CS 101
Problem Solving

Any burning questions?

✓ Piazza?
✓ Syllabus?
✓ Schedule?
✓ Textbook? (Piazza -> @37)
✓ Gradescope?

Before next class:

- Read chapter 1 and 2
- Watch required videos (last slide)
- Read Assignment 1 (has been posted today)

What is **Computer Science** ?

In simpler terms, computer science can be defined as…

Problem Solving *using* ***Computational Techniques***

Problem Solving: The process of finding solutions to difficult or complex issues.
Computational Techniques: Defining a set of steps or instructions to be run by a computer for accomplishing a particular task.

What is **Computer Science** ?

Combining the definitions:

The process of finding solutions to difficult or complex issues by defining a set of steps or instructions to be run by a computer for accomplishing a particular task*

**Note: some areas of CS are very theoretical and formalize the idea of what can/cannot be computed.*

Problem Solving

Our running definition of Computer Science is:

The process of finding solutions to difficult or complex issues by defining a set of steps or instructions to be run by a computer for accomplishing a particular task

So let’s talk about problem solving.

Problem Solving

- Humans have an intuitive sense of what it means to “Solve a Problem”
  - If the kitchen is full of dirty dishes, we ***solve the problem*** by cleaning them one-by-one
  - If the grass in the lawn is too high, we ***solve the problem*** by getting out the lawn mower
  - If we are hungry, we ***solve the problem*** by systematically assembling a meal, and then eating it

Problem Solving

As with most problems, the solution to each of them can be broken down into a series of ***steps*** that need to be taken to arrive at the solution

Problem Solving - Dishes

Let’s define the “Dishes” problem in more detail:

The Problem: There is a stack of dirty dishes in the right side of the sink

The Ideal Outcome: All dishes are cleaned and in their proper place

The Solution: . . .

1) Turn on the water to the left sink
2) Grab the sponge
3) Put some soap on the sponge
4) As long as dishes remain in the right sink
    a) Grab a dish from the right sink
    b) Scrub it well
    c) Place it in the left sink & rinse
5) Grab the drying rag
6) As long as dishes remaining in the left sink
    a) Grab dish from the left sink
    b) Dry it well
    c) Put it in the proper cabinet

In Class Activity (ICA)

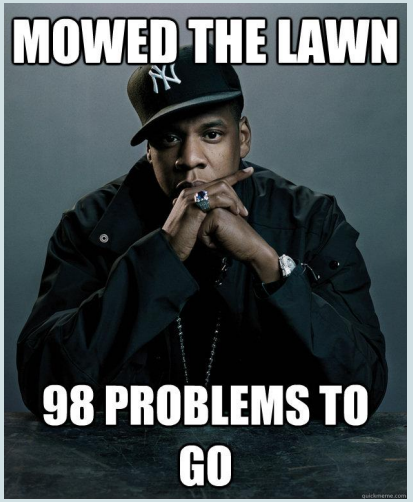
- We will collect them at the end of the class and scan them
- We will upload them to Gradescope for you
- Write your name and netid clearly
    1. First try individually on your sheet. Submission is individual
    2. Talk to group mates

Problem Solving - Grass

Let's define the "Grass" problem in more detail:

The Problem: The grass in the lawn is getting too high. The lawn is a nice square.

The Ideal Outcome: All grass on the lawn should be no longer than 1 inch



The Solution: . . .

1 minute for individual (silent) work

4 minutes for group work

ICA

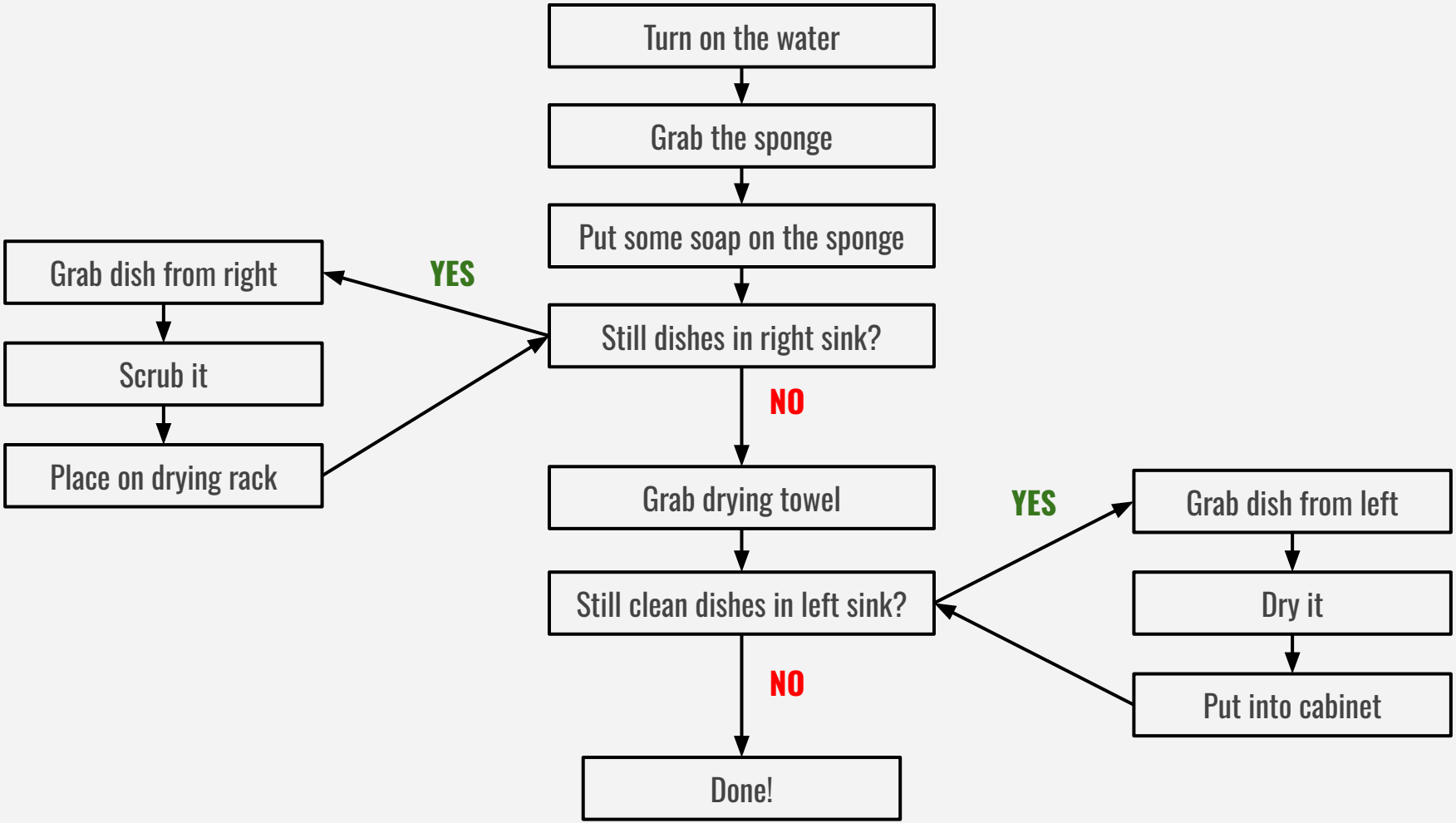
Problem Solving

- These steps can also be represented with ***decision trees***
- A ***decision tree*** is a diagram that can be used to represent the sequential steps of a solution
- Arrows are used to show which step is next

Converting to Decision Tree

How can this be converted into a decision tree?

1) Turn on the water to the left sink
2) Grab the sponge
3) Put some soap on the sponge
4) As long as dishes remain in the right sink
    a) Grab a dish from the right sink
    b) Scrub it well
    c) Place it in the left sink & rinse
5) Grab the drying rag
6) As long as dishes remaining in the left sink
    a) Grab dish from the left sink
    b) Dry it well
    c) Put it in the proper cabinet

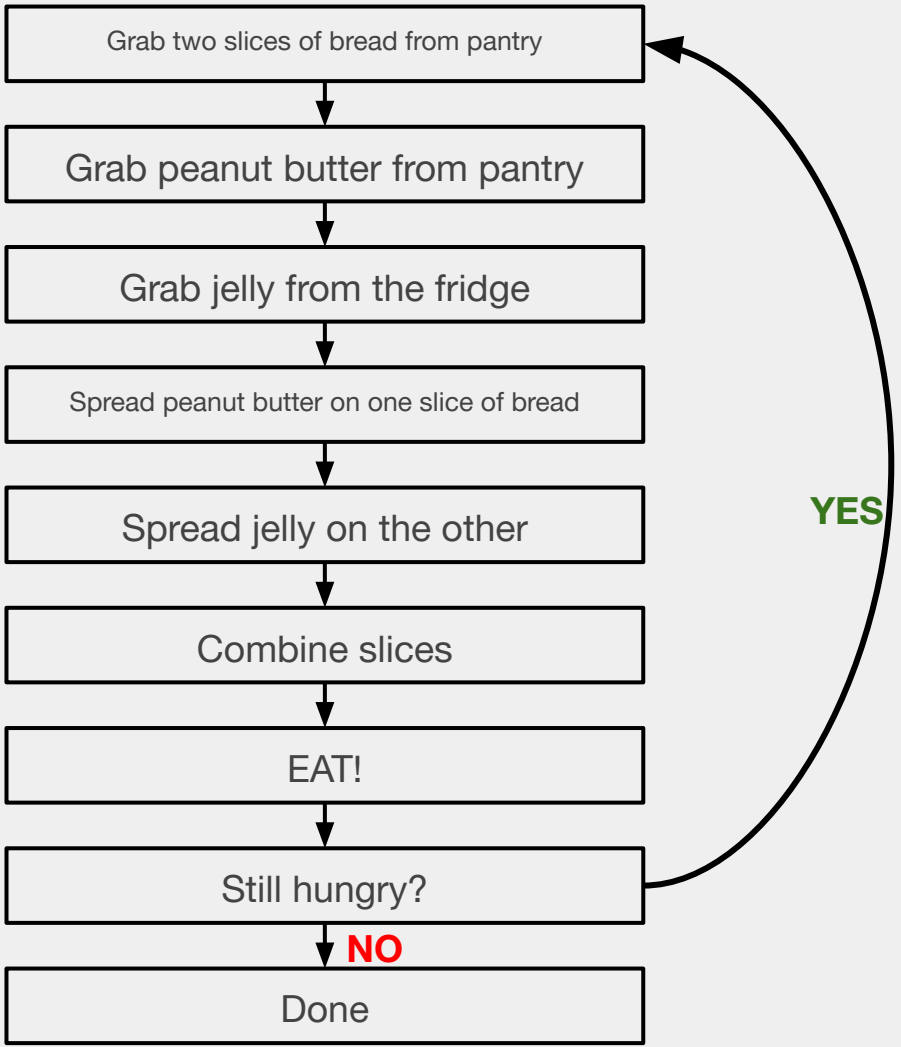

Turn on the water
Grab the sponge
Put some soap on the sponge
Still dishes in right sink?
YES
Grab dish from right
Scrub it
Place on drying rack
NO
Grab drying towel
Still clean dishes in left sink?
YES
Grab dish from left
Dry it
Put into cabinet
NO
Done!

Problem Solving - simpler example

How can this be converted into a decision tree?

1) Grab two slices of bread from pantry
2) Grab peanut butter from pantry
3) Grab jelly from the fridge
4) Spread peanut butter on one slice of bread
5) Spread jelly on the other
6) Combine slices
7) EAT!
8) If still hungry, go back to step 1

Problem Solving



Converting to Decision Tree

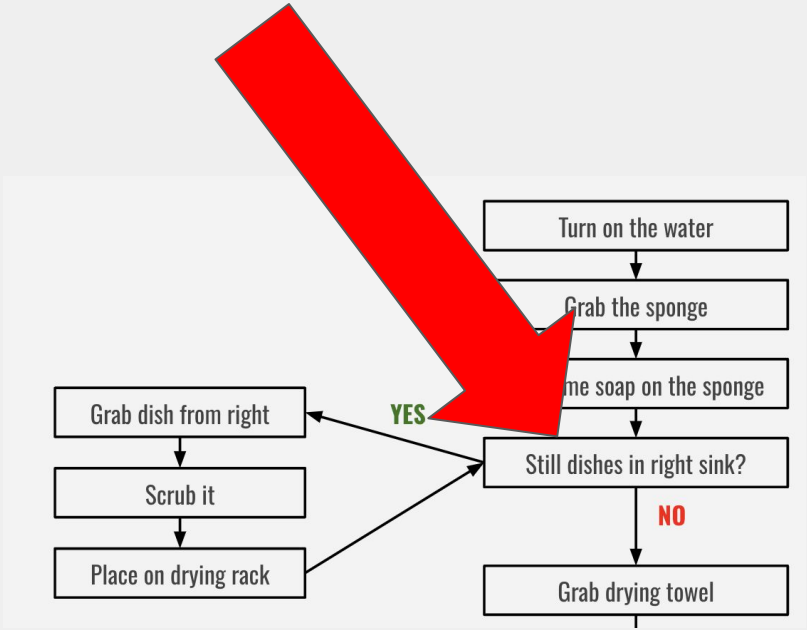
How can this be converted into a decision tree?

1) Pour/spray 0.75 gallons of water into mixer
2) Cut open 1 bag of concrete
3) Pour bag concrete into mixer
4) Turn on mixer
5) If too stiff
    a) Add more water
6) If too watery
    a) Add more concrete mix
7) Pour concrete out of mixer

ICA

Conditions

- Notice that these diagrams have ***conditions***
- Some of the ***conditions*** have ***repetitions*** and some do not
- ***Conditional statements*** are an important construct when designing solutions and are fundamental in programming



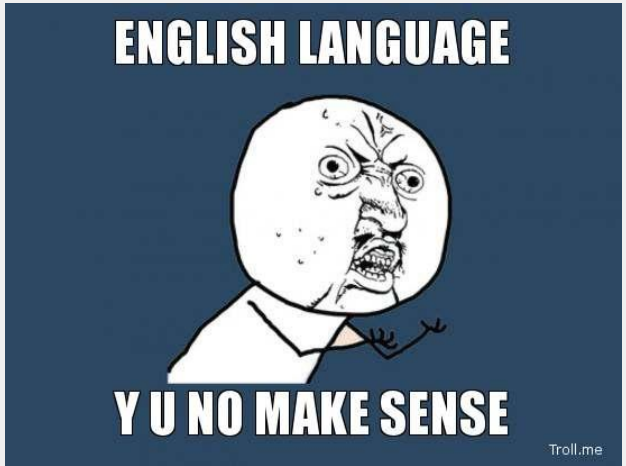
Problem Solving

- We just described detailed steps for solving several problems
- Notice that each of them
  - Had a ***flow*** of steps. IE, start from the first step, and follow along sequentially
  - Steps were described in ***great detail***
  - In computer science, we call a detailed set of steps like this an ***Algorithm***

Algorithms *are a foundational concept in computer science, which we will discuss and revisit throughout the semester (your career)*

Problem Solving - Algorithm

- ***Algorithm*** *is a set of detailed steps to be followed in problem-solving operations, especially by a computer.*
- We can't just give a computer instructions written in ***English*** like we did in our examples here. ***Computers don't speak English***.



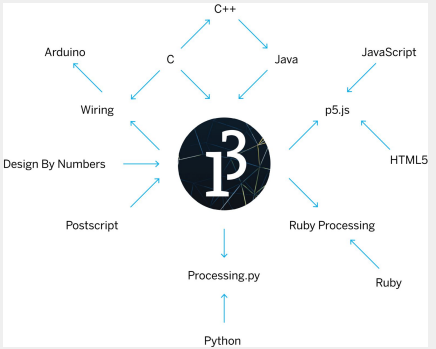
Problem Solving - Programming Language

- This is where a ***Programming Language*** comes into play
- A ***Programming language*** is a language that computers “understand”

- **Computer programming** means to write algorithms using a programming language.

Problem Solving - Programming Language

- Throughout the semester, we will learn one (of many) programming languages named ***Processing***
- Why Processing?
  - it's "visual"
  - designed to make interactive graphics easy
  - focused on code that creates images, animations and interactions
  - Perfect for an introductory class!



Processing

- Processing
  - Its “domain” is the computer screen
  - Initially, drawing (programming) in Processing is like drawing on graph paper (conceptually)

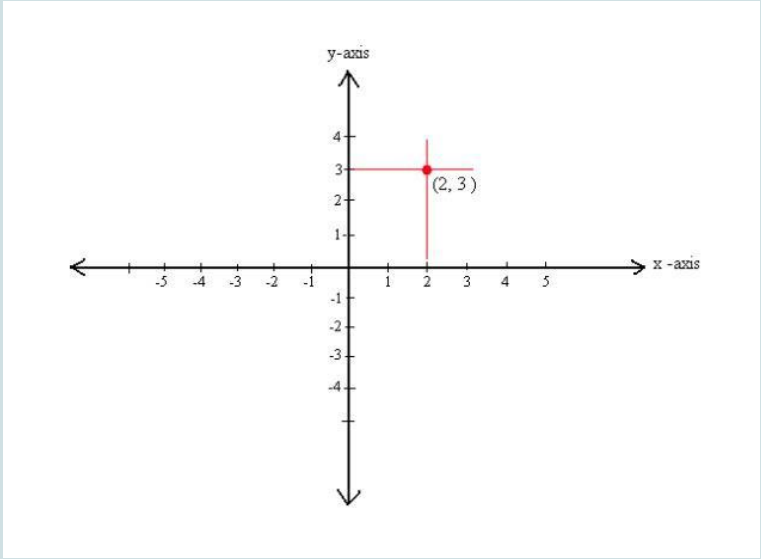
Processing

- Do you remember drawing on graph paper?
- Q: How would we draw a line, a point, anything?
- A: Specify the coordinates
- Let's look back at the cartesian coordinates
    - We’ll draw two points on a graph

ICA

Processing

- Do you remember drawing on graph paper?
- Let's look back at the cartesian coordinates
  - Draw the graph shown
  - Add the points listed on your paper



Problem Solving - Programming Language

- Becoming proficient with a programming language takes time, but the reward is great
- Throughout the semester, you will write several programs in Processing

Problem Solving - Required Videos

- Required Videos
  - Computer Science is for everyone (TED video) (10 mins)
  - Algorithms are taking over the world! (TED video) (11 mins)
  - What is an Algorithm? (video) (5 mins)