**

Using previously known successes

- **Previous successful (and even failed) projects are used to identify useful solutions for possible reuse**
- **Previous failed projects are used to identify types of solutions to be avoided**
- **Creation of a library of successes can have benefit**
  - **Also helps to set out a company design culture**

Problem decomposition

- **Novices and experts alike decompose large problems into smaller ones**
- **These smaller sub-problems are generally more well defined**
- **These sub-problems are then addressed as if they were the main problems**
- **Why decompose?**
  - **Enhance the likelihood that a known solution will be recognized**

Alternative designs

- **Generating alternatives is not so easy**
  - **Basic human trait: Gathering support for an existing idea is easier than identifying a new one**
- **How to generate alternatives?**
  - **Look at previous work**
  - **Design reviews with designers not on the project**

Design simulation (prototyping and mockups)

- **Why?**
  - **Look for inconsistencies**
  - **Work out the details**
  - **Show to outside designers to get "fresh eye"**
  - **Involve users to check the match with user model**

Problem domain exploration

- **Experienced designers spend time exploring the domain BEFORE generating a design solution**
  - **Understanding the task environment**
  - **Understand the task**

- **Often no real substitute for being there and observing (at least a little)**

Support for idea generation

- **Based on a study of interface designers**
- **Fall into three categories**
  - **Preparation and information gathering**
    - **Generate task scenarios, take the user perspective, interview, observe, include users, investigate trade press, …**
  - **Discussion and analysis of information gathered**
    - **Brainstorm, discuss, explain to coders, use distraction, produce notes, charts, diagrams**
  - **Trying out ideas**
    - **Build and test prototypes**

Support for design teams

- **Most design problems are only partially decomposable → designers must interact!**
- **Communication is key**
  - **Consideration of alternatives**
  - **Recognition and resolution of conflicts**
  - **Integration of elements**

Communication

- **Access to each other, each other's ideas and partial designs**
- **Must use a common language**
- **Environment must promote communication**
- **One approach is the design room**
  - **Provides a context that supports the design work**
  - **Especially useful in the early stages of design**
  - **Recognizes the importance of the social context of design**

Problems with teams

- **Cost (in time) of coordination**
- **Written communication is inadequate**
  - **Does not support the dialectic required**
- **Meetings**
  - **50% of time taken up coordinating and clarifying issues**

Other support

- **Design rules and design guidelines**
- **Support for communicating and recording design decisions; capture of ideas; alternative exploration**
- **Software support for recording design decisions; capture of ideas; alternative exploration**

Questions?
About the lecture?
Or the readings?

Administration

Homework #0 Assigned