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: Stuart Smith

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.

I think a hash table would best model this situation, because there are a number of keys with associated values (tickets), and there is always a potential need to insert a new key/values pair at any point in the table.

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

The first way to implement this is to give every ticket a key, and have a value associated with it that corresponds to the urgency of the ticket.

Keys	Values
Ticket 1	10
Ticket 2	987
Ticket 3	56

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

Another possibility is to use urgency scores as a key, and have the ticket number as the value. This could speed up the process of searching for the ticket with the highest urgency, but no two tickets could be allowed the same urgency.

Keys	Values
100	1
789	2
65	3

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 occur_num(string, char):
    count = 0
    for i in string:
        if i == char:
            count += 1
    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)

Explanation of best case time complexity:

In the best case, all **k** numbers to be inserted are already in ascending order, and go before all **n** numbers in the list. The search for where to insert them therefore find the correct location after 1 operation, and only **k** operations are needed.

Worst case time complexity of algorithm: O(kn)

Explanation of worst case time complexity:

In the worst case, all **k** number to be inserted belong after all **n** numbers in the list. The search for the correct location for each number in **k** takes **n** operations. The total number of operations needed is **k** times **n** operations.

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)*
none		

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when an algorithm tends to have outcomes that favor/promote a certain side or group.

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

College admissions software could be made to admit a variety of people with different interests or extracurriculars. However, this could unfairly admit a larger portion of people from wealthy backgrounds, where applicants have access to a wider variety of activities.

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:
There could be more freedom in the computing industry to use sections of code from other APIs. This might lead to lots of innovation that wouldn't be possible without building off the work of others.

Second possible impact:

Organizations might have less incentive to create new or innovative code.

Third possible impact:
Organizations might be more secretive about how their software works, there might be less open-source 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:
The software could steer the car into a pedestrian.

Second type of harm:
The software might have limited security, and allow outside parties to control the car, possibly with malicious intent.

Third type of harm:
The software could crank the speakers too loud, damaging the ears of the passengers.

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.

Backpacking for a year post-graduation. No job offers, no plans for grad school.

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)*
Intramural Sports	40

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)*
none	

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: Code review on pulls

Non-trivial feature 2: Creating contributer files easily

Non-trivial feature 3: Remote repositories

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)*
Independent python/java projects	100

Best wishes wrapping up the semester and in the future!