Montana State University Computer Science Department

Graduating Senior Exam

Spring Semester 2022, 60 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 Connor Snow

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.

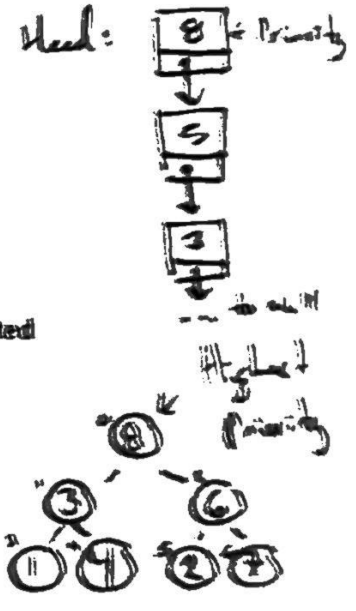
a) What simple data structure would best model this situation? Explain.

Priority Queue. Each element is associated with a priority value. Elements are served on the basis of their priority.

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

Linked List:

In a linked list we would simply keep the highest priority entry at the front of the queue and lower priority at the back of the list (list)



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

Binary Heap:

Binary heaps can be Min Heap (smallest value at top) or Max Heap (largest value at top). Given our necessity to find higher priorities the max heap method reuse

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 class Exam {
    public static void main(String args[]) {
        int total = countChar("abracadabra", 'a');
        System.out.println(total);
    }
    public static int countChar(String word, char c) {
        int len = word.length();
        int sum = 0;
        for (int i = 0; i < len; i++) {
            char check = word.charAt(i);
            if (check == c) {
                sum++;
            }
        }
        return sum;
    }
}
```

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:

In the best case, we can assume that we know the location of the last node and that the node being inserted will maintain the ascending order. So the time will remain constant, $O(1)$, no matter what.

Worst case time complexity of algorithm:

$O(n)$

Explanation of worst case time complexity:

In the worst case, we won't know if the item being added will maintain the ascending order, so we will have to traverse the entire list of n item to check and that will take $O(n)$ time.

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)*
Teledyne PMI	Software Internship	700+
ASMSU Senate	Represented student interests	100
OIP Global Ambassador	Study abroad advisor	30
CSCI 495: Consulting	Consulting for CSCI 167	30

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is systematic and repeatable errors in a computer system that create unfair outcomes, such as privileging one group of users over another

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

Say that for every entry in the college admission software there were a field that denoted whether that prospective student's family had donated to the alumni association or had funded some university related function, so the algorithm starts weighing their admissions prospect more favorably- no matter the other factors of their application. This would be an example of where algorithmic bias could occur.

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 Wins

First possible impact:
The lines that determine what is within the realm of "fair-use" starts to blur

Second possible impact:
Globally, copyright law may have to be revised and potentially become more restrictive

Third possible impact:
Technology benefits when knowledge can be freely shared, not being able to use existing technology could hinder technological advancement

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:
Self driving cars (currently) rely on the structure of our roads and infrastructure that are not optimized or well maintained. There is so much variability that could result in accidents.

Second type of harm:
Jobs that are dependent on human drivers would disappear and many could lose their livelihood.

Third type of harm:
Autonomous cars could be hacked to be stolen, locked out, or otherwise tampered with in such a way that compromises safety and reliability.

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've received a job offer from Fast Enterprises as a Software Implementation Consultant. I'll be relocating to the Pacific Northwest this Summer. After getting established, I plan to study for cyber security certifications in my free time.

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)*
N/A	N/A

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)*
EGEN 310: Multi-D. Engineering	90
CSCI 493R: Capstone Project	120+

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 (Git)

Non-trivial feature 1: Advanced Merging - being able to seemlessly merge multiple code branches into one unified code base.

Non-trivial feature 2: Update/Sync speed - can quickly pull existing changes on a remote server and update your local code base with efficiency.

Non-trivial feature 3:

Code review tools make the code review process more ~~thorough~~ thorough and painless.

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)*
N/A	N/A

Between work and school, I never had time to pursue personal projects related to CS.

Best wishes wrapping up the semester and in the future!