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 Maria Gallivan

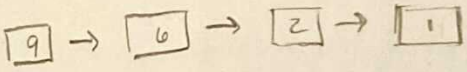
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

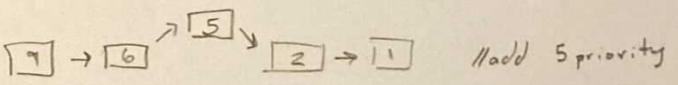
Priority queue - this first in - first out structure shifts the order based on priority and allows elements with the same priority to be served chronologically

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

Linked list

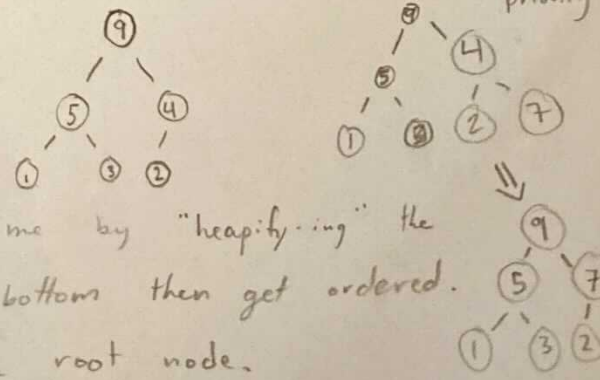


This would allow the developer to add a node in the correct order and look at the head for most urgent ticket.



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

Binary Heap



This would allow the developer to ensure the priority queue is in the right order at any time by "heapify-ing" the tree. Added nodes go to the bottom then get ordered. The most urgent ticket is the root node.

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 int CountChar (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:

If every floating point number added into the list was already sorted and greater than all values already in the list, Each added element could be added at the head. O(1)

With k elements added : k * O(1) = K operations

n : [6] → [5] → [4]
K = {7 8}

n : [7] → [6] → [5] → [4] K = {8}
n : [8] → [7] → [6] → [5] → [4] K = { }

Worst case time complexity of algorithm: O(n)

Explanation of worst case time complexity:

If every floating point number added into the list was already sorted and less than all values already in the list, each added element would have to be added to the tail. O(n)

With k elements added : k * O(n) = k*n operations

n = [6] → [5]
k = {4}

n = [4] → [6] → [5]
K = { }

n = [6] → [4] → [5]
n = [6] → [5] → [4]

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	served on board. facilitated community	720 hrs.
ACM	learned professional development staff	60 hrs.
Engineering Ambassador	help prospective students	45 hrs.
Northrop Grumman Intern	Systems Engineering	400 hrs.
Undergrad Course Assistant	help with lower division labs / grading	150 hrs.
Spirit Squad	D1 student athlete	2400 hrs.

6 hr wk 30 wk/yr 4 yr

1 hr wk 15 wk/yr 4 yrs

1 hr. wk 15 wk yr 3 yr

40 hr week 10 week

5 hr week 15 wk/sm 2 sm

20 hr wk 30 wk/yr 4 yr

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Systemic errors in computer systems that lead to unfair outcomes for a group.

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

Depending on the data set the software is trained on then algorithm could be valve different types of volunteering differently for example working with kids in local daycare could be "less valued" that working with kids in Boy Scouts despite a similar experience and dedication to service. This means people without access to National "name" programs will be biased against.

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: (Positive)

This allows for more new technologies to grow off the foundation of other technologies.

Second possible impact: (Positive)

Engineers won't fear losing their IP by using an API in a programming language.

Third possible impact: (Negative)

Could weaken protections for copyright of code and allow those with the best resources to develop improved versions of 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: Physical harm.

A car may have to decide between hitting a pedestrian or hitting a tree. This is possible physical harm to the driver or pedestrian and the developer has to decide which to hit.

Second type of harm:

Disclosure of Information (unjustified)

A car may communicate with other cars to find the fastest path through traffic. This might disclose information of where a car is going and thus allow for lack of location privacy for the driver.

Third type of harm:

Mental harm

A car may hit a person or animal to save the driver's life. There would be psychological harm of not having control over the vehical as it kills or injures something to save the driver.

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 accepted a position with Raytheon in Maryland as a Cyber Research Engineer. In mid-July, I will move to Maryland and start my career in the Cyber Security world.

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)*
AWC	720 hrs
HackerCats	30 hrs
Spirit Squad	2400 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)*
EGEN 310 - built RC car from scratch	75 hrs.
NCL - cyber security competition in teams	40 hrs.
Spirit Squad - student athletic team	2400 hrs.
AWC Board - plan meetings, outreach	480 hrs.
Wellness Committee Leadership - set up wellness committee for CS department	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: git hub

Non-trivial feature 1: branching

take independent lines of development and organize versions of the repository then merge together when ready

Non-trivial feature 2: sharing

can easily add collaborators and share code but also make a repository private if need be so no one can view its contents

Non-trivial feature 3: cloning

since the repository is online you can make a local copy by cloning the info. This allows it to be on any number of devices, and adds to the collaboration aspect.

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 basic HTML/css/JS	10 hr
Attended Grace Hopper Conference	40 hrs. 8 hrs 5 days
Attended ACM /AWC regularly	120 hrs.
Competed in NCL (cyber league)	40 hrs.

Best wishes wrapping up the semester and in the future!