Montana State University Computer Science Department

Graduating Senior Exam

Fall Semester 2021, 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 Natalia Eigner

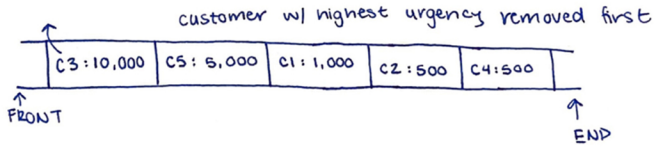
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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.

A maximum ~~minimum~~ priority queue would best model this situation. This is because in this structure, ~~elements are added~~ customers would be added when they enter the system and the customer w/ the highest urgency score would be removed first.

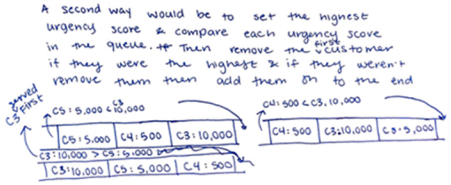
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

This could be implement by adding a customer to the queue as a key value pair w/ the values being the urgency score. That way, the customer w/ the highest urgency score would be removed from the queue and addressed first.



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

A second way would be to set the highest urgency score & compare each urgency score in the queue. If then remove the first customer if they were the highest & if they weren't remove them then add them on to the end



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): Python

Your solution:

```
input = 'refrigerator'
lookChar = 'r'
count = 0

for element in input:
    if element == lookChar:
        count += 1
print("the character", lookChar, "appears in", input,
      count, 'times')
```

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(kn)

Explanation of best case time complexity:

This is the best case ~~because~~ time complexity because it accounts for the best case where k and n are already sorted and only the ~~ordering~~ sorting between the two lists need to be found

Worst case time complexity of algorithm: O(nlogn · klogk)

Explanation of worst case time complexity:

This is the worst case that ~~sorting~~ mergesort is used first to sort n in ascending order, then k in ascending order, then the two combined in ascending order.

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)*
TechLink	internship	600
SensorLogic	internship	400
Cru	leadership	600
Girls who code	tutoring/mentoring	40

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is bias that is encoded into how an algorithm was originally developed such that it favors ~~or~~ a specific group of people.

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

If college admissions software gave rankings to certain activities, grades, or demographics that was biased towards a specific group of students.

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: Google

First possible impact:

progression in technology

Second possible impact:

more transparency on effective tools for new innovation

Third possible impact:

more discoveries about efficient operating systems

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:

might be vulnerable to hacking causing harm to driver and pedestrians from outside threats

Second type of harm:

might make the wrong moral decision when deciding between two collisions

Third type of harm:

might not have a thourough enough definition of obstacles and thus not recognize one and run into it.

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 continue working at SensorLogic where I am interning and then look for a job in Seattle in the fall.

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)*
Intramural soccer	40
Cru	400
Humanitarian club	20
Competitive freeskiing	100

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)*
Girls who Code	40
Humanitarian club	20

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: Github

Non-trivial feature 1: issue tracking

Non-trivial feature 2: merge control and conflict detection

Non-trivial feature 3: automated tests

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)*
LinkedIn learning videos	15
various CS related talks	10

Best wishes wrapping up the semester and in the future!