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 Muzhou Chen

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.

The data structure that would be best model for this situation is a singly linked list. Since we are required to remove and insert new element into the data structure, linked list is faster than an array, especially if we want to insert an element in the middle (connect the ith element and (i+2)th element).

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

In the singly linked list, we store the urgency score as the item of each node. For insertion, we can iterate through the linked list and make comparison, add the score in-order, so that the end of the linked list contains the most urgent ticket. We can easily remove it from the list.

LowestScore -> …… -> HighestScore

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

Another way to implement this data structure can be store the urgency score in ascending order. Same as the insertion in question b, we can iterate through the list, make comparison, and insert it in proper location. The running time is O(n). Additionally, we can delete our root by assigning the root node to be the 2nd node in our list.
HighestScore -> …… -> LowestScore

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 checkOccurs(inputStr, character):
    answer = 0
    for char in inputStr:
        if char == character:
            answer += 1
    return answer


def main():
    inputStr = input("Enter a string: ")
    character = input("Enter the character: ")
    answer = checkOccurs(inputStr, character)
    print(answer)
main()
```

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 best case is that we are going to insert the elements at the beginning of the linked list (the k floating point numbers are inorder and larger than the 1st floating point in the list). In this case, we just do 1 iteration each time, make comparison with the root node, and add it at the beginning of the linked list. As a result, it takes constant time for time complexity. To be specific, it takes O(k).

Worst case time complexity of algorithm: O(n)

Explanation of worst case time complexity: The worst case is that the additional floating point numbers are in ascending order, and the largest floating point number is smaller than the last element in our linked list. In this case, we need to iterate through the linked list to the end for each insertion. As a result, it takes O(kn), by simplify that, we have O(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.

N/A

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

The algorithmic bias refers to the algorithm that are overly subjective, or the data that has been used contains legislation concerning certain protected characteristics, such as race, gender, etc. If the algorithm considered or used inappropriate factors, then it meets the algorithmic bias.

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

One hypothetical example of how algorithmic bias could manifest itself in college admissions software is relate to the inappropriate variables. For example, if we use gender, race, or sexuality as a variable to make any decision, it becomes an algorithmic 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: Oracle

First possible impact: The government will come up laws to protect copyright of the code. For developers, they may ask money if we are going to use the code.

Second possible impact: It may engage individuals to develop programs and people can earn money from the code they wrote.

Third possible impact: For the users, we may have fewer open resources of code than before. For example, we have to ask for using the code from Oracle if we are programming in 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: The first type of harm will be the decision that would be made during the accident. For example, the software have to decide where to go if the car is out of control.

Second type of harm: The second type of harm is hacking. It is necessary for the company to prevent customers from hacking.

Third type of harm: The third type of harm will be eco-friendly. Since the self-driving car need to make a balance between comfort, safety, and speed, it is hard to avoid wasting energy.

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 am planning to continue studying in computer science in MS program. I have applied the thesis track MS in our school (Montana State University) and do research project with Dr. Binhai Zhu in the computational biology field. I am now waiting for my recommendation letters, once I finish the application, me and Dr. Zhu are going to do some research for some potential topics that can be explore more in the future.

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.

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 EGEN310, working with students in engineering majors to create an auto-lock for the storage.

Hours Spent(estimate) One semester

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: Contribute to projects quickly with automatic environment setup.

Non-trivial feature 2: Allows contributors to notify you of changes once you push to a respository.

Non-trivial feature 3: Able to post and update within the people you chosen as a team.

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**.**

N/A

Best wishes wrapping up the semester and in the future!