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 Colton Weeding

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 hash map would be the best data structure for this model. This would allow for each ticket to have an urgency score associated with it. This way you could look up/sort the tickets by their urgency score.

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

Key	Value
10,000	ticket 1
9,000	ticket 2
7,200	ticket 3
1	ticket 4

You could have the keys represent the urgency the the value of the keys be the ticket.

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

((ticket 1, 10,000),
(ticket 2, 9,000),
(ticket 3, 6,000),
(ticket 4, 2,000))

You could also have the values (tickets) in a list with an associated key(urgency) and sort the list by urgency.

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 SOLUTION###

def my_function(str, char):
  num = 0

  for i in str:
    if i == char:
      num = num + 1

  return num

aString = str(input('Enter a string\n'))
while len(aString) == 0:
  aString = str(input('String invalid, please try again\n'))

aChar = str(input('Enter a character\n'))
while len(aChar) == 0:
  aChar = str(input('Character invalid, please try againr\n'))


number = my_function(aString, aChar)
print('\nThe character "' + str(aChar) + '" appears ' + str(number) +' time(s) in the string "' +
str(aString) + '"')
```

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 each number could be added at the first position checked, so the best case would be O^(k)

Worst case time complexity of algorithm:

O^(n*k)

Explanation of worst case time complexity:

In the worst case each item will be added to the end of the list, so for each item the list has to be read through fully. For this reason the worst case should be O^(n*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)*
Yellowstone E-Waste Solutions Intern	IT help / Computer Repair	40hrs/week - 12 weeks
Naval Undersea Warfare Center Keyport Intern	Torpedo Simulation Team	40hrs/Week - 10 Weeks
CSCI 107 Helper	Helped CSCI 107 Students in Class	2hrs/Week - 15 Weeks

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithms that bias certain groups unintentionally based on things such as race, gender, sexuality, etc.

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

An admissions software that assesses students based off of family income. This would reflect negatively on single-parent families and families with low income.

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:

Open source code becomes a thing of the past.

Second possible impact:

Teams/companies/solo developers now have to write ALL code from scratch, thus slowing software development.

Third possible impact:

Everyone who has ever written code that is used by someone else is now thinking of filing a law suit to get rich.

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 the driver if the car crashes or makes a wrong decision.

Second type of harm:

Harm to pedestrians that could be hit by the car.

Third type of harm:

Harm to the taxi/uber employee community by taking jobs away.

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 have already been offered a full time position at Computers Unlimited following my graduation. I have been put in the mobile app development department.

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)*
None	None

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)*
Playing Basket at the Gym	4hrs/week

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:

Open Source

Non-trivial feature 2:

Tracks History

Non-trivial feature 3:

Allows Collaboration

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)*
None	None

Best wishes wrapping up the semester and in the future!