Montana State University Computer Science Department

Graduating Senior Exam

Spring Semester 2022, 80 minutes.

Your performance helps us assess how well we are meeting our stated learning outcomes for computer science majors. To pass this exam, spend at least 45 minutes in order to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Walker O. Ward

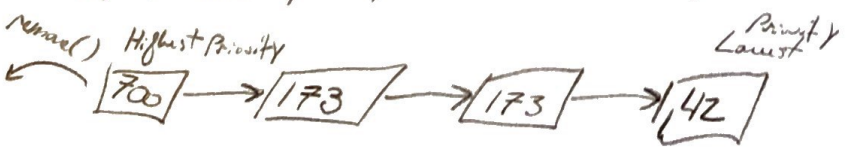
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer service team needs a way to find the most urgent ticket in the system and remove it when it has been addressed. New tickets can arrive at any time.

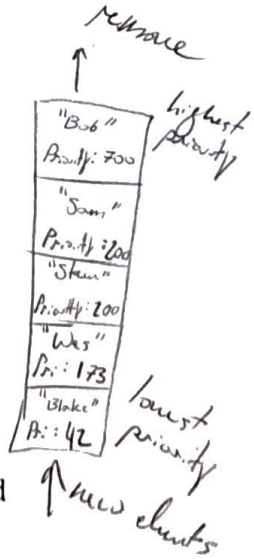
a) What simple data structure would best model this situation? Explain.

Priority Queue. A priority queue orders elements at the front of the queue by highest priority. Then based priority is tied, elements that arrived first w/ the same priority will appear before others

b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

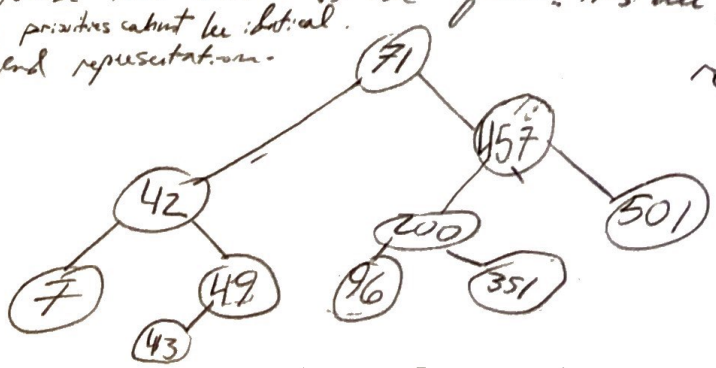
You could implement w/ a Linked List.
Each element would have a priority & a value.
To insert find the first element in the List w/ a lower priority & insert this element just before it.





c) Describe a second way in which this data structure could be implemented and draw a picture of that data structure.

You could implement w/ a Binary Search Tree.
Cache the tree & find right most Node when removing one from the "front" of the queue. #'s are priorities. Values stored elsewhere
However priorities cannot be identical.
in the standard representation.



remove() would return value of element w/ priority 501

Question 2: Write a function in a language of your choice that has two parameters: a string and a character. The function should return the number of times that the character occurs in the string.

Your language of choice (e.g. Python):

Your solution: python 3

```
def occurances_in_str(string: str, character: str) -> int:
    if len(character) != 1:
        raise ValueError("Length of arg character should be 1")
    return string.count(character)
```

Question 3: Consider a singly linked list that contains **n** floating point numbers and is maintained in ascending order. An additional **k** floating point numbers will be added to the list, one at a time. You may assume that **k << n**.

Best case time complexity of algorithm:

O(k)

Explanation of best case time complexity:

In the best case each new float will be added onto the front of the list. Ie. Each new float is less than the previous. & each insertion only needs to move the HEAD pointer, create a new node & point to the previous node

Worst case time complexity of algorithm:

O(kn)

Explanation of worst case time complexity:

In the worst case each new node will be added to the end of the list. Each node in the list will have to be compared against the value of the new node

Question 4: List any extracurricular community involvement (e.g. the Gallatin Valley Food Bank or coaching), extracurricular university involvement (e.g. Engineering Ambassadors, Swing Cats, AWC or ACM) or paid internships (e.g. Workiva intern or Undergraduate Course Assistant) that you were involved with during your time at MSU. For each activity, (1) **provide** the name of the organization, (2) **describe** briefly your main activities and (3) **estimate** the total number of hours you spent.

Organization	*Main Activities*	*Hours Spent (estimate)*
Bridger Solar Team	Member; EE & ME related	100hrs
CS Outreach	Hour of Code, etc.	10-20hrs
AWC & ACM	Member	~30hrs
Table Top Brigade	Member; board games	~100 hrs
Robocats	Software Team Lead	~150hrs
Datamine QAE Intern	Programming	~580 hrs
Undergrad Research Asst.	Programming & Research	More than 440hrs
FIRST Volunteer	FLL, FTC, FRC events	+60hrs
LAHF (club) Ie. HEMA	Member; boyscouts	~16hrs

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

An issue in software that produces unfair results based on favoring certain protected data points

b) Provide a hypothetical example of how algorithmic bias could manifest itself in college admissions software.

Could cause an admission system to disproportionately accept or recommend the admission of a specific race or gender over others

Question 6: In 2010 Oracle sued Google claiming copyright and patent infringement for 11,500 lines of Java API copied code. Google used this small subset of code from the JAVA API for their mobile platform operating system. Pick a side (Google or Oracle) to win this lawsuit and explain 3 possible impacts to the computing industry of this win.

Side you choose to win: Oracle

First possible impact:

Any segment of code could be copywritten which could make some code 'illegal to use'

Second possible impact:

Possible that applications would have to be restricted or 'limited' from interfacing w/ certain applications based on arbitrary

Third possible impact:

API would not be able to be forked (to add/modify f(x)-ality

Question 7: In the ACM Code of Ethics and Professional Conduct, one ethical principle stated is to ***avoid harm***. Describe three different types of harm that the software of an autonomous, self-driving car might cause.

First type of harm:

Physical: Could cause death or injury based on decisions

Second type of harm:

Emotional: Controls can erratically or make dangerous decisions, ect.

Third type of harm:

Psychological: Could threaten life of passengers if don't pay some kind of service fee or something.

Question 8: Describe your one-year plan following graduation. If you plan to work, list where you have applied (the company and the position) and mention whether you have received any offers. If you plan to go to graduate school, list where you have applied (the school and the area of study) and mention whether you have received any acceptances.

I plan to work at Datahins as a Quality Engineer. Position accepted on Nov. 1st 2021.

Question 9: List any organized social activities that you were involved with during your time at MSU. For each activity, (1) **provide** the name of the organization, (2) **estimate** the total number of hours you spent.

Organization Name	*Hours Spent (estimate)*
D&D	4/60
Table Top Brigade	100 hrs

Question 10: List any activities that you were involved with during your time at MSU that prepared you to work more effectively with teammates whose backgrounds are significantly different than your own. For each activity, (1) **describe** the activity and (2) **estimate** the total number of hours you spent.

Activity Description	*Hours Spent (estimate)*
Bridge Software Team	100hrs
Robocats	150hrs

Question 11: Name the most sophisticated version control system that you use and describe three nontrivial features it has.

Name of most sophisticated version control system:

Git

Non-trivial feature 1:

Branches: Allow you to maintain multiple versions of a codebase simultaneously

Non-trivial feature 2:

Changes: Changes are tracked for the life of a codebase

Non-trivial feature 3:

Revert: Allows you to undo changes after they've been commited

Question 12: During your time at MSU, list any major non-classroom, non-paid activities that you engaged in to help prepare for your computer science career. For example, you might have taught yourself a programming language or attended a workshop on a CS topic. For each activity, **estimate** the number of hours spent.

Activity Description	*Hours Spent (estimate)*
Personal Projects	
- Ubuntu Server	100 hrs
- Ras. Pi	30 hrs
- Arduinos + Microcontrollers	+100 hrs
Advanced Python + Programming Concepts	40 hrs
Personal Research: Comp. HW, SW, Etc.	+1000 hrs

Best wishes wrapping up the semester and in the future!