CSCI 232:
Data Structures and Algorithms

Course Conclusion, Review

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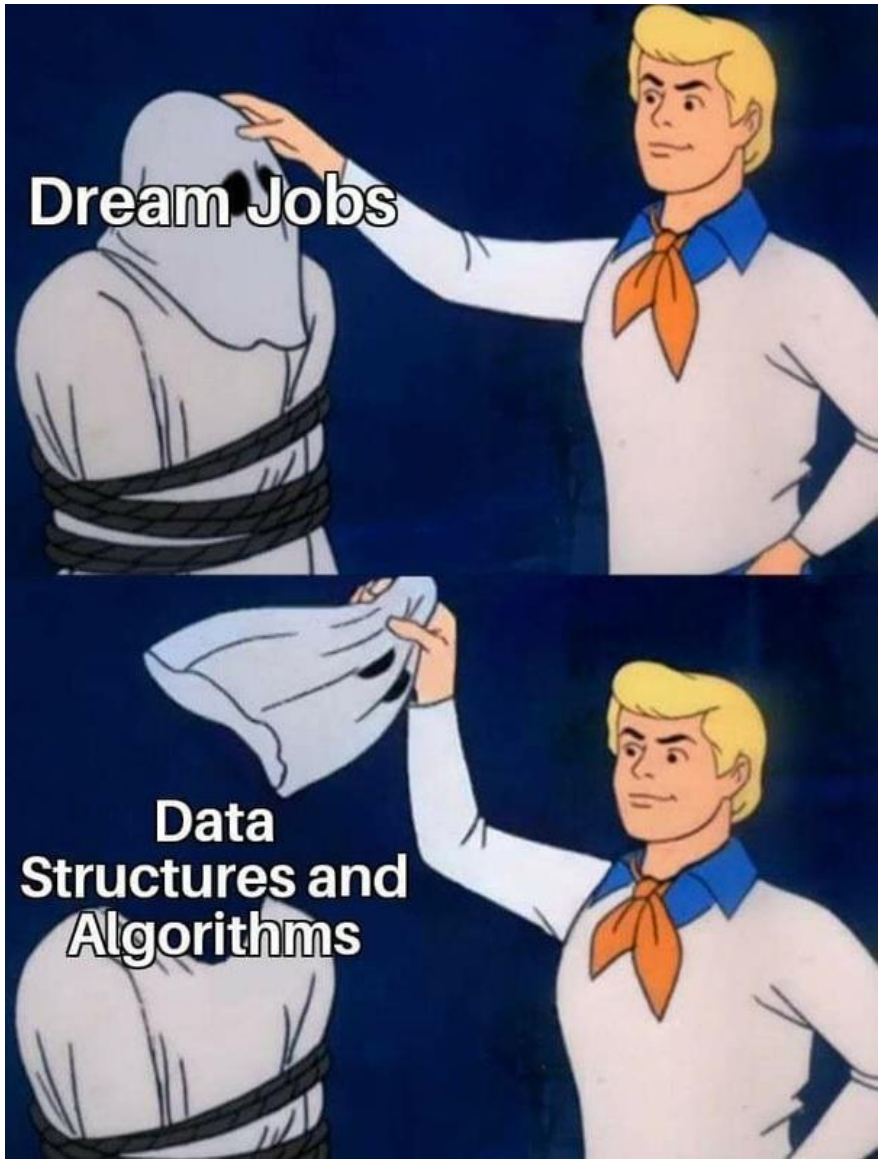
Spring 2024

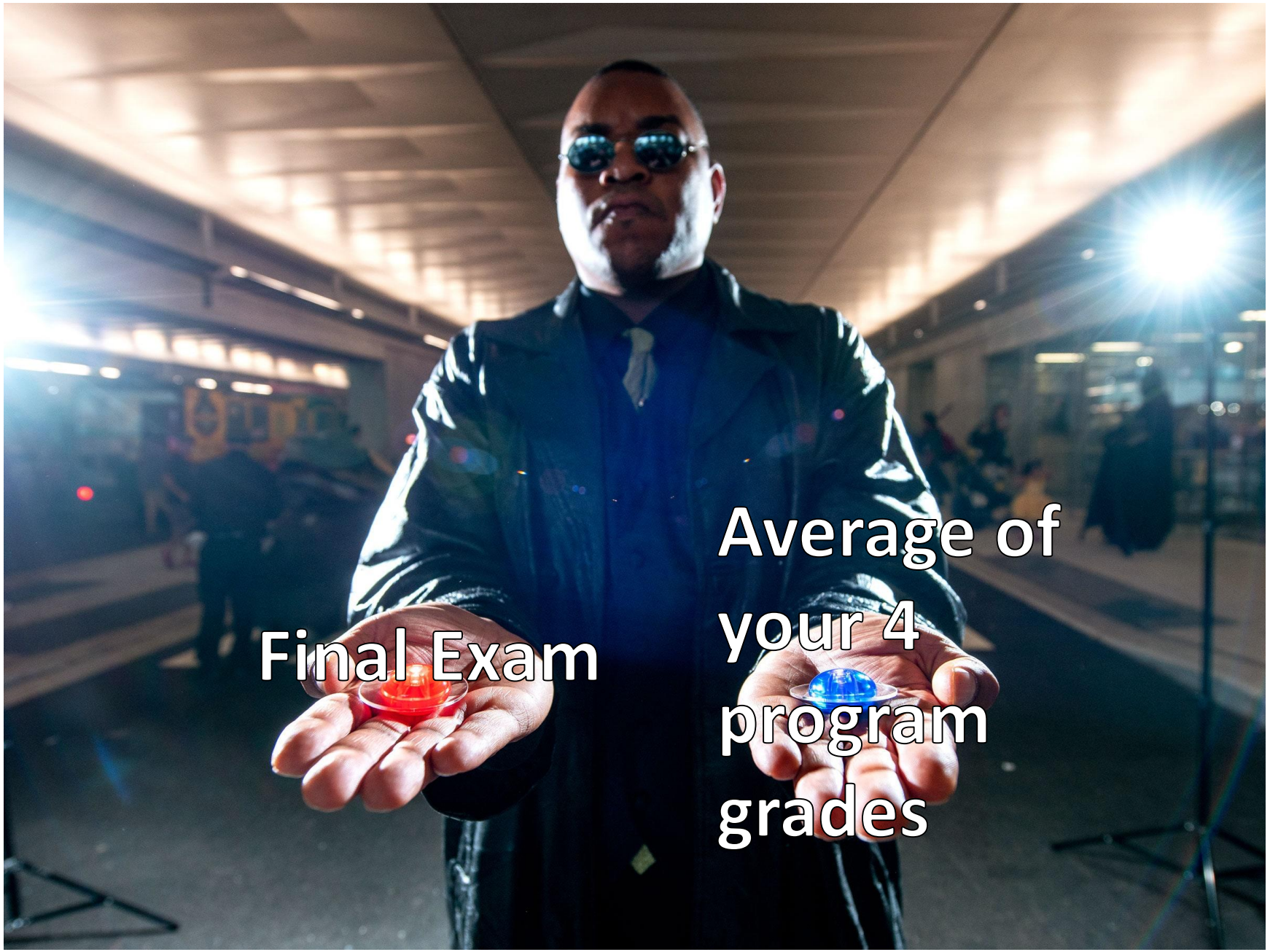
Announcements

Lab 13- Course Evaluation

Program 4 due **Sunday @ 11:59 PM**

Check your grades this week.
Make sure nothing seems wack




Final Exam
Average of your 4 program grades

Final Exam

Optional

Thursday, May 9th @ 10:00 AM – 11:50 AM
Barnard Hall 103

(1) Show up, take the exam normally

OR

(2) Don't show up, and accept the average of your 4 program grades

I will always take the highest of these two grades

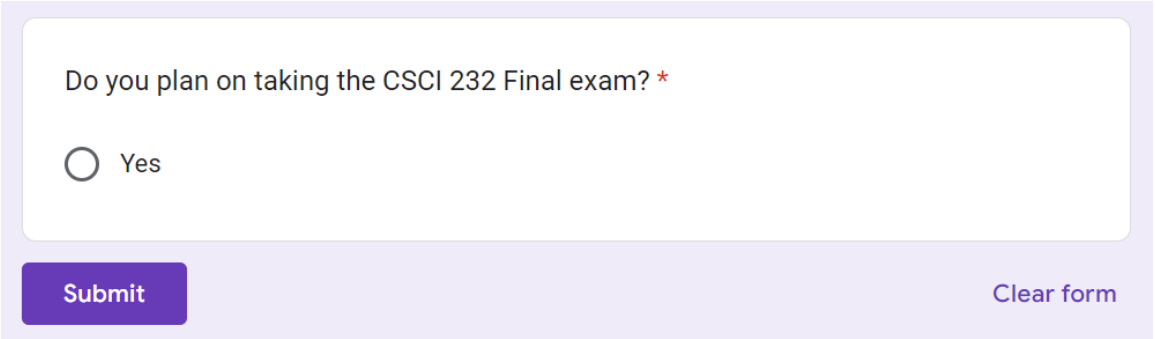
Exam Contents

- Graphs
- Minimum Spanning Tree
- Shortest Path
- Dynamic Programming
- Greedy Algorithms
- Divide and Conquer

Same rules and format as midterm exam

Please Let me know if you are planning on taking the final exam

On the course → website



Final Exam Review

CSCI 232- Data Structures and Algorithms

“Tools”

- Arrays
- Linked Lists
- Stacks/Queues
- **Hash Tables**
- **Trees**
- **Graphs**

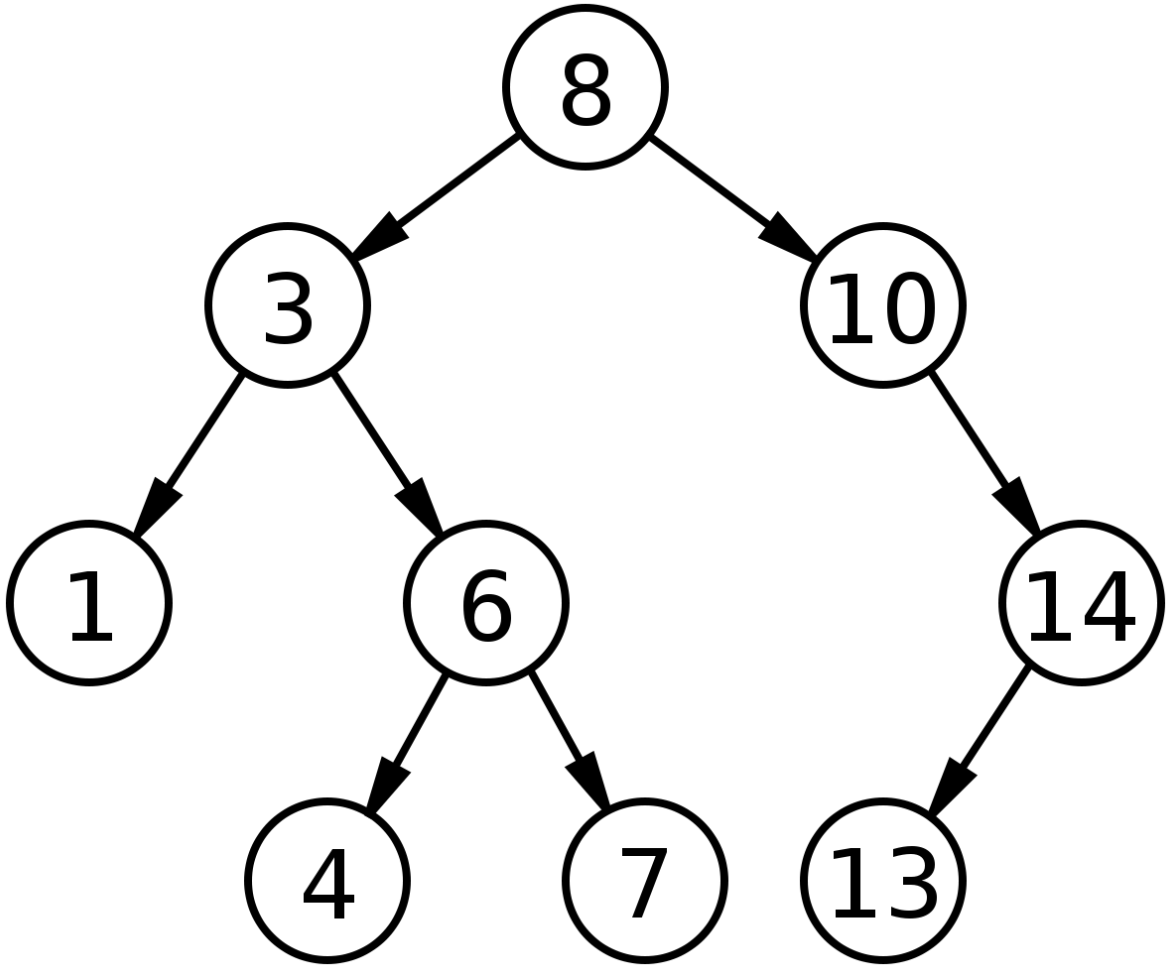
“Use of tools”

- Sorting
- Searching
- Routing
- Optimization

A **data structure** is a mechanism for storing and organizing data

An **algorithm** is a series of instructions to be followed to solve some problem

(Balanced) Binary Search Trees



Class TreeSet<E> Class TreeMap<K,V>

- **O(logn)** Addition Time
- **O(logn)** Removal Time
- **O(logn)** Search Time

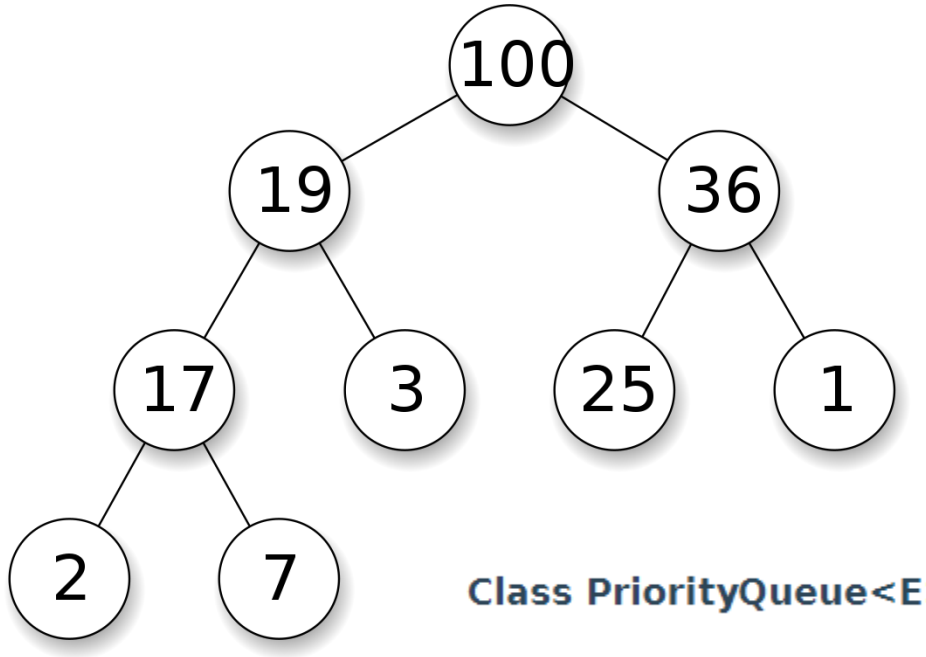
Not as efficient for adding/removing, but much more efficient to search through

How to guarantee balance?
→ Red/Black Trees!

More complex operations, especially in a self-balancing tree (rotations, replacements, etc)

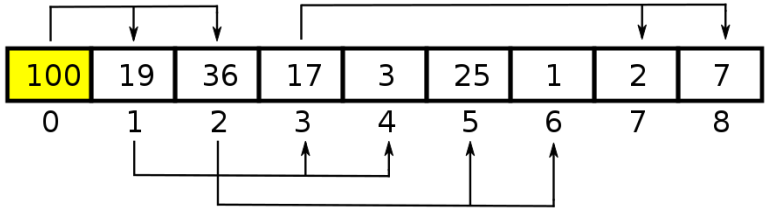
Heap

Tree representation



Class PriorityQueue<E>

Array representation



- **O(logn)** Addition Time
- **O(logn)** Removal Time
- **O(n)** Search Time
- **O(1)** Retrieving Highest Priority Element

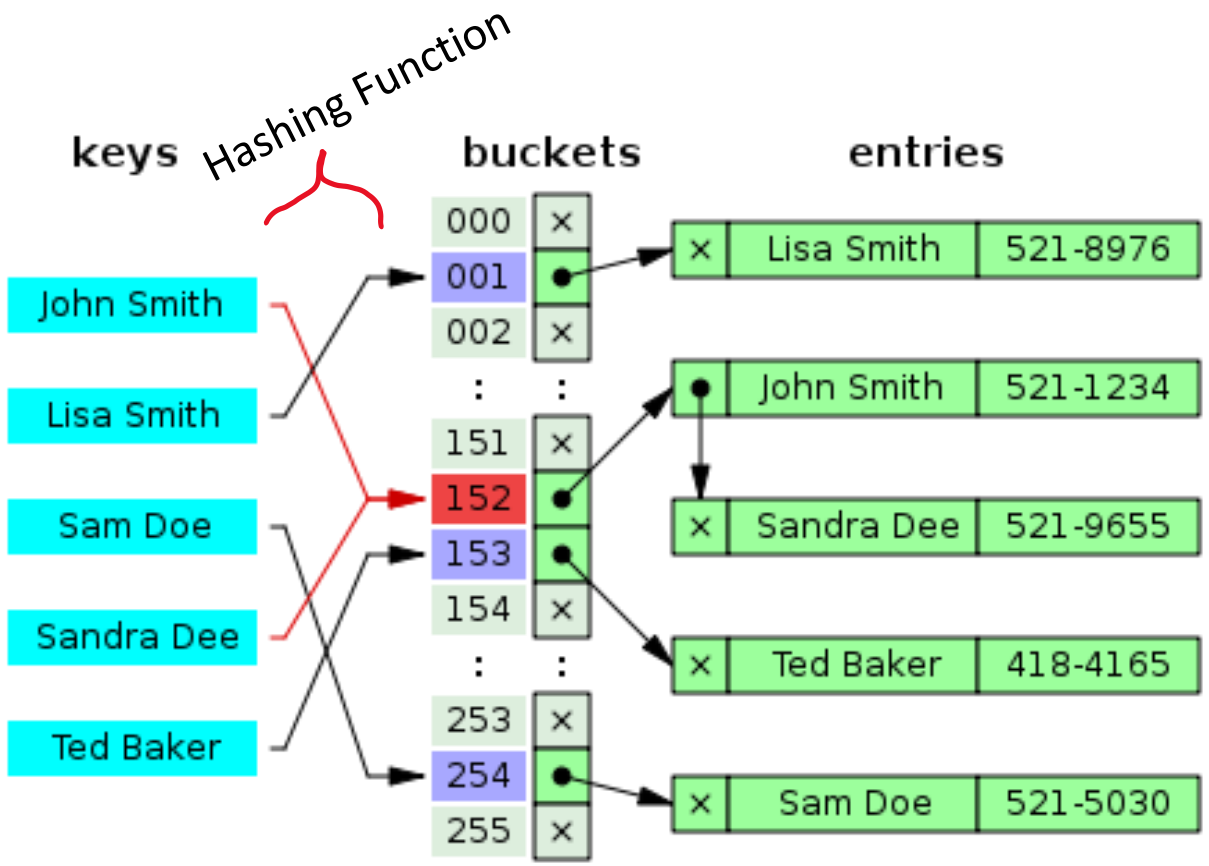
A priority queue!!

Efficient at retrieving the highest priority element

General searches are not as efficient

Creating a heap from an (unsorted) array is also efficient

Hash Tables



Class HashMap<K,V> Class HashSet<E>

(These libraries are very optimized to avoid collisions ☺)

- **O(1)** Addition
- **O(1)** Removal
- **O(1)** Retrieval/Contains
- **O(n)** searching if you don't have key
  (n = # of keys)

<u>Downsides</u>

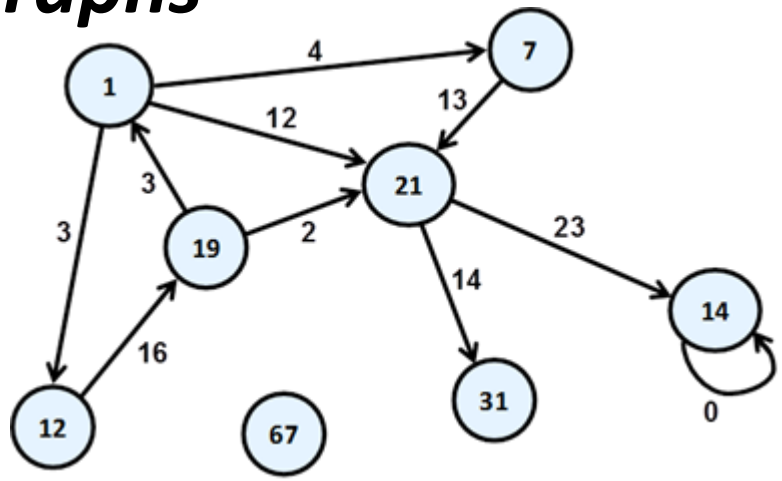
No Duplicate Keys

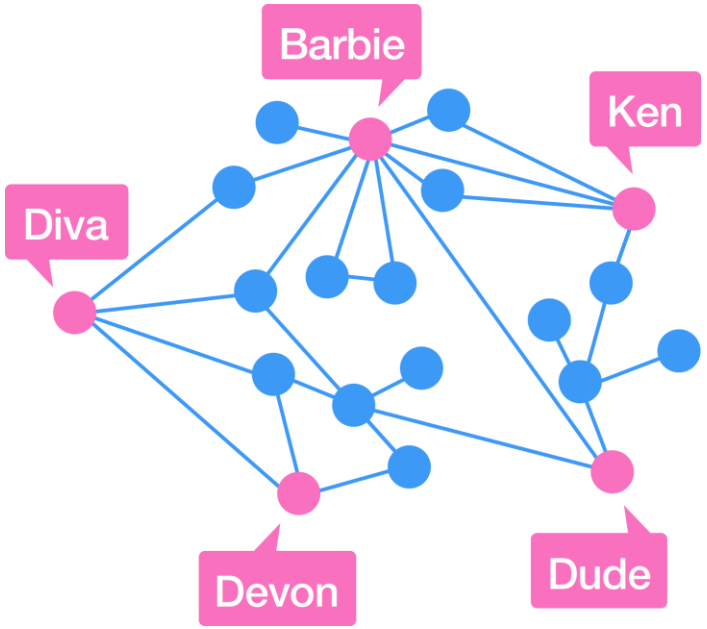
Unordered

Difficult to Sort

Collisions can be spooky

Graphs





A fundamental data structure that can be applied to *many* problems

Many problems that don't seem like a graph problem can be restructured to a graph problem

Many graph algorithms can be done in polynomial time (shortest path, searching, MST)

JGraphT

a Java library of graph theory data structures and algorithms

Algorithms

- Breadth-First
- Depth-First

- Heap Sort

- Hashing Function
- Collision Resolution

- Kruskal's Algorithm (MST)
- Primm's Algorithm (MST)

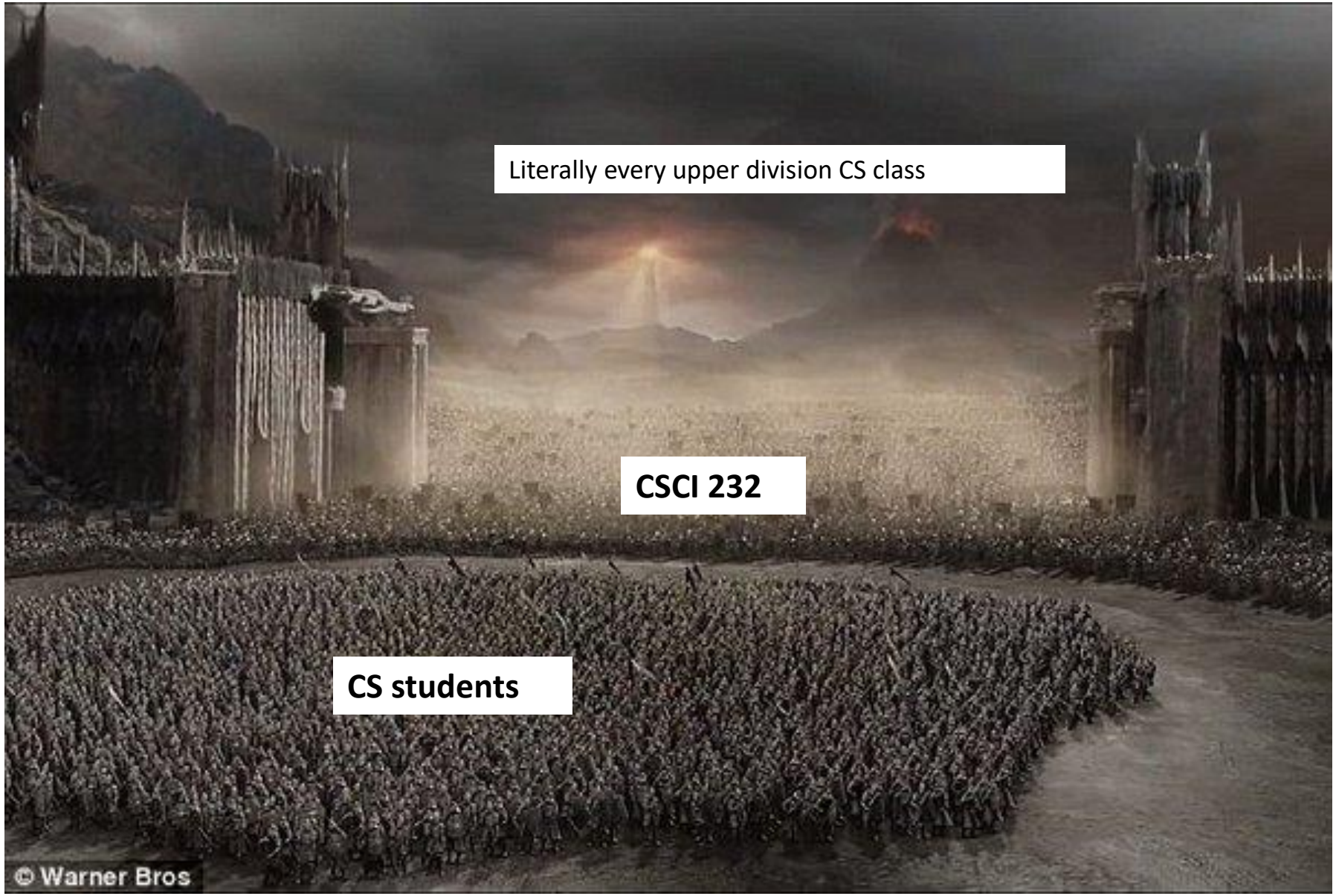
- **Dijkstra's Algorithm** (Shortest Path)
- A* (Shortest Path)

- Greedy Algorithms
  - Knapsack Problem
  - Traveling Salesman

- Dynamic Programming
  - Change Making
  - Rod Cutting
  - Edit Distance

- Divide and Conquer
  - Closest Pair

There are some problems that we don't have an efficient algorithm for!


Literally every upper division CS class
CSCI 232
CS students
© Warner Bros

Thank You!

This class has been fun to teach. I think this class is much more enjoyable and interesting than CSCI 132. *(you built some pretty cool things in this class!)*

It really enjoyed being able to have you in CSCI 132 *and* CSCI 232

I hope you enjoyed this class, and I hope the stuff you learned will be helpful in your career/future classes (this is one of the **most important** classes you take!)

If I can be of assistance to you for anything in the future (reference, advising, support), please let me know!

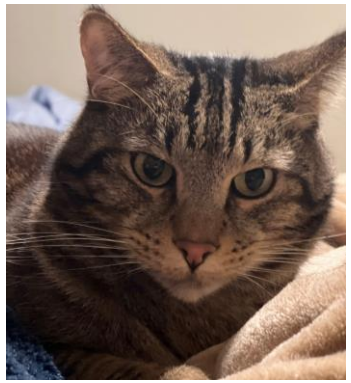
I will be teaching CSCI 466, CSCI 476, and ??? next semester**

Connect with me on LinkedIn!

Reese Pearsall (He/Him)
Instructor at Montana State University
Bozeman, Montana, United States · Contact info

**if I am here

Congrats to those that are graduating next weekend! I hope you find a job that you love!



Meatball wishes you good luck