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 Garrett Turner

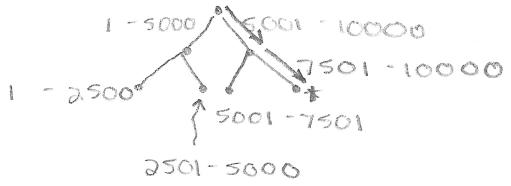
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 tree would be the best way to model this situation, the different branches could be separated into score ranges (i.e. 1-5000 + 5001-10000). If you continued to do this search the time complexity would be much less starting on the furthest right node instead of searching every ticket individually.

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

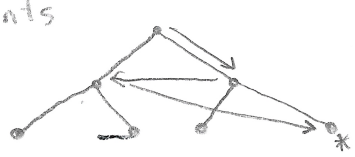
A series of if statements could be constructed to filter values into the tree.



A depth-first search would travel as far right and down as possible before backtracking.

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

A series of if statements could be constructed again to filter values.



A breadth-first search would traverse the tree differently as seen by the arrows. It would not be as efficient especially in a large tree but it is the other main algorithm for searching trees.

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(string, char):
    count = 0
    for i in range(len(string)):
        if (string[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(1)

Explanation of best case time complexity:

The additional k floating point number is added either to the start or end of the list.

Worst case time complexity of algorithm: O(n)

Explanation of worst case time complexity:

The list is searched linearly until the position for the floating point number k is found.

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)*
n/a	n/a	n/a

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

If there is an unintended or unjustified result from an algorithm that would be bias.

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

If an algorithm were to accept or decline a person addmission to an university based on race. This could even be unintentional or not carry a lot of weight in said algorithm, it would still be bias.

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: This lawsuit sets a standard for what is okay to use from other people's work (or lack thereof), 11500 lines of code is a significant amount of code.

Second possible impact: Companies are allowed to use each other's API's.

Third possible impact: What can and cannot be copyrighted by companies as far as code goes is defined in this case.

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 oneself, the vehicle could be crashed into a wall for example causing injury or death to the driver.

Second type of harm: Harm to others, the vehicle could crash into another vehicle causing injury or death to the people in that vehicle.

Third type of harm: The software is used to infringe on a person's privacy (information or actions) and that info is used to cause stress or mental harm against that individual.

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 on doing some traveling after I graduate and to take a break from work and school. I'd like to travel around on my motorcycle and possibly move somewhere I haven't been, Portugal would be cool.

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)*
Ramp Manager on Duty (My job at the airport)	35-40 hrs/week for 4.5 years
	↑ This is the main reason I wasn't participating in other activities in this test

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

Non-trivial feature 1: Can share projects across machines

Non-trivial feature 2: Ability to see and review changes made to projects.

Non-trivial feature 3: Can use the command line or a web-based interface, it is up to user preference

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

Best wishes wrapping up the semester and in the future!