Montana State University Computer Science Department

Graduating Senior Exam

Fall Semester 2021, 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 Hannah Madsen

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 hashmap would be the best to model this situation, so it can easily relate an urgency score to a ticket id.

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

The key would be the urgency score & value would be the ticket id.

keys	1	26	1005	52	(urgency score)
values	AB2	CE5	JP4	ML3	(ticket id)

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

The key would be the ticket id & the value would be the urgency score.

keys	KE7	PQ8	OH9	DC5	(ticket id)
values	12	3862	9846	274	(urgency score)

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 total_char(s, c):
    total_chars = 0
    for letter in s:
        if letter == c:
            total_chars = total_chars + 1
return total_chars
```

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)

Explanation of best case time complexity:

If the number you are adding is always the smallest, then you will only need to check against the first value in the list before inserting it to be the new head. This only takes O(1) time & performed for k numbers in the list produces O(k).

Worst case time complexity of algorithm:

O(k*n)

Explanation of worst case time complexity:

If a number from k is always the largest, we will have to compare against every number in n and then insert at the end. This takes O(n) time & if performed for all values in k, we will have a worst case time complexity of O(k*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)*
AWC	Attended meetings	20 hours
Wellness Committee	Organized Acts w/Rec	25 hours
LANL Intern	Data Visualization SW engineer	1040 hours
Undergrad Course Assistant	Helped in CSCI 107	160 hours
Lab Assistant (MSU)	Insect Lidar ML	160 hours

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) **Describe briefly what algorithmic bias is.**

Algorithmic bias is when an algorithm is designed or tested using data that fails to include all groups or people, and inheventily leaves them out.

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

Algorithmic bias could manifest itself in college admissions software, if the software were to determine admission using a previous data set of individuals who successfully graduated college; however, this data set could be composed of mostly white, wealthy males, and so the algorithm would likely favor white, wealthy males for admission, & fail to include women, non-binary folks, people of color, or poor people.

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:
Open source & sharing of code mentality is adopted by the bigger companies (i.e. FANG).

Second possible impact:
It may be harder to get patents/copyrights for code and/or require more specificity.

Third possible impact:
Other companies would be allowed to copy code subsets from the JAVA (or other) API.

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:
Harm to the driver by crashing into trees or failing to make a turn on an icy road.

Second type of harm:
Harm to others by failing to break or slow down for people and animals.

Third type of harm:
Harm to property by failing to identify and avoid signs, fences, or non-road paths.

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.

After graduation, I will be moving to seattle to start as a software developer at Microsoft. I received and accepted my offer from them on October 19th.

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)*
Career Fair	5 hours
Women in Eng Dinner	3 hours

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)*
My research in the lidar ML lab	160 hours
Internship at LANL	1040 hours

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:

Sharing code with others via repositories & services like GitHub

Non-trivial feature 2:

Compare Histories of commits (git range-diff)

Non-trivial feature 3:

Avoid conflicts when merging by using branches

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 Go	30 hours
LeetCode Interview prep	50 hours
Mock interview prac w/sister	10 hours

Best wishes wrapping up the semester and in the future!