BEGINNINGS

ADAM SWEENEY
CS 211

INTRODUCTION

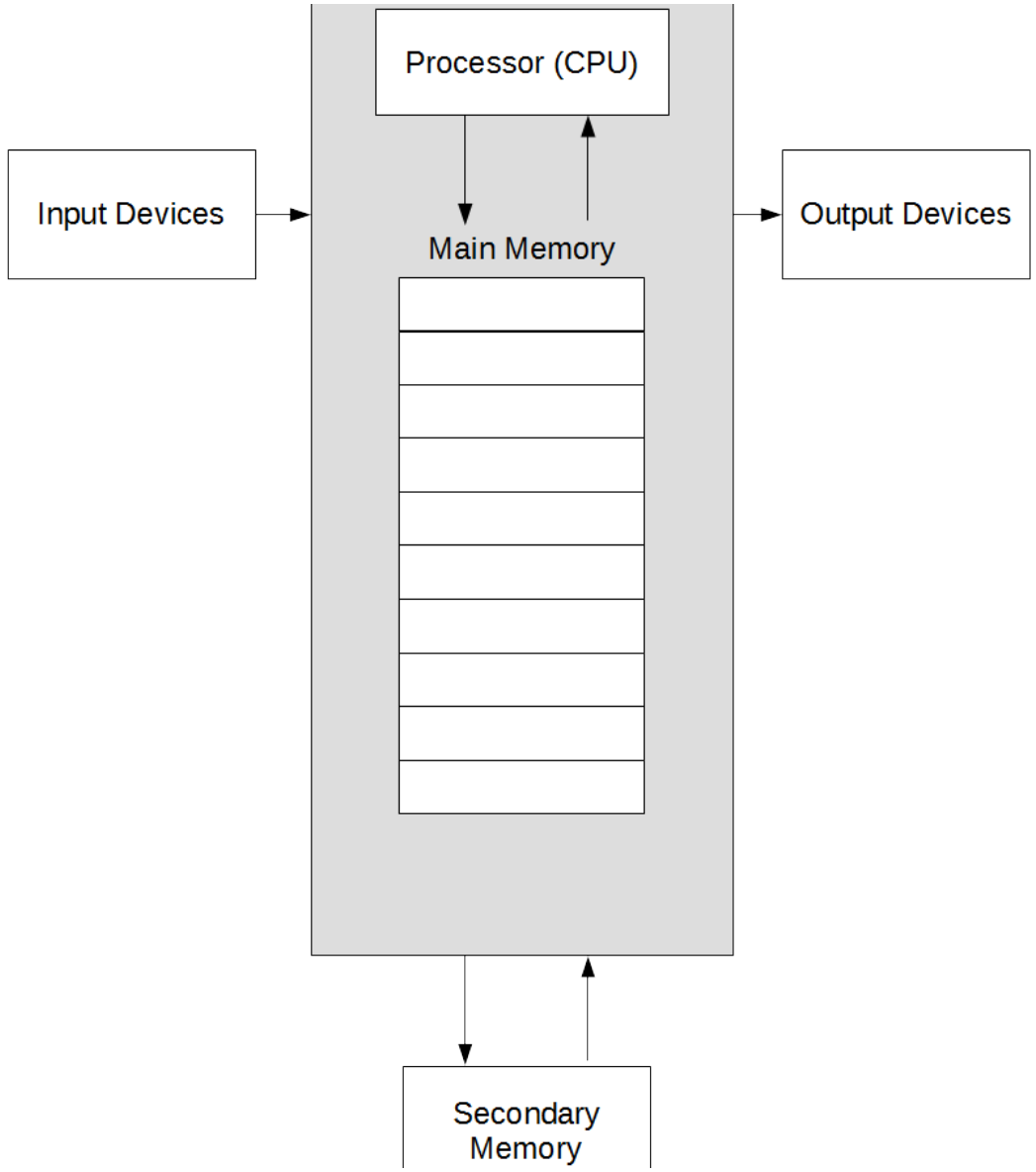
- Broad concepts
- Chapter 1 from Think Like a Programmer

AGENDA

- Computer systems
- Problem Solving
- My First Program
- Testing & Debugging

COMPUTER SYSTEMS

A COMPUTER, GENERALLY



MAIN MEMORY

- We are going to consider memory as a single entity
- Memory is divided into bytes
  - 1 byte == 8 bits
  - 1 bit == 1 xor 0 (bit is short for binary digit)
- Every byte has an address (a number)
  - Usually seen as hexadecimal (0 – F)
  - 0x0, 0x1, …, 0xF, 0x10, etc.
- Most data does not fit in a single byte

DATA SIZES (ABRIDGED)

- bool
  - Values of true or false only
- char
  - Single ASCII character
  - Letter, number, common symbol
- int, unsigned int
  - Whole numbers
  - Unsigned means 0 or positive only
- double
  - Number with decimal representation

Type	Size (bytes)
bool, char	1
int, unsigned int	4
double	8

PROBLEM SOLVING

THINKING LIKE A PROGRAMMER

- The hardest part of this course is not writing code
  - C++ syntax is unfamiliar, not overly complicated
  - Practice makes perfect
- It is producing the solutions to the given problems
  - The series of steps required to complete a task is called an algorithm
  - Producing an algorithm will be the tough part (adaptive challenge)
  - Translating the algorithm to code is easier (technical challenge)

WHAT DOESN'T WORK

- Throwing code at the compiler
  - Wastes time
  - Doesn't develop critical thinking
- Finding code online
  - Wastes money
    - How much are paying, and what are you paying for? Learning to learn, critical thinking, problem solving skills, etc? Or how to copy/paste?
  - Doesn't internalize syntax or logic, code never gets easier to write

CHANGING HOW WE THINK

- Spend a little time reviewing a few puzzles
- Each puzzle highlights a different way to approach a problem

FOX, GOOSE, & CORN

A farmer with a fox, a goose, and a sack of corn needs to cross a river. The farmer has a rowboat, but there is room for only the farmer and one of his three items. Unfortunately, both the fox and the goose are hungry. The fox cannot be left alone with the goose, or the fox will eat the goose. Likewise, the goose cannot be left alone with the sack of corn, or the goose will eat the corn. How does the farmer get everything across the river?

FOX, GOOSE, & CORN SOLUTION

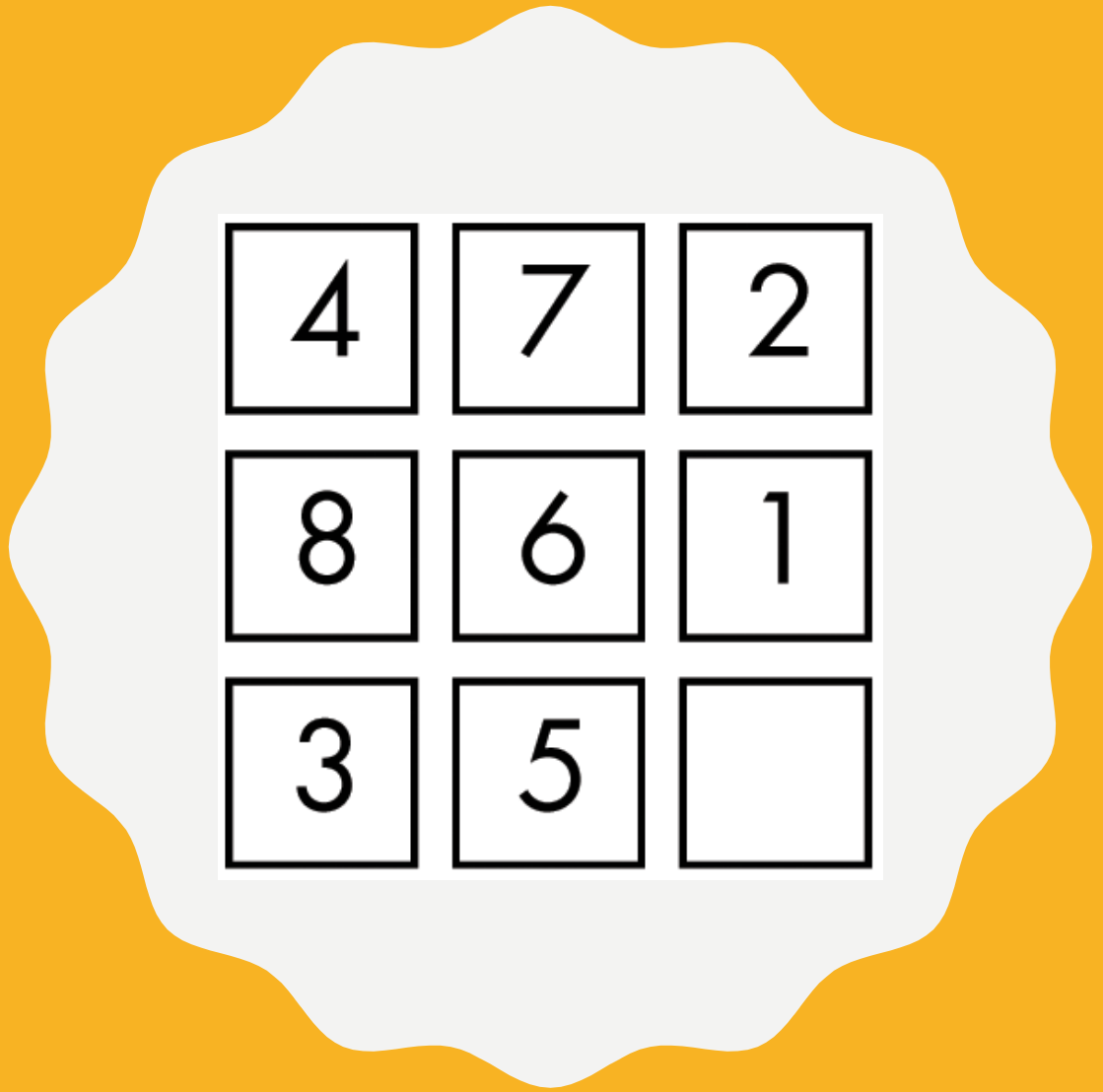
- Take goose across
- Take corn across
- Take goose back
- Take fox across
- Row back
- Take goose across

- Taking the goose back is a counter-intuitive step

DISCOVERING "HIDDEN" STEPS

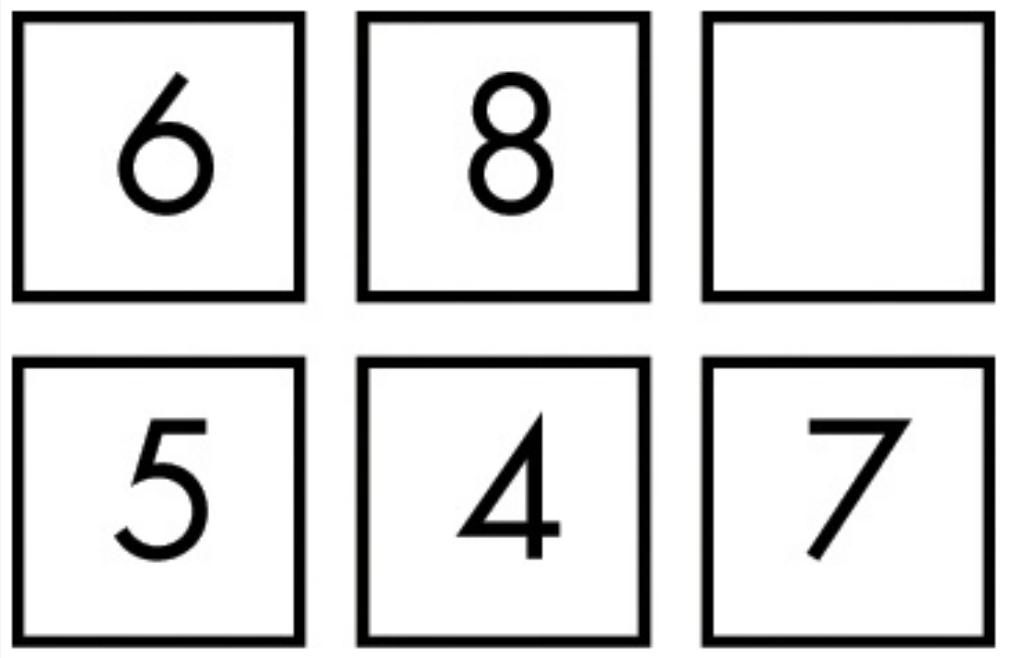
- Restate the problem in your own words
- List constraints
  - Farmer can only take one item at a time
  - Fox and goose can NOT be left alone
  - Goose and corn can NOT be left alone
- List allowed operations
  - Being too specific may not offer insights
  - Try to generalize
  - Instead of "take fox to far side", try "load an item in the boat"

SLIDING TILE



BREAK THE PROBLEM DOWN

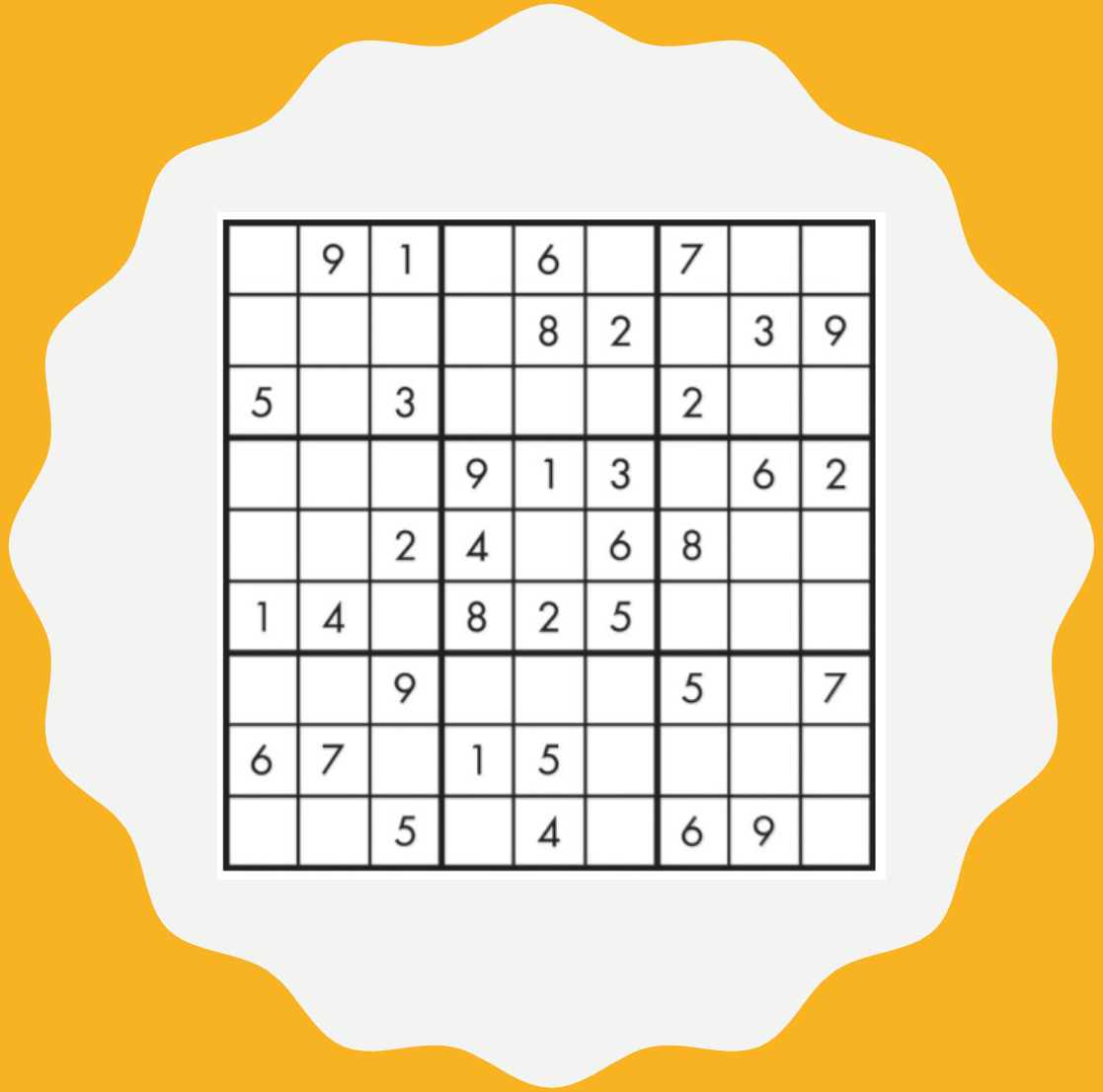
- Is this puzzle easier or harder?



MOUNTAIN CLIMBING

- Climbers typically don't approach a mountain with the plan "Get to the top"
  - Planned stops, routes to each stop
  - The sum of the smaller plans results in reaching the top of the mountain
- Don't approach a problem with the mindset of solving it all at once
  - Break it down into smaller problems
  - Break those down
  - Keep going until you have a series of small tasks that get you where want to be

SUDOKU



	9	1		6		7		
				8	2		3	9
5		3				2		
			9	1	3		6	2
		2	4		6	8		
1	4		8	2	5			
		9				5		7
6	7		1	5				
		5		4		6	9	

PICK THE BEST STARTING POINT

- Start where your problem is the most constrained
  - Solve where you are the most limited first
- Corollary, start with the most obvious part

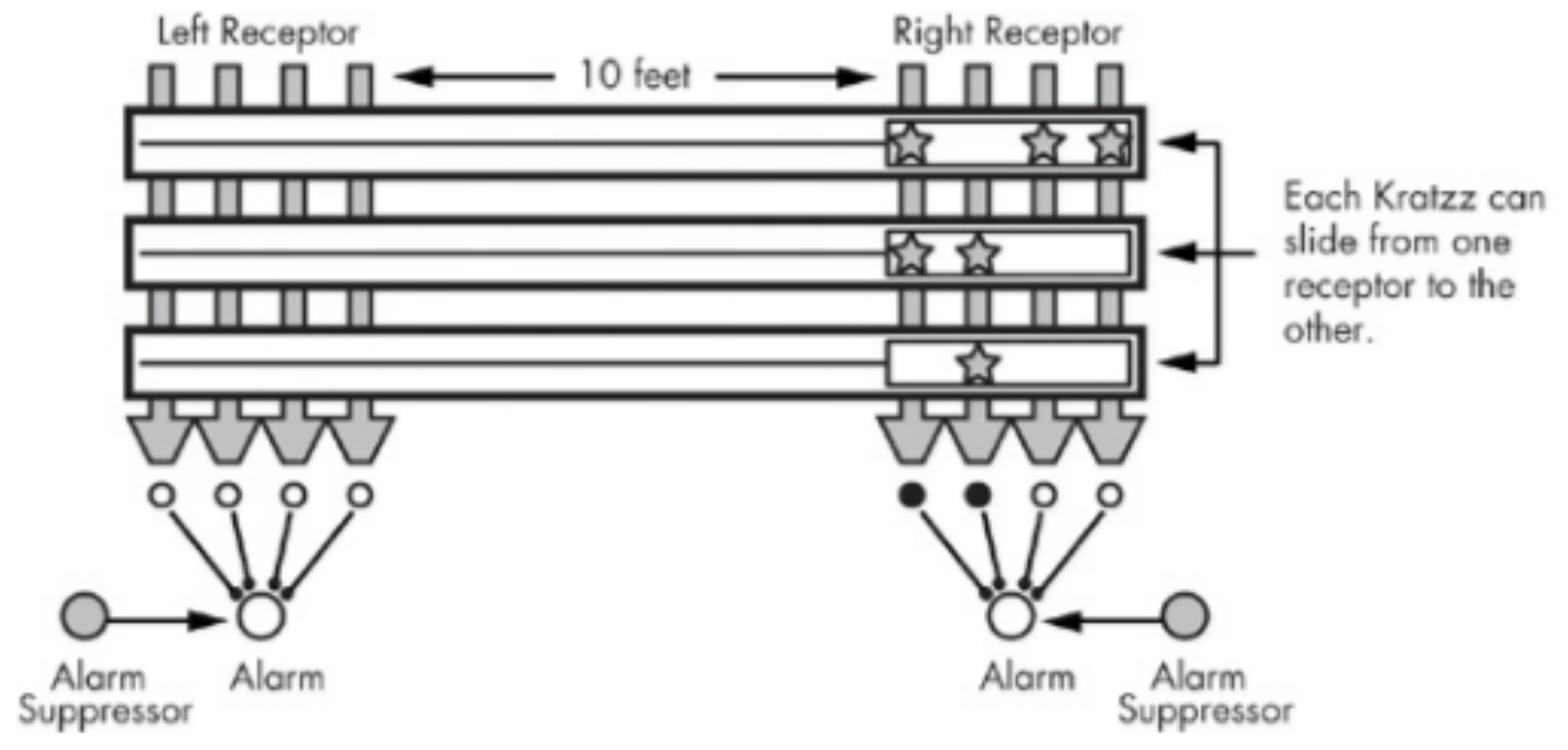
QUARRASI LOCK

An alien race, the Quarrasi, has landed on Earth, and you've been captured. You've managed to overpower your large, tentacled guards, but to escape the spaceship, you must open the massive door. The instructions for opening the door are, oddly enough, printed in English. To open the door, you must slide the three bar-shaped Kratzz along tracks that lead from the right receptor to the left receptor, which lies at the end of the door, 10 feet away.

That's easy enough, but you must avoid setting off the alarms, which work as follows. On each Kratzz are one or more star-shaped crystal gems known as Quinicrys. Each receptor has four sensors that light up if the number of Quinicrys in the column above is even. An alarm goes off if the number of lit sensors is ever exactly one. Note that each receptor's alarm is separate: You can't ever have exactly one sensor lit for the left receptor or for the right receptor. The good news is that each alarm is equipped with a suppressor, which keeps the alarm from sounding if the button is pressed. If you could press both suppressors at once, the problem would be easy, but you can't since you have short human arms rather than long Quarassi tentacles.

Given all of this, how do you slide the Kratzz to open the door without activating either alarm?

VISUALIZATION OF QUARRASI LOCK



THE SIMPLE SOLUTION

- We've already solved this problem
  - The constraints are identical to fox, goose, & corn
- New problems, or sub-problems may be solved already if we've encountered them before
  - The more problems we solve, the more problems we will be able to solve

GENERAL PROBLEM-SOLVING TECHNIQUES

- Always have a plan
- Restate the problem
- Divide the problem
- Start with what you know
- Reduce the problem
- Look for analogies
- Experiment
- Don’t get frustrated

MY FIRST PROGRAM

TESTING & DEBUGGING

TYPES OF ERRORS

- Syntax
  - Improperly written code; compiler will catch these and emit an error or warning
- Run-time
  - Program compiles, but crashes while executing
- Logic
  - Program compiles and runs, but output is not correct

DEBUGGING

- Use of a debugger will not be taught in this course
  - There is already enough content
- Easiest "tool" for this course will be printing to screen
  - Next best is pen & paper execution
- Cheatsheets/links for using debuggers will still be provided