CS 4470: Introduction to User Interface Software &
CS 6456: Principles of User Interface Software

Fall 2015

Jump to syllabus

General Information:

- **Course Goals:**
  - Understanding of the architectural and algorithmic principles behind the development of the 2-dimensional graphical user interface
  - Experience in modern GUI toolkits and development environments
  - Exposure to a variety of advanced topics for developing interactive systems, including "off the desktop"
- **Meeting Time:** Tuesdays/Thursdays 9:35-10:55
- **Meeting Place:** KACB 1447
- **Instructor:** Keith Edwards
  - keith (at) cc (dot) gatech (dot) edu
  - Office: TSRB 213; hours TBA (currently by appointment)
- **TA:** Larry Freil
  - larry.freil (at) gatech (dot) edu
  - Office: hours TBD

Class Policies and Grading

How Grades Will Be Computed. Final grades will be calculated based on the following weighting scheme. It is possible that the weighting formula may be adjusted as the semester progresses. Any such changes will be announced to the class:

Undergrads

Category	Weight
Homework 1	15%
Homework 2	15%
Homework 3	15%
Homework 4	15%
Homework 5	15%
Exam #1	12.5%
Exam #2	12.5%

Grads

Category	Weight
Homework 1	15%
Homework 2	15%
Project (5 deliverables)	45%
Exam #1	12.5%
Exam #2	12.5%

For final letter grades, an overall average of 90-100 will result in an A, between 80-89 a B, between 70-79 a C, between 60-69 a D.

Students taking the class pass/fail must receive a B or better to pass. Students auditing the class will not be required to complete homework or exams.

Homeworks. Details on the requirements for successfully completing the homeworks will be given in the assignment on the Web. The homework is due by 11:55PM on the assigned due date. The grade for a late homework assignment will be marked down 10 points for each day it is late, maximum of three days (homework turned in more than three days late will receive a zero).

The work is expected to be completed by individuals and not in collaboration with others.

Exams. Exams will be based on assigned readings, lectures, and homework.

I expect all students to show up for exams and submit homeworks in a timely manner. No make-up exams will be given without written notice of an emergency (doctor's notice if in the hospital, for example), and IN ADVANCE if possible.

Project. Graduate students in the class will be expected to complete a multi-part project during the second half of the course. The project structure will be presented in class. The project consists of separate milestones, including a project proposal, implementation, demo, and final writeup.

Other Policies. A good portion of the learning in any upper level or graduate class comes from intelligent discussion during the class. If you don't attend class, you cannot participate, and your performance may reflect that. I expect that each student will make an effort to attend all lectures and contribute constructively to the discussion.

Students are expected to follow Georgia Tech's code of academic conduct. **All code submitted for homeworks in this class must be written by you alone.** Please do not share your code on public repositories (such as public GitHub). I am required to forward all suspected cases of academic misconduct to the Dean of Students, where they will be pursued to resolution. This is a very unpleasant process for all involved, so please do not put us in this situation.

Reading Materials

There is no *required* textbook for this class.

However, as we will be doing programming assignments using the Java Swing GUI toolkit, understanding the nuts and bolts of Swing programming may be useful. Thus, I'm *recommending* *Java Swing, Second Edition* (Loy, Eckstein, Wood, Elliot, and Cole; O'Reilly Press) as a good book on Swing with broad coverage of the toolkit.

If you don't want/need the book, you still may want to take a look at some of the links and documents in the Resources section of this page.

Another good book (also not required, but useful if you want to do fancy Swing stuff either in class or later on your own) is *Swing Hacks* (Marinacci and Adamson; O'Reilly Press). Lots of nifty tricks, plus it's written by a Georgia Tech alum. Another, more recent book in a similar vein that I haven't yet checked out in as much detail is *Filthy Rich Clients* by Haase and Guy.

Additional required readings for each class will be provided electronically and posted on the course syllabus. In addition, some supplemental readings will be provided. These readings will not be required but may prove useful as background material for students.

Resources, Documents, and Software

We will be using Java Standard Edition, version 8 for this class. Please be sure your code works with this version, as it's what we'll be testing against. If you don't already have Java installed, make sure you download the Java 8 SDK (software development kit) rather than just the JRE (Java Runtime Environment). You can download Java 8 here.

- Oracle's site for all things Swing
- JDK download
- Java Desktop site. Another portal with links to components, projects, etc., for people doing rich GUIs on the desktop. There are some links to cool stuff here.
- The Swing Connection. Links to Swing propaganda, bug databases, etc.
- Extra components and resources (open source or free):
  - Swing Labs. Sun's open source incubator for some very cool Swing components and libraries. Good site.
  - Java Desktop Integration Components. A bunch of nifty components to make Java apps integrate better onto the desktop. There's some cool stuff here.
- Swing/AWT tutorials and books (let me know if you come across other good ones)
  - Nice Swing wiki with some good tutorials
  - Free AWT book on the web! This is actually a great resource for basic event and layout materials.
  - Official Swing Tutorial
  - Quick Tutorial for AWT Programmers

Tentative Class Schedule and Syllabus

(Please check the class schedule periodically, as it may be updated as necessary.)

Week	Date	Topic	Materials	Assignments & Readings
1	Tues Aug 18	Introduction • Introductions • Course goals • Grading, policies, admininstrivia. • Grad project overview • Motivation: why a class on UI software?	Slides: Introduction • Keynote • PDF Supplemental Readings: • James Landay's slides on technical contributions to HCI	Overview of Grad Project
	Thur Aug 20	UI Software Organization • Separation of concerns • Basic UI toolkit functionality • Some Swing examples	Slides: UI Software Org • Keynote • PDF Supplemental Readings: • Creating a GUI with JFC/Swing	Assignments: • Homework #1 out Readings: • User Interface Software Tools, Brad Myers (ONLY Sections 1, 2, 4, 6)
	Tues Aug 25	Wrap up UI Software Organization Movie Day! Links to some of the videos here	Slides: • None Links: • Doug Engelbart demo • Early Smaltalk 80 Video • Xerox Star video • Fictional UIs from movies and games	Readings: • Evaluating User Interface Systems Research • Usability Testing Considered Harmful

2	Thur Aug 27	Wrap up movies Output: Low-Level • Basic devices (CRTs, LCDs) • Framebuffers, color palettes, and gamma correction • Imaging models (raster, vector, stencil-and-paint) • "Undrawing"	Slides: Output 1 (Hardware) • Keynote • PDF Supplemental Readings: • How CRTs (and Television) Work • How LCDs Work • How Plasma Displays Work	
3	Tues Sept 1	Continue Output: Low-Level • Imaging models (raster, vector, stencil-and-paint) • "Undrawing" Output: Toolkits and Window Systems • What's a window system? • Toolkit responsibilities • Compositing window systems • Division of responsibilities between toolkits and window systems • Resolution independence and HiDPI • Computer typography	Slides: Output 2 (Software) • Keynote • PDF Supplemental Readings: • Painting in AWT and Swing • The BIT-BLT Algorithm • Java 2D Graphics Tutorial • Another Java 2D Graphics Tutorial • Getting Started with Java 2D • Java 2D Graphics (book chapter) • Performing custom painting in Swing	
	Thur Sept 3	Continue Output: Toolkits and Window Systems • Division of responsibilities between toolkits and window systems • Resolution independence and HiDPI • Computer typography	Slides • Continued from previous class Supplemental Readings: • Article on Compositing Window Managers	Readings: • Prefab: Implementing Advanced Behaviors Using Pixel-Based Reverse Engineering of Interface Structure
4	Tues Sept 8	Input: Devices • Keyboards • Buttons • Valuators • Locators • Input hardware	Slides: Input 1 (Devices) • Keynote • PDF Supplemental Readings: • How a Computer Keyboard Works • How a Computer Mouse Works • How an Optical Mouse Works • Crazy input device: The Handykey Twiddler	Readings: • The Design Space of Input Devices, Card, Mackinlay, and Robertson
	Thur Sept 10	Input: Toolkits and Window Systems • Dealing with device diversity • Device ontologies • The event model as unifying abstraction • Implementing event	Slides: Input 2 (SW) • Keynote • PDF Slides: Using MVC with Swing Components • Keynote • PDF	Assignments: • Homework #1 DUE 11:55PM • Homework #2 out

		systems • Dispatch strategies, focus, and picking	Supplemental Readings: • Tutorial on writing event listeners • A bit of history on where the Java "delegated" event model came from • Tutorial on using the Swing focus subsystem • Tutorial on Swing drag-and-drop • MVC Meets Swing (somewhat out-of-order but will be helpful in the next homework) • Chapter 28 (esp. *Creating Your Own Component*) in *Java Swing* • The ImageIcon class is the easiest way to load and display an image in Swing	
5	Tues Sept 15	Wrap up Input (SW) • Picking • Focus Interaction Techniques • What's an interaction technique? • Design of interaction techniques • Affordances and feedback • Fitts' law • Case studies • "Beating" Fitts' law	Slides: Input 3 (Interaction Techniques) • Keynote • PDF Supplemental Readings • Article on visualizing Fitts' Law • Tutorial on Swing data transfer (drag-and-drop, copy-and-paste) • Good article on managing UI complexity	Readings: • Extensible Input Handling in the subArctic Toolkit, Hudson, Mankoff, and Smith
	Thur Sept 17	Continue Interaction Techniques • "Beating" Fitts' law Implementing Interaction Techniques • Case study: rubber banding • Finite State Machines • Hand-coded FSMs • Table-driven FSMs	Slides: Implementing Interaction Techniques • Keynote • PDF	Assignments: • Grads: preliminary project proposal DUE! Readings: • Instrumental Interaction: An Interaction Model for Designing Post-WIMP User Interfaces • Tangible Bits: Towards Seamless Interfaces Between People, Bits, and Atoms --> • Adaptive Semantic Snapping--A Technique for Semantic Feedback at the Lexical Levvel, Hudson
	Tues Sept 22	Wrap up FSMs Damage and Layout • Recap of damage • Swing validation • Bottom-up versus top-down layout • Boxes-and-glue • Springs-and-struts • Constraints • One-way versus multi-way constraints • Implementing constraints	Slides: Damage and Layout • Keynote • PDF Supplemental Readings: • Video showing a constraint-based layout system for fancy graph drawing and manipulation • A couple of video tutorials showing the AutoLayout constraint-based layout in iOS; these are good examples of a graphical interface for constraints (part 1 and part 2) • Video of ConceptDraw, a structured diagramming editor that uses a one-way constraint solver for layout (click the Watch Video link) • Tutorial on how layout works in Swing • Tutorial on creating a custom Swing layout manager • Tutorial on doing without a layout manager	Readings: • Composing User Interfaces with InterViews, Mark A Linton et al. • Solving Linear Arithmetic Constraints for User Interface Applications

6			• Some hints on solving common layout problems	
	Thur Sept 24	Wrap Up Constraints • Constraints as a Layout Solution • One-way versus multi-way constraints • Implementing Constraints Pen Interfaces and Recognition • Pens for text and command input • Implementing simple recognizers	Slides: Recognizers • Keynote • PDF Supplemental Readings and Materials: • Overview of SiGeR recognizer from Microsoft • C# implementation at SourceForge • Video of Teddy system, showing how strokes are interpreted as commands based on context • Article on the history of handwriting recognition (part of a longer article on the history of Palm)	Readings: • Gestures without Libraries, Toolkits, or Training: a $1 Recognizer for User Interface Prototypes
7	Tues Sept 29	Continue Pen Interfaces and Recognition • Pens for text and command input • Modality • 9-square recognizer • Siger recognizer **Brief Exam Preview and Q&A**	Slides: • Continued from previous class	Readings: • Pen-Based Interaction Techniques for Organizing Material on an Electronic Whiteboard, Moran et al. • Teddy: A Sketching Interface for 3D Freeform Design, Igarashi et al.
	Thur Oct 1	**TBD**		Assignments: • Homework #2 DUE • Undergrads: Homework #3 out
8	Tues Oct 6	**TBD**		
	Thur Oct 8	**TENTATIVE: MIDTERM EXAM.**		
9	Tues Oct 13	**GT Fall Recess**		
	Thur Oct 15	**Exam Review** Wrap-up of Recognition Pen-Based and Touch-Based Computing • Natural data types • Pen technology • Pen interaction • Ink as data • Pen versus touch interaction	Slides: Pen- and Touch-Based Computing • Keynote • PDF Supplemental Readings: • Great article comparing the Nokia Tablet's UI with that of the Newton • SATIN website • Introduction to PenPoint (the operating system of the Go computer). Article is from 1992, but the system is way cool. • About Tablet Computing Old and New, article by Dan Bricklin covering the history of tablet computing • Tablet PC Home Page • Takeo Igarashi's web site, source of a lot of great sketch-based interface ideas • An interesting multitouch window manager	Assignments • Grads: final project proposal with lit review DUE 11:55PM tonight! Readings: • Interactive Sketching for the Early Stages of User Interface Design, Landay • SATIN: A Toolkit for Informal Ink-based Applications, Hong and Landay

			concept	
10	Tues Oct 20	Animation in the Interface • Why animation? • Three principles from traditional cartoon animation: solidity, exaggeration, reinforcement • Animation in a toolkit • Example: subArctic • Example: Swing	Slides: Animation in the Interface • Keynote • PDF Video: • Video showing some of the techniques we'll discuss in class Supplemental Readings: • Core Animation preview • Beginner's Guide to Animation at Stick Figure Death Theater • Threading in Swing • *Swing Hacks*, hacks #8, 18, and 42 especially • Great article on Disney's animation principles and how to use them in user interfaces	Readings: • Animation: From Cartoons to the User Interface, Chang and Ungar • Animation Support in a User Interface Toolkit: Flexible, Robust, and Reusable Abstractions, Hudson and Stasko • Bringing Physics to the Surface
	Thur Oct 22	**No Class Today!**		Assignments: • Undergrads: Homework #3 DUE! • Undergrads: Homework #4 out
11	Tues Oct 27	**TBD**		
	Thur Oct 29	Wrap up of Animation • subArctic, Core Animation, and Swing Touch Interaction: Hardware • Resistive • Capacitive • Vision-based • Limitations and trade-offs	Slides: Touchscreen Technology • PPT • PDF Supplemental Readings: • Jeff Han's FTIR paper • Shahram Izadi's ThinSight paper • Andruid Kerne's Zero Touch paper • VIDEO of Zero Touch in action • Paper with a variant of the four-camera technique discussed in class	
12	Tues Nov 3	Wrapup of Touch Hardware Touch Interaction and Touch Gestures • Single-touch • Multi-touch • Bi-manual input and interaction techniques (magic lenses, toolglasses • Multi-user multi-touch	Slides: Touch Interaction and Touch Gestures • Keynote • PDF Supplemental Readings: • A VIDEO showing Microsoft Surface (the tabletop version) • A VIDEO showing the original toolglass system • A VIDEO on tape drawing, and digital tape drawing • A VIDEO of DiamondTouch, a multi-person multitouch display that can identify the user associated with each input.	Readings: • Pen + Touch = New Tools • LiquidText: A Flexible, Multitouch Environment to Support Active Reading • NEAT: A Set of Flexible Tools and Gestures for Layout Tasks on Interactive Displays
	Thur Nov 5	Wrap-up of Touch Interaction • Toolglasses and Magic Lenses • Examples and advantages • Implementing lenses	Supplemental Readings: • Tutorial on specialized panes in Swing • Doing overlay graphics on the GlassPane • Another overlay graphics example • Entry from Josh Marinacci's Blog on event redisppatch • Doing magic lenses in Swing	Readings: • Toolglasses and Magic Lenses: The See-Through Interface, Bier, Stone, Pier, Buxton, DeRose

13	Tues Nov 10 **UIST**	Sound and Non-speech Audio • Basics of sound • Speech versus non-speech audio • Using audio in interfaces • How audio interaction is different from graphical interaction • Case study: Mercator • Audio input	Slides: Sound and Non-speech Audio • Keynote • PDF Supplemental Readings: • Site for JavaSound • Other JavaSound resources • Auditory illusions entry at Wikipedia • Sound localization article at Wikipedia	Readings: • Mapping GUIs to Auditory Interfaces, Mynatt and Edwards
	Thur Nov 12	Speech-based Interfaces • Low-level properties of speech • Challenges of speech-based interfaces • Features of speech • Menu systems versus SpeechActs • Case studies: Suede, PAL, Family Intercom	Slides: Speech-based Interfaces • Keynote • PDF Supplemental Readings: • Interesting article on How Siri Found Her Voice • JavaSpeech API • FreeTTS	Assignments: • Undergrads: Homework #4 DUE! • Undergrads: Homework #5 out Readings: • Designing Speech Acts: Issues in Speech User Interfaces, Yankelovich, Levow, and Marx • The Audio Notebook: Paper and Pen Interaction with Structured Speech Stifelman, Arons, Schmandt
14	Tues Nov 17	**Grad Project Demos (Project Milestone 3)**		Assignments: • Grads: project implementations due BEFORE the start of class (9:35AM) for ALL TEAMS.
	Thur Nov 19	**Grad Project Demos (Project Milestone 3)**		
15	Tues Nov 24	**Grad Project Demos (Project Milestone 3)**		
	Thur Nov 26	**Thanksgiving!**		
16	Tues Dec 1	**Undergrad Project Demos (Optional; extra credit)**		Assignments: • Grads: final writeup due TONIGHT at 11:55PM
	Thur Dec 3	**Exam Preview/Q&A Session/Course Feedback**		Assignments: • Undergrads: Homework #5 DUE
Finals	TBD	**FINAL EXAM: Date and Time TBD Location: our usual classroom.**		