CS134 Lecture 34: Wrapping Up

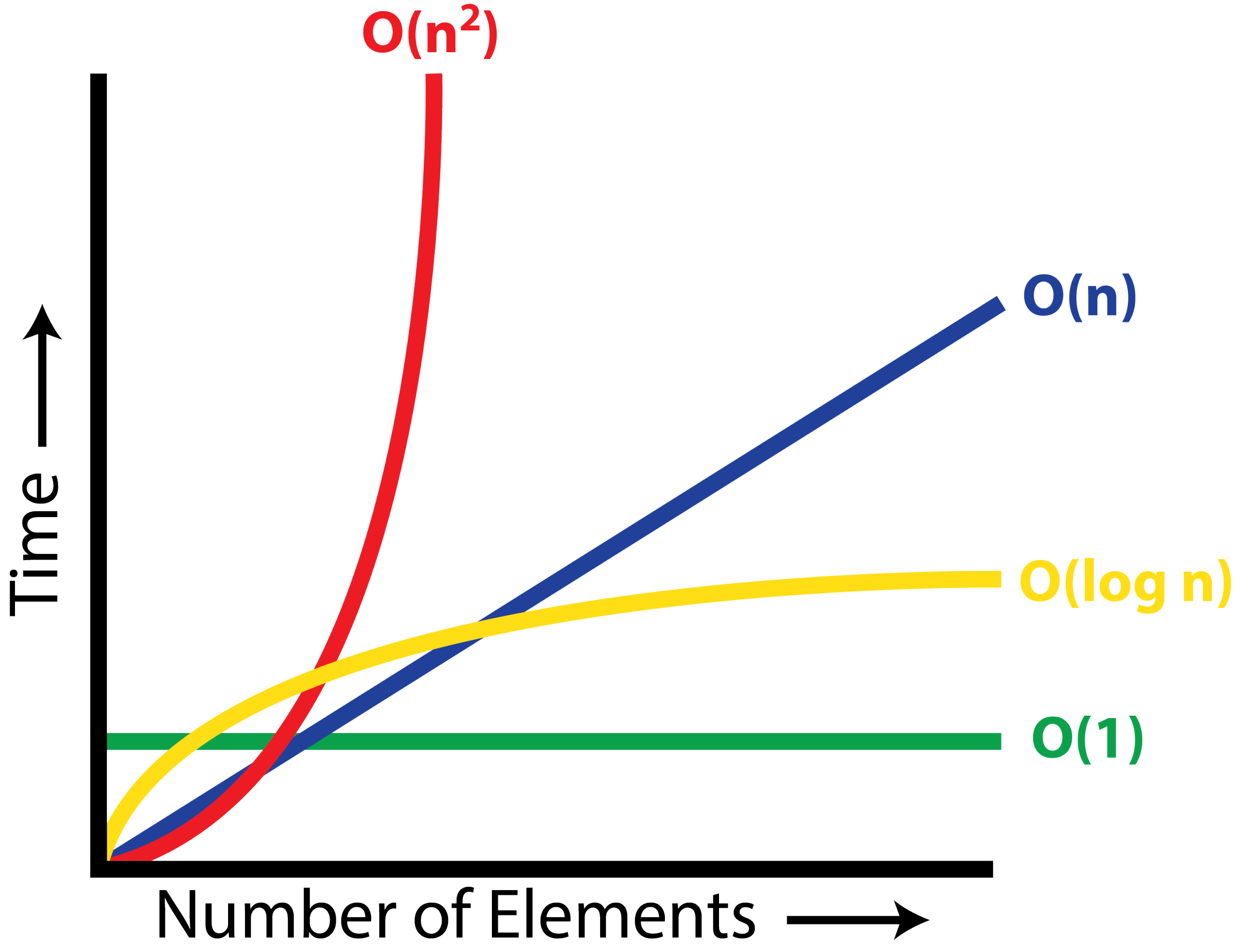
Announcements & Logistics

- **Lab 10** due Wed/Thus at 10 pm
- CS134 Scheduled Final: **Friday, May 17, 9:30 AM**
  - Room: **TCL 123 (all sections)**
- CS134 Review Session before Finals:
  - **Wednesday, May 15, 4:30-5:30 PM**
  - Room: **TCL 123**

Do You Have Any Questions?

Last Time: Sorting Wrap Up

- Discussed efficiency of selection and merge sort
  - You implemented and compared wall-clock time in Lab 10
- If you take CS136, you will see these algorithms and concepts again



Today and Friday

- Today we will wrap up the course (first 30 mins):
    - Overview of what we learned
    - Concepts vs programming language: discuss high level differences between Python vs Java, and why your CS134 skills will translate
    - How to do more CS stuff on your own/at Williams
- Last 15 or so mins: course evaluations
- Friday's class plan:
    - Jeopardy style review session!!
    - Form teams with your classmates and come up with team names!
    - CS has a long tradition of bad puns and obscure references...

CS134 in a Nutshell

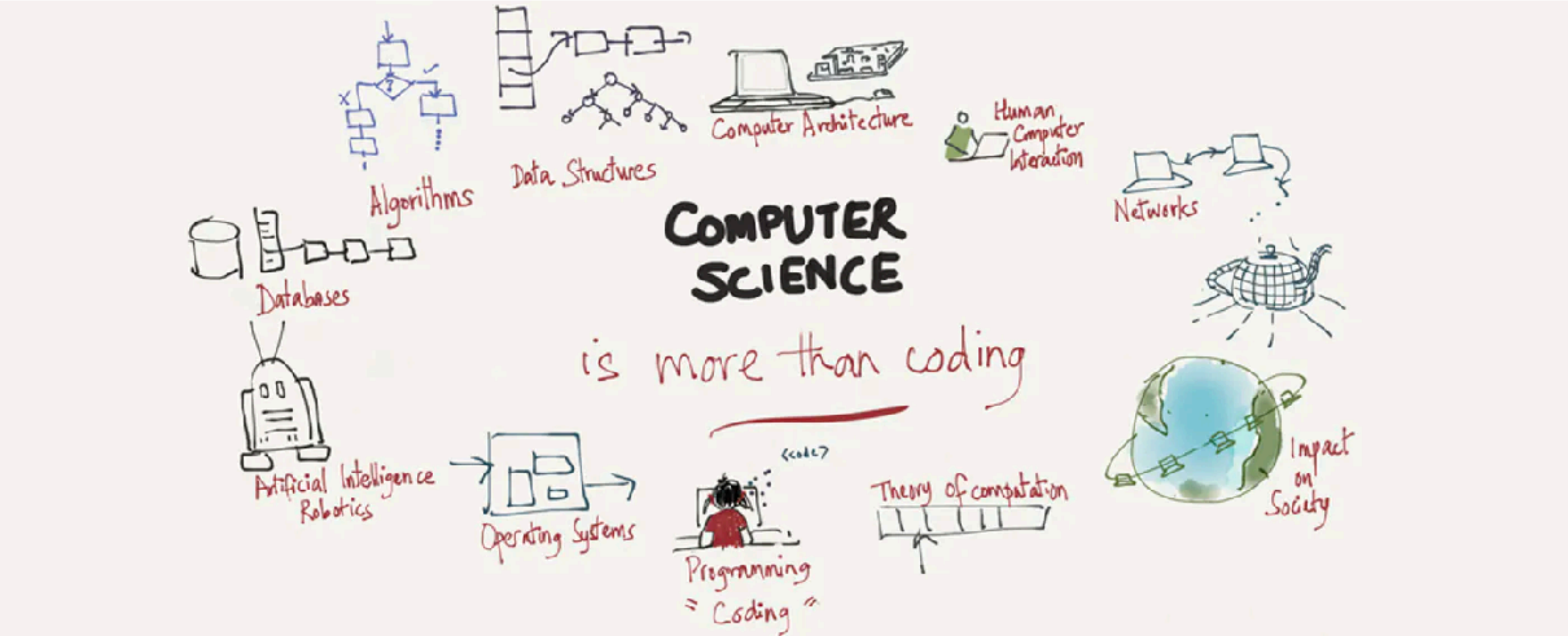
- We have covered many topics this semester!
- We started out learning the basics of programming, and we used python as our medium to explore these building blocks
- **Pre-midterm**
  - **Types & Operators** (int, float, %, //, /, concatenation, etc)
  - **Functions** (variable scope, return vs print, defining vs calling functions)
  - **Booleans and conditionals** (if elif else, >, <, ==, not, and, or)
  - **Iteration**: for loops, while loops, nested loops, accumulation variables in loops
  - **Sequences**: strings (operators, in/not in, iteration, etc) , lists (operators, indexing, slicing, etc), ranges, tuples, lists of lists
  - **Mutability** and **aliasing**
  - **Built-in python data structures**: lists, tuples and sets

CS134 in a Nutshell

- Then we moved on to more advanced CS topics
- **Post-midterm**
  - **New data structure**: dictionaries
  - **File reading**: with open(…) as, processing file lines in a loop
  - **Recursion**: recursive methods and classes
    - **Graphical recursion** with **turtle** graphics library
  - **Classes, Objects, and OOP**
    - attributes, special methods, getters, setters, inheritance
    - "Bigger" OOP Examples: Autocomplete, Tic Tac Toe, Boggle
    - Special methods as well as sorted() with optional key argument
  - **Advanced topics**:
    - Efficiency (Big-O), Linked Lists, Searching and sorting

Takeaway: What is Computer Science?

- Computer science ≠ computer programming!
- Computer science is the study of what computers [can] do; programming is the practice of making computers do useful things
- Programming is a big part of computer science, but **there is much more to CS** than just writing programs!
- A big part of CS (and CS134) is computational thinking



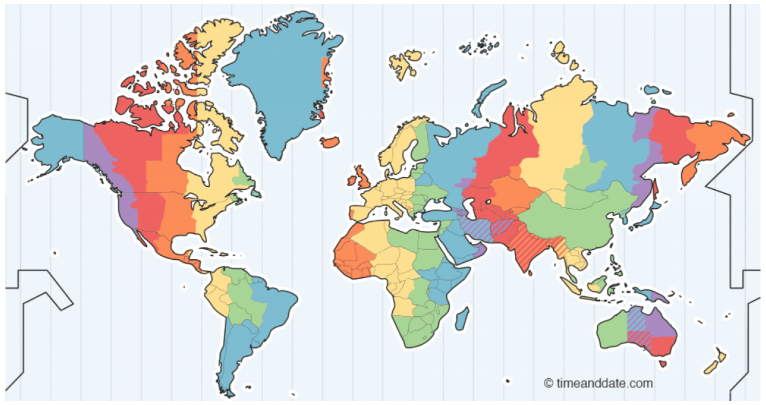
https://www.edsurge.com/news/2015-12-02-computer-science-goes-beyond-coding

Biggest Takeaway: Computational Thinking

- Computational thinking allows us to develop solutions for complex problems. We present these solutions such that a computer, a human, or both, can understand.
- Four pillars of CT:
  - **Decomposition** - break down a complex problem into smaller parts
  - **Pattern recognition** – look for similarities among and within problems
  - **Abstraction** – focus on important information only, ignore irrelevant details
  - **Algorithms** - develop a step-by-step solution to the problem
- A computer can performs billion of operations per second, but computers only do exactly what you tell them to do!
- In this course we ~~will learn~~ **learned** how to 1) use CT to develop algorithms for solving problems, and 2) implement our algorithms through computer programs

CS134 Labs: Practice with Computational Thinking

- Labs were designed to make look at real life **commonplace** processes through a computational lens



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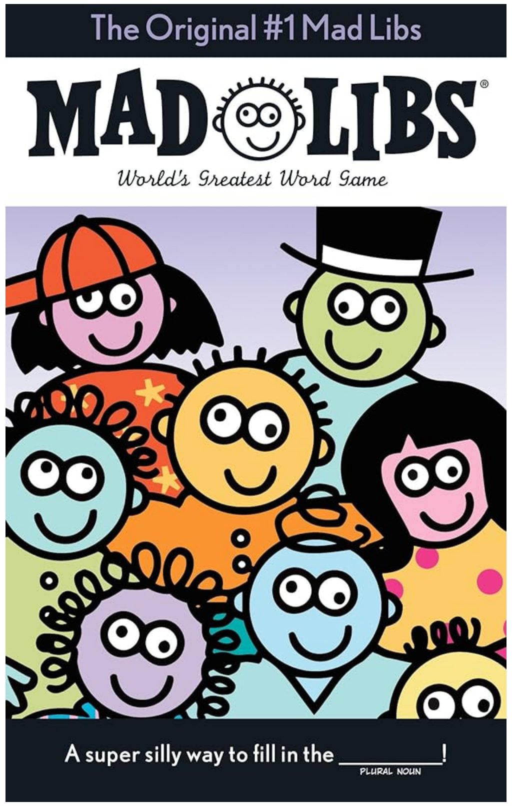
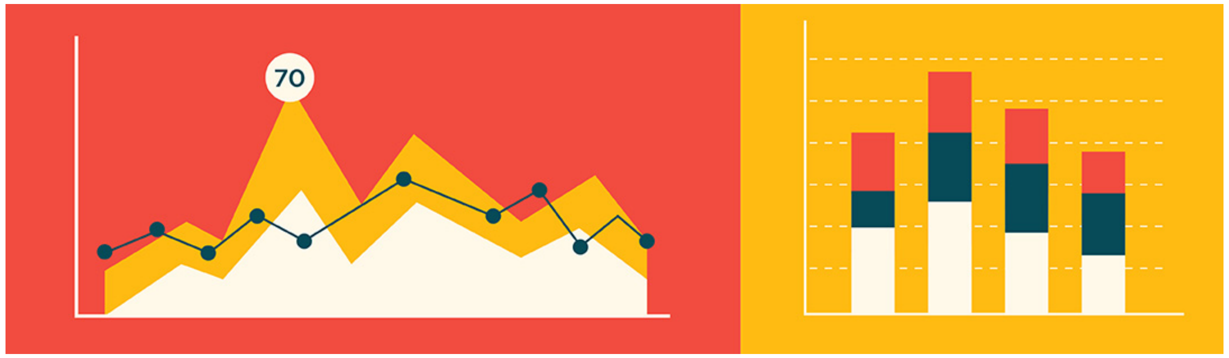
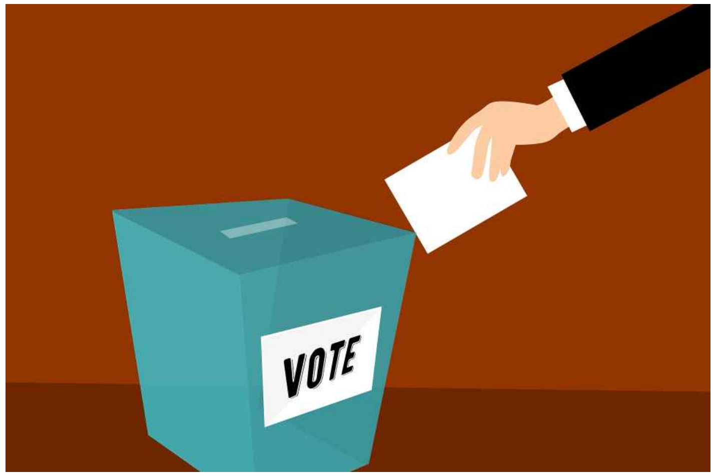
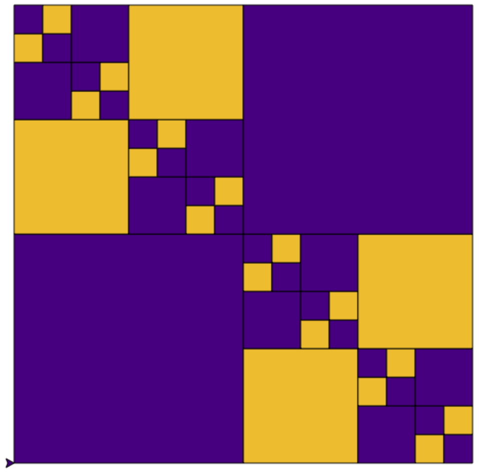

The Original #1 Mad Libs
MAD LIBS
World's Greatest Word Game
A super silly way to fill in the ________!
PLURAL NOUN







These Concepts Carry Over

- We used Python as a way to practice fundamentals of CS
    - Decomposition, Pattern recognition, Abstraction and Algorithms
- Programming languages just give us a way to express our logic
    - If the language changes, this expression changes (syntax)
    - But the outline of the solution (the logical steps) stay the same!
- Adapting to a new language is just a matter of getting familiar with its syntax, main structure and quirks
- Let's discuss this through high level comparison of Python vs Java

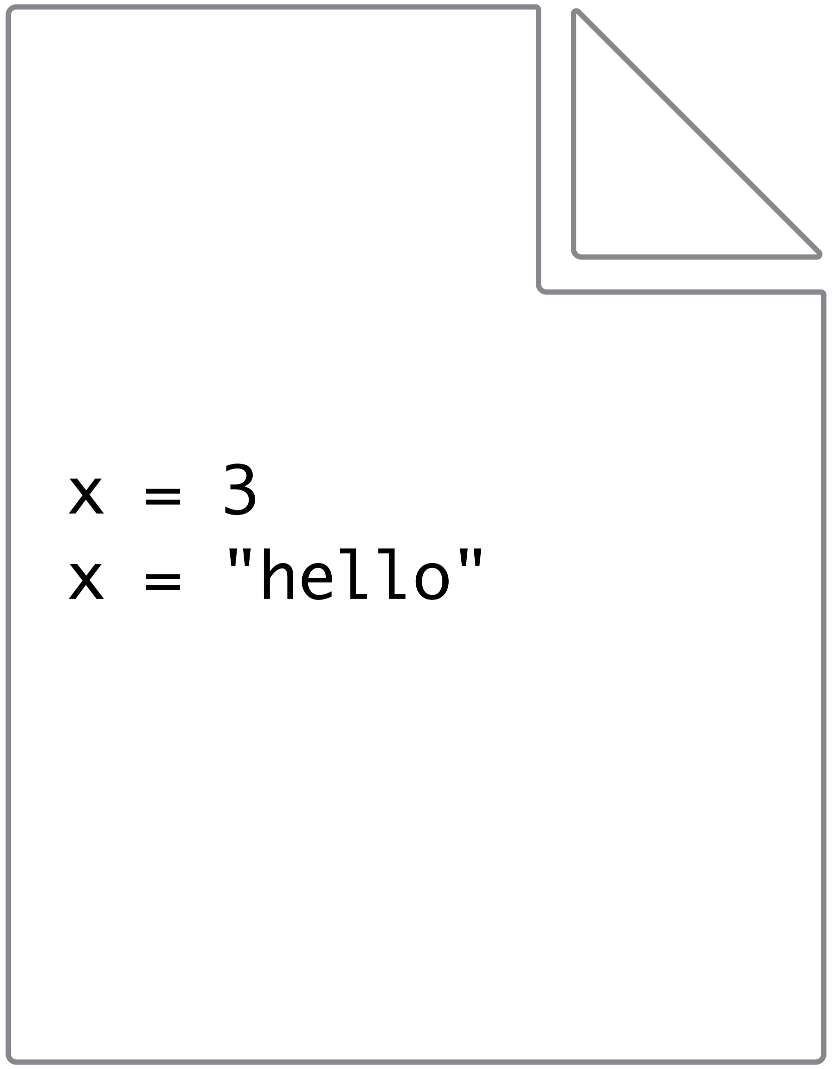
Java AND Python both share …

- Both languages support similar building blocks
  - Loops and conditionals (if/else, for loops and while loops)
  - Built-in data types for numbers, booleans, strings, arrays/lists
  - Classes and OOP
  - Function frame model and scope
  - Recursion
  - …

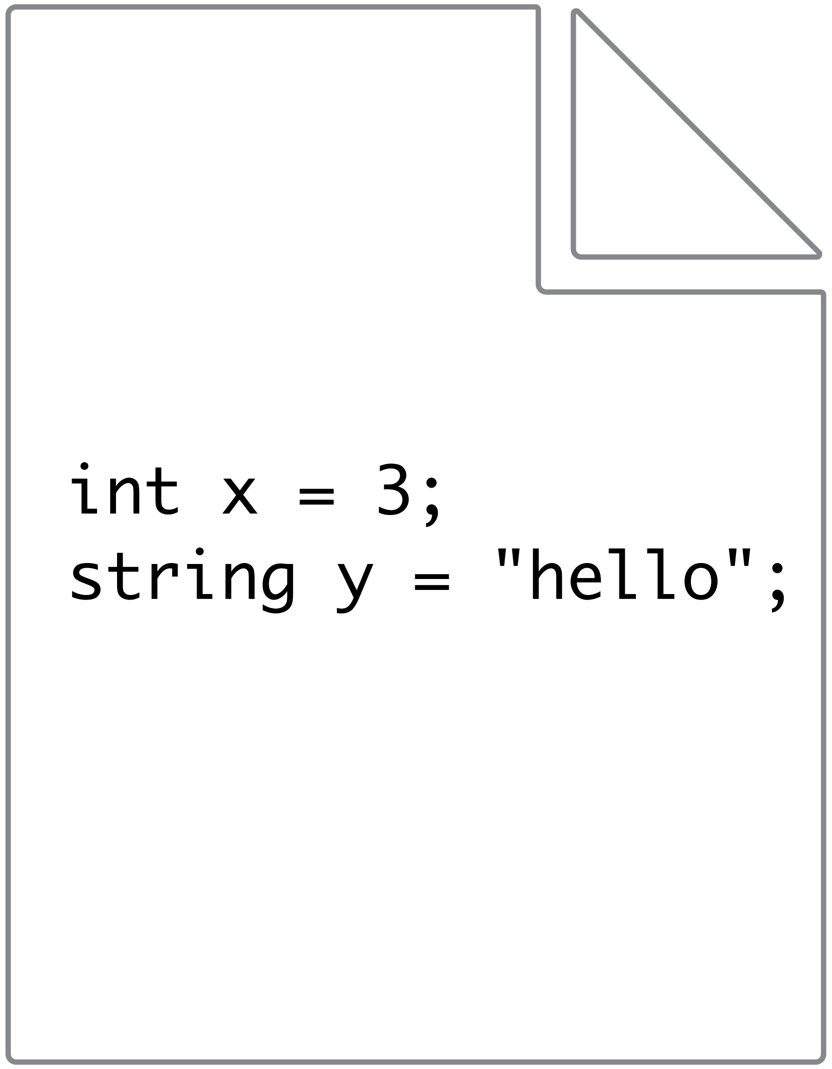
The ideas we learned in Python carry over to Java, we just need to learn how to express them using new syntax!

Unlike Python, Java is ...

- Java is a statically typed language
  - In Java, each variable must specify a type which *cannot be changed*
  - In Python, types are not specified, and a variable's type can change



```
x = 3
x = "hello"
```



```
int x = 3;
string y = "hello";
```

Pros and Cons of Strict Typing

- **Python** is a "Loosey goosey" (technical term: **loosely typed**) language
  - Why good? Makes it easy to get started, less cumbersome / overhead
  - Why bad? Can lead to unexpected runtime errors, Python tries to "overcorrect" type issues whenever possible leading to unexpected behavior
- **Java** is a **strongly-typed** language: all variable types need to be declared at initialization and cannot change types
  - Why good? Can catch most type errors during compilation!
  - Why bad? Makes the code more verbose/requires more "boilerplate"

Example: Python's Loose Types

- Confusingly, Python tries to fix "type mismatches" by doing bizarre things
- Does this look familiar?

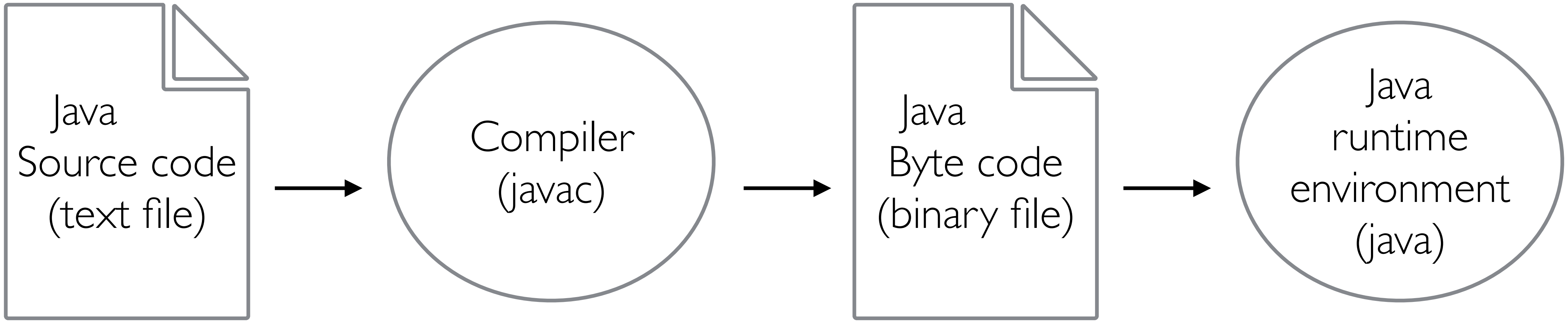
```
>>> word1 = ["hello"]
>>> word2 = "world"

>>> word1 += word2  # calls.append secretly
>>> print(word1)

['hello', 'w', 'o', 'r', 'l', 'd']
```

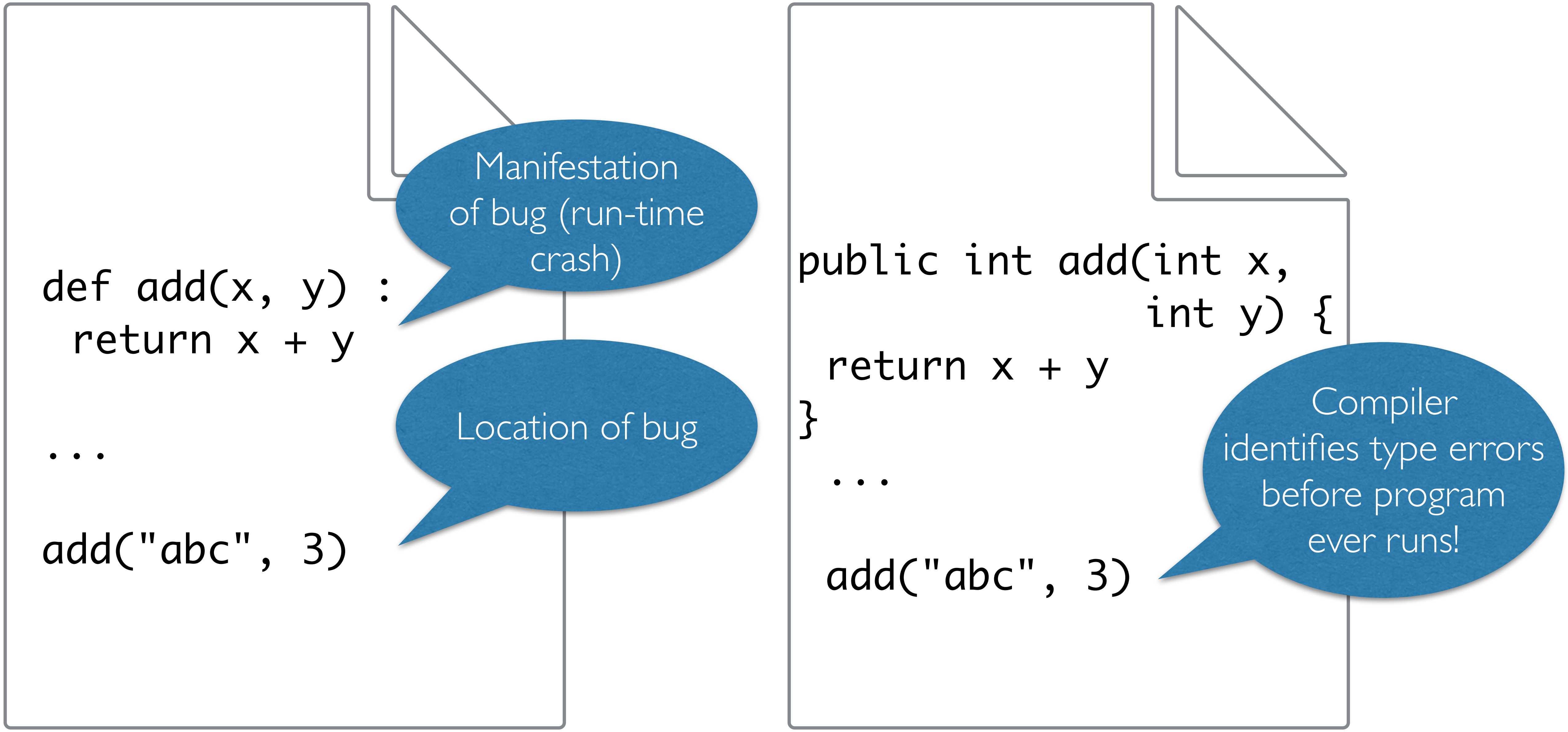
Unlike Python, Java is ...

- Java is (in many senses) a compiled language
  - Java code you write is translated into bytecode
  - Bytecode is run in a Java virtual machine
    - There is no REPL (no equivalent of interactive python)
    - The Java virtual machine runs all the code in the "main method"



Compiling Can Be Helpful

- One consequence of the compiler is that certain type of errors can be found at *compile time*
  - This is almost like a round of debugging before there are even any bugs!



```
def add(x, y) :
  return x + y

...

add("abc", 3)
```

Manifestation of bug (run-time crash)

Location of bug

```
public int add(int x,
                int y) {
  return x + y
}
  ...

  add("abc", 3)
```

Compiler identifies type errors before program ever runs!

Python vs. Java

Python

- Powerful language used by many programmers
- Designed for making common programming tasks simple
- Good for new programmers, and for scientific computing

Java

- Powerful language used by many programmers
- Designed for building large-scale systems design
- Good fit for large, scalable reliable software projects

Neither language is "better" than the other. They are each useful for different things.

Python vs Java: Hello World

- Python has low overhead to get started
- Java has more overhead upfront (but we'll see why in CSCI 136)

```
# hello.py

print("Hello, World!")
```

```
# Hello.java

public class Hello {
    public static void main(String args[]) {
          System.out.println("Hello,
      World!");
    }
}
```

Python vs Java: Running Our Code

- **Python** is an **interpreted** language: ***interpreter*** runs through the code line by line and executes each line: this can also be done interactively!
- **Java** is a **compiled** language: code must be compiled first (converted to machine code) before it is executed

```
# hello.py

print("Hello, World!")
```

```
% python3 hello-simple.py
Hello, World!
```

```
% python3
>>> print("Hello World!")
Hello World!
```

```
# Hello.java

public class Hello {
    public static void main(String args[]) {
         System.out.println("Hello,
     World!");
    }
}
```

```
% javac Hello.java
% java Hello
Hello, World!
```

What's Next?

- If this is the last CS course you take, you can use Python to solve real problems!
  - A good way to practice is to use Python to accomplish interesting tasks (hobbies, course projects, ...)
- If you take CSCI 136, you will learn to write code that is reusable, maintainable, and scalable
  - More open-ended assignments that focus on design
  - Build your own data structures and learn to identify which data structure is the most appropriate for a given problem
  - Build on Big-Oh discussion and add mathematical rigor

What's Next?

- If you liked coming up with your own algorithms and you enjoyed the "puzzle" aspects of labs, CS 256 is for you!
    - How to: apply different algorithmic paradigms and prove that algorithms are correct and efficient
- If you're curious how computers work, how data is represented in memory, how software and hardware interface, CS 237 is for you!
    - How to: optimize the practical parts of your program, get the most out of your physical computing resources, become a "hacker"
- If you enjoyed the process of learning python and want to better understand the design choices of the language itself, CS 334 is for you!
    - How to: program in different language paradigms and pick the best language for the job (or design your own!)

Takeaways

- You all should be proud of how much you've learned!
- Computer Science is all about breaking down the problem and figuring out how to put the pieces together
  - This problem-solving mindset transcends languages/ majors, and will help you throughout your life!
- **Thank you** for your patience and enthusiasm throughout the course

WE MADE IT!

Course Evals Logistics

- Two parts: **(1) SCS form**, **(2) Blue sheets** (both online)
- Your feedback helps us improve the course and shape the CS curriculum
  - Your responses are **confidential** and we only receive anonymized comments after we submit our grades
  - We appreciate your constructive feedback
- **SCS forms** are used for evaluation, **blue sheets are open-ended** comments directed only to your instructor

To access the online evaluations, log into ***Glow*** *(glow.williams.edu) using your regular Williams username and password (the same ones you use for your Williams email account). On your Glow dashboard you'll see a course called "****Course Evaluations****." Click on this and then follow the instructions you see on the screen. If you have trouble finding the evaluation, you can ask a neighbor for help or reach out to ir@williams.edu.*

Beyond CS134

- For those interested in continuing on the CS path:
    - Take CS136 or MATH 200
    - Practice Java over summer break: redo CS134 labs in Java
- In general, if you enjoy puzzles and programming, you can practice these skills on your own:
    - Project Euler (Math + CS puzzles)
    - LeetCode (Coding Interview Prep, Python/Java examples)
    - MIT online course: The Missing Semester of Your CS Education
- CS courses as non-majors: can still take CS136, Math 200 etc, winter study courses (Video games, Lida's winter study, etc)