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 Isabelle Bennett

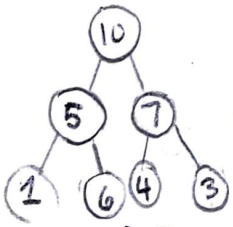
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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.

Max heap (priority queue) This structure would ensure the data associated with larger values would be at the top of the queue.

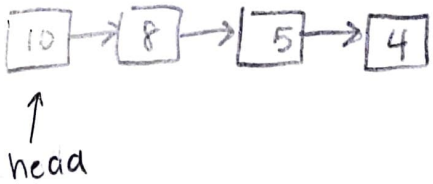
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

this could be implemented as a binary tree. Insert a node in the tree, then sort by value. So parent nodes are of greater values.



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

A second implementation is a linked list priority queue. traverse the list and insert data in front of whatever value it is larger than.



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): Java

Your solution:

```
public static int countChar(String word, char target) {

    int occur;
    char[] characters = word.toCharArray()
    for(char c: characters) {
        if(c == target)
            occur++;
        }

    return occur;
}
```

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:

All k values are less than the first item in the list

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

Explanation of worst case time complexity:

All k values are greater than the value at 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)*
Alpha Omicron pi	Social events	4 hour/ week
Paid Internship	Software testing	19 hour / week

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Unfair algorithms targeting one group of users over another.

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

By eliminating student's based on their backgrounds, certain attributes like Gpa or achievments can unfairly prioritize student's who've had access to more resource and opportunity than other student's.

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:

Reimplementing code would be a copyright offense

Second possible impact:

Developers would need to be much more cautious not to violate copyright rules. They couldn't use API's as freely in their work.

Third possible impact:

Less progress in the software development world. Not being able to use preexisting tools would halt productivity. There would be less sense of an industry standard in developp practices.

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:

Environmental damage — the convenience of an autonomous self-driving car could cause people to drive excessively. The resources required to make a car like this could also be tolling on the environment.

Second type of harm:

Societal harm. Reliance on a self-driving car would discourage individuals to learn how to drive.

Third type of harm:

Errors and malfunctions causing wrecks would cause physical harm to passengers.

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 plan on working at Submittable as a backend engineer.

I've been sent an offer for this position and I plan on accepting.

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)*
Alpha Omicron Pi	20/semester

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)*
Internship	19/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:

GitHub

Non-trivial feature 1:

Boards to tag and organize issues

Non-trivial feature 2:

A compare feature to view differences for branches

Non-trivial feature 3:

To-do list to view what you've assigned yourself to work on

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)*
HackerRank.com	2 hours / week

Best wishes wrapping up the semester and in the future!