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.

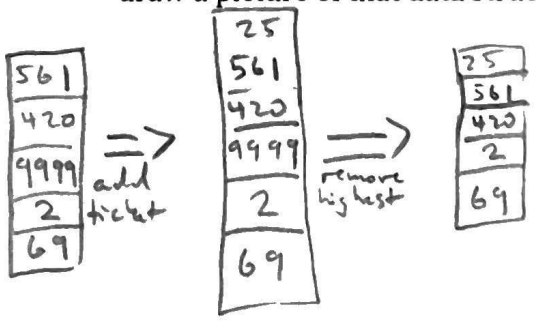
Name Mark Mousel

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.

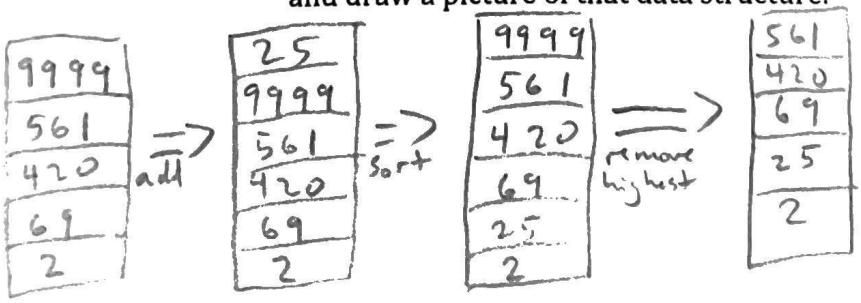
A priority queue would be a good choice for this system, as each ticket could be assigned a node with a priority value assigned by the person who submitted the ticket. Different ranges of priority could be determined based on time to ensure only important tickets are marked as such.

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



The first way would be to use an unsorted queue, pushing new tickets onto the stack as they come in. When a ticket needs removed, a search for the highest priority will commence and the appropriate ticket will be removed when completed.

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



The second way would be to have the queue be sorted. This way the highest priority ticket could simply be popped off the top of the queue when needed. However, the stack would have to be sorted after every data entry to ensure the pop works correctly.

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): Java

Your solution:

```
Public int count (String s, char c) {
    counter = 0;
    for (int i = 0; i < s.length; i++) {
        if (s.charAt(i) == c) {
            counter++;
        }
    }
    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: O(1)

Explanation of best case time complexity:
With a sorted list, the best case would be if the element being added is the largest and is therefore added to the front. This means that only one element is being checked at each iteration, and the time complexity would be O(1).

Worst case time complexity of algorithm: O(n)

Explanation of worst case time complexity:
Since the list is sorted, the list will have to be checked element by element to see where the number being added fits. The worst case would be if the number is the smallest, meaning the whole list is checked and the time complexity is O(n).

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)*

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias simply means that algorithms can create unfair outcomes for different groups of people, even when using seemingly innocuous data.

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

If a potential student who belongs to a historially unprivelleged minority group applies to the University in question, the algorithm might make assumptions on things like their financial need based solely on their being a part of that minority group.

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:
Google has to rewrite the code in question, leading to a disruption of service to the Google mobile platform.

Second possible impact:
A precedent of using prewritten code being much more difficult or impossible is set.

Third possible impact:
There would likely be a wave of similar legal actions from other companies that would lead to countless companies losing significant portions of their code base.

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 injury from the autonomous car hitting a pedestrian or another driver.

Second type of harm:
Financial harm resulting from such a collision.

Third type of harm:
Psychological harm resulting from such a collision, particularly if the collision is severe.

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 somewhere in the video game industry post graduation, and to that end I have applied to several companies, including Obsidian Entertainment, Bethesda Game Studios, and Paradox Interactive, among others.

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)*
Bobcat E-Sports: R6 Siege team	140
Intra-mural Soccer (Indoor and outdoor)	~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)*
Bobcat E-Sports; R6 Siege Team	140
Intramural Soccer	~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: Github

Non-trivial feature 1:
Allows for multiple programmers to work on a project simultaneously.

Non-trivial feature 2:
Repos can be made public or private making it good for open-source programming and for private enterprise.

Non-trivial feature 3:
Has several project management features such as the ability to set milestones, create tickets, and see individual's contributions, all of which help facilitate a better work environment.

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 self Unity	30-50

Best wishes wrapping up the semester and in the future!