SECTION 2:
HW3 Setup

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slides borrowed and adapted from Alex Mariakis and CSE 390a
DEVELOPER TOOLS

- Remote access
- Eclipse and Java versions
- Version Control
VERSION CONTROL
WHAT IS VERSION CONTROL?

- Also known as source control/revision control
- System for tracking changes to code
  - Software for developing software
- Essential for managing projects
  - See a history of changes
  - Revert back to an older version
  - Merge changes from multiple sources
- We’ll be talking about git/GitLab, but there are alternatives
  - Subversion, Mercurial, CVS
  - Email, Dropbox, USB sticks (don’t even think of doing this)
VERSION CONTROL ORGANIZATION

● A *repository* stores the master copy of the project
  ○ Someone creates the repo for a new project
  ○ Then nobody touches this copy directly
  ○ Lives on a server everyone can access

● Each person *clones* her own *working copy*
  ○ Makes a local copy of the repo
  ○ You’ll always work off of this copy
  ○ The version control system syncs the repo and working copy (with your help)
REPOSITORY

● Can create the repository anywhere
  ○ Can be on the same computer that you’re going to work on, which might be ok for a personal project where you just want rollback protection

● But, usually you want the repository to be robust:
  ○ On a computer that’s up and running 24/7
    ■ Everyone always has access to the project
  ○ On a computer that has a redundant file system
    ■ No more worries about that hard disk crash wiping away your project!

● We’ll use CSE GitLab – very similar to GitHub but tied to CSE accounts and authentication
VERSION CONTROL
COMMON ACTIONS

Most common commands:

● add / commit / push
  ○ integrate changes from your working copy into the repository

● pull
  ○ integrate changes into your working copy from the repository
VERSION CONTROL
UPDATING FILES

In a bit more detail:

- You make some local changes, test them, etc., then…
- `git add` – tell git which changed files you want to save in repo
- `git commit` – save all files you’ve “add”ed in the local repo copy as an identifiable update
- `git push` – synchronize with the GitLab repo by pushing local committed changes
Other common commands:

- `add`, `rm`
  - add or delete a file in the working copy
  - just putting a new file in your working copy does not add it to the repo!
  - still need to commit to make permanent
THIS QUARTER

- We distribute starter code by adding it to your GitLab repo. You retrieve it with `git clone` the first time then `git pull` for later assignments.
- You will write code using Eclipse.
- You turn in your files by adding them to the repo, committing your changes, and eventually pushing accumulated changes to GitLab.
- You “turn in” an assignment by tagging your repo and pushing the tag to GitLab.
- You will validate your homework by SSHing onto attu, cloning your repo, and running an Ant build file.
331 VERSION CONTROL

create/push

Repository

pull

Working copy

Working copy for grading

clone/pull

commit/push

add
ECLIPSE
WHAT IS ECLIPSE?

- Integrated development environment (IDE)

- Allows for software development from start to finish
  - Type code with syntax highlighting, warnings, etc.
  - Run code straight through or with breakpoints (debug)
  - Break code

- Mainly used for Java
  - Supports C, C++, JavaScript, PHP, Python, Ruby, etc.

- Alternatives
  - NetBeans, Visual Studio, IntelliJIDEA
# Eclipse Shortcuts

<table>
<thead>
<tr>
<th>Shortcut</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl + D</td>
<td>Delete an entire line</td>
</tr>
<tr>
<td>Alt + Shift + R</td>
<td>Refactor (rename)</td>
</tr>
<tr>
<td>Ctrl + Shift + O</td>
<td>Clean up imports</td>
</tr>
<tr>
<td>Ctrl + /</td>
<td>Toggle comment</td>
</tr>
<tr>
<td>Ctrl + Shift + F</td>
<td>Make my code look nice 😊</td>
</tr>
</tbody>
</table>
ECLIPSE and Java

- Get Java 8

- Important: Java separates compile and execution, eg:
  - `javac Example.java` produces `Example.class`
  - Both compile and execute have to be the same Java!

- Please use Eclipse 4.5 (Mars), “Eclipse for Java Developers”

ECLIPSE and Java

.java files
- Human readable ‘code’ file

.class files
- Compiled version of .java files. Typically represented as Byte code to run on the Java Virtual Machine (JVM)

.jar files
- Packaged aggregate of .class files and metadata
331 VERSION CONTROL

- Your main repository is on GitLab

- Only clone once (unless you’re working in a lot of places)

- Don’t forget to add/commit/push files!

- Check in your work!
HW 3

- Many small exercises to get you used to version control and tools and a Java refresher


- Committing changes: **Instructions**
  - How you turn in your assignments

- Updating changes: **Instructions**
  - How you retrieve new assignments
Turning in HW3

- **Instructions**

- Done by simply committing your changes
  - Good to do this early and often
  - Then when you’re done, create a *hw3-final* tag on the last commit and push the tag to the repo

- After the final commit and tag pushed, remember to log on to attu and run **ant validate**
Ant Validate

- What will this do?
  - You start with a freshly cloned copy of your repo and do “git checkout hw3-final” to switch to the files you intend for us to grade, then run ant validate
  - Makes sure you have all the **required** files
  - Make sure your homework builds without errors
  - Passes specification and implementation tests in the repository

  **Note**: this does not include the additional tests we will use when grading
  - This is just a sanity check that your current tests pass
Ant Validate

- How do you run ant validate?
  - Has to be done on attu from the command line since that is the environment your grading will be done on
  - Do not use the Eclipse ant validate build tool!
  - Be sure to use a fresh copy of your repo, and discard that copy when you’re done
    - If you need to fix things, do it in your primary working copy (eclipse)
Ant Validate

● How do you run ant validate?
  ○ Steps
    ■ Log into attu via SSH
    ■ In attu, checkout a brand new local copy (clone) of your repository through the command-line
    ● **Note:** Now, you have two local copies of your repository, one on your computer through Eclipse and one in attu
    ■ Go to the hw folder which you want to validate through the ‘cd’ command, then switch to the hw3 tag
    ● For example: cd ~/cse331/src/hw3
    git checkout hw3-final
    ■ Run ant validate
Ant Validate

- How do you know it works?
  - If successful, will output **Build Successful** at the bottom
  
  - If unsuccessful, will output **Build Failed** at the bottom with information on why
  
  - If ant validate failed, discard the validate copy of the repo on attu, fix and commit changes through eclipse, go back to attu, clone a fresh copy of the repo, and try ant validate again
ECLIPSE DEBUGGING (if time)

● System.out.println() works for debugging…
  ○ It’s quick
  ○ It’s dirty
  ○ Everyone knows how to do it
● …but there are drawbacks
  ○ What if I’m printing something that’s null?
  ○ What if I want to look at something that can’t easily be printed (e.g., what does my binary search tree look like now)?
● Eclipse’s debugger is powerful…if you know how to use it
ECLIPSE DEBUGGING
Double click in the grey area to the left of your code to set a breakpoint. A breakpoint is a line that the Java VM will stop at during normal execution of your program, and wait for action from you.
Click the Bug icon to run in Debug mode. Otherwise your program won’t stop at your breakpoints.
Controlling your program while debugging is done with these buttons.
ECLIPSE DEBUGGING

Play, pause, stop work just like you’d expect
Step Into

Steps into the method at the current execution point – if possible. If not possible then just proceeds to the next execution point.

If there’s multiple methods at the current execution point step into the first one to be executed.
ECLIPSE DEBUGGING

Step Over

Steps over any method calls at the current execution point.

Theoretically program proceeds just to the next line.

BUT, if you have any breakpoints set that would be hit in the method(s) you stepped over, execution will stop at those points instead.
ECLIPSE DEBUGGING

Step Out

Allows method to finish and brings you up to the point where that method was called.

Useful if you accidentally step into Java internals (more on how to avoid this next).

Just like with step over though you may hit a breakpoint in the remainder of the method, and then you’ll stop at that point.
Enable/disable step filters

There’s a lot of code you don’t want to enter when debugging, internals of Java, internals of JUnit, etc.

You can skip these by configuring step filters.

Checked items are skipped.
**ECLIPSE DEBUGGING**

Stack Trace

Shows what methods have been called to get you to current point where program is stopped.

You can click on different method names to navigate to that spot in the code without losing your current spot.
ECLIPSE DEBUGGING

Variables Window

Shows all variables, including method parameters, local variables, and class variables, that are in scope at the current execution spot. Updates when you change positions in the stackframe. You can expand objects to see child member values. There’s a simple value printed, but clicking on an item will fill the box below the list with a pretty format.

Some values are in the form of ObjectName (id=x), this can be used to tell if two variables are referring to the same object.
Variables that have changed since the last break point are highlighted in yellow.

You can change variables right from this window by double clicking the row entry in the Value tab.
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ECLIPSE DEBUGGING

There’s a powerful right-click menu.

- See all references to a given variable
- See all instances of the variable’s class
- Add watch statements for that variable’s value (more later)
Show Logical Structure

Expands out list items so it's as if each list item were a field (and continues down for any children list items)
Breakpoints Window

Shows all existing breakpoints in the code, along with their conditions and a variety of options.

Double clicking a breakpoint will take you to its spot in the code.
**ECLIPSE DEBUGGING**

**Enabled/Disabled Breakpoints**

Breakpoints can be temporarily disabled by clicking the checkbox next to the breakpoint. This means it won’t stop program execution until re-enabled.

This is useful if you want to hold off testing one thing, but don’t want to completely forget about that breakpoint.
**Hit count**

Breakpoints can be set to occur less-frequently by supplying a hit count of $n$.

When this is specified, only each $n$-th time that breakpoint is hit will code execution stop.
Conditional Breakpoints

Breakpoints can have conditions. This means the breakpoint will only be triggered when a condition you supply is true. **This is very useful** for when your code only breaks on some inputs!

Watch out though, it can make your code debug very slowly, especially if there’s an error in your breakpoint.
Disable All Breakpoints

You can disable all breakpoints temporarily. This is useful if you’ve identified a bug in the middle of a run but want to let the rest of the run finish normally.

Don’t forget to re-enable breakpoints when you want to use them again.

ECLIPSE DEBUGGING
ECLIPSE DEBUGGING

Break on Java Exception

Eclipse can break whenever a specific exception is thrown. This can be useful to trace an exception that is being "translated" by library code.
Expressions Window

Used to show the results of custom expressions you provide, and can change any time.

Not shown by default but highly recommended.
Expressions Window

Used to show the results of custom expressions you provide, and can change any time.

Resolves variables, allows method calls, even arbitrary statements “2+2”

Beware method calls that mutate program state – e.g. stk1.clear() or in.nextLine() – these take effect immediately.
ECLIPSE DEBUGGING

Expressions Window

These persist across projects, so clear out old ones as necessary.
ECLIPSE DEBUGGING

● The debugger is awesome, but not perfect
  ○ Not well-suited for time-dependent code
  ○ Recursion can get messy

● Technically, we talked about a “breakpoint debugger”
  ○ Allows you to stop execution and examine variables
  ○ Useful for stepping through and visualizing code
  ○ There are other approaches to debugging that don’t involve a debugger