

User Interface Design

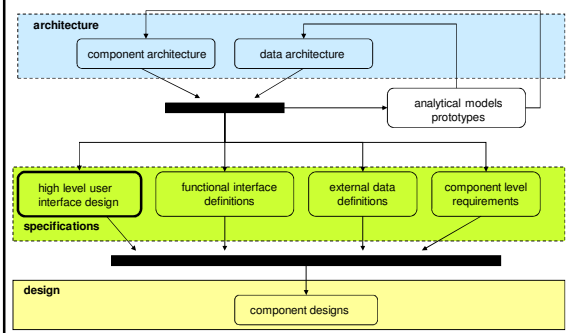
- problems of User Interface design
- elements of good User Interface design
- designing U/Is and content structure
- U/I design exercise
- supplementary subjects
 - web vs. graphical U/Is
 - choice of presentation/navigation metaphor
 - reviewing and testing U/Is
 - CLIs

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Model Hierarchy/Succession



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Why User Interfaces are critical

- sit between the user and the software
 - good UI enables users to exploit the s/w
 - bad UI prevents users from using s/w
- most users do not receive formal training
 - UI must be obvious and/or self-teaching
- technical support is difficult to get
 - UI must prevent/diagnose/fix most problems
- UI can make or break a product
 - largest single element of the user experience

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User Interfaces aren't easy

- the tools are growing ever more complex
 - encompassing ever more tasks & options
 - working in ever more complex environments
 - integrating with ever more applications
- the users are not homogeneous
 - they have different needs and goals
 - they have different technical depth
 - they have different backgrounds
- the designers are not at all like the users
 - and have very different goals

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It takes a village to build a UI

- Technical Knowledge/Skills
 - familiarity with the product design
 - familiarity with the chosen UI toolkit
- Domain Knowledge/Skills
 - familiarity with the various classes of users
 - familiarity with the tasks being automated
- Human Factors skills
 - techniques of complexity assessment
 - techniques of information organization
- plus artistic and writing skills

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Elements of good U/I design

- Familiar and Consistent
 - familiar contexts, objects, actions
 - consistent icons, positions, style
 - consistent metaphors, navigation, “grammar”
- Intuitive and Understandable
 - current context (objects & options) is clear
 - offers context/history-appropriate options
 - clear how to perform all common operations
 - meaning of presented information is obvious

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Understandable Displays

- organization
 - group related functions (content, navigation)
 - consistent positioning of all elements
- presentation
 - most of the space reserved for content
 - use white space to separate display elements
 - avoid putting too much info in one display
 - use multiple windows where this makes sense
- usability
 - consider smaller displays, slower links
 - don't over-use scroll-bars

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Elements of good U/I design

- Simple and Convenient
 - doesn't expect user to remember much
 - don't overwhelm with information or options
 - anticipates needs (likely actions, default values)
 - but ... does not force user down a path
- Communicative and Responsive
 - current context, state and options are clear
 - status of in-progress operations is clear
 - completion and status of recent operations

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Elements of good U/I design

- Helpful and Robust
 - defaults and option menus for user input
 - thorough input and request validation
 - error response is meaningful and helpful
- Adaptable and Configurable
 - offers different user roles different views
 - offers multiple (e.g. novice/expert) modes
 - configurable default context, options, views
 - language, locale, and accessibility options

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Levels of User Interface design

- interaction and content models describe
 - sequence of screens for each task
 - general contents of each screen
- navigation design describes
 - how user will move through defined screens
 - general structure, and then widget types
- detailed widget behavior
 - is usually very well defined by UI toolkits
 - defining new UI widget behavior is dangerous

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Developing a User Interface

1. Identify the scope of the user interface
 - user types, use cases, domain objects
 - develop detailed task descriptions
2. Structure the user interface
 - identify the user visible states and transitions
 - resolve the task steps into screens
3. Structure the content
 - types of content to be presented
 - how to rationally structure and present them
4. Detailed design of each screen
 - specify contents, control, navigation options

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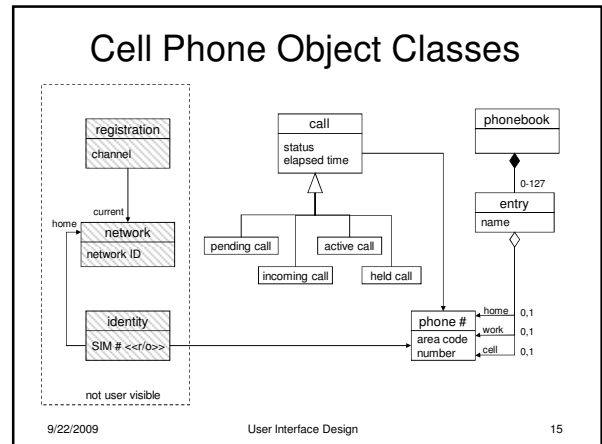
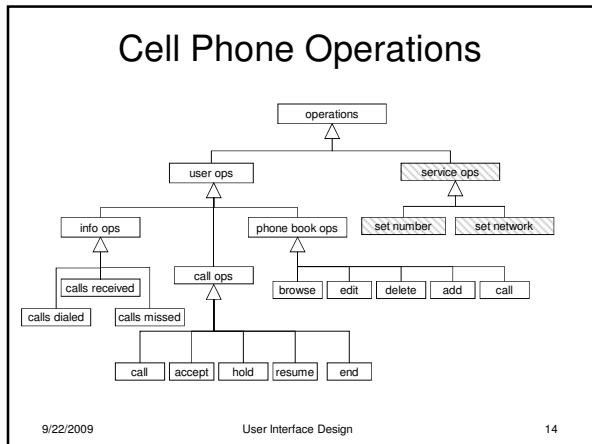
1. Identify scope of User Interface

- identify the types of users for the S/W
 - characterize each by needs and experience
 - refine a set of distinct user-roles
- identify tasks performed by each role
 - use case scenarios for each task
- develop detailed task descriptions
 - class diagrams to describe domain objects
 - activity/state diagrams to describe task steps
 - list information users will provide and want
- elaborate and validate these descriptions

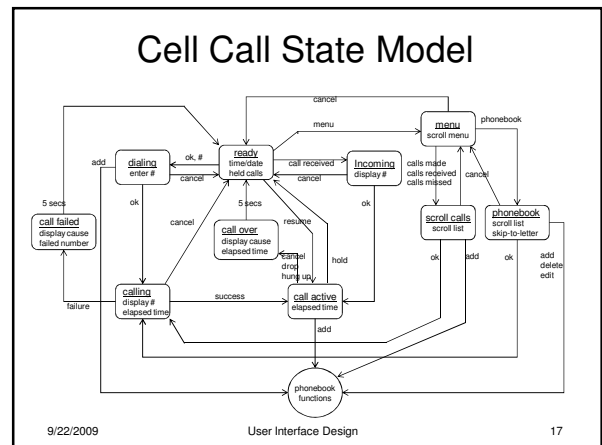
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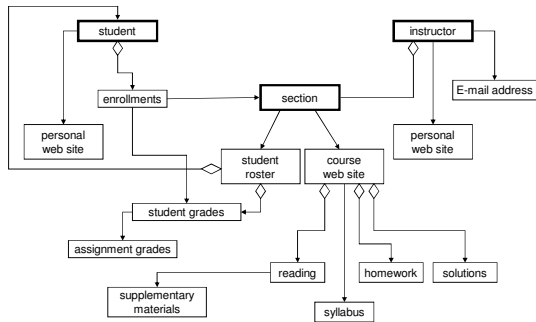
- ## 2. Structuring the User Interface
- break tasks down into screens
 - where information is presented/gathered
 - changes result from user or external events
 - map all the screens with a state diagram
 - name each screen
 - summarize information to be presented
 - summarize information to be entered
 - show all possible transitions to other screens
 - refine, review, and validate this model
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- ## 3a. Content Model - Scope
- enumerate types/sources of all content
 - information directly associated with tasks
 - information displayed in course of tasks
 - information entered in course of tasks
 - information accessible through application
 - task domain object attributes and history
 - attributes and history of related objects
 - help information
 - related information links
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- ## 3b. Structuring the Data
- identify entry points into data hierarchy
 - students, sections, professors
 - identify all containment associations
 - course description contains a roster
 - identify all relevant associations
 - section directly refers to an instructor
 - reading assgts include supplementary URLs
 - student can get from section to his grades
 - association implementation is unimportant
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map natural structure of data



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3c. Define User Visible Structure

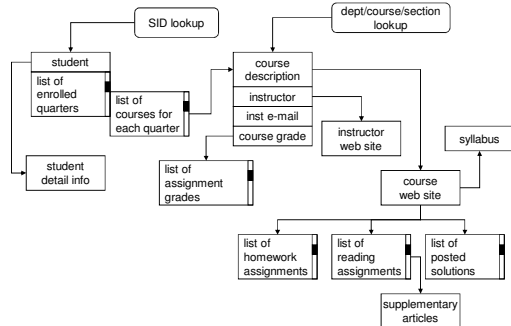
- **UI views need not be the domain classes**
- one UI view can include many classes
 - bring referenced objects into container
 - hiding irrelevant classes and associations
- one class can break into multiple UI-views
 - create new (useful) relationships
 - summary and detail views
 - search and browse views
 - view data in context of different relationships

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UI views



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3d. Specify Content Navigation

- define means to follow each UI view arrow
- many choices may be obvious
 - from a name/icon to the corresponding object
 - from a summary field to the supporting detail
 - object selection from a list (incl. scrolling)
 - previous/next object in current succession
- some navigation may not be obvious
 - different view of the same object
 - new high level object search

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U/I design exercise

- Consider: your game
 - identify the key content elements
 - identify the key user tasks/goals
- in that context
 - identify natural task based navigation paths
 - identify natural content structure/relationships
 - identify “relevant” information on each path
- one team present a 5 minute overview and rationale (to replace their worst quiz)

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For Next Lecture

(short and conceptual)

- SEI: definition of S/W Architecture
- Garlan & Shaw: Intro to S/W Architecture
 - just 1. Intro, 2. from languages to arch
- McConnell: 3.5-3.6 arch considerations
- McConnell: 5-5.2 elements of good design
- Wiki: Mechanism/Policy Separation
- Kampe: S/W Testability
- Kampe: Interface Stability

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Supplementary Slides

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Graphic User Interfaces

- There are competing GUI toolkits
 - Windows, Motif, MAC, Java UI classes, etc.
 - they offer different widgets
 - with different appearances and behavior
 - they offer different programming models
 - these are confusing for users and developers
- When building a native GUI
 - you must choose a toolkit to use
 - may affect choice of navigation metaphors
 - will definitely affect design of components

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Web Application UIs

- HTML browsers are more standardized
 - links, forms, frames, pop-ups, scrollable text boxes, style-sheets, multi-media content, etc.
 - powerful extensions (DHTML, Java, J-script)
 - provide interfaces for local and remote users
- some GUIs are becoming WEB front-ends
 - providing improved standardization
- but this is not yet a panacea
 - Java applets can still create own widgets
 - high performance apps still use direct screen

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Standard GUI Metaphors

- Information
 - forms w/ input fields
 - tables of information
 - successive pages
 - scrollable displays
 - wizard dialogs
 - pop-up windows
 - (cursor) tool tips
- Controls
 - menu/action bars
 - control button icons
 - object icons
 - drag-n-drop
 - right-click
- Navigation Aids
 - explicit links
 - tabs
 - site maps
 - search windows

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choosing application metaphors

- many well known navigation techniques
 - each has advantages and adherents
 - none is intrinsically superior to another
- the best choice is the most familiar
 - other applications used by same customers
 - other applications in same product family
- this decision may be forced
 - by user interface toolkit
 - by corporate style guidelines

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Reviewing U/I Functionality

- Conformance with Requirements
 - supports all specified tasks and options
- Ease of Use
 - how many screens for common scenarios
 - how many cursor motions and key strokes
 - how much information remembered/supplied
 - how it responds to the most likely errors
- Consistency
 - of navigation, metaphor, operation grammar

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Reviewing U/I Appearance

- General
 - Consistent positions and representations?
 - All content displays are self-identifying?
 - Distinct elements are readily distinguishable?
 - Primary navigation options are obvious?
- Large report displays
 - Easily viewable in subsets?
 - Ease of navigation to desired subset?
 - How does it scale to smaller windows?

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UI Evaluation - Usability Testing

- informal usability testing
 - a few customers play with a prototype
 - they write a report on how they liked it
 - developers may be present during testing
- formal usability testing
 - performed in a controlled usability testing lab
 - users are given a scenario to perform alone
 - developers are not present during testing
 - the session is video recorded
 - usability analysts produce formal report

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Command Line Interfaces

- two kinds of users
 - power users who know just what they want
 - automated scripts (shell, Perl, CGI, make, ...)
- both want to avoid program interaction
 - all parameters are specified up-front
 - input data from specified files or stdin
 - results to specified files or stdout
 - diagnostics go to stderr
- this completely changes design goals
 - but many of the principles remain the same

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Command Line Interface goals

- Power
 - all options can be set from command line
- Brevity
 - short specification strings (reduce typing)
 - e.g. “-l” vs “-view=long”
 - good defaults (eliminate need for args)
 - reasonable built-in defaults
 - system and per-user configuration files
 - key parameters set by environment variables
 - e.g. search paths, location of configuration file

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Command Line Interface goals

- Cohesion - program does only one thing
 - a few basic get/set/transform functions
 - may even be separate commands to get and set
 - all related to one set of objects or functions
- Familiarity and understandability
 - standard/mnemonic arguments
 - e.g. -l for long, -v for verbose
 - consistent argument syntax rules
 - e.g. optarg conventions
 - unrecognized options give usage message

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Typical CLI conventions

- single letter options
 - turn specific options on or off
 - can be specified separately or in groups
 - e.g. “-l -v -r” or “-lvr”
- options with arguments
 - specify value for an input parameter
 - e.g. -l /usr/include/midnight
- environment variables set context
 - e.g. LIBPATH=“/usr/lib:/usr/ucb/lib:/usr/local/lib”
 - LOCALE=ENG_US

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Pipe-line-ability

- The toolbox concept
 - build transformations out of standard tools
 - one program's output is another's input
- many handy stream processing tools
 - grep, sort, cut, tr, awk, etc.
- functions that work with lists of files
 - ls, find, test, tar, mail, print, more, etc.
- make your output suitable as input
 - one line per record, tab separated fields, etc.

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