Compsci 201
Arrays, ArrayList, APIs

Susan Rodger
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Today is the last day of drop/add
It is almost too late…

• You cannot switch your section without a permission number.
• DO NOT drop your section until you can get a perm number for the other section
• Go to https://www.cs.duke.edu/undergrad/registration
• Scroll down below office hours til you see Permission number for Spring 2020 courses
• Then fill out that form
• You must use permission number today!
• We will not be handing them out after 5pm
D is for ...

• **Debugging**
  • A key skill in making your programs *correct*, your program will *run* without this skill

• **Digital**
  • All about the 1s and 0s
Plan for Today

• What work is here, what work is coming
  • P0, P1, APTs

• Understanding arrays and ArrayList: Tradeoffs
  • APTS always use arrays, convert to ArrayList?

• Reasoning empirically and analytically
  • Working well enough and working at scale
Announcements

• Assignment P0 due last week
  • No late penalty since first assignment til Jan 24
• APT-1 now due Thurs, January 23
  • Can still turn in Friday til 11:59pm
• Discussion 3 on January 27
  • Prediscussion, do before, out by Friday
• APT-2 out today, due January 28 (short 1 due)
• Assignment P1 out Friday, due Thursday, Jan 30
• Reading on calendar
  • Slowing down …..
  • try to read by date posted, ok if you need a few more days
Visualizations Help Understanding?

- Javatutor to visualize code: http://pythontutor.com/java.html
- Using the java.awt.Color class
- Both String and Color are immutable
  - Once created, cannot ever change

```java
import java.awt.*;

public class ObjectColorDemo {
    public static void main(String[] args) {
        Color c = Color.RED;
        Color d = c;
        Color e = c.darker();
        Color f = new Color(255,0,0);

        System.out.printf("%s\n%s\n%s\n%s\n", c,d,e,f);
    }
}
```
Arrays and APIs

- Accessing a list of sandwich ingredients
  
  https://www2.cs.duke.edu/csed/newapt/sandwichbar.html

  - Ingredients specified as string "lettuce tomato"
  - String split method

  ```java
  String[] d = "lettuce tomato".split(" ");
  ```
APTs: parsing/processing data

• String <-> String[]: parameter and return types
  String s = "apple pear lemon orange";
  String[] ar = s.split(" ");

• Bridge from array to string?
  String[] a = {"one", "two", "three"}
  String b = String.join(":",a);
Helper methods
Creating your own API

• **SandwichBar APT** writeup
  https://www2.cs.duke.edu/csed/newapt/sandwichbar.html

• Clue/hint that indexing loop appropriate

• *Helper function*: array of strings contains all strings. Be creative in wanting an API for that
WOTO SandwichBar

• How to test locally?
  • Write main method. Create new object …
  • Faster to debug locally, even use debugger?

```
public static void main(String[] args) {
    SandwichBar sb = new SandwichBar();
    String[] av = {"cheese", "cheese", "cheese", "tomato"};
    String[] orders = {
        "ham ham ham", "water", "pork", "bread",
        "cheese tomato cheese", "tomato lettuce"},
    int dex = sb.whichOrder(av, orders);
    System.out.printf("index = %d\n", dex);
}
```
Helper methods
Creating your own API

• SandwichBar APT writeup
  • Helper function: array of strings contains all strings. Be creative in wanting an API for that
Scoring WOTOs going forward

• Each regular WOTO form is worth 2 pts
• If 2 WOTOs in a lecture, each worth 2 pts
• Some WOTO forms correctness will count and each problem is worth pts (likely 1 pt each)
• We are dropping all WOTOs done before today

• SUBMIT ALL WOTO FORMS – they count!
• Work Together with others
WOTO (4 minutes)

Nancy Leveson: Software Safety

- (@MIT) Mathematical and engineering aspects, invented the discipline
  - Air traffic control
  - Microsoft word

  “There will always be another software bug; never trust human life solely on software”  huffington post?

- Therac 25: Radiation machine
  - Paper on this: http://bit.ly/5qOjoH

- Software and steam engines
Source Code, Byte Code

- High level languages compiled to low level languages
  - In C/C++ low-level *specific to platform*
  - In Java byte code is low-level
- Execute by machine: real or virtual
- JVMs must be ported to platform
- Android doesn't use JVM
  - Dalvik and now ARM
- Be grateful!!!!!
  - High level source code
public class Hello {
    public static void main(String[] args) {
        System.out.println("hello world");
    }
}

Code:
0: aload_0
1: invokespecial #1
4: return

Code:
0: getstatic #2
3: ldc #3
5: invokevirtual #4
8: return
Project P1 out soon

• See course website for details, discussion D3
  • Not quite this, but …
    https://www.youtube.com/watch?v=DoLe1c-eokl

• Read assignment before starting to code
  • Think before fingers on keys

• Use Piazza and Helper Hours
Projects in 201: Review

- Start with GitLab project, fork repository
  - Starter code and cloud-based storage for projects
  - Clone repo to your machine: you need Git for this

- You use Duke Compsci GitLab website
  - You manage your code/projects with GitLab

- Make changes, complete project
  - Push changes frequently using Git … hourly/daily
What is Git?

• Git is a free and open source distributed version control system designed to handle everything from small to very large projects with speed and efficiency. https://git-scm.com/

• In teams, huge win. Individually, huge win
  • Git is complicated when it doesn’t work, lots of commands
  • Git relies on SSH to be secure
Assignments P0 and P1

• Simple Java class with driver programs
  • How is a program run? What is main?
  • Testing methods and testing classes

• Example of 201 work-flow
  • GitLab for starter code and your code
  • Using SSH and GitLab together
  • Submitting via Gradescope, Analysis
What is a static method?

• Objects are instances of a class
  • Thus objects have instance variables
  • Typically private, accessed in methods

• Static method belongs to class, not object
  • No instance variables
  • Accesses static variables and methods
  • More on this later, for now? …
Static Methods

• The class Math has many (java.lang)
  • sqrt, cos, abs, ...
• The class Arrays has many (java.util)
  • sort, fill, toString, asList, ...

• Invoke as Math.sqrt(25.0) or String.join(…)
  • Math is a class. Convention for name?
  • There aren't different Math objects, none!
    • No state needed, all code in methods
WOTO: Correctness Counts