

USER INTERFACE DESIGN

Today

- Before we talk about how to code interfaces in Java, some concepts.
- Norman:
 - The Design of Everyday Things;
 - General design principles;
 - Activity theory;
 - Gulf of execution; gulf of evaluation
- Shneiderman:
 - Specific guidance for UI design
 - Theories; principles; guidelines

References

- The Design of Everyday Things, by Donald A. Norman,
 - *Ch 1, The psychopathology of everyday things*
 - *Ch 2, The psychology of everyday things*
- Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th edition), by Ben Shneiderman and Catherine Plaisant.
 - *Ch 2, Guidelines, principles and theories.*
- I'll give out copies of a couple of these next week.

NORMAN: DESIGN OF EVERYDAY THINGS

Design of Everyday Things

- Issue: Everyday items that are poorly designed and are hard to figure out how to use
This is BAD!!
- After all, there is no reason why objects that we use everyday cannot be designed well.
- Chapter 1 of the book is a rant about some instances of poor design.

- Coffeepot for Masochists



- Jaques Carelman “Catalogue of unfindable objects”.

- Examples:
 - microwave oven
 - washing machine
 - doors
 - audio/visual equipment
 - telephones
- Typically, things that are designed to do *everything* are usually hard to figure out how to do *anything* with

Doors





- Common Design Problems
 - poor instructions
 - poor “visibility” (see ahead) of the operation of the technology
(lacking appropriate visual cues for how to use something)
 - lack of “feedback” (see ahead)
- When simple things need instructions, the design has failed!



- Doors can be pushed, pulled, slid
- “User” is faced with two questions:
 - Does it push/pull or slide
 - Which direction does the door move?
 - On which side do you operate the door (to make it move)?



(Jeff Voight)

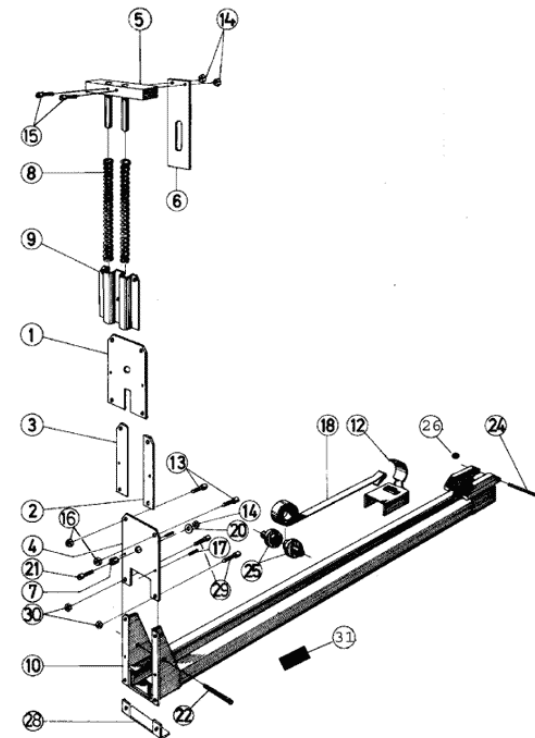
- This last example is particularly confusing since the “pull” side, which is some ways is the obvious one to use, is on the left.
- Natural (in the US) to move through a double door on the right.

Everyday Things

- There are somewhere between 20,000 and 30,000 everyday things!
- These include:
 - lights, sockets, screws, watches, etc.
 - writing devices / utensils
 - fasteners (e.g., on clothing, like buttons, zippers, snaps)
 - furniture
 - food utensils (e.g., fork, knife, chopsticks, spatula, egg beater)
 - tools (e.g., hammer, screwdriver)

- Each is simple, but all work differently.

- How many parts do everyday things have?
e.g., Norman's stapler has 16 parts!
- How many parts do you need to know about?
- How long does it take a person to learn to use all these things?



- One minute per object, 20,000 things.
 - 20,000 minutes
 - 333 hours
 - 8 40 hour weeks
- How do we cope?

Conceptual model

- Mental simulation of operation.



Jaques Carelman, Convergent Bicycle

- No visual clues that provide a clear conceptual model is a design fail.

Design Principles

- Principles of design for *Understandability* and *Usability*
 - Provide good “Conceptual Model”
 - Make things “Visible”
- Visibility
 - Mapping between intended actions and actual operation
 - Feedback indicating action succeeded (or didn’t)
 - *Natural design* \Rightarrow natural signs (for how to use something), should be naturally interpreted
 - Be aware of cultural references (e.g., stop sign)



Affordances

- Properties of an object provide clues to the operation of the object
 - Perceived and actual properties of objects.
- Examples:
 - Buttons are for pressing
 - Knobs are for turning
 - Slots are for inserting things into
- Handles on a door are an affordance.

- Glass is for breaking



- Wood is for writing on.

Conceptual Model

- Visible structure that implies:
 - affordance (what an object was designed to do)
 - constraints (what cannot be done with an object)
 - mappings (between what the object can do and how to use the object to do it)
- “Mental model” — models people have of themselves, others, devices, etc.
- “System image” — visible part of a device

- Hiding functionality is bad.



- Harder to operate most of the functions of a phone than those of a car.

Mapping

- Relationship between two things
- Correspondance between what you want to do and how to do it
- This is where phones often fail
(Though things are better with smartphones)
- In contrast, cars do well.

Feedback

- Send user information about their action
 - Are they doing well or badly?
 - Are there things they should do differently?
- Information can be auditory and/or visual
 - Haptic?

Causality

- Response after an action indicates that the action *caused* the response
 - May be no connection
 - But we often infer there is
- Can we predict the effects of our actions?
- Can we figure out what happened when something goes wrong?
- Natural connection with feedback.

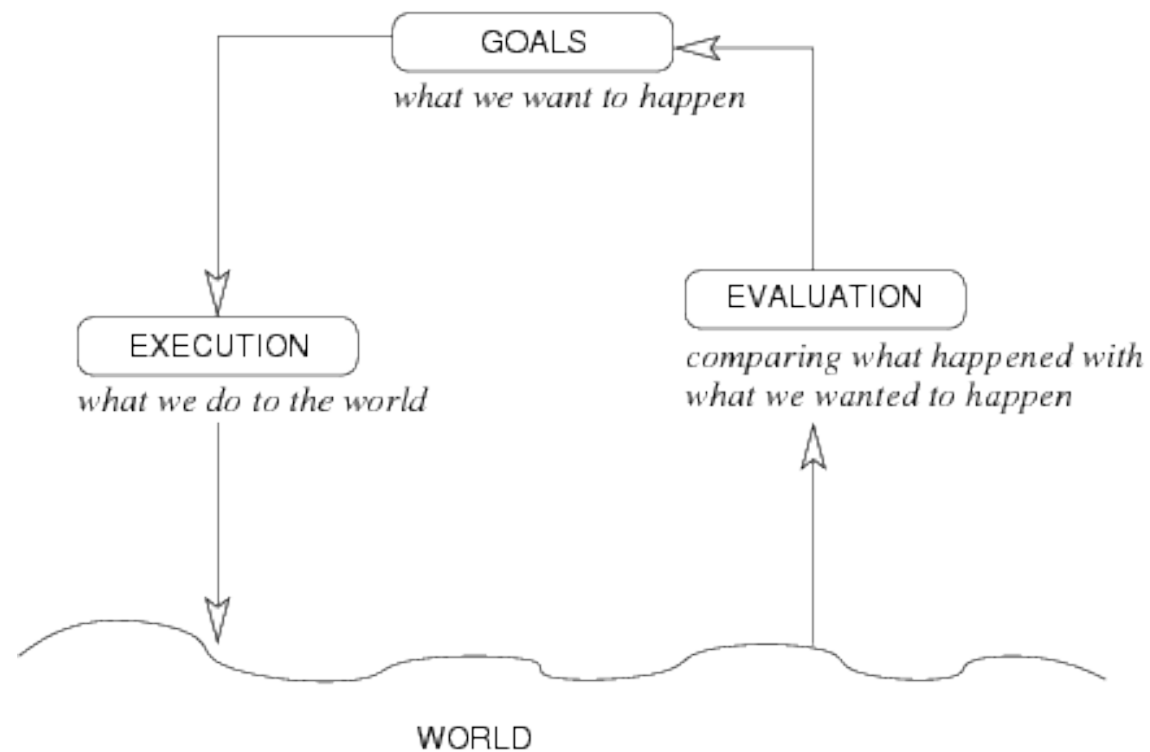
Good design



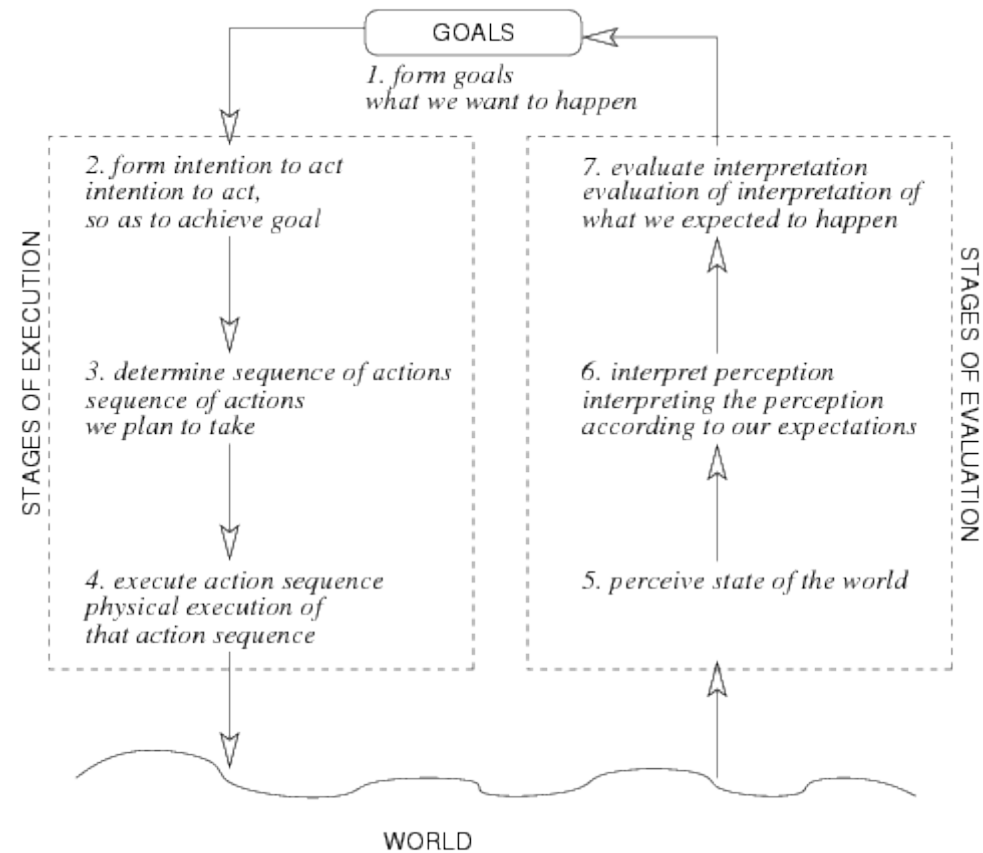
- If a bit old-fashioned.

Activity Theory

- Action Cycle:



- Seven Stages of Action



Gulf of Execution

- Difference between user's intention and allowable actions.
- Identify it by asking:
 - How well does a system allow a user to perform their intended actions?
- Steps 2–4 in the action cycle.
- Example “record” on a video recording device

- User thinks:
 1. Press “record”.
- What is required:
 1. Press “record”.
 2. Specify time of recording.
 3. Select channel.
 4. Save these settings
- The difference between these is the gulf of execution.

Gulf of Evaluation

- Amount of effort required to interpret state of the system and how well the user's intention has been met.
- Identify by asking:
 - How easy is it to get information about the system and interpret that information, and match that interpretation with the user's expectations?
- Steps 5–7 in the action cycle

- Example, my calling card.
 1. Dial service
 2. Enter code
 3. Dial number
- If number is engaged, hear engaged tone after number is dialed.
- If code is wrong, hear engaged tone after number is dialed.
- WTF?

SHNEIDERMAN AND PLAISANT

Theories, Guidelines, Principles

- Guidelines
 - Specific practical ideas that identify good practice, warn against bad.
- Principles
 - Use to analyze and compare alternatives.
- Theories
 - Attempt to provide high level explanations

Describing theories

- User Interface (UI) design theories can be categorized in either of the following ways:
 - *descriptive* vs
 - *explanatory* vs
 - *prescriptive* vs
 - *predictive*
- or
 - *motor* vs
 - *perceptual* vs
 - *cognitive*

What do these mean?

- Descriptive
 - Provide consistent terminology
- Explanatory
 - Describe sequence of events,
 - Cause and effect
- Prescriptive
 - Give guidance

- Predictive

- Evaluate design's execution time, error rates, trust level, conversion rates.
- Depends on type of user (novice, expert);
- These values can have high standard deviations across user types

- Motor
 - Pointing with mouse, using keyboard;
 - Theories such as Fitt's Law describe human capabilities
- Perceptual
 - Finding items on a display
- Cognitive
 - Planning sequences of actions;
 - Memory load requirements

- Users *forage* for useful content
 - Especially on the web.
- Good “scent” \Rightarrow which way to go; helps user find what they are looking for.



- “taxonomy” = classification of complex set of ideas/phenomena/actions into categories

Challenges

- Theories should be more central to research and practice.
- The power of a good theory is to shape design practice.
- Theories should lead practice, rather than drag behind.

Theories

- Design by levels
- GOMS
- Stages of action (Norman)
 - Described earlier
- Context (Suchman)
 - “situated action”

Design-by-levels

- Natural decomposition of a system
- Conceptual: user's (mental) model
 - Painting program: pixels
 - Drawing program: objects
- Semantic: meanings conveyed by interface design
 - What does “undo” do?
- Syntactic: how users conveys semantic meaning
 - Delete by putting an object in the trash
- Lexical: hardware, device dependent
 - Mouse click within 200 milliseconds

Example

- GOMS
 - Goals: user's goals
 - Operators: actions
 - Methods: decomposed actions
 - Selection rules: how to select between methods
- Has successfully predicted performance times.

Other kinds of theory

- Stages-of-action models
- Contextual theories

Principles

- Determine user's skill level
- Identify the user's tasks
- Choose interaction style
- Eight Golden rules
- Prevent errors
- (Ensure human control while increasing automation)

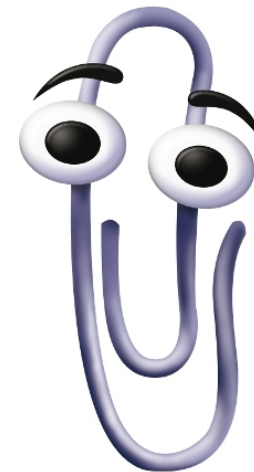
Determine user's skill level

- Know your user!
- Their level of comfort/knowledge drives the interface design:
 - novice or first-time user
 - knowledgeable intermittent user
 - expert or frequent user
- Don't pretend they are all alike.

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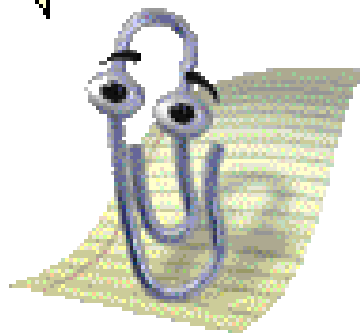
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helpdesk pts/35 Oct 6 08:09 (sun086.leeds.ac.uk)
central pts/41 Oct 10 09:02 (uaa-pc71.leeds.ac.uk)
csc6db pts/43 Oct 10 10:23 (csgi33.leeds.ac.uk)
eclops pts/44 Oct 10 09:50 (UCS-pc41.leeds.ac.uk)
root pts/4 Oct 10 08:44 (sunserv3)
ecljc pts/78 Oct 9 12:46 (cs6400.mcc.ac.uk)
eclsnst pts/37 Oct 10 08:43 (gps0)
ecl6nb pts/82 Oct 9 10:41 (sgi042.leeds.ac.uk)
ecl6ab pts/56 Oct 10 09:13 (sun092.leeds.ac.uk)
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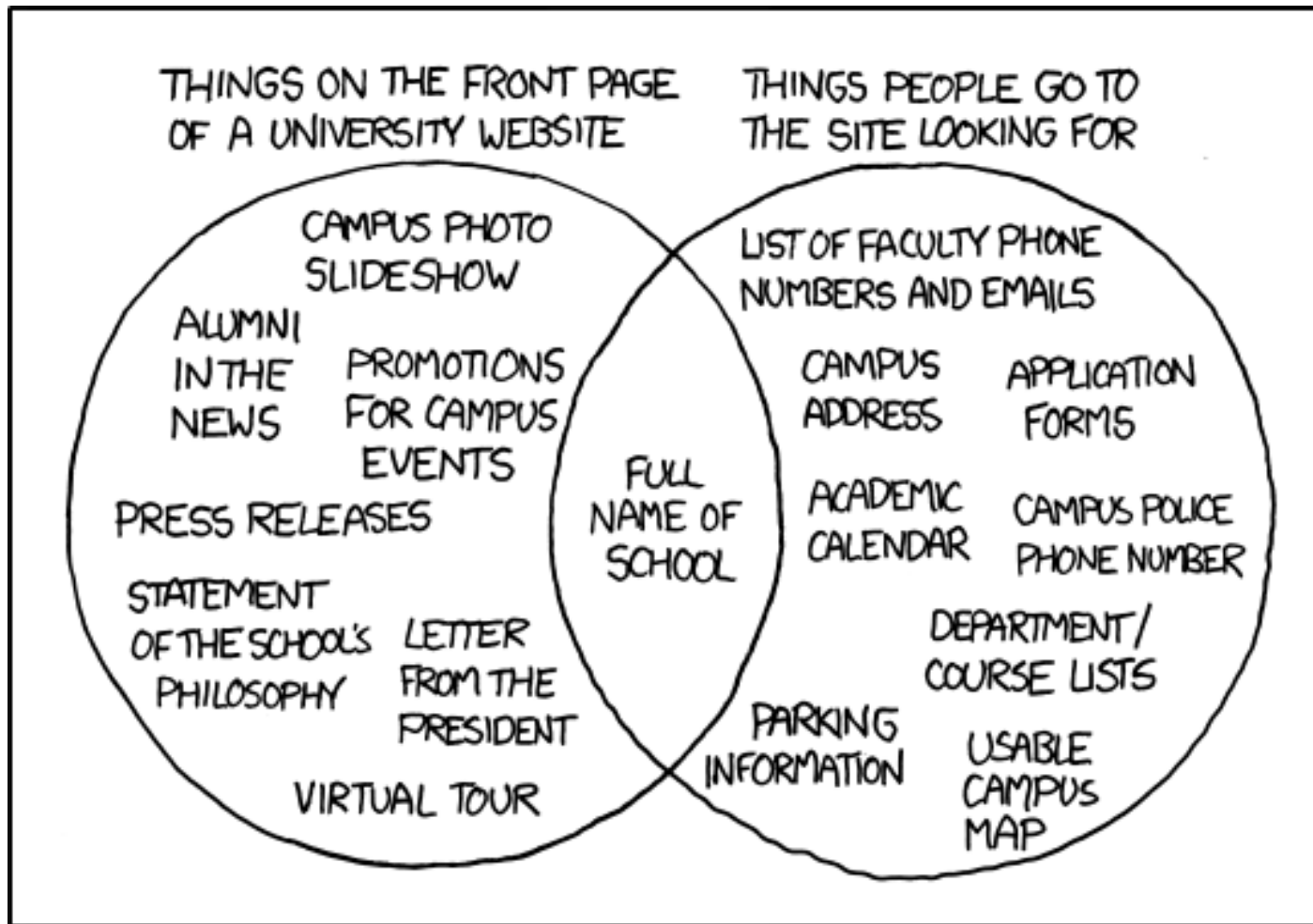
It looks like you're trying to get some work done. Would you like me to bug you instead?

- Annoy me till my eyes bleed
- Go away please, but come back right in the middle of my PowerPoint presentation this afternoon.



Identify the user's tasks

- High-level, mid-level, low-level tasks \Rightarrow *Task Analysis*
 - The Palmpilot experience
- Consider frequency of actions
 - Frequent things should be quick.
 - Unfrequent things can be more time-consuming



<http://www.xkcd.com/773/>

Choose interaction style

- Direct manipulation
 - Desktop
 - Drag and drop
- Menu selection
 - Clear structure (if well done)
 - Can be frustrating to frequent users
- Form fill-in
 - Good for data entry
 - Confusing for novices

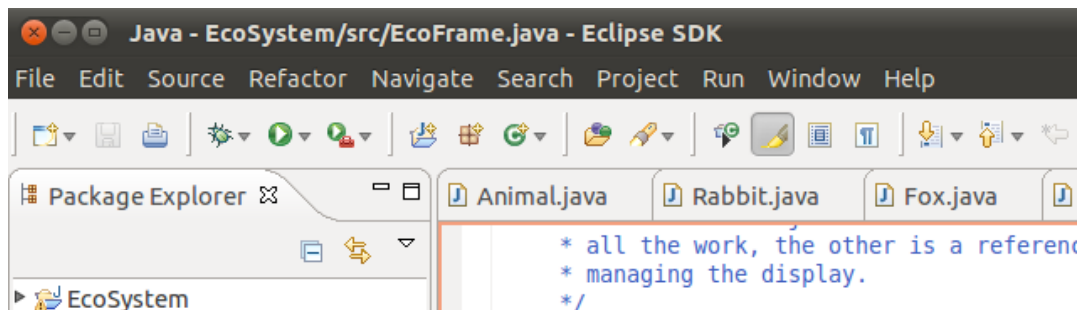
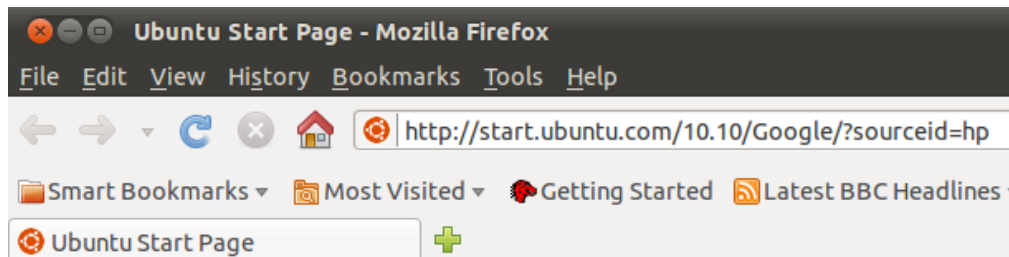
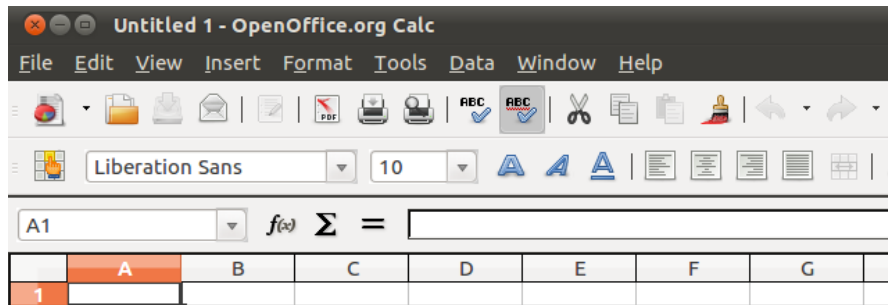
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- Command language
 - eg. Unix command line
 - Good for expert frequent users
- Natural language
 - Eg. Siri
 - Hard :-)

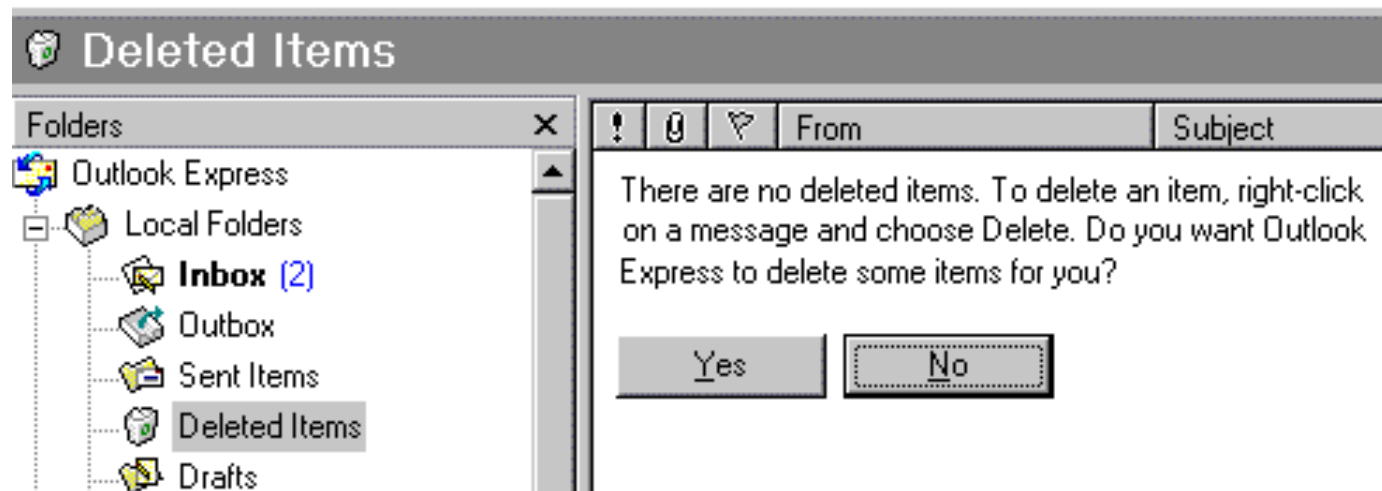
Eight rules of interface design

1. Strive for consistency.
2. Cater to universal usability.
3. Offer informative feedback.
4. Design dialogs to yield closure.
5. Prevent errors.
6. Permit easy reversal of actions.
7. Support internal locus of control.
8. Reduce short-term memory load.

Good



Bad



Prevent errors

- Correct actions
 - Take away bad options
 - Grey out \equiv no reverse
- Complete sequences
- Better error messages:
 - The printer needs paper, can you refill it please?

Guidelines

- Guidelines:
 - provide *consistency*
 - promote *best practices*
- Following slides give some examples of these things

Navigating the interface

- A good interface should “reduce the user’s workload”
- Some examples:
 - Standardize task sequences
 - Ensure embedded links are descriptive
 - Use unique and descriptive headings
 - Use radio buttons for mutually exclusive choices
 - Develop pages that will print properly
 - Use thumbnail images to preview larger images

Good

Google

Google
images

Peek ahead at image results with new related search previews. [Learn more.](#)

Google
scholar

☒ Articles (☒ include patents) ☐ Legal documents

Stand on the shoulders of giants

Scholar Updates: Recommended articles for you

Bad

The screenshot shows the MyTweetSpace website. At the top, there's a navigation bar with a 'MENU' button and a link to 'OUR SOCIAL NETWORK'. Below this, the 'my tweet space' logo is visible. A central banner features a cartoon character and the text: 'The only way to completely customize and brand your twitter space on the web!'. To the left of the banner, there are three small profile cards for 'RichH', 'Jeniuze', and 'Web2.21'. Below the banner, a section titled 'Create your twitter badge!' contains a form with fields for 'Comments', 'Twitter Username', 'LinkedIn', 'MySpace', 'Ecademy', 'Facebook', and 'Plurk'. To the right of the form, there are several advertisements, including one for 'Brand your profile with my tweet space', one for 'FOLLOW US ON TWITTER', and one for 'Web-Stat Traffic Analysis'. At the bottom of the form, there are 'Back' and 'Next' buttons. A small banner at the bottom right says 'Want a custom twitter background made just for you? AMAZING!'.

- Though mainly its the ads that mess it up.

- Consider *accessiblity*:
 - Use text alternatives
 - Provide alternate ways of conveying time-based media (e.g., movies, animations)
 - Make elements distinguishable from one another
 - * Don't just rely on visual cues
 - Design for predictability
- These allow the use of tools like screen readers.

Organizing the display

- Consistency of data display
 - e.g., colors, fonts, capitals, etc)
- Efficient information assimilation by user
 - Familiar format
 - Justification of text etc.
- Minimal memory load on user
 - Don't expect them to carry information between screens
 - Don't make people write things down
- Compatible data display with data entry
- Flexibility of user controls for data display

Getting user's attention

- Intensity (e.g., brightness of color)
 - Two levels only
- Mark items
 - Underline, box etc.
- Size
 - Up to four sizes
- Fonts
 - Up to three fonts

- Inverse video
- Blinking (use sparingly)
- Color
 - Up to four colors
- Audio
 - Soft tones for regular positive feedback
 - Harsh tones for warnings
- **DON'T overuse these!!!!!!**

Facilitating data entry

- Consistent data entry transactions
 - Don't have to remember which page you are on.
- Minimal input actions
- Minimal memory load
- Compatible data entry and display
- Flexible user control for display

Summary

- This class has looked at some of the theory underlying user interface design.
- Some of this is general good sense design.
- Some is specific to user interfaces.
- From it we can distill some good practice.
- Next time we'll look at the tools that Java gives us to create interfaces.
 - But that is in 2 weeks, after the midterm.

To Do

- Read: Norman *The Psychopathology of Everyday Things*
- Read: Shneiderman and Plaisant *Guidelines, principles and theories*
- (To be handed out next time).