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 Jacob Connelly

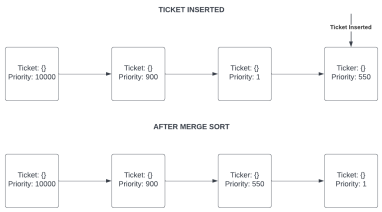
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

If I were to not use a complex data strucuture such a priority queue then I would use a Linked List that contains the tickets data and a priority field. I would then iterate over the linked list and find the highest priority ticket. This way holds the tickets data and priority in a way that is easy to access but iterating over the Linked List is not exactly fast. Sorting the Linked List every time a new node is added might make it easier to find the highest priority but would also tax the system's resources.

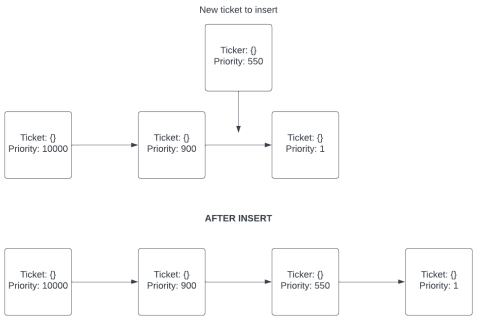
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

Create a Linked List containing a data field that holds the ticket object and a priority field that is an integer. Implement Merge Sort for the Linked List and call sort after every insert on the Linked List.



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

Create a Singly Linked List with the first node. Every time a ticket comes in it gets inserted into the appropriate position in the List where the root is highest priority and the end is lowest priority



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): C#

Your solution:

```
1 reference
public int CountOccurances(string str, char toFind)
{
    int count = 0;
    for (int i = 0; i < str.Length; i++)
    {
        if (str[i] == toFind)
        {
            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(N)

Explanation of best case time complexity:

In order to add to the linked list you must traverse it to find the correct spot to insert the node. Therefore you may need to traverse the list O(z - N) times where z is the position the node will be inserted. Removing constants we are left with O(N).

Worst case time complexity of algorithm:

O(N)

Explanation of worst case time complexity:

In the worst case k will be the largest element in the list, thus we must traverse the entire list to find that is needs to be inserted at the end. Meaning that if the list has n elements we must traverse all n. Thus our time complexity it O(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)*
PFL.com	Develop internal tools	1440

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when an algorithm produces unfair outcomes based on protected characteristics such as race, gender, sexuality etc.

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

An AI algorithm could look through a data set containing past admissions and learn that a specific race has a higher percent chance of being admitted into the school and graduating. This could lead to the algorithm denying entry based on race because it believes that individual will not perform as well as an individual of a race it sees with a higher acceptance rate.

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:

API's can be made identical to other API's stealing the original makers business.

Second possible impact:

Business's can create an API similar to another's API but with small adjustments and not worry about a lawsuit.

Third possible impact:

API's can be reused to quicken development time and waste less development resources.

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 in the form of an accident or hitting a pedestrian the car could not register.

Second type of harm:

Economic harm to companies that are based around a human driven vehicle

Third type of harm:

A false sense of security where the user might not excpect an accident and thus not wear a
seatbelt.

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 currently work for PFL.com as a software developer intern. I will start as a full time Junior Developer on May 23rd 2022. I plan to work mostly on the backend team and may dable in the front end as well. I will be placed on to the new product team being formed.

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)*
NA	

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)*
Class projects with partners	100

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:

BitBucket with git

Non-trivial feature 1:

Subtrees. As a company we use subtrees to share code across repos and easily merge code changes without copy and paste.

Non-trivial feature 2:

Webhooks. Webhooks are setup to trigger processes such as Sonar Cloud code analysis when Pull Requests are updated.

Non-trivial feature 3:

Branching. Branches are used to do local work before pushing the code into the main branch. Branches are also used to keep track of releases and where the code currently sits.

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)*
NA	

Best wishes wrapping up the semester and in the future!