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 Ahmon Collins

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.

Hash table:
- provides faster look-up times than other data structures
- Can handle relatively large amounts of data with ease via mapping

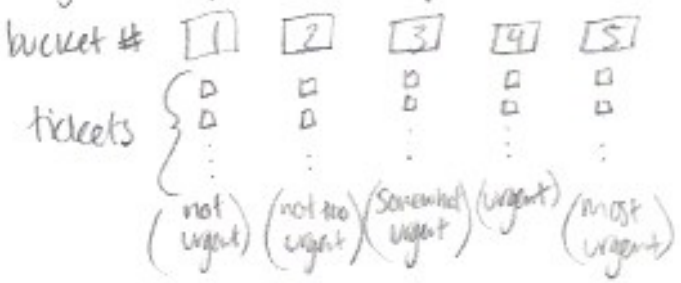
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

All urgency scores are mapped to their respective buckets numbered 1 to 10,000



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

Reduce the number of needed buckets to 5 buckets, then figure out a way to map values 1-10,000 into buckets 1-5. This method would provide significantly faster look-up times than the implementation above.



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): Node.js

Your solution:

```
function countString(string, char) {
    let count = 0;
    Array.from(string).forEach((c) => {
        if(c === char) {
            count ++;
        }
    });
    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: O(1)

Explanation of best case time complexity:

In a perfect world, all values of the k-floating point numbers are in perfect decreasing order, therefore every instance in k will be placed at the beginning of the linked list.

i.e. $n_0 = 2.3$ $k_2 = 2.0$
$k_0 = 2.2$ $k_3 = 1.9$
$k_1 = 2.1$
⋮ ⋮

Worst case time complexity of algorithm: O(n·k)

Explanation of worst case time complexity:

Worst case scenario would be traversing the entire list of n floating point numbers as well as all of k floating point numbers that have been added on top of the n elements

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	club meetings	30
Bridger Robotics	assist with programming	200
TechLink Intern	QA, web development	1400

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Any bias an algorithm takes on due to the quality of the dataset on which it was trained.

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

Training an algorithm to select the best candidates for college admission on a dataset of the top collegiate scholars in the country.

This bias would result in the algorithm only selecting students based on academic merit while ignoring well-rounded students with less academic achievement.

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: APIs are seen as public access unless otherwise specified for internal use only

Second possible impact: Prevention of co-ownership for using openly public resources

Third possible impact: Limitations on proprietary software

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~~ a social media platform (much bigger of an issue) might cause.

First type of harm: purposeful disinformation
↳ ACM Code – be honest and trustworthy

Second type of harm: obtaining profit off of PII
↳ ACM Code - respect privacy; honor confidentiality

Third type of harm: deliberate construction of social media bubbles through algorithms to conquer and divide populations
↳ ACM code - avoid harm; foster public awareness of computing and its consequences

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.

1) Support the local agriculture industry
2) Pay off student loans
3) Buy some land
4) Start a farm/beekeeping residence :

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)*
Expanding Your Horizons	5
Grace Hopper Conference	10

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)*
Bridger Robotics	200

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 / Gitlab

Non-trivial feature 1: code repository management

Non-trivial feature 2: commit history (timetravel capabilities)

Non-trivial feature 3: issue tracking

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)*
JetBrains' JavaScript Dev (html :)	2
HackTheBox	15

Best wishes wrapping up the semester and in the future!