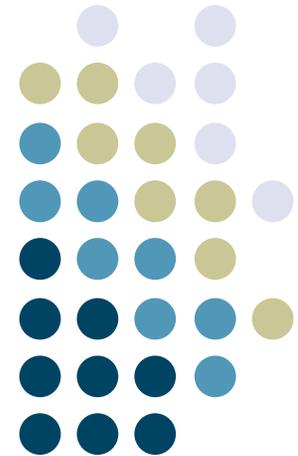


Welcome to CS6452!



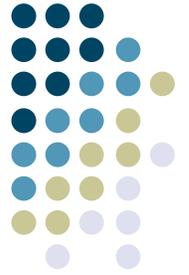
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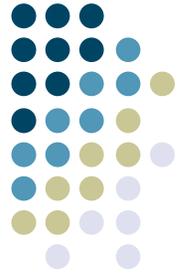


Keith Edwards
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Some Preliminaries

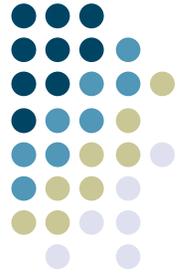
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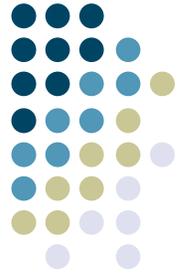
Nuts and Bolts

- This is only the second time this class has been taught
- This is the second required class in the HCC Ph.D. program
 - Designed to ensure a basic level of competency in building medium-scale programs
 - Best thought of as the second part of CS4452 (which is CS1315++)
 - In HCC terms, should give you the skills needed to do your computation portfolio requirement
- This semester: allowing CS students for the first time as an experiment (more on this later)



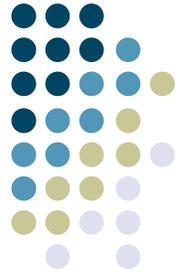
Setting Expectations

- What does “Prototyping Interactive Systems” mean, anyway?
- The course title has caused a lot of confusion:
 - *Not* about using prototyping tools (e.g., Director)
 - *Not* about evaluating prototypes (take the HCI class for this)
 - Instead, about the *rapid creation* of *interactive systems* through *programming*
- Emphasis on scripting languages and common technical idioms that are useful across a breadth of CS
- Covers both *theory* and *practice* of pragmatic systems building



Programming and Prototyping

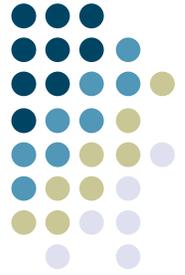
- What does programming have to do with prototypes?
 - It's the final (and most time consuming) stage of the prototyping lifecycle
 - Gives you the most high-fidelity approximation of a “real” system
 - Useful for communicating with end-users, other developers, etc.
- How is prototype programming different than other programming?
 - Focus on rapid creation of basic functionality, appearance, behavior
 - Less on dealing with errors, boundary conditions, performance, etc.



Theory and Practice

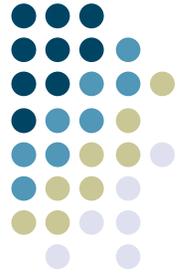
- Last year: 100% practice
- This year: 50/50 balance

- We'll read and discuss papers on alternative approaches while developing the project



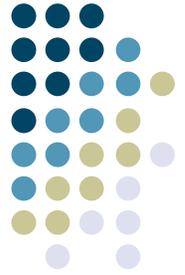
What Do We Mean By Practice?

- Software development with a focus on breadth, not depth
- Skills to produce high-fidelity interactive prototypes
- Skills to produce code that *makes an argument*: demonstration of concepts
- HCC: skills to complete the computation portfolio requirement
- Skills in *talking* and *writing* about code
- Pragmatic development:
 - Scripting languages (Jython)
 - Integration with non-scripting languages (Java)
 - Multi-file development
 - Command line tools
 - GUIs, networking, threads, databases, web services, security, ...



What Do We Mean By Theory?

- Understanding why things work the way they do
- Understanding competing architectures and approaches
 - E.g., client-server versus peer-to-peer
 - E.g., different models for GUI programming
- Not just building systems for you to evaluate...
- ... but understanding the design choices embedded in systems, and what those implications are for HCC

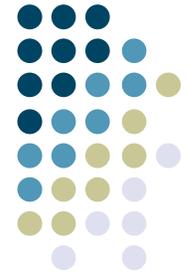


This Semester's Experiment

- The theory aspects are likely to be useful to everyone
- How to develop a practical project that is useful to everyone?
- This semester: different projects
 - HCC + HCI: medium-sized project focused around basic computer science concepts
 - Likely 2,000-3,000 lines of code
 - Basic GUI, networking, database, web services, ...
 - Topics covered in lectures
 - CS: large-sized project focused around more advanced concepts
 - Likely 20,000-30,000 lines of code
 - Advanced GUI, networking, security, ...
 - Much more self-guidance required
- Goal: projects appropriate to the skill levels taking the class

My Goals for this Class: HCC and HCI students

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- Hone your programming chops to the point where a medium-sized project (say, 5000 lines of code) is not a terrifying prospect
 - Learn how to decompose a problem into manageable chunks
 - Learn enough of the “idioms” of programming to be able to do more than just simple, straight-line programs
- Impart a few “meta skills” in the process
 - Communicating *about* software
 - Communicating *through* software
 - How to appropriate (read: steal) others’ code and adapt it
 - Basic software project management
- Basic understanding of a range of systems architectural choices

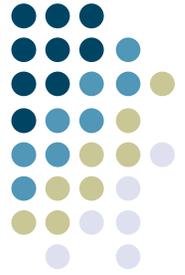
My Goals for This Class: CS Students

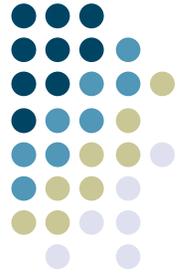


- One-semester coverage of a broad range of CS topics that may not be familiar to you
 - GUI toolkit internals, animation, and advanced techniques
 - Peer-to-peer networking
 - Security and cryptography
 - ...
- Experience with scripting languages to the point where a large-sized project (say, 50,000 lines of code) is not a terrifying prospect
- Practice bridging scripting and non-scripting languages
- Communication skills around software
- Basic understanding of a range of systems architectural choices

Course Structure

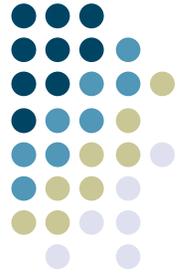
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Course Structure

- Course is structured as a set of “modules”
 - Each module covers a subject area in CS
 - Modules align with topics needed to complete a part of the project
 - Readings cover advanced topics related to each module
- Each module is roughly 2-3 weeks, but we’ll adapt as needed
- Roughly:
 - First half of class is lecture, mostly focused on practical concepts
 - Second half is either paper discussion, or problem solving/lab
 - Occasional: invited guest lectures on topics of interest
- Everybody works individually, but we’ll share experiences
 - Short in-class presentations toward the end of each module
 - Describe the architecture of a portion of your prototype, how you solved a problem, what design choices were available, etc.



Modules

I. Asynchronous Programming

- Event-based programming, callbacks, polling

II. Distributed Applications

- Idioms of networking, client-server, peer-to-peer

III. Web Services

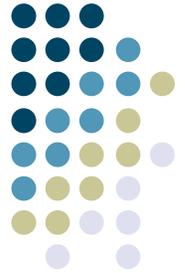
- XML, SOAP, using web services in practice, integration with Java code

IV. Data Management

- Logging, instrumentation, data storage and querying, databases

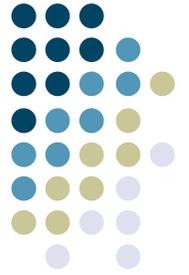
V. Advanced Topics

- TBD, but candidates include: security, hardware, research in prototyping



The Project

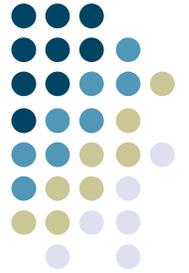
- This is a project class
- We will do one project that lasts the duration of the semester
 - HCC + HCI: IM/Chat program, probably 2000-3000 lines of code
 - CS: P2P Social Networking Tool, probably 20,000-30,000 lines of code
 - Single-person “teams”
- Assumes Python knowledge at about the level of CS4452
 - Good mastery of control flow, variables, scoping
 - Basic object-oriented programming concepts
 - How to use JES (or another development environment)



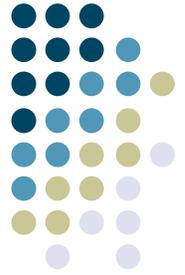
Exams

- Four exams this semester
 - Roughly one per module
 - Non-cumulative
 - Combination of simple answer and essay
 - Drawn from readings and in-class discussions

Grading Criteria

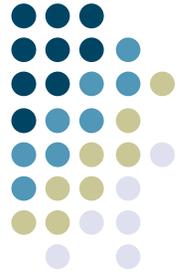


Project Implementation: how functional is your prototype? How well does it work? How well does it demonstrate the concepts taught in class?	40%
In-class examinations (roughly one per module)	30%
Class participation and attendance	20%
In-class presentations	10%



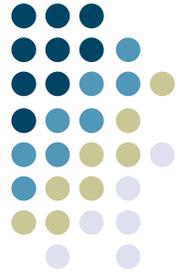
Today's Class

- Outline for the remainder of today's class:
 - What is prototyping?
 - Why prototype?
 - The kinds of prototyping
 - The first project assignment
 - Practicum: getting started



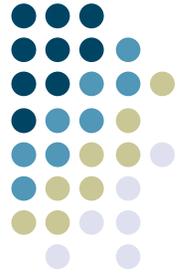
What is Prototyping?

- The creation of *artifacts* that can be used to:
 - Assess the utility and usability of a proposed system, through *evaluation*
 - Communicate design alternatives with various stakeholders
 - The “customer”
 - Engineers/builders
 - Management
- Ideally, a prototype should
 - ... be quick enough to build to allow easy experimentation
 - ... have fidelity *appropriate* to demonstrate the desired concepts



Why Prototype?

- In two words: **risk mitigation**
- From an evaluation perspective, allows you to get feedback on designs before there's a huge investment in it
- From a design perspective, allows you to quickly experiment with alternatives, cheaply

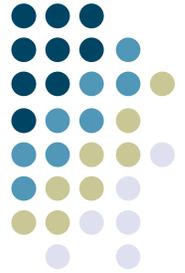


An Example

- When interfaces go bad...



- What's wrong with this?

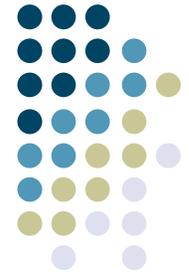


An Example

- When interfaces go bad...



- What's wrong with this?
 - The "From" field is editable, but doesn't do anything!
 - Let's you change the file extension without warning
 - Is modal!
- Could this have been saved by prototyping?

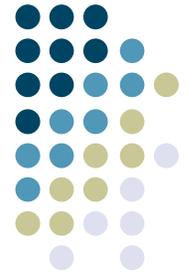


Another Example

- Not just restricted to applications...

“If you are seated in an exit row and you cannot understand this card or cannot see well enough to follow these instructions, please tell a crew member.”

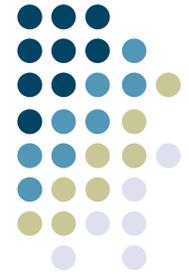




One more...

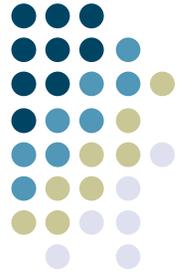
- Alarm Clock, a la Terry Gilliam's *Brazil*





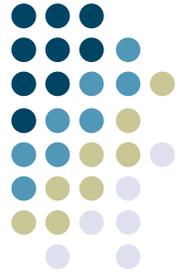
Kinds of Prototypes

- There are a range of prototyping techniques, for a range of goals
- Ideally:
 - Start with lightweight prototypes to communicate the “big picture”
 - Move to more realistic ones as risk factors are mitigated and you need to communicate about the details
- Fidelity in prototyping
 - Fidelity is the level of detail in a prototype
 - Low-fidelity: many details missing, maybe “sketchy” appearance
 - High-fidelity: prototype looks like the final system on the surface



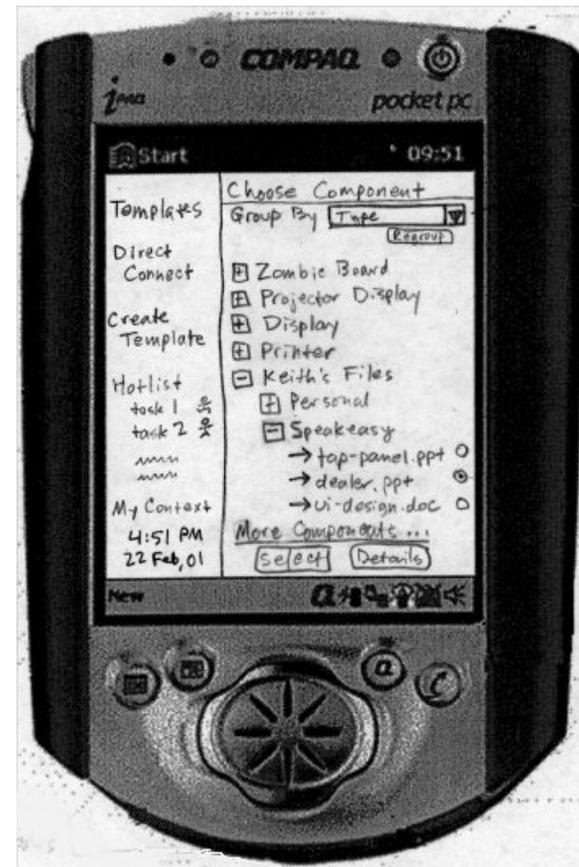
Low-fidelity Prototyping

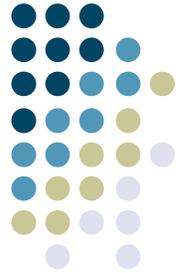
- The lowest of the lo-fi: paper prototyping
 - If you've ever designed a UI, this is probably something you've done informally
 - Capture overall layout
- Storyboards
 - From the film and animation arts
 - Capture *behavior*, not just *appearance*
- Goal: keep the design/implement/evaluate cycle as tight as possible
- These techniques do it by keeping the implementation phase small



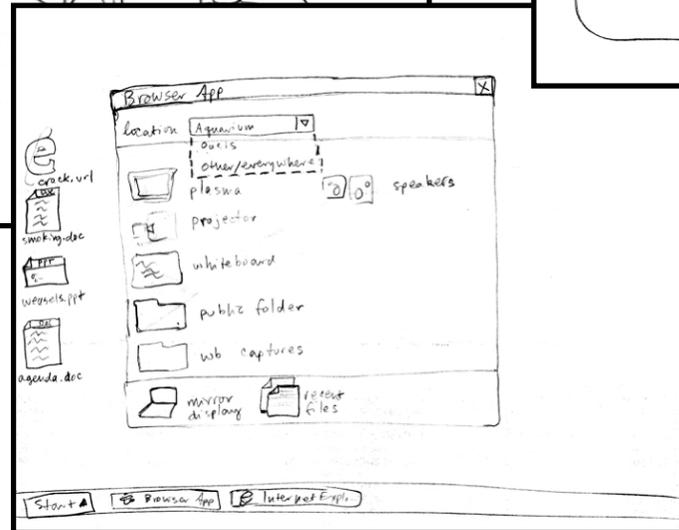
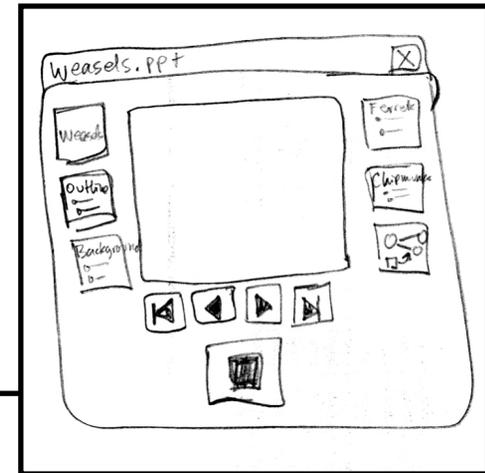
Example: Simple Paper Prototype

1. Get image of iPaq
 2. Cut out screen area
 3. Make lots of copies
 4. Fill in copies as needed
- Can be turned into storyboard
 - Annotate controls with numbers
 - Numbers lead to other sheets



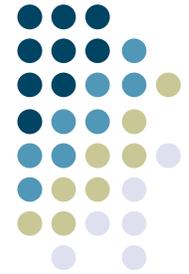


A Few More Examples

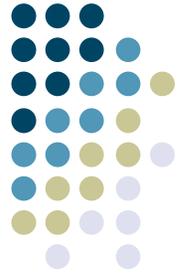


Developing and Evaluating Low-fidelity Prototypes

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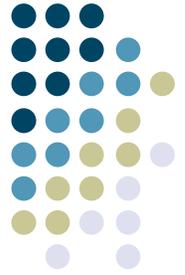


- Basic tools of the trade:
 - Sketch large window areas on paper
 - Put different screen regions (anything that changes) on cards
 - Overlay cards on paper
- The copier is your friend:
 - Can easily produce many design alternatives
- Evaluation: You can “run” your paper prototype
 - The designer “simulates” the computer in front of a user
 - Need to be ready for any user action (drop-down menus, etc.)



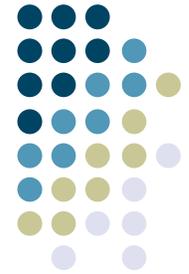
High-fidelity Prototyping

- Once again, a range of practices that give you higher fidelity in exchange for higher implementation time
- Tool-based approaches
- GUI builders
- Code-based approaches
- Downsides:
 - Cost is the obvious one
 - Also:
 - Warp perceptions of the customer: elicit more comments on color, fonts, etc.
 - Attending to details can lose the big picture

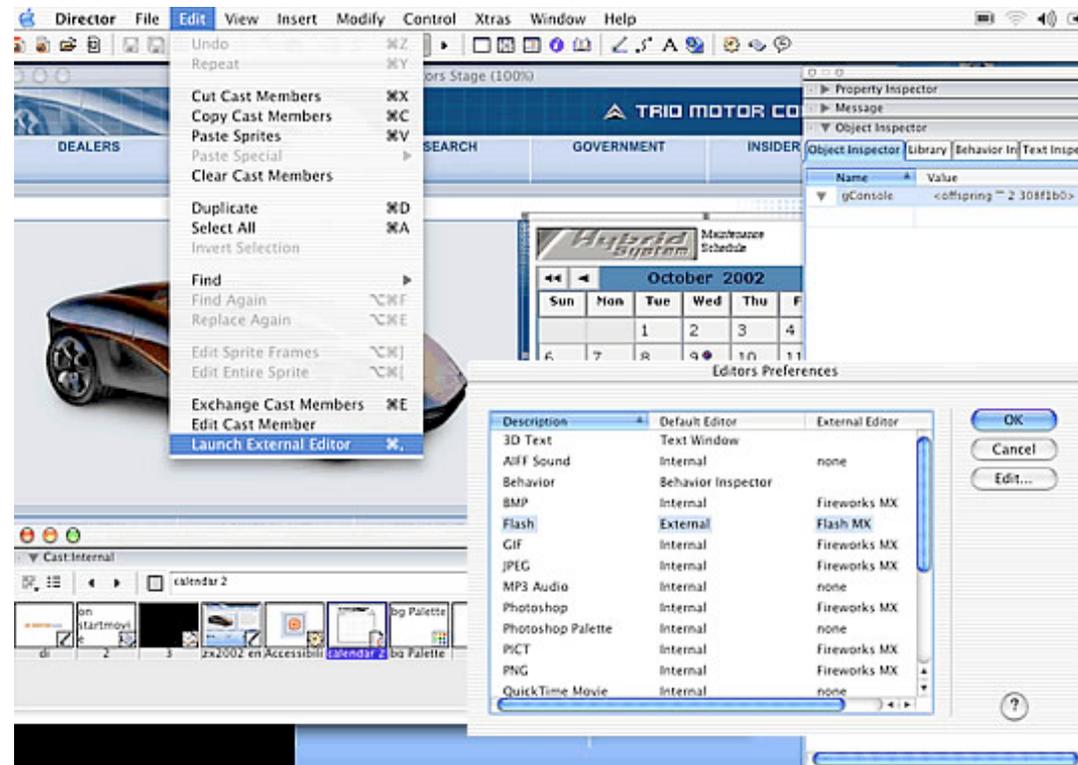


Tool-based Prototyping

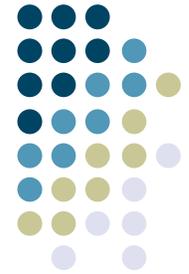
- Examples: Director, Flash, the Web
- Pros:
 - Faster than writing code
 - Easier to incorporate changes
 - Often more reliable (hit the back button, rather than program crash)
- Cons:
 - No easy way to transition to a finished product
 - May not allow access to the full range of features available to the finished product (e.g., may not be able to prototype networking, or certain platform-specific features)



Example: Director

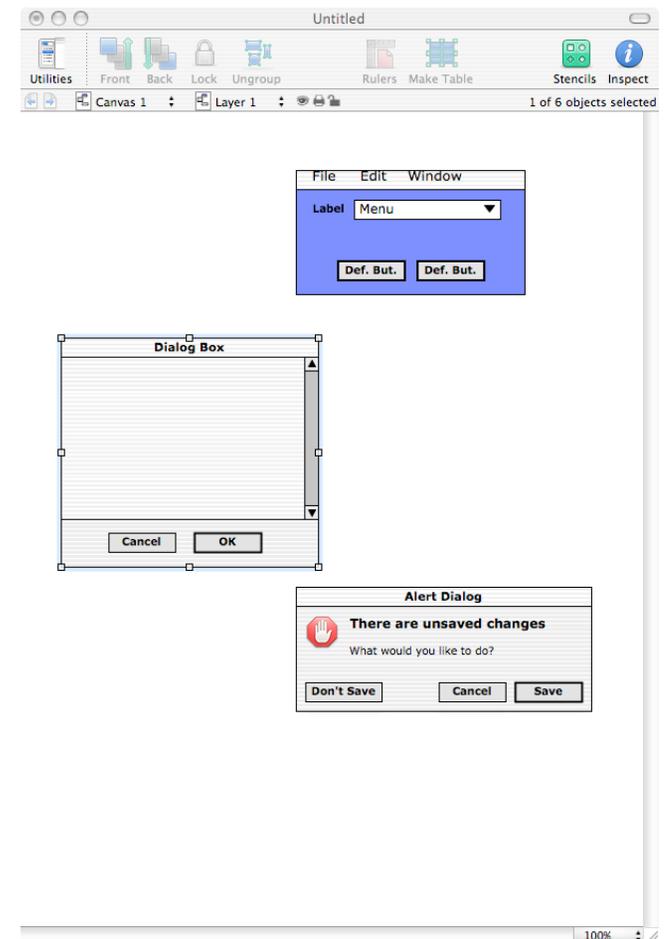


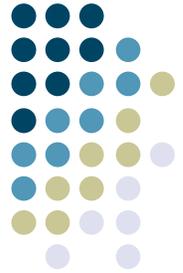
- Timeline editing, palettes of graphical widgets, etc.
- Emits a file that can be executed on any program that has the required runtime engine



Example: OmniGraffle

- Drag graphics that depict GUI elements onto canvases
- Canvases can be linked
 - Example: Click on element A on canvas 3 goes to canvas 4
- Can emit an interactive set of web pages
- Mac only, unfortunately

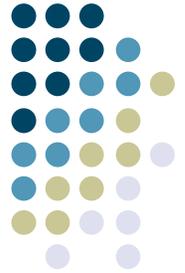




Example: Web Prototyping

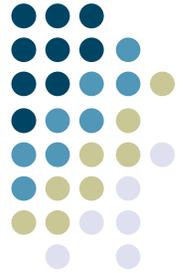
- Web-based version of lo-fi prototype shown earlier
- “Controls” simply link to another page
- Allows fine-tuning of text, graphic size, after behavior has been tested on paper
- Can be done by hand or by web development tools



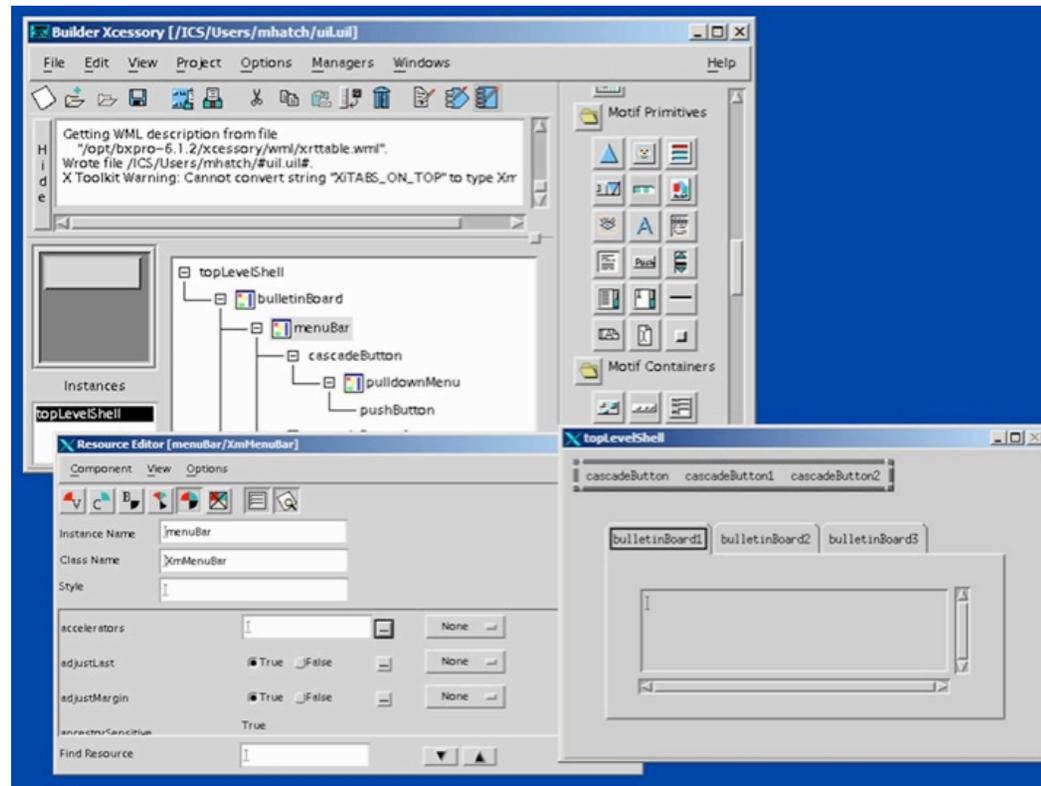


GUI Builders

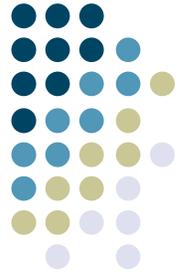
- A special class of tool for creating GUI systems
 - Drag-and-drop “widgets” from a palette
 - Emit code that you then edit: fill in the blanks
- Pros:
 - Facilitate reasonably good transition to the final product
 - What you get looks exactly like what the finished product will look like
- Cons:
 - Still have to know a lot about programming
 - *AND* have to know about programming peculiarities in the GUI builder itself (can be very opaque)



Example: BX Pro

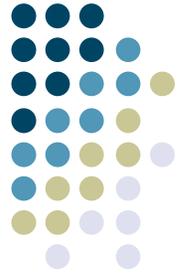


- Drag and drop graphical “widgets” onto a screen canvas
- Set properties of widgets
- Fill in C++ code for behavior



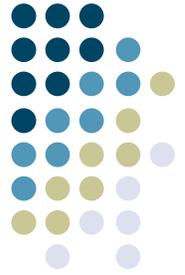
Code-based Prototypes

- This is what we'll be focusing on, after this week
- Many approaches:
 - Production languages (Java, C++, etc.)
 - Scripting languages (Jython, Python, Visual Basic, AppleScript, TCL)
- There is often a fuzzy line between code and the use of tools
 - Can often “drop down” to code to augment behavior
- Pros:
 - Very high fidelity
 - True interactivity
 - Good transition to final system
- Cons:
 - Cost, learning curve



Evaluating Hi-Fi Prototypes

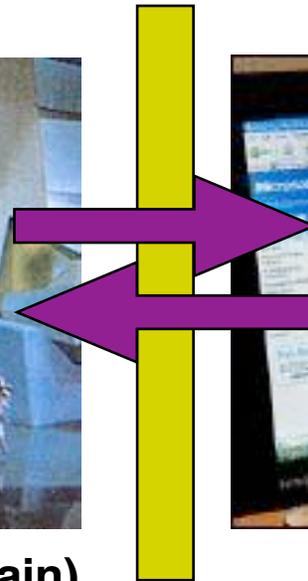
- Some hi-fi prototypes are *hi-fi-enough* that standard HCI-style analyses work fine
- But what if you don't have all the necessary behaviors implemented?
- Answer: ***fake it!***
- *Wizard of Oz* technique
 - You are the person “behind the curtain”
 - Provide simulation of missing implementation details as necessary
 - Especially important for features that are hard to implement
 - E.g., speech or handwriting recognition, activity sensing, intelligent interfaces, etc.



Example: WoZ

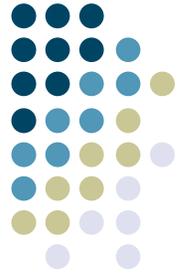


Wizard (behind the curtain)



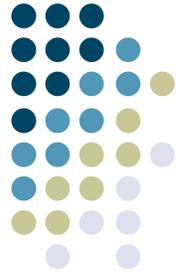
Unsuspecting User

- Wizard watches human input and explicitly controls the computer



This Week's Assignment

- Create a lo-fi paper or web prototype of the UI for the project
- This prototype will serve as the basis for the *interactive* UI we will create in the first module
- *Prototyping as a **design** tool, not an **evaluation** tool*
- Requirements:
 - Should show every screen/window that is reachable in the UI
 - Identify all graphical elements
 - Identify transitions between elements
 - Should be sufficiently detailed that you could “run” a user through it, by playing computer
- Submit to TA (or me, if we don't have one) by next Monday

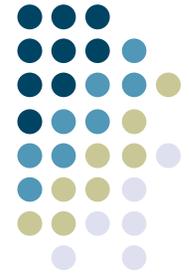


Requirements for IM GUI

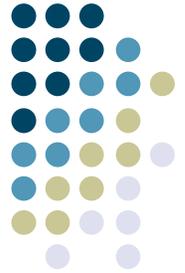
- Provide list of all online users
 - Allow selection of one (or optionally, more) users
 - Provide some control to initiate a chat
- Requested users should receive an invitation window
 - Allow them to accept or reject the invitation to chat
- For each chat a user is engaged in, one chat window
 - Text area that shows chat transcript of all parties
 - Area to enter your text
 - Provide some control for disconnection
- Other members of chat should receive notification upon disconnect of another chat member

Requirements for Social Networking Tool GUI

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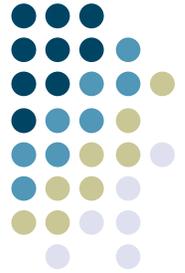
- Provide list of all online users, grouped into friends and others
 - Support the following operations on users: start chat, send a file (through drag-and-drop), view an info page, browse shared files, set “friend” status
- Chat functionality:
 - Users get an invitation window, allows them to accept/reject chat, or block user
 - One chat window per chat, with transcript area, text entry area, disconnection control
 - Peer chat members get notified upon disconnect of another member
- File sharing functionality
 - Two ways to share files: explicit send, and browsing
 - Send via drag-and-drop to user. Peer receives confirmation allowing them to accept/reject, or block
 - Accepted files appear in an Inbox window, accessible from UI. Controls to manage (delete, sort) files in Inbox
 - Browse another user’s shared files, with notification to that user
- Social networking functions
 - Visualization of degrees-of-separation
 - Physical location placement on map
- “Housekeeping” functions
 - Set my icon, info page, shared files directory, availability status



Practicum

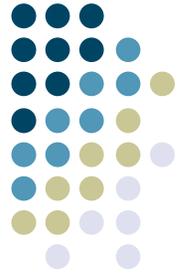
Getting set up for development

- Install Java, *if you don't already have it*
 - Macs: comes with OS X
 - Windows, Linux: <http://java.sun.com/j2se/1.5.0/download.jsp>
 - I'll be using Java 1.5.0; you're welcome to use earlier versions at your own risk
 - Either the full Java Software Development Kit (JDK) or Java Runtime Environment (JRE) should be sufficient
- Downloading Jython
 - <http://www.jython.org>
 - Jython 2.1 or 2.2a1
 - Should run on any platform that supports Java 1.2 or later



Practicum, cont'd

- Development environment
 - I'm agnostic about which (if any) development environment you use
 - JES: simple, single-window environment for Jython
 - <http://coweb.cc.gatech.edu/mediaComp-plan/94>
 - Eclipse: *much* more complicated, but more “real”
 - <http://www.eclipse.org>
 - JEdit
 - <http://www.jedit.org> -- used with some success last time
 - Others:
 - You're more than welcome to use a simple text editor and command-line Jython
- If you're unsure what to use, or new to programming, my suggestion is to use JEdit

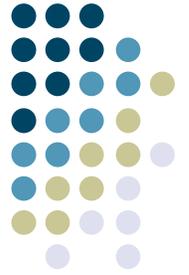


Readings for Next Class

- “Low vs. High Fidelity Prototyping Debate,” Jim Rudd, Ken Stern, Scott Isensee
- “Sketching Interfaces: Toward a More Human Interface Design,” James Landay, Brad Myers
- “DENIM: Finding a Tighter Fit Between Tools and Practice for Web Site Designers,” James Lin, Mark Newman, Jason Hong, James Landay
- Please read and be prepared to discuss!

A Reminder

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NO CLASS NEXT WEEK!
(MLK Holiday!)