Montana State University Computer Science Department

Graduating Senior Exam

Fall Semester 2021, 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 Wesley Smith

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 table would best model this as each ticket (key) can be placed into the table with its urgency score (value) at any time independent of other tickets. As in a hash table, the keys and values can be found quickly and not need to traverse the whole list.

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

As I mentioned above, the hash table could be implemented with each ticket # as a unique key paired to the urgency score value. The values can be quickly searched and taken care of before removing from the system

ticket Id	Urg. Score
15	587
287	6,521
198	9,847
→5309	23
1408	3,426

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

A second way to implement this is to just change what is used for the key and value pair. This time, just use the urgency score as the key and ticket id as the value.

Urg. Score	Ticket Id
1289	15
5623	488
→499	27
8497	626
6244	1827

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:

```
#Technically Python's "character" type is just a string of
# length 1, but this works all the same.

full = "Hello World"
search = "o"
#hold the number of found results here
result = full.count(search)
print(result)
```

```
>> 2          #result printed here
```

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) best case time complexity

Explanation of best case time complexity:

The best case scenario for this search and insert would be O(k) as O(1) would represent searching the list and finding our insert spot at the beginning of the list. Best case scenario we would have this search a "k" number of times.

Worst case time complexity of algorithm:

$O(n^k)$ worst case time complexity

Explanation of worst case time complexity:

In the worst case scenario we would have to traverse the entire linked list to the max size of the list a number of "k" times for all values to be entered correctly.

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)*
AWC	Hour of Code	2-3
ACM	Technical Chair Member	15-20
Office Student Engagement	Service Saturdays	5-6

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is where an algorithm will produce unfair results that it is biased more to output.

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

In admissions software, algorithmic bias could manifest by making sure the software will only approve applications of a certain race or certain sex of the applicants.

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:
More strict copyrights being placed on code from larger companies.

Second possible impact:
Need for new patent rules on what kind of code can/cannot be used for other applications.

Third possible impact:
More partnerships being struck between computing industry clients to deliver products

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 property: rather than cause harm to the occupants the car might be programmed to run into signs/obstructions to slow down/keep passengers safe.

Second type of harm:
Harm to environment: similar to above, the car might be programmed to hit trees/bushes rather than cause harm to others.

Third type of harm:
Harm to data privacy: if implemented incorrectly, a self driving car could accidentally disclose personal information (home location, hours at home, etc.) to those who are not authorized to access it.

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.

Hopefully after graduation I will find a computer science related job to gain some experience in the field. So far I have applied to a few local companies in their intro c.s. related software positions (Zoot, onX, Workiva) and am waiting to hear back from their management.

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)*
ACM Hour of Code	2-3 hrs
ACM C.S. Ice Cream Social	2 hrs

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)*
BreaksAway Border Trip 2019	180 hrs (week trip)
ACM Club Meetings	15-20 hrs

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 is the only VCS I have used

Non-trivial feature 1:

Graphical representation of branch history

Non-trivial feature 2:

SSH key security for repository access

Non-trivial feature 3:

Commit code feature before push/pull for code consistency

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)*
Taught myself Blender	6-7 hrs
Updated local company's comp. system	2-3 hrs
Consulted startup business for app dev.	2 hrs

Best wishes wrapping up the semester and in the future!