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 Kieran Ringel

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 dictionary/ hashmap

the key would be the priority and the value would be the customer

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

if there was a collision, if a new customer gets added with the same priority as someone in the queue, then their priority will increase by 1 until they can be added without a collision

dict
{ 1:Joey,
3:Brian,
7:Jane }
add Sue with priority 3
it will see the collision and then try to add Sue with priority 4 resulting in
{ 1:Joey,
3:Brian,
4:Sue,
7:Jane }

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

if there was a collision the customer would be added to a singly linked list at that priority

dict
{ 1:Joey,
3:Brian,
7:Jane }
add Sue with priority 3
it will see the collision and add Sue to a linked list resulting in
{ 1:Joey,
3:Brian → Sue,
7:Jane }

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 char_occurances(str, char):
    count=0
    for let in str:
        if let == 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:

1k which reduces to O(1)

Explanation of best case time complexity:

if every value that is being added to the list is less than the smallest value in the list then the node will just be inserted which is O(1) the time complexity to look at the first node is O(1). O(1) + O(1) = O(2) this is done k time resulting in O(2k) but 2 and k are constants so in big O notation they reduce to O(1)

Worst case time complexity of algorithm:

nk which reduces to O(n)

Explanation of worst case time complexity:

if every value that is being added to the list is larger than the greatest value we have to traverse the list every time before inserting. the complexity of traversing the list is O(n), this plus the complexity of inserting is O(n+1), this is done k times resulting in O(nk+k) but values of a lower magnitude are removed because k<<n so we have O(nk) and k is a small constant so it is negligble resulting in 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)*
Girls Who Code	Volunteer w/ 3-12 graders	30
Los Alamos National Lab	Intern	400
Micron	Intern	400
Undergrad Course Assistant	Web Design	750

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

It is human bias that has been encoded in algorithms that will provide unfair results based on input that should not affect the outcome

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

Maybe a school historically would not admit students from a certain zipcode because previous admissions committees felt they did not have the academic background to succeed in college. This could unintentionally be included in an algorithm if it was included in a traning set, now even if a student in this zip code has standout academic performance the algorithm may make it harder for them to get in

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:
It would establish that APIs are not copyrightable

Second possible impact:
This would result in less companies publishing their APIs for people to use out of fear people may take their code

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:
If the car is not trained to 100% accuracy it could cause an accident taking someones life

Second type of harm:
the car could violate traffic law leaving the "driver" liable for something it didn't do

Third type of harm:
it could leave truck drivers and taxi drivers unemployed if they are replaced by autonomous cars

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 accepted a job at Microsoft on their Bing Ads team as a Software engineer and will be starting August 1st.

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)*
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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)*
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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:

allowing multiple people to work on code on seperate branches at the same time without creating conflicts

Non-trivial feature 2:

ability to rollback code to the last commit where things were working

Non-trivial feature 3:

allows code to be backed up off of a users personal device

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)*
CodePath Technical Interview Prep Course	50

Best wishes wrapping up the semester and in the future!