Designing User Interfaces

G22.2280-001
Overview
Me

• Professor Logan Poelman
• You can call me:
  – Logan
  – Mr. Poelman (pronounced like Pole – man)
  – Professor
  – Professor Poelman
Why are you here?

• Interested in understanding the art & science behind designing **usable** user interfaces

• Interested in the Web UIs or Java Swing UIs

• Want to learn something that you can apply in other courses, disciplines or vocations.

• Other?
What you can do …

• Please **attend** each and every lecture.
• Please be **prepared** for each lecture.
• Please get to lecture **on time**. That means be seated and ready to go by 7:05 PM
• To understand how to get the most out of this class see that section on the class web site.
• If you have **special needs** that can be accommodated to help you learn better in this course please let me know by sending me an email detailing your needs AND introduce yourself to me after class to let me know who your are.
• I’d like to learn the **names** of as many of you as I can. I’ll need your help to do that.
Caveats

- This course requires fluency in spoken and written English greater than most CS courses.
- This course is very open ended – you will not be told every step of every exercise
- You must:
  - Use your own judgment
  - Prioritize tasks
  - Take initiative
  - Work in teams and as individuals
  - Determine / create your own solutions
  - Invent, innovate and experiment
Course Description
(from the class site)

• Theory and practice GUIs
• Understanding the processes …
• Topics:
  – General design principles
  – General design process
  – Widget choice
  – Application design
  – Layout
  – Desktop UI
  – Web design
• Assignments … Java SWING based UIs … Web UIs …
• Discussion …
  – different UIs, different level users, Internationalization
  – GUI vs. non-graphical based UIs
  – Desktop, Web, Dedicated hardware, …
Course Description

• A course devoted to understanding the design of User Interfaces (UI).
• Primarily focused on Graphical User Interfaces (GUI).
• Design Process – a process to create a UI from idea to working prototype. Methods and techniques to facilitate the steps in the process.
• Design Tools – Paper, pens, whiteboards, wordprocessors and GUI/HTML editors.
• Design Components - understand the choices of layout, widgets, navigation, typefaces, images, colors, …
• Understand via the hands on design of several UIs.
Course Goals

• Learning to **think** about what constitutes a good UI and a bad UI
• Learning **techniques** to develop a good UI
• Understanding the **similarities and differences** between UI “platforms” i.e. desktop, web browser, PDA, kiosk, VRU, phone, dedicated console, …
• Difference between **Engineering** and **Design**
Not Course Goals

• Not to teach graphic design/graphic arts
• Not to teach you Java or HTML
• Not to teach a specific platform
• Not to concentrate only on desktop GUIs, web GUIs or even GUIs alone. Instead a bit of each and others.
# Course Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
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<tr>
<td>Jan 26th</td>
<td>1.) What is a UI?</td>
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<td>Feb 2nd</td>
<td>2.) A process - Design vs. implementation</td>
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<td>Feb 9th</td>
<td>3.) UI Widgets &amp; Input Devices</td>
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<td>Feb 16th</td>
<td>President's Day - NO LECTURE</td>
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<td>Feb 23th</td>
<td>4) <strong>ACTIVITY</strong> IN CLASS: Collaborative Design Session - Please Attend. Bring your observation &amp; interviews.</td>
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<td>Mar 1st</td>
<td>5.) Swing Programming Intro</td>
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<td>Mar 8th</td>
<td>6.) What makes a good, bad or great UI? Why the Mac, Win, KDE all stink. Flow &amp; Csikszentmihalyi Layout &amp; Organizational structures</td>
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<td>9.) App Design 2a &amp; Midterm Exam Review</td>
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<td>10.) Project constraints</td>
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<td>11.) Design technique</td>
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<td>12.) Site Critiques Alternative UI devices</td>
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<td>May 3th</td>
<td>13.) Site Critiques Alternative UI devices</td>
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<td>May 10th</td>
<td><strong>FINAL EXAM</strong></td>
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Misc Class Info

• Office Hours
  – 6-7pm Mondays 4th Floor Warren Weaver Hall Room 401

• Class Web Page
  – check it every week
  – Suggest checking Monday before class
  – http://cs.nyu.edu/courses/spring04/G22.2280-001/index.htm

• Class mailing list
  – http://www.cs.nyu.edu/mailman/listinfo/g22_2280_001_sp04
  – Subscribe
  – Read email daily
  – Use it

• You need a CIMS account or equivalent
  – email csgrad@cs.nyu.edu to request a new account.
Weather, etc.

• “In the event of inclement weather or other conditions that could affect NYU classes, scheduled events and work hours, you may learn whether the University will be open or closed by checking www.nyu.edu or calling 212-998-1220 at anytime for a recorded message.”

• Interwise – class via the internet
TAs

• <<TBD>>

• TA office hours will be posted by second week of class on the class website.
Reading Assignments

• There are three **required** texts:

• **Optional** but recommended:

• You will be assigned reading assignments each week. You are expected to complete the readings **before** the next lecture.

• Readings will be part of the material for the **homework** and the **exams**.

• Several copies of the books will be place on reserve in the CIMS library.

• All should be available through www.amazon.com or the bookstore.

• **Amazon links:**
Activities

• In class we will do a number of activities that students will be expected to participate in. The participation in the activities is voluntary but the lessons learned and content will be part of the material for the tests.

• Possible activities we will do in class include:
  – Focus Groups
  – Observations and Interviews
  – Collaborative Design Sessions (JAD)
  – Site Review & Critique – Play the game of “Trash the designer”
  – Developing Mockups
  – Developing 1st cut prototypes
  – Refining prototypes (SWING & Web GUIs)
Course Grades

• Homework – 30%
• Midterm – 30%
• Final – 40%
Grading Policy

• 1000 Total points
• 7 Homework Assignments (300 points total)
• 2 Exams (300 + 400 = 700 points)
  – Midterm (300 points)
    • open book
    • 2 hours
    • Multiple choice and short answer
  – Final (400 points)
    • open book
    • 2 hours
    • Multiple choice and short answer
    • comprehensive
Grading Policy (cont)

Homework + Midterm Final

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Total Points

• **Initial Grading Curve:**
  – ≥ 900 → A
  – ≥ 800 → B
  – ≥ 700 → C
  – ≤ 650 → F

• Most of you should get A’s or B’s!
Homework

• Homeworks – still to be finalized. The content of which may include:
  – Field Observations
  – Gathering requirements, analyzing, designing and implementing designing
  – Task Analysis
  – Peer Project Reviews
  – Prototyping - Using paper, drawing programs, Java Swing IDE tools and HTML editing tools
  – Site reviews and critiques
  – Usability analysis
Project Tracks

• Electronic Voting System
• Online Course Scheduling System
• Electronic Book
• Airport Reservation System – self checkin, online support, ordering
• Computer Intelligence Piloted Automobile Navigation System – a car that drives itself
• Online City Government System
• Grid Computing Computer Graphical OS UI
• <<TBD>>
Homework Assignments

• 1 + 5 Homework Assignments
  – (0 + 6*60 = 300 points total)
  – Homework 0 is worth 0 points
  – Homeworks 1 – 5 are each 60 points

• Based on real world problems when possible.
• Submitted via email when appropriate.
• Will require you doing some field research.
• You will be required to draw using paper, pencil and/or drawing programs.
• You are not expected to be Artists but neatness is important.
• They will be posted on the day they are assigned. (I will send a class email to notify you when they are posted.)
Homework is due:

• Most will be submitted, via email to your TAs.
• If to be submitted via EMAIL - Due before 5PM the day it is due. After that timestamp its considered late.
• If to be handed in, must be in my mailbox by 5PM or handed to me at the start of class (7:05 PM).
• If handed in AFTER I START CLASS , its considered late!
• Due dates will vary. Check the website.
• See the website for points deducted if late.
• I will discuss each assignment at the end of the lecture it is assigned in.
• Having problems understanding the homework assignment:
  – Email the class.
  – Contact your TAs.
  – Contact me.
Homework #0

• You need to download the NetBeans IDE
• You need to install it
• You need to:
  – create a several a simple Java Swing GUIs
  – zip them up
  – Email them to the TAs
• You need to do this by Feb 2rd!
Resources

• Me
  – Via Office Hours, Email, Lecture

• The TAs
  – Via Office Hours, Email, Lecture
  – You will be assigned to a TA for grading purposes. You may contact either for help, though.

• The class website
  – http://cs.nyu.edu/courses/spring04/G22.2280-001
• Questions
• Comments

• 7.5
History of the GUI (briefly)
Definition of User Interface

• The mechanism by which a user interacts with a given system
• The mechanism that facilitates a user providing input to and/or receiving output from a system
• The point at which the combined user-system becomes the system and stops being the user. That surface that defines that boundary between the two.

<<add a strict definition>>
History of user interfaces

• First tools created by humanoids
  – Stone tools with no handles
  – Stone tools with handles

• Hunting tools
  – Spears, knives,

• Shelter

• Domesticated Animals

• Fire

• Farming
Communication Interfaces

• Communication
  – Gestures
  – Verbal Symbolic – Noises, Grunts
  – Visual Symbolic – Ideograms
  – Verbal Language - 170+ languages/dialects currently spoken
  – Written Language – 40,000+ characters in UNICODE
  • [http://www.unicode.org/charts/](http://www.unicode.org/charts/)
Communication Interfaces

• Persistent Information Storage
  – Stone & Clay Tablets – Sumerian ??
  – Papyrus – Greek – 500 BCE
  – Paper – China – 100 ACE
  – Punched Cards – 1890’s
  – Magnetic Core Memory - 1940
  – Floppy disk – 1970
  – CDROM - 1980
## Controls and Basic Latin

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**Image:** [The Unicode Standard 4.0, Copyright © 1991–2003, Unicode, Inc. All rights reserved.](http://www.unicode.org/charts/PDF/U0000.pdf)
Greek and Coptic

http://www.unicode.org/charts/PDF/U0370.pdf
Cyrillic

http://www.unicode.org/charts/PDF/U0400.pdf
Bengali, Arabic and Hebrew
What is being communicated by these two images? How?
Ideograms
## Letterlike Symbols

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Music Symbols
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# Symbols

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Computational Devices

• ??? - Abacus
• 1642 - Pascal’s adding machine
• 1670 - Liebnitz improves it (multiplication)
• 1800 - Jacquard Loom
  wooden boards that “program” the loom
• 1830 – Babage’s Difference Engine
  gears and levers
• 1890 - Hollerith Punched cards
UI Design Example

• Printing Press
• Movable Type - Gutenberg
• Typewriter
  – Invented by Mill – 1714
  – Remington 1873 (Sholes, Glidden & Soule’)
  – QWERTY – designed to limit speed of typing
  – Dvorak alternative layout
  – No real difference between good typist using QWERTY vs. Dvorak layouts
  – IBM Selectric – replaceable typeface balls
Modern Computers

• Punched Cards & Electronic Tabulating Machines – 1890 – IBM

• Howard Aiken – 1940’s
  – 1st digital
  – Punched paper tape

• Mauchley and Eckert – 1946
  – ENIAC – Electronic Numerical Integrator and Computer
  – Hardwired computer

Modern Computer UIs

• Punched cards – in/out
• Teletype, paper tape, print out
• CRT – command line interfaces
• Unix – 1969
  – Timesharing of the CPU
  – VI full screen character mode editor – Bill Joy of SUN fame – wrote it in a weekend
  – Emacs
  – X Windows (1980’s)
GUI

• Sketchpad
  – 1963
  – Sutherland at MIT
  – Light pen

• Doug Englbart at Stanford Research Institute
  – Started work in 1963
  – Windowed and used a mouse
  – Demoed 1968!

• http://sloan.stanford.edu/mousesite/MouseSitePg1.html
Alan Kay

- Conceived of FLEX 1967
  - Tablet, windows, icons, hires
  - Never implemented
  - (created Smalltalk & Kaypro Computer)

- Dynabook 1969
  - Modelessness
  - Overlapping window
  - Unimplemented
  - www.artmuseum.net/w2vr/overture/integration.html
Athena and X Windows

- MIT in 1968 – Project Athena – to get standard interface to various workstations.
- X developed in mid 80’s
- Device independent windowing system
- 1988 MIT release X11R2 to the public
- http://www.x.org/
- KDE & Gnome are based on it.
Xerox PARC (Palo Alto Research Center)

• Alto
  – 1972
  – Single User
  – Bitmapped Graphics
  – Mouse
  – WYSIWYG Editor – Bravo
  – 1 Meg removable HD
  – $7000 but never marketed
PARC

• Xerox STAR
  • 1\textsuperscript{st} commercial GUI based product
  • $18000!
• Windows, Icons, Mouse Pointer (WIMP) UI
  • Desktop and Office Metaphors
    – File Cabinet Icons
    – No direct manipulation (used menus)
• Unsuccessful in the market place
Apple in 1976 – Apple I
PC – Personal Computers

• MITS Altair 8800 – Toggle Switches, then keyboard, CRT and printer
• Apple II - 1977
• Commodore VIC / 64
• Sinclair / Timex ZX80
• TI99/4A
• IBM PC – 1981
  – 8 mHz, 320 Kbytes mem, dual floppy (no HD),
    80 x 40 characters by 4 colors (CGA)
Apple visits PARC

• 1979
• Steve Jobs and the Lisa team
• Apple gives stock to Xerox in exchange for allowing them access
• Several PARC employees leave and go to Apple
Microsoft visits PARC

• Bill Gates and others 1980
Apple Lisa

- Released Jan 1983 ($12,000!)
- Multitasking, 1 meg ram!
- Direct manipulation (dragging with mouse)
- Hires B&W graphics (800 x 600)
- One Button Mouse
- WIMP (Windows, Icons, Mouse, Pointing) Interface
- Unreliable hardware / OS
- Failed in marketplace
Apple Macintosh

- January 1984
- Simpler version of Lisa
- 128K Ram, single tasking
- Desktop metaphor UI
- Built in UI toolkit in ROM
- B&W display
- No multitasking (initially)!
- First successful WIMP machine
- Originally didn’t have the file system metaphor for storage (more a database metaphor) but pressured into a file system metaphor.
Commodore Amiga 1000/512/2000

• WIMP
• Multitasking
• 256K memory or greater
• 640 x 480 x 4096 color!
• 4 channel wave based audio
• Special audio and video graphics chips – graphic accelerator chip!
• Not very successful in the business marketplace
• 1985!
MS Windows

• V 1.0 1987
  – Tiled windows (no overlaps)
  – No multitasking, max 1 meg ram
  – Unusable

• V 2.0 - 1987
  – Still weak features, 286 chip support!

• V 3.x
  – Finally usable
  – Multitasks, Overlapped Windows, Somewhat Stable
  – DTP (Desktop Publishing) – PageMaker – Killer App

• “Windows 95” (V 4) - 1995
  – Vast improvement, now close to a Mac for features
Next

• Steve Jobs left Apple in 1985
• 1988 1st NextCube unveiled
• BSD 4.3 + Mach Kernal OS
• New window system not X
• Object Oriented UI (OOUI)
• 1000x1000 color resolution
• Rewritable Optical Drive (250 meg) removable NO HD! NO Floppy!
• Why is this relevant? (Hint: OS X)
PC GUI Timeline

1983 - Apple Lisa
1984 - Apple Mac
1985 - Amiga – multitasks, Color, Hi Res Video, Audio in 256K mem
1985 - Windows 1.x - Unusable – 1 meg address
1987 - Windows 2.x – Runs on a 286!
1988 - OS/2 – MS + IBM – Multitasks
1989 - System 7 for Mac
1989 - New Wave by HP
1989 - Steve Jobs leave apple forms Next
1990 - Windows 3.x - Finally somewhat usable
1992 - OS/2 Warp
1995 - Version 95
1993 - Win NT 3.1
1993 - NextStep 3.1 OS on Intel
1994 - Linux
1995 - Apple Newton released – Handheld Computer with handwriting recognition
1996 - Next is dead (or is it?)
1996 - Win NT 4.0
1998 - Win98
2002 - WinXP
Good sites for computing history

• The Smithsonian institution
  – http://www.si.edu/resource/faq/nmah/techhistory.htm

• Anthony J. Pennings, PhD - Marist College
  – http://www.academic.marist.edu/pennings/hyprhsty.htm

The Virtual Museum of Computing

http://vmoc.museophile.sbu.ac.uk/pioneers/
The Future

• Voice
• Tablet
• Writing
• Wearable Computers
  – Display
  – Waldos
• Avatars / Proxies
• 3D / 4D
• Virtual Reality
• RFID
• Thinking IF
• Questions
• Comments

• 8.0
What is UI Design?
Terms

• User Interface
• UI Design
• UI Architecture
• Information Architecture
• Application Architecture
• Navigation
• Widget
• Metaphor
• Idiom
• Model
UI – User Interface

• The devices and mechanisms that support the communication dialog between a user and the application / information / tool.

• The user issues requests via the UI and receives feedback from the application via the UI. The application can also make requests of the user through the UI and receive feedback through the UI.
What do we mean by design?

- Creating a User Interface that matches the users needs by providing a UI that allows the user to achieve their goals as efficiently as possible
  - Intuitiveness / predictability
  - Power
  - Safety - undo
  - Consistency
  - Ease of learning
  - Obvious - easily understood model of the system
  - Aesthetically pleasing
  - Support the appropriate level of user and their specific needs – expert vs. novice, occasional vs. frequent users
How?

• Use a process that is centered around the user
• Iterative testing of the UI by users along the way
• Application of Human Factors Research
• Application of design guidelines
• Observation, interviews, collaborative sessions & analysis
• Hands on experimentation
• Reviewing other existing software
• Architecture
Architectures

- Application Architecture =
  - Functionality
  - Usability
  - Presentation Layer Architecture –
    - UI Architecture
      - Look, Feel, Flow, Navigation, Mental Model
    - Information/functionality Architecture
      - How is information and functionality organized
    - Actual platform and devices that display the user interface to users.
- Business Logic Architecture –
  - Calculations & Manipulation related to the business needs
- Data Persistence Logic Architecture –
  - Files and Database (DB)
  - CRUD (Create Read Update Delete) – of data stored in memory and on disk
How do UIs come into being?

• Accidental / Repurposing
  – Rock becomes weapon
  – Lightning -> Fire -> Cooked Food & Heating the Cave
  – Cell phone has keypad, use cell phone keypad to send text messages by “triple keying”

• Evolution
  – Why 5 fingers not 3?
  – Why an opposable thumb?
  – URL - Why “www.xyz.com”?
  – Survival of the fittest / most useful mutations not the best and cleanest design

• Design
  – Intentionally creating a “surface”/interface to interact with
STP (Something To Ponder)

- Why does a telephone have a 3 x 4 keypad? 0-9 # *
- Why not 0 – 4?
- Why not 0 – 9 A – Z?
- Why is it different that the layout of a calculator?
- Why do I have a phone, cell, email, pager, mail number/address?
  - Could I just have a **locator id** that was delivery **modality** sensitive?

- [http://www.howstuffworks.com/question641.htm](http://www.howstuffworks.com/question641.htm)
Why is a phone number in the US 7 digits?

• ### - ### - ####
  – Area code – Prefix – Line

• **Area code** – geographic area

• **Prefix** - a specific switch in the phone companies central switching station

• **Line** - your line in that switch

• **What is the “1” that I dial before the area code?**
  
  • There are 680 usable area codes in the United States, of which 215 are currently in use. Each area code has 7,920,000 telephone numbers (out of a possible $10^7$) available within it. Some numbers, such as those that would start with 0,1 or 911, are unavailable for use.

  • Others, like the area code “555”, which is used for fake phone numbers in movies and on TV, are reserved for special use.
What’s your opinion of the design?

• VI the editor – Good or Bad?
• Macintosh OS X
• MS Windows XP OS
• X Windows
• The CS department web site
• MS Word
• MS PowerPoint
• MS Excel
UI Concerns

• 1st word is User
  – Goals of the user
  – General user characteristics
    • Expertise – novice, user, expert, admin
    • Child, Adolescent, Adult, Senior, with Disabilities
    • Physical – age, physical facility (sight, hearing, …)
    • “attention span”
  – Frequency of usage
  – Tolerance of a learning curve
  – State of the art for software of that category (genre)
UI Concerns

• 2nd is *Interface*
  – The *boundary* between the user and the tool (application)
  – Facilitates the users *interaction* with the tool
  – The users “view” of the tool
  – Allows the user to *communicate* with the tool and the tool to communicate with the user
  – The efficiency, accuracy and power of that *communication*
Users Create a Mental Model

• How they believe the system will behave if they do certain things to it (prediction).
• A good system UI lets them accurately predict what will happen.
• Allows them to intuit how to do the tasks they need to accomplish their goals.
• The mental model DOES NOT have to match the implementation model to be effective.
Thermostat

• Many people don’t understand that if a room is at 70 degrees and you change the setting of the thermostat it will not get warm faster if you set it to 75 versus setting it to 80 degrees.

• Their mental model doesn’t match the physical (implementation) model of the system.

• They can predict that the room will get warmer but not how quickly.
Elevator Buttons

• Even if the button is already lit they will press it, maybe they think it will come faster?
• The elevator is already coming and isn’t going to speed up just because you’re impatient.
• They can’t predict that pressing it again has no effect.
Mental Model is used to make decisions on how to accomplish a task with the UI
Address

• To send a letter do you really need anything but the name, street and ZIP+4?

• Why do we enter all that info then?
• http://www.usps.com/zip4/zipfaq.htm
User Interface Maxims

- UI design is **not easy**
- UI design is **not common sense**
- Different user types need different UI features and maybe even designs!
- A GUI is NOT always better than a text UI.
- UI Design without feedback from **real users** will always produce an inferior design.
- UI programming can easily be **50%+** of the effort on a programming project
- Most developers are really **bad** at creating UIs
- Developers minds work differently than software users. The way they organize information mentally is not the way most non-developers think (that’s why not everybody is good at software development).
• Questions
• Comments

• 8.5
What you need for this class

• A machine running Windows, linux + X or Mac
• NetBeans or some IDE
• 500 mHz PIII or better
• 512 meg ram (256 is ok but may be slow)
• 500 meg disk space
• Color monitor + mouse
Homework #0

• Zero points but you still must do it
• Download NetBeans IDE (or some other SWING Designer IDE) and install it
  – Create 2 simple SWING based GUIs
• Zip up the GUIs and send them to your TA
• Download and install IE, Mozilla, Safari, and/or Opera Browsers (pick two or more for your platform)
• Subscribe to the class mailing list
Installing NetBeans

- [www.netbeans.org](http://www.netbeans.org)
- Latest Version ONLY!
- Supported on Windows, Linux and the Mac
- You can use other IDEs but the TAs and myself can only offer limited help with other editors.
- It MUST support Java 1.4 and Swing
- Ex:
  - JBuilder from Borland
  - Dreamweaver by Macromedia
Using NetBeans

- Create a directory on your root that is called UIHomework
- Mount it in netbeans.
- Create a set of subdirectories: Homework0, Homework1, …, Homework6
Create an Application
New >> Java GUI Forms >> Sample Forms >> Application

Choose Template:
- Java GUI Forms
  - JApplet
  - JDialog
  - JFrame
  - JInternalFrame
  - JPanel
  - Bean Form
  - AWT Forms
  - Sample Forms
    - Application

Template Description:
This template consists of a skeleton JFrame-based application, including three menus.
Call it “MyFirstSwingApp” in Homework0
Just click “next” until “Finish”
What you might see
To execute press the green triangle.
What you get if you run it.
The go back and create a JDialog called “MyFirstSwingDialog”
Then go to the layout and right click. Then select the absolute layout manager.
Using the Swing tab of widgets, place these into the dialog

• Add a JLabel
• Add a JButton
• Add a JTextBox
Should look like this
Change the title by editing the properties of the dialog. “My First Swing Dialog”
Executing it you should get …

![My First Swing Dialog](image.png)
Submitting your homework.

• The zip up your Homework0 directory and send it to your TA along with your full name and SID4 (last 4 of your SID) in the email.

• The TAs emails will be posted on the website.

• Due before lecture Feb 2\textsuperscript{nd} at 5PM!
NetBeans & Swing books

• Recommended:
  – “NetBeans: The Definitive Guide” by Tim Boudreau, Jesse Glick, Simeon Greene, Jack Woehr, Vaughn Spurlin
    – O’Reily - ISBN: 0596002807