Objectives

- Introduction to Java
- Introduction to Version Control

1

Review

- What questions should you ask to determine if some state should be a local, instance, or class variable?
- What are some Unix commands? What task do they do? How do you use them?

2

INTRODUCTION TO JAVA

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What is Java?

… and, why should I learn it?

- From Sun Microsystems
  - 1995, James Gosling and Patrick Naughton
  - Specifications
- Object-oriented
- Rich and **large** library
- Develop cross-platform applications
  - Web, desktop, embedded
- Widely used
  - Frameworks to enable easier development

http://www.tiobe.com/tiobe-index/

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What is Java?

- Java Programming Language
- Java Virtual Machine
- Java Class Libraries

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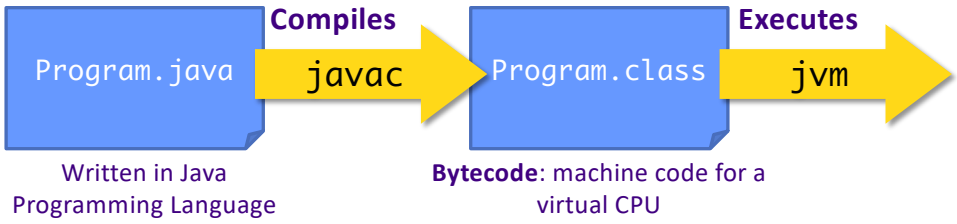
Overview: Compiling, Executing Java Programs



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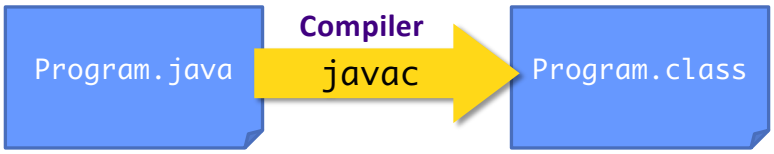
Compiling Java Programs

Step 1:



Written in Java Programming Language

Bytecode: machine code for a virtual CPU

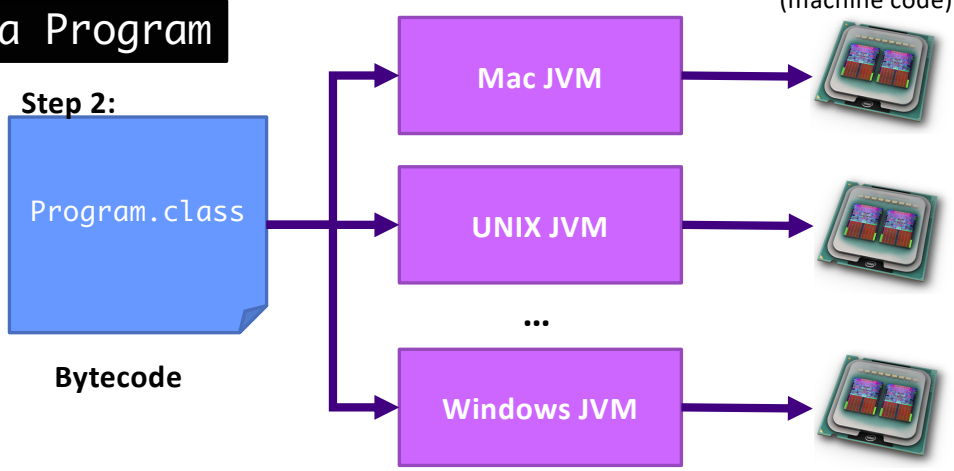
```
javac Program.java
```

- Compiler catches some errors
- Need to fix those errors and recompile

Executing Java Programs

```
java Program
```

Step 2:



- Same **bytecode** is executed on each platform
- Don't need to provide the source code

Java Virtual Machine (JVM)

- Emulates the CPU
  - Usually specified in software (rather than hardware)
- Executes the program's ***bytecode***
  - Bytecode: virtual machine code
- JVMs available for each Java-supported platform
  - Enables program *portability*
- HotSpot VM
  - Code dynamically compiled to machine code
- Garbage Collection

Traditional (C/C++) Program Execution

- Example: I use my Mac-specific compiler to compile program into a Mac-specific executable
- Limitation: Executable is not portable

How does Java's approach affect distribution of software?

2 - How does software being Java-based affect its distribution?

Makes it harder because you have to install a JVM on every machine	A
Makes it more secure because you don't provide the source code	B
Makes it easier because same bytecode can be run on multiple platforms	C
Makes it easier because many machines already have Java installed	D
None of the above	E

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Traditional (C/C++) Program Execution

- Example: I use my Mac-specific compiler to compile program into a Mac-specific executable
- Limitation: Executable is not portable to any OS

What is Python's approach?
How are (I) Java and (II) the traditional approach the same and different from Python's approach?

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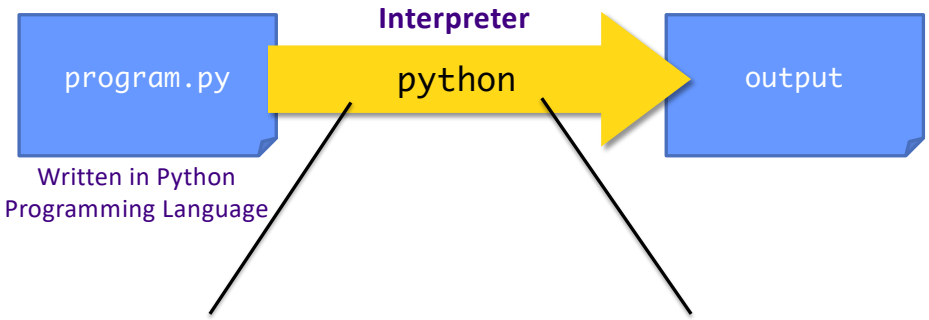
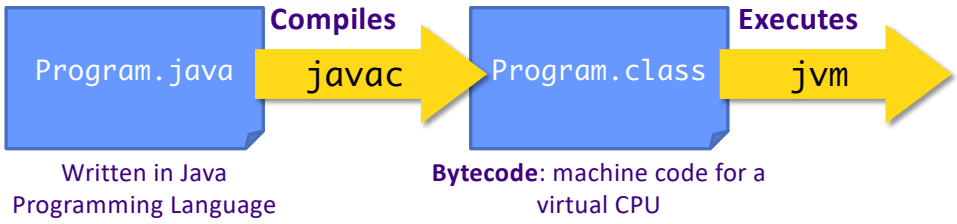
Executing Python Programs



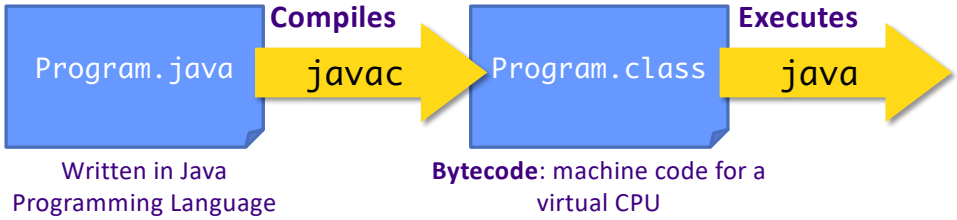
1. Syntax validation
   - exit if not valid
2. Translate Python code to Python bytecode
   - Bytecode stored in __pycache__ directory
3. Python virtual machine execute Python bytecode

Overview: Compiling, Executing Java Programs



JDK: Java Development Kit

- Contains
  - `javac`: Java compiler
  - `java`: Java Virtual Machine
  - Java class libraries



Java Class Libraries

- Pre-defined classes
  - Included with Java Development Kit (JDK) and Java Runtime Environment (JRE)
  - View the available classes online:

https://docs.oracle.com/en/java/javase/18/docs/api/index.html

- Similar in purpose to *modules* available for Python

What is Java?

- Java Programming Language
- Java Class Libraries

} What this course is about

- Java Virtual Machine
  - Use the JVM but won't learn about how it works
  - For more information on JVM:
    http://docs.oracle.com/javase/specs/

Bringing It Together: Benefits of Java

- Rapid development of programs
  - Large library of classes, including GUIs, Enterprise-level applications, Web applications
- Portability
  - Run program on multiple platforms without recompiling
- Compiled
  - Find some errors before execution!
    - Statically typed
  - Can give performance boost by doing optimizations

VERSION CONTROL: GIT

Motivating Version Control

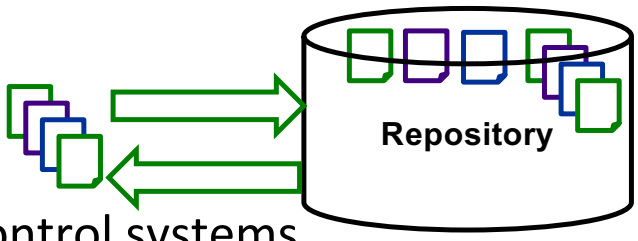
- Do you name your documents like the following?
  - Paper-final.pdf
  - Paper-final2.pdf
  - Paper-final_real.pdf
  - Paper-FINAL-final.pdf
- Do you sometimes break your code so badly and really want to go back to a previous state?
- Do you forget why you made a code change?
- Do you want to just try something out and, if it doesn't work, revert back?

Motivating Version Control: Collaboration

- How do you share documents with teammates?
  - Emailing with conflicting updates?
  - Google Docs/Box Notes → not meant for code
  - Merging contributions
  - Who has the *real* version of the documents?

Version Control Systems Can Help!

- Main idea: ***repository*** holds the code and all changes to it
  - Need to push and pull code to and from the repository



- Centralized version control systems
  - E.g., CVS, Subversion, …
- Distributed version control systems
  - E.g., Git, Mercurial, …

Git & GitHub

- We're going to use Git
  - Distributed version control system
- Our repositories will be hosted by GitHub
  - How you'll get code from me
  - How you'll submit assignments

GitHub's Octocat

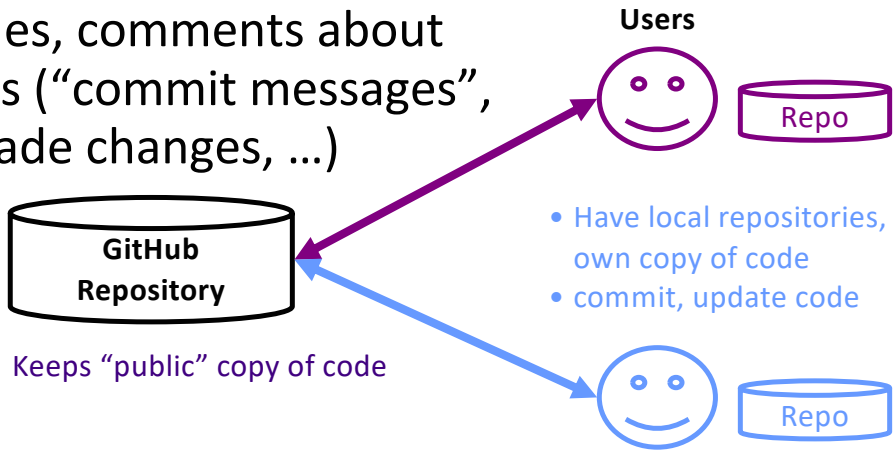
Common Git Commands

Command	What it does
clone	Clones a repository – sets up your repository so that you can coordinate
add <*file*>	Adds the *file* to the staging area
commit	Commits all the staged files (locally)
push	Push all your changes to the remote → You need your code to be pushed so that I can see it.
branch	List all local branches
branch <*name*>	Creates a new branch named *name*
checkout <*name*>	Switches to the branch named *name*

https://xkcd.com/1597/

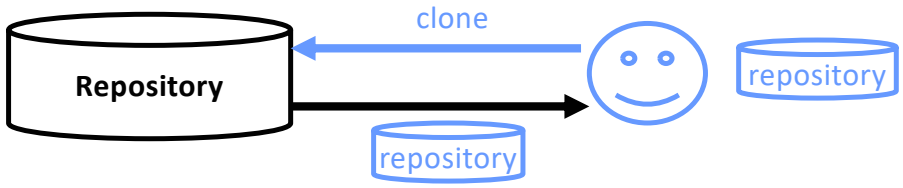
Using Git

- Git is a *distributed* VCS
- ***Repositories*** store all versions of all files, comments about changes ("commit messages", who made changes, …)



Using Version Control: `clone`

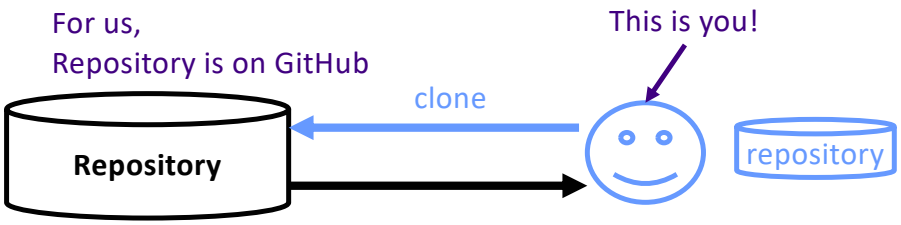
- Our typical workflow: first, **clone** the repository




```
git clone url_of_repository
```

Using Version Control: `clone`

- Our typical workflow: first, **clone** the repository



Using Version Control: `commit`

- After you make changes that you want to document, **commit** your version
  - Include comments about changes you made and ***why***

- Updates each modified file
- Records comments with updated files

```
git commit
```

Using Version Control: `add, delete`

- You need to **add** and **delete** files and directories to the *staging area*, then **commit**

- Marks the files that will be part of the next commit
- When you commit, these files are added to your local repository

- Add, delete files and directories

```
git add myfile
```


Using Version Control: Commit Messages

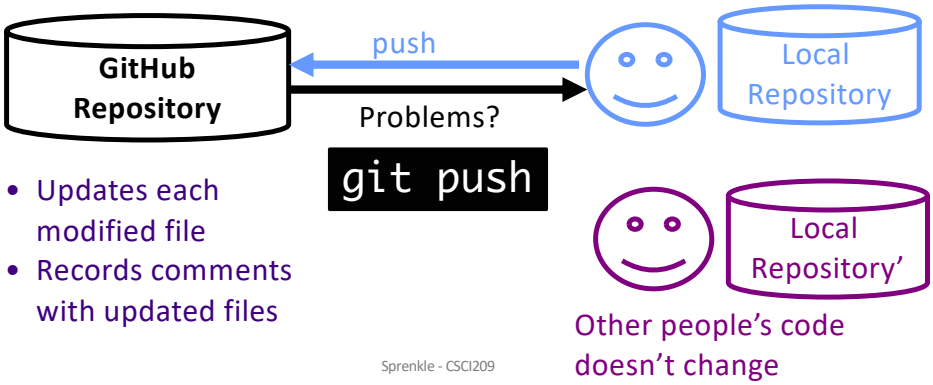
- Many different conventions
- Make your messages meaningful and descriptive
  - Emphasis on the *why*
  - Your future self and contributors will thank you
  - Especially as you move to bigger projects with more collaborators

When Should I Commit?

- Depends – up to you
- Every time you get the next "thing" working
- Every time you fix a bug
- Best practice:
  - Don't wait until you're completely done an assignment before committing

Using Version Control: **push**

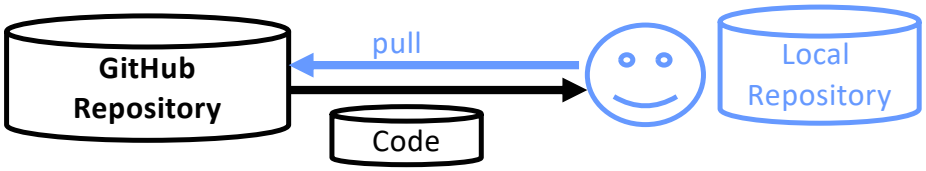
- After you make changes that you want others (at first, that's just me) to see, **push** your version
  - Sends your previous commits and associated comments



- Updates each modified file
- Records comments with updated files

Using Version Control: `pull`

- To see the *current* version of the code in the remote repository, **pull**
  - Resolve conflicts (more on this later this term)




```
git pull
```


Using Git: Branches

- We create branches when we want to create a new "sandbox" to play in for …
  - New functionality
  - Bug fixes
  - Different approach

Why the Command Line?

- Because you *should* know it
  - Alumni feedback
- It can make your development process quicker
  - After you get used to it
- Because you look so badass using it

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Got it?
Let's practice!

https://xkcd.com/1597/

Looking Ahead

- Rest of today: working on Git Lab
  - Due Monday before class
  - In general, reload your assignments in the browser when you return to them
    - I may have updated based on student questions