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

Fall 2013

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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:** *Instructional Center room 215*
- **Instructor:** Keith Edwards
  - keith (at) cc (dot) gatech (dot) edu
  - Office: TSRB 213; hours TBA (currently by appointment)
- **TA:** Gabriel Reyes
  - greyes (at) gatech (dot) edu
  - Office: outside TSRB 344; hours TBA (currently by appointment)

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. 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 7 for this class. Please be sure your code works with this version. If you don't already have Java installed, make sure you download the Java 7 SDK (software development kit) rather than just the JRE (Java Runtime Environment).

Special Note for Mac Users: for people using OS X, by default Apple ships only Java 6. You can download Java 7 here. Chris Simpkins has a writeup of further tweaking of your Java environment, in case you're interested, 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 20	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 22	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: • A Brief History of Human Computer Interaction Technology, Brad Myers
2	Tues Aug 27	Wrap up UI Software Organization Movie Day!	Slides: • None Links: • Doug Engelbart demo • Early Smaltalk 80 Video • Xerox Star video	
	Thur Aug 29	Wrap up movies Output: Low-Level	Slides: Output 1 (Hardware) • Keynote • PDF	Readings: • User Interface Software Tools, Brad Myers (ONLY Sections 1, 2,

		• Basic devices (CRTs, LCDs) • Framebuffers, color palettes, and gamma correction • Imaging models (raster, vector, stencil-and-paint) • "Undrawing"	Supplemental Readings: • How CRTs (and Television) Work • How LCDs Work • How Plasma Displays Work	4, 6)
3	Tues Sept 3	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 5	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	
4	Tues Sept 10	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 12	Input: Toolkits and Window Systems • Dealing with device diversity • Device ontologies • The event model as unifying abstraction • Implementing event systems • Dispatch strategies, focus, and picking	Slides: Input 2 (SW) • Keynote • PDF Slides: Using MVC with Swing Components • Keynote • PDF 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	Assignments: • Homework #1 DUE 11:55PM • Homework #2 out Readings: • Extensible Input Handling in the subArctic Toolkit, Hudson, Mankoff, and Smith

			• 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 17	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	
	Thur Sept 19	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: • Adaptive Semantic Snapping--A Technique for Semantic Feedback at the Lexical Levvel, Hudson
6	Tues Sept 24	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: • Tutorial on how layout works in Swing • Tutorial on creating a custom Swing layout manager • Tutorial on doing without a layout manager • Some hints on solving common layout problems	Readings: • Composing User Interfaces with InterViews, Mark A Linton et al.
	Thur Sept 26	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: • 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.

7	Tues Oct 1	Wrap Up 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	
	Thur Oct 3	TBD		Assignments: • Homework #2 DUE • Undergrads: Homework #3 out
8	Tues Oct 8	**MIDTERM EXAM.**		
	Thur Oct 10	**NO CLASS TODAY!** **Instructor out of town.**		Assignments: • Grads: final project proposal with lit review DUE 11:55PM tonight!
9	Tues Oct 15	**GT Fall Recess**		
	Thur Oct 17	**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 concept	Readings: • Interactive Sketching for the Early Stages of User Interface Design, Landay • SATIN: A Toolkit for Informal Ink-based Applications, Hong and Landay
	Tues Oct 22	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 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

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	Thur Oct 24	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 • Paper with a variant of the four-camera technique discussed in class	Assignments: • Undergrads: Homework #3 DUE! • Undergrads: Homework #4 out
11	Tues Oct 29	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 the original toolglass system • A VIDEO on tape drawing, and digital tape drawing	Readings: • Toolglasses and Magic Lenses: The See-Through Interface, Bier, Stone, Pier, Buxton, DeRose
	Thur Oct 31	**No class today!**		
12	Tues 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	
	Thur Nov 7	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
13	Tues 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: • JavaSpeech API • FreeTTS	Readings: • Designing Speech Acts: Issues in Speech User Interfaces, Yankelovich, Levow, and Marx
	Thur Nov 14	Ubiquitous Computing and Vision-Based Interfaces • Ubicomp and the third	Slides: Ubicomp and Computer Vision • PPT • PDF	Readings: • A Design Tool for Camera-Based Interaction, Fails and Olsen

		wave of computing • Envisionment videos • Video as a natural data type • Kinect and Wiimote • Off-the-desktop interaction	Supplemental Readings: • Java Media Framework (for video input/playback and basic video processing) • VIPER vision toolkit • OpenCV vision toolkit	Assignments: • Undergrads: Homework #4 DUE! • Undergrads: Homework #5 out
14	Tues Nov 19	**Grad Project Demos (Project Milestone 3)**		Assignments: • Grads: project implementations due BEFORE the start of class (9:35AM) for ALL TEAMS.
	Thur Nov 21	**Grad Project Demos (Project Milestone 3)**		
15	Tues Nov 26	**Grad Project Demos (Project Milestone 3)**		
	Thur Nov 28	**Thanksgiving!**		
16	Tues Dec 3	**Undergrad Project Demos (Optional; extra credit)**		Assignments: • Grads: final writeup due TONIGHT at 11:55PM
	Thur Dec 5	**Exam Preview/Q&A Session/Course Feedback**		Assignments: • Undergrads: Homework #5 DUE
Finals	Date TBD	**FINAL EXAM: Date and Time TBD Location: In our normal classroom.**		