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 Caden Fong

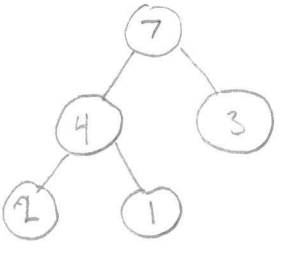
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

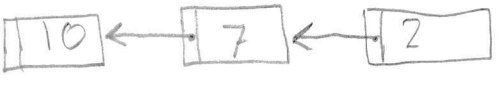
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

This could be implemented using an object to represent a ticket with a priority and a heap to store the tickets.



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

A linked list could also be used to implement the queue.



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:

```
public static int countCharInString( String str, char c) {
        int count = 0;
        for ( int i =0; i < str.length(); i ++) {
            if ( c == str.charAt(i)) {
                count ++;
            }
        return count;
}
```

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:

$O(k)$ or $O(1)$

Explanation of best case time complexity:

The best case scenario is that each additional floating point number should be added at the beginning/ending making it constant time complexity.

Worst case time complexity of algorithm:

$O(kn)$ or $O(n)$

Explanation of worst case time complexity:

The worst case scenario is that you would need to search the entire list everytime you insert a number which means that the time complexity is linear.

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)*
Society of Physics Students	Listening to talks	2
MSU Adventuring club	ttrpgs	50

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithic bias is when an algorithm has the unintended consequence of making decisions based on a biased model.

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

If the college admissions software is built on a biased model it could discrimminate applicants dispraportionately based on statistics showing that a particular marginalized group is not a good fit.

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:

More software is open to be used given a proper use of said software.

Second possible impact:

Licensing becomes a very important step in development.

Third possible impact:

Bigger companies will seek more secretive routes to protect their software

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:

Failure to react to unknown events leading to injure / fatalities.

Second type of harm:

Make unethical decisions based on bias black box software

Third type of harm:

Failure to meet standards leading to slower transportation.

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.

Get a job and pay off debt. I have sent no applications and have received no offers.

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)*
Worked Mod Crew at Walmart	350
Played D&D	200

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:

Commit history

Non-trivial feature 2:

Easy to use with Github

Non-trivial feature 3:

Rolling back significant changes

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 Javascript	80

Best wishes wrapping up the semester and in the future!