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 Brandon Marceau

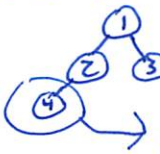
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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. A priority queue is similar to a regular queue, except it has the additional priority associated with each element. We can use the priority to dequeue the element with the highest priority first (where priority = urgency score)

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

This can be done as a binary tree with min heap structure, so that the root node is the smallest (lowest urgency score) and every parent is smaller than its children. Highest urgency scores are at the bottom and can be removed first. As new nodes are added, it gets sorted.



Processed and removed first, based on urgency score "4".

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

This can be done with a queue data structure where every time an element is added the queue is sorted, so the highest urgency scores are at the front and dequeued first.



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:

```
def count_character(string, character):
    num_character = 0
    for i in range(len(string)):
        if string[i] == character:
            num_character += 1

    return num_character
```

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:

$O(n)$

Explanation of best case time complexity:

Every k that is added to the list is larger than any n already in the list, so each k is added to the end of the list and the list does not need full resorting.

Worst case time complexity of algorithm:

$O(n^2)$

Explanation of worst case time complexity:

Every k that is added to the list is smaller than all n values in the list, so must be sorted to reach the beginning of the list in order to maintain ascending order for the list.

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)*
MSU STAT 216 TA	Grading, In Class Questions	~30-40

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is errors in a system or program that choose one group of people over others. This could give one group an advantage over others, or give a group a disadvantage.

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

A college admissions software might take old historical data and feed it to the system. That old data may contain past admissions for a college that is highly skewed towards accepting white males. It could also have data showing rejection of people with African or Middle Eastern sounding names. The AI learns from that skewed data, then continues to accept white males and reject others disproportionately.

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:

Web development is stunted, because APIs are copyrighted and noone can create free open source web applications using APIs.

Second possible impact:

Oracle is the number one tech company in the world and has the best and brightest programmers, while Google lags behind not nearly as big as it is now.

Third possible impact:

The Java programming language is the number one sought after skill for companies looking to hire. Anyone that wants to go into software dev better learn Java.

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:

A self driving vehicle could malfunction doing harm due to a software bug in the form of running off the road and killing, maiming, or injuring a person.

Second type of harm:

A software bug could cause a car or truck carrying harmful chemicals to run off the road into a water source and contaminate that water source.

Third type of harm:

Software that allows for autonomous, self driving vehicles could cause loss of employment and job opportunities for bus drivers, truck drivers, taxi cab drivers, mail carriers, etc.

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 get a job in the tech world, and am trying to stay in the Bozeman or Missoula area.

I have applied at:

Zoot Enterprises - Solutions Developer (Interview, No offer)

Workiva - Software Engineer (No offer)

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	

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)*
TA for STAT 216	~30-40
TA for CSCI 127	~30

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:

Multiple people working on one project in a single repository.

Non-trivial feature 2:

Commit history can be seen and looked up.

Non-trivial feature 3:

Compatible with all operating systems and compatible with most other version control systems.

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)*
Udemy Java Programming Masterclass	~ 20
Udemy Complete Python Bootcamp	~ 8
Udemy Master SQL for Data Science	~ 4

Best wishes wrapping up the semester and in the future!