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 Aiden Scallen

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 would use a priority que. It allows us to add this "urgency" to a normal que. Normal tickets get added to the end of the que, priorities get added up front where applicable.

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

Essentially it breaks down to several ques forming an escalator. Top priority to medium to low and com section builds as normal.



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

"Rebuild" que from front to back each time





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): Java

Your solution:

```
Private static int FindChar(char c, String str){
    int charNum = 0;
for (cntr = 0; cntr < str.length(); cntr++){
    if (str.charAt(cntr) == c){
        charNum++;}
}
return charNum;}
```

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:

In this case we either have only n floating point numbers and k = 1, or we have a new floating point number that is less than all k and greater than all n.

Worst case time complexity of algorithm:

$O(n+k)$

Explanation of worst case time complexity:

When our new number is greater than all n and all k.

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)*
NA	NA	NA

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is. Usage of bad data sets or improper use of data sets that lead to discrimination based of protected classes such as race or gender

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

An algorithm that selects students may use a data set that shows a majority of CS students are males and could select majority male students for admission assuming male = preferred as opposed to the reality of them just being more common in CS.

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: This API requires substantial cost to use and so falls out of favor losing market share.

Second possible impact: Oracle improves the API, offsetting the cost of licencing with quality serving out a loyal customer base.

Third possible impact: The fine for copyright infringement is less than the licensing cost and so google eats the cost and acts like nothing happened.

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 car must sacrifice the driver or someone else. Unavoidable accident. We must choose who is unharmed and who must be hurt.

Second type of harm: Bad code leads to side walks being classified as valid roads. Cars barrel down sidewalks until a patch is rolled out.

Third type of harm: Bad actors release a virus causing cars to accelerate and turn at random, mass accidents ensue.

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. Return home to spend a little more time with my parents while I still can. Then start the job hunt first in our local area but maybe look elsewhere as a flood of wealthy new arrivals are pricing the locals out.

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)*
NA	NA

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)*
Chem labs	60
Web design (lots of art majors)	15

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 / github

Non-trivial feature 1: Protected branches

Non-trivial feature 2: Code "owners", see who did what/when

Non-trivial feature 3: Make private repos from public.

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)*
learned python	30
watched videos ob AI/ML	20
Watched old talks from industry people	25

Best wishes wrapping up the semester and in the future!