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

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
  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?

```java
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);
}
```

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

From Hello.java to Hello.class

```java
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-eokI
- 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