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 Patrick O'Connor

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 best data structure that can model this situation is a tree or more specifically a max heap. A tree inherently provides a hierarchal way of storing data, allows for efficient insertion and removal at any time with a time complexity of O(Log n), and lastly getting the max priority ticket is in O(1) as it is sitting at the top of the max heap.

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

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

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):

Your solution:

Python using built-in and iteratively, This could be done with mapping but two simple solutions already exist:

```
def functionCountOccurBuiltIn(stringS, charC):
	countBuiltIn = stringS.count(charC)

	return countBuiltIn

def functionCountOccurIter(stringS, charC):
	countIter = 0
	for char in stringS:
		if char == charC:
			countIter += 1
	return countIter


def main():
	stringEx = "I am not sure how many times char a occurs here"
	charEx = 'a'
	aOccurencesBuiltIn = functionCountOccurBuiltIn(stringEx, charEx)
	aOccurencesIter = functionCountOccurIter(stringEx, charEx)
	print(aOccurencesBuiltIn)
	print(aOccurencesIter)

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:

The best case would be O(1).

Explanation of best case time complexity:

In the best case we are able to find the insertion point at our first node thus we just need to create the new node and fix pointers. This would only happen if the we need to insert the new additional floating point number at the beginning of the linked list each time.

Worst case time complexity of algorithm:

Worst Case is O(n).

Explanation of worst case time complexity:

For this worse case we get an O(n) time complexity as we must iterate through the entire list to find the insertion point of new node. Even in the better case that we do not need to traverse the entire linked list the insertion and adjustment of pointers ends up back at the original time complexity of 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.

Organization	*Main Activities*	*Hours Spent (estimate)*
Fly Fishing Club	Fishing and meetings	100+
ACM	Meetings	20 Covid stopped attendance
CS UCA	Student Assistance and Grades	300+
University Wiring	Wiring and Trouble Shooting	300+

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

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

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:

First possible impact:

Second possible impact:

Third possible impact:

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:

Second type of harm:

Third type of harm:

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.

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)*

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)*

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:

Tracking changes with the ability to roll back to previous version and back to current versions effortlessly within IDE.

Non-trivial feature 2:

Branching and merging between other peoples code

Non-trivial feature 3:

The ability for a distributed version control system.

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)*
Self-taught Programming Languages	100+
Self-taught Electronics	50+
Career Success Center Meetings	30
Financial Success Center Meetings	15

Best wishes wrapping up the semester and in the future!