Introductions to:

- Each other
- Object-Oriented Programming (OOP)
- Java

CSSE 220—Object-Oriented Software Development

Rose-Hulman Institute of Technology

Daily Quizzes

- I expect you can answer every question.
- Stop me if I don’t cover a question!

Q1, Q2

Roll Call, Introductions

- Tell me what you prefer to be called
- For introductions give:
  - Name
  - Major
  - Hometown
  - Something about yourself that we might not guess

Feel free to interrupt during class discussions

- Even with statements like, “I have no idea what you were just talking about.”
- We want to be polite, but in this room learning trumps politeness.
- I do not intend for classroom discussions to go over your head. Don't let them!

- Throughout:
  Ask, evaluate, respond, comment!

Acrobat Games: An introduction to object-oriented design

- We need 11 volunteers
  - BasicAcrobat x 3
  - ProudAcrobat x 2
  - DoublingAcrobat
  - AcrobatWithBuddy x 2
  - Choreographer x 2
  - Curmudgeon
- Instructor:
  - Write the 6 types on the whiteboard
  - Beside each type, write the names of the actors for that type
  - Announce instructions per the next slide

This exercise is adapted from Joe Bergin's page at http://cis.pace.edu/~bergin/Java/RolePlay.html that describes an idea presented by Steven K. Andrianoff and David B. Levine at SIGCSE-2002

Each volunteer gets:
- White sheet with instructions for how to behave
- Yellow sheet (blank): scratch pad
- Red sheets (blank): for returning data

Acrobat Games (continued)

The instructor announces these commands (using students' names or *basicAcrobat1*, etc). When paper returns to the instructor after a *count* command, she will announce what is on the paper.

```
basicAcrobat1.clap(2);
basicAcrobat2.twirl(1);
basicAcrobat1.twirl(2);
basicAcrobat1.count();
basicAcrobat3.count();
basicAcrobat3.sing();

proudAcrobat1.clap(3);
proudAcrobat2.twirl(1);
proudAcrobat1.bow();

curmudgeon.twirl(3);
curmudgeon.clap(3);

acrobatWithBuddy1.clap(4);
acrobatWithBuddy1.clap(2);
acrobatWithBuddy1.twirl(1);
acrobatWithBuddy1.nameBuddy();

acrobatWithBuddy2.nameBuddy();
acrobatWithBuddy2.clap(3);
acrobatWithBuddy2.jump(4);
acrobatWithBuddy2.count();

acrobatWithBuddy1.twirl(1);
acrobatWithBuddy1.nameBuddy();
acrobatWithBuddy2.nameBuddy();

doublingAcrobat.clap(3);
doublingAcrobat.count();
doublingAcrobat.twirl(100);
                          // just kidding!
choreographer1.clap(3);
choreographer1.clap(3);
choreographer2.clap(2);
choreographer1.count();

basicAcrobat1.count();
```

Acrobat Games (continued)

- Consider the following command:
  - `acrobatWithBuddy1.clap(2);`
- When
  - acrobatWithBuddy1's buddy is acrobatWithBuddy2
  - acrobatWithBuddy2's buddy is acrobatWithBuddy1
- When
  - acrobatWithBuddy1's buddy is herself

Instructions for the actors

- The next six slides give the instructions that tell each actor how to behave.
- There is a single set of instructions for each type of actor:
  - BasicAcrobat
  - ProudAcrobat
  - DoublingAcrobat
  - AcrobatWithBuddy
  - Choreographer
  - Curmudgeon

You are a BasicAcrobat

When you are asked to:

- ***clap***, you will be given a number.
  Clap your hands that many times.
- ***twirl***, you will be given a number.
  Turn completely around that many times.
- ***count***, write on a piece of paper how many actions (claps and twirls) you have performed so far.
  - For example, after **clap 2** and **twirl 1** you would write 3 on the paper.

  Give that paper to the person who asked you to count.

If you are asked to do anything else, say (as dramatically as you can)
"I refuse"

You are a ProudAcrobat

When you are asked to:

- ***clap***, you will be given a number. Clap your hands that many times. Say "Thank you." Then take a bow (as dramatically as you like).
- ***twirl***, you will be given a number. Turn completely around that many times. Say "Thank you." Then take a bow (as dramatically as you like).
- ***count***, write on a piece of paper how many actions (claps and twirls) you have performed so far.
  - For example, after **clap 2** and **twirl 1** you would write 3 on the paper.

  Give that paper to the person who asked you to count. Say "Thank you." Then take a bow (as dramatically as you like).
- ***bow***, say "Thank you." Then take a bow (as dramatically as you like).

If you are asked to do anything else, say (as dramatically as you can) "I refuse"

You are a DoublingAcrobat

When you are asked to:

- ***clap***, you will be given a number.
  Clap your hands ***twice*** that many times.
  - For example, if you are told to **clap 3** then you should clap 6 times
- ***twirl***, you will be given a number.
  Turn completely around ***twice*** that many times.
  - For example, if you are told to **twirl 2** then you should twirl 4 times
- ***count***, write on a piece of paper how many actions (claps and twirls) you have performed so far.
  - For example, after **twirl 2** and **clap 3** you would have twirled 4 times and clapped 6 times, so you would write 10 on the paper

  Give that paper to the person who asked you to count.

If you are asked to do anything else, say (as dramatically as you can) "I refuse"

You are an AcrobatWithBuddy

When you are given this card, before we start the role play, you should (mentally) choose another actor (anyone except a Curmudgeon) to be your Buddy. That person will be your Buddy for the rest of the exercise

When you are asked to:

- ***clap***, you will be given a number. Clap your hands that many times. Then pass that same instruction to your Buddy.
- ***twirl***, you will be given a number. Turn completely around that many times. Then pass that same instruction to your Buddy.
- ***count***, first ask your Buddy to count. Your Buddy should then give you a piece of paper with a number written on it. Add that number to the number of actions (claps and twirls) you have performed so far, and write that sum on your own piece of paper.
  - For example, after **clap 2** and **twirl 1** your own count would be 3. So if your Buddy gives you a piece of paper with (say) 7 written on it, write 10 on your own piece of paper.

  Then give your own piece of paper to the person who asked you to count.
- ***nameYourBuddy***, say (loudly) the name of your Buddy

If you are asked to do anything else, say (as dramatically as you can) "I refuse"

You are a Choreographer

- When you are given any instruction (such as ***twirl***, ***clap***, or ***count***), pass it on to two other actors.
  - For example, if you are told to **clap 3** then you might respond by saying
    John, clap 3
    and when John has finished, saying
    Mary, clap 3
    assuming that John and Mary are names of two of the actors. You should **not** clap.
  - Do not directly refuse any command. However, if either of your two actors says "I refuse," then you say "**I refuse.**"
  - If the command is ***count:***
    - Both of your actors will eventually hand you a piece of paper (unless they refuse, in which case you refuse)
    - Add the two numbers from their papers and write the sum on your own paper
    - Then give your own paper to the person who asked you to count

Pick your two actors at random each time (but never pick a Curmudgeon).

You can pick the same actor twice (instead of two different actors) or you can even pick yourself as one (or both) of the actors. Try these!

But don't do these fancy tricks the first time a Choreographer is given an instruction.

You are a Curmudgeon

- When given any instruction (such as **twirl**, **clap**, or **count**), ignore it. Stand up, cross your arms over your chest, smirk, and say (as smugly and dramatically as you can) "**I refuse**."

Then sit down again if you were originally sitting.

Acrobat Games – Debriefing: *Classes* and *Objects*

- What are the names of some ***classes*** represented in Acrobat Games?
  - See below
- What are the names of some ***objects***?
  - ***john***, ***mary***, … (names of the actors in your classroom)
  - Or perhaps you think of them as named by numbers:
    - *basicAcrobat1*, *basicAcrobat2*, *basicAcrobat3* *proudAcrobat1*, *proudAcrobat2* etc.
- Can there be more than one object from the same class?
  - Yes!

BasicAcrobat

Choreographer

Curmudgeon

ProudAcrobat

DoublingAcrobat

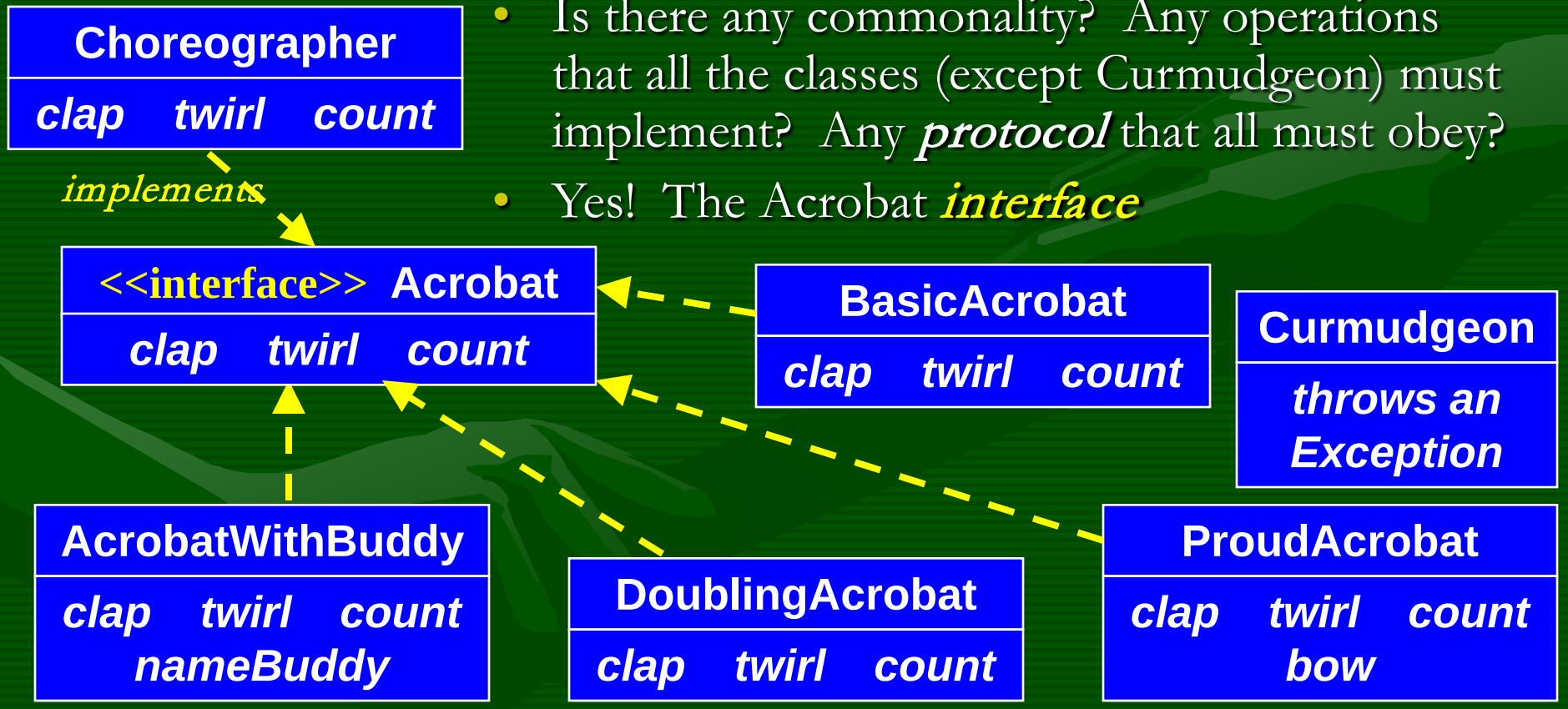
AcrobatWithBuddy

Acrobat Games – Debriefing: *Operations*

- What are the names of some ***operations*** that the objects in Acrobat Games can do?
  - ***clap***, ***twirl***, ***count***, ***bow***, ***nameBuddy***
  - Later we will call these operations ***methods***
- Are all objects able to do the same operations?
  - No. For example, only an ***AcrobatWithBuddy*** can ***nameBuddy***
- Are all objects of the same class able to do the same operations?
  - Yes. For example, all ***ProudAcrobats*** can ***bow***

Acrobat Games – Debriefing: *Interfaces*

- For each type of object, what operations can that object do?
- Is there any commonality? Any operations that all the classes (except Curmudgeon) must implement? Any ***protocol*** that all must obey?
- Yes! The Acrobat ***interface***

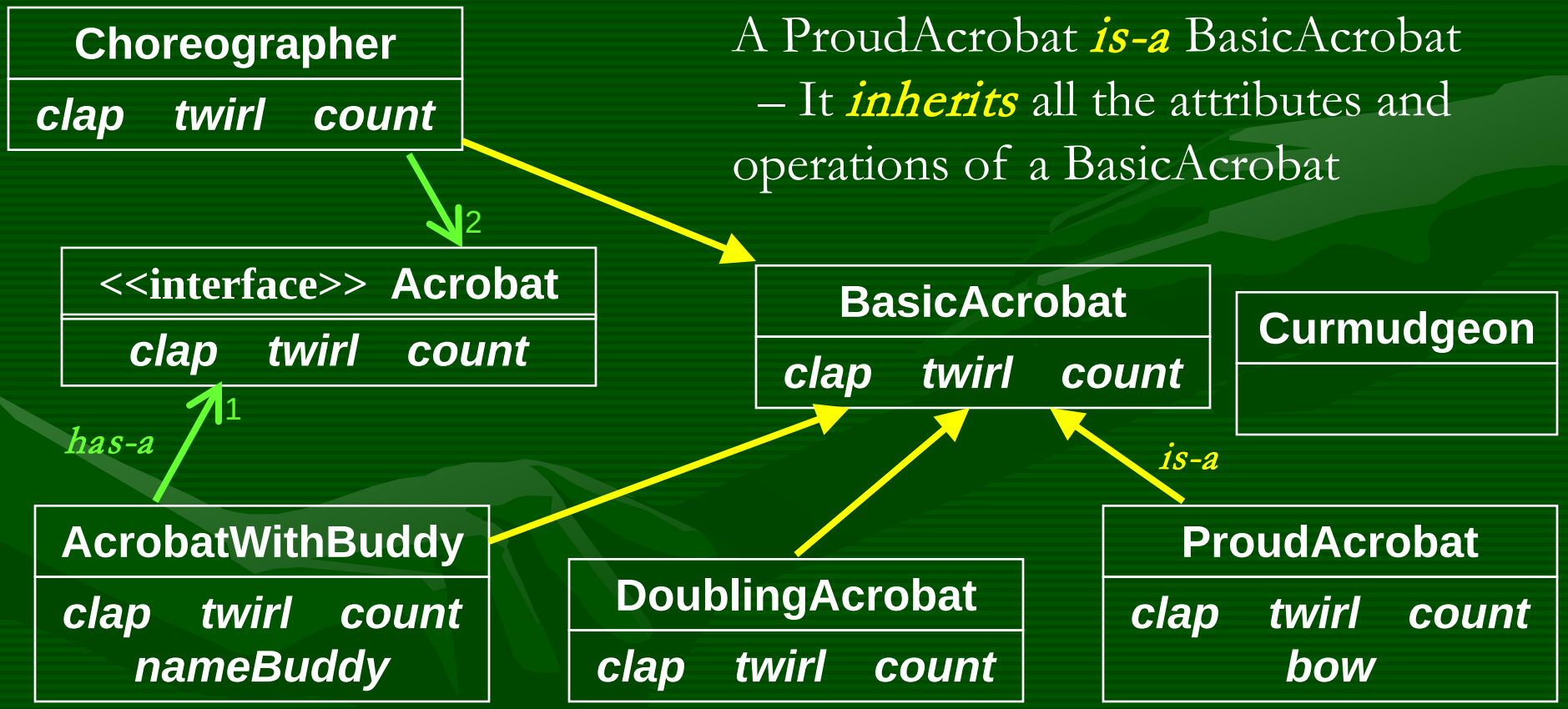


Acrobat Games – Debriefing:

is-a and *has-a*

An AcrobatWithBuddy *has-a* Acrobat
– It can ask its Acrobat buddy to do things

A ProudAcrobat *is-a* BasicAcrobat
– It *inherits* all the attributes and operations of a BasicAcrobat



What other *is-a* relationships exist above? *has-a*?

Acrobat Games – Debriefing: *arguments* and *returned values*

- When asking an object to perform an operation, we say three things. What are they?

- What determines how a particular object performs the *clap* operation?
  - Answer: What class it is an instance of. For example, a BasicAcrobat claps one way, while a ProudAcrobat claps another way. Also, what argument it is given. sally.clap(2) claps twice, while sally.clap(6) claps six times.
- Do objects have to act alone when performing?
  - No. For example, a Choreographer asks others to act on its behalf.
- How are the *clap* and *count* operations fundamentally different?
  - Answer: *clap* does something, while *count* returns a value.

Acrobat Games – Summary

- In Acrobat Games, we saw many of the ideas of Object-Oriented Programming (OOP), including:
  - ***Classes*** (BasicAcrobat, ProudAcrobat, …)
  - ***Objects*** (***proudAcrobat1***, ***proudAcrobat2***, … – ***instances*** of the classes)
  - ***Methods*** (the operations ***clap***, ***twirl***, ***count***, …)
    - ***Arguments***: ***clap*(2)**
    - ***Returned values***: from ***count***
  - ***Encapsulation*** in classes and in methods
  - Internal ***state*** (each object keeps track of its count)
  - ***Inheritance*** (e.g., ProudAcrobat ***is-a*** BasicAcrobat)
  - ***Associations*** (e.g., an AcrobatWithBuddy ***has-a*** Acrobat)
  - Implementing to an ***interface*** (… implements the Acrobat interface)
  - ***Exceptions*** (e.g., from Curmudgeons)
  - ***UML class diagrams*** (that show relationships between classes)

Introductions to:

- Each other ✓
- Object-Oriented Programming (OOP) ✓

- Java
  - Why Java?
  - Similarities to C and Python
  - Check out your first Java program and modify it
  - Write your own first Java program

Why Java?

- Widely used in industry for large projects
  - From cell phones
  - To global medical records
- Object-oriented (unlike C)
- “Statically type safe” (unlike Python, C, C++)
- Less complex than C++
- Part of a strong foundation

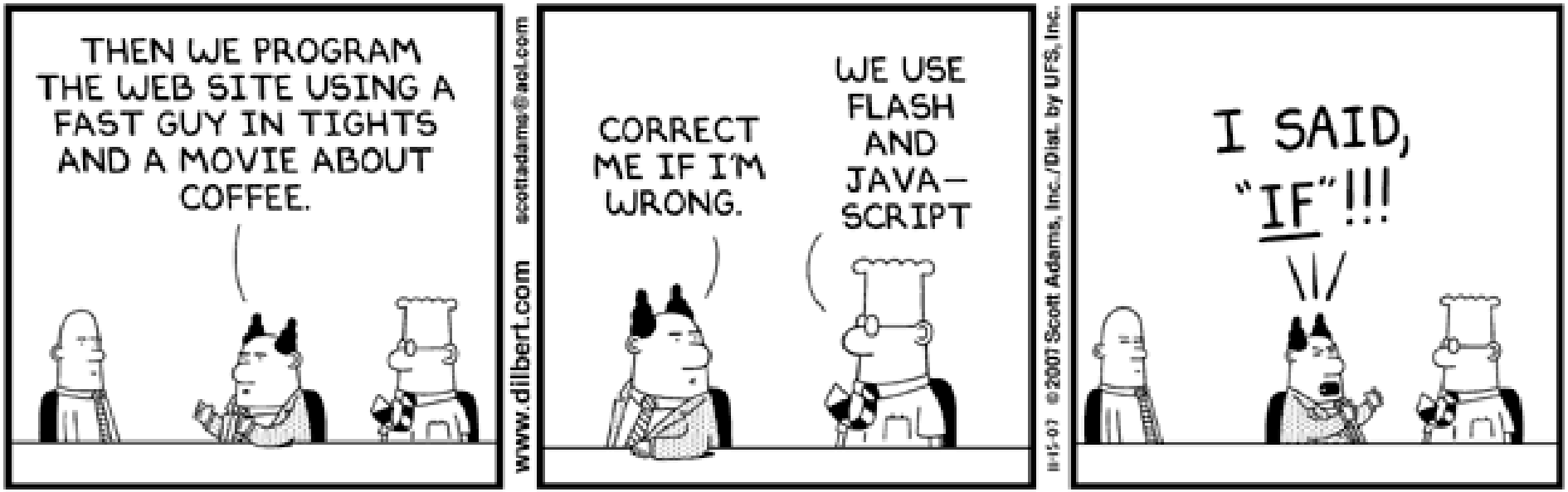
Things Java Has in Common with Python

- Classes and objects
- Lists (but no special language syntax for them like Python)
- Standard ways of doing graphics, GUIs.
- A huge library of classes/functions that make many tasks easier.
- A nicer Eclipse interface than C has.

Things Java Has in Common with C

- Many similar primitive types: int, char, long, float, double, ….
- Static typing. Types of all variables must be declared.
- Similar syntax and semantics for **if**, **for**, **while**, **break**, **continue**, function definitions.
- Semicolons required mostly in the same places.
- Execution begins with the main() function.
- Comments: // and /* … */
- Arrays are homogeneous, and size must be declared at creation.

Interlude



A First Java Program