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.

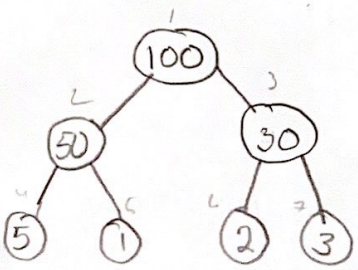
Name Alyssa Newhart

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 priority queue would best model this situation because in a priority queue, the item with the highest value/priority is served first regardless of when it was added. In this case, the ticket with the highest urgency score would be served first.

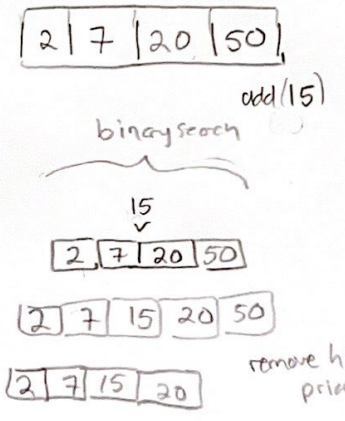
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.



A priority queue can be implemented using a max heap in which the root node would be the highest priority ticket and the heap would be sorted based on priority. A new ticket would be added to the end of the heap and the heap would be heapified in order to preserve priority. Upon removal of the highest priority ticket, it would be replaced by the last leaf node and heapified again to move up the new highest priority

100	50	30	5	1	2	3	
0	1	2	3	4	5	6	7

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



A priority queue can be implemented using a sorted array in which the highest priority ticket would be the final element in the array. In order to find where to insert a new ticket into the array, binary search can be used to locate the index, upon which all elements from the index onward would be shifted over to accomodate the new entry. In order to remove the highest priority ticket upon completion, remove the last element in the array.

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:

```
public int checkOccurence(String s, char c){
    int count = 0;
    for(int i=0; i<s.length(); i++){
        if(s.charAt(i)==c){
            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:

insert O(1)
search for place O(1) if the value is added at the front and is less than the value of the head, you would just insert the new floating point number before the head and make it the new head of the linked list.

Worst case time complexity of algorithm:

O(n)

Explanation of worst case time complexity:

insert O(1)
search for place O(n) since you would need to traverse the linked list once to find the correct insertion spot for any additional numbers.

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)*
Undergrad. Course Assistant	CS 145 Technical Lab Grading	40-50
SWE intern @ Kohl's	SRE tasks, UX project	1800
MSU BreaksAway	Refugee Focus 2018	60

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when the AI can produce incorrect or unfair results when handling the data of certain groups of people.

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

Algorithmic bias could manifest itself in college admission software if the software is only trained on students of a certain background. This could result in the AI favoring students from that background over other backgrounds because it has only been trained to consider those students.

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:

Could change the way that copyright applies to propietary software, making copyright infringement legal under certain circumstances

Second possible impact:

Companies, like Oracle, may no longer be able to enforce total copyright on their software, leading to potential financial loss

Third possible impact:

Companies may be more likely to use copyrighted or patented software up to the new, legal limit potentially set by the case

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:

A software bug could lead to a crash.

Second type of harm:

A software bug could cause the car to drive over the speed limit, resulting in the driver receiving a ticket

Third type of harm:

The software could be hacked allowing the car to be stolen or crashed

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 received and accepted an offer from Kohl's to start work as a remote Associate Software Engineer, in August of 2022.

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)*
N/A	

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)*
N/A	

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:

CI/CD; Automation

Non-trivial feature 2:

Project management

Non-trivial feature 3:

Private repos

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)*
Coursera Courses	50
LinkedIn Learning	20
Stanford Code in Place 2021	20

Best wishes wrapping up the semester and in the future!