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: *Tanner Rubino*

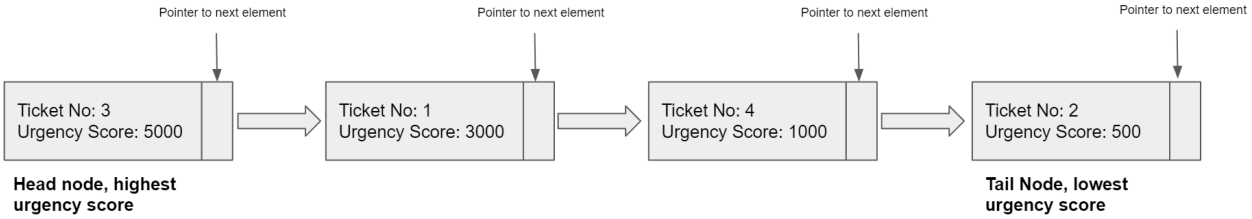
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 priority queue data structure would work best for this situation as it would automatically sort the data by urgency score every time a new entry is added and keep the highest urgency score at the top and ready to be removed.

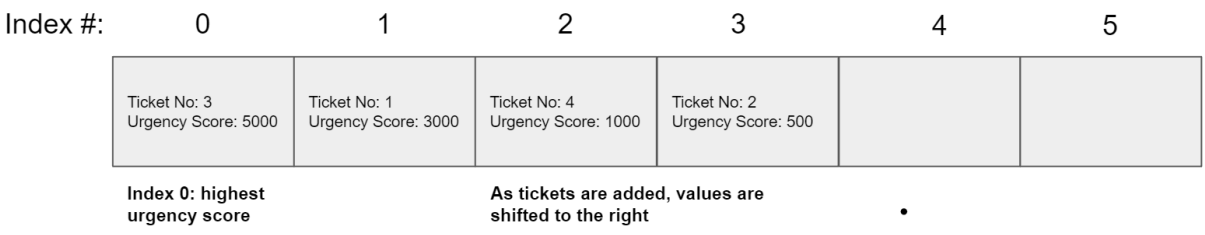
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

You could use a singly linked list of ticket objects to implement a priority queue. The list would ensure that each time a ticket is inserted into the list it will traverse to the correct spot based on urgency score with the highest value always at the head



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

An array of ticket objects could also be used for the priority queue. An array would be created and each time a ticket is added to the queue the array would find the proper index and shift every element of lower priority to the right. If the max size of the array was reached then the size would be doubled.



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: ***Python***

Your solution:

```
def count_chars(string, check):
        counter = 0
        for char in string:
                if char == check:
                        counter += 1
        return counter
```

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: ***k***

Explanation of best case time complexity:

If every number added to the list is consistently lower than the last number added and the rest of the list then the list will only need to keep adding elements to the beginning of the list. In a linked list this can be done without traversing the list and in O(1) time and would therefore only need to be done k times to add all k numbers.

Worst case time complexity of algorithm: ***kn***

Explanation of worst case time complexity:

If every number added to the list is higher than the previously added number and the rest of the list then the list would need to be fully traversed every time a new number is added. Because it requires n operations every time an element is added it would require kn total operations.

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)*
Spirit of the West Marching Band	Played at every home football and most home basketball games Traveled for playoff and championship games	about 300 (outside of class time)

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is esentially a phenomenon that occurs when datasets that are used to feed an algorithm use data that is not very diverse, and therefore the predicitons that the algorithm may make are biased towards those similar datapoints without taking as much consideration from the different data points.

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

If a college admissions software relies on an algorithm to help predict the best possible cantidates based on current data of students enrolled or based on qualities of other students who have been accepted then algorithmic bias could occur.

If a large percentage of the current or previously accepted students were of a certain race the algorithm may then prefer students of that race as being better cantidates because of a large amount of data supporting students of that race. This can lead to major problems if students of a different race are applying for school as they could be less likely to be picked as their race would be less represented in the dataset

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:

A win by Oracle could mean that code snippets could become harder to use and could destroy many projects that use snippets of code from other companies.

Second possible impact:

Code as a whole could become more personalized, companies would have stronger ownership of their own code, even just small sections of it

Third possible impact:

If the Java API code was used by Google in developing the Android operating system then the operating system might have to undergo large changes which would have a huge impact on the mobile app industry.

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 harm to someone or multiple people if the car is unable to avoid a pedestrian or another car

Second type of harm:

Autonomous cars could greatly disrupt traffic flows and cause harm to the entire traffic system if they stop working or fail to follow basic traffic laws

Third type of harm:

They can cause major financial harm if they crash into other cars or destroy property

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 have recently accepted a job offer at Computers Unlimited based in Billings. I will be a programmer on the Medical Development team and will start in mid June about a month after graduation. I will be mainly working remotely from home in Bozeman.

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)*
Gallatin Trumpet Guild	20

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)*
Section leader in the SOTW marching band	100

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/GitHub

Non-trivial feature 1:

Ability to create branches if members of the team want to work on features seperately and then merge them back in later

Non-trivial feature 2:

Can view all previous commits to trace errors or revert back to earlier versions of code

Non-trivial feature 3:

Can easily share code accross different devices and platforms and keep code up to date if working from different devices

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)*
Taught myself basics of Kotlin langauge	5
Created complex Excel spreadsheets for investments	20
Researched and built a computer from scratch	20

Best wishes wrapping up the semester and in the future!