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 Jesse Dahl

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.

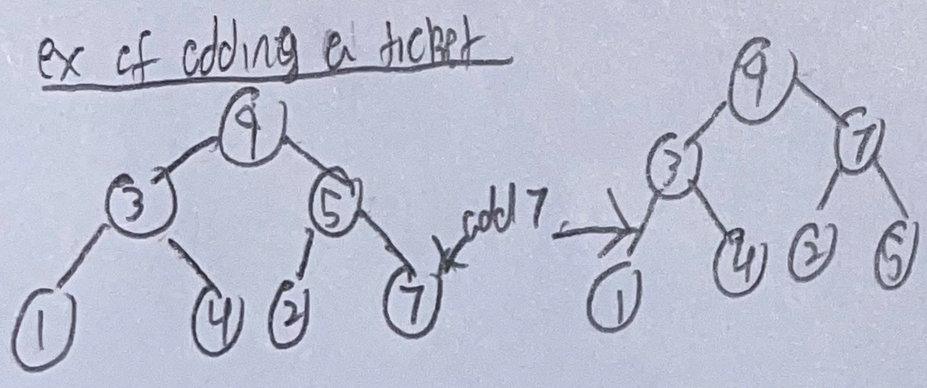
a) What simple data structure would best model this situation? Explain.

Priority queue. While this is an abstract data structure, it offers the best functionality for the issue. A Priority queue operates similar to a normal queue except that each element has a certain priority. In this case, the priority value that we assign to each element is obviously the urgency score

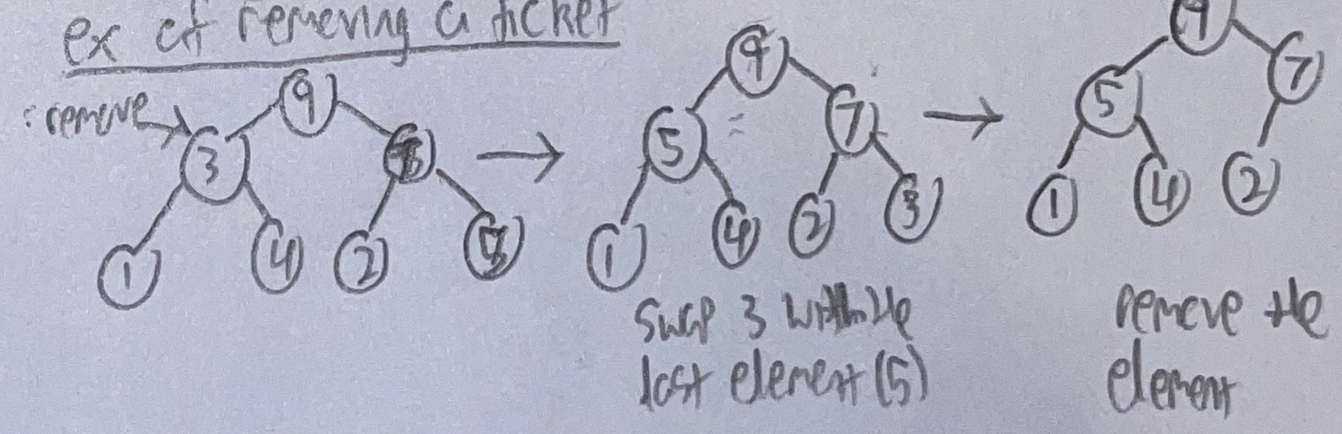
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

one way to implement a Priority queue would be to use a binary heap.

ex of adding a ticket



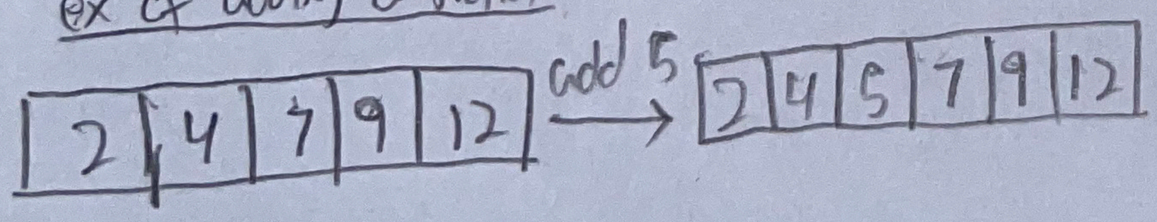
ex of removing a ticket



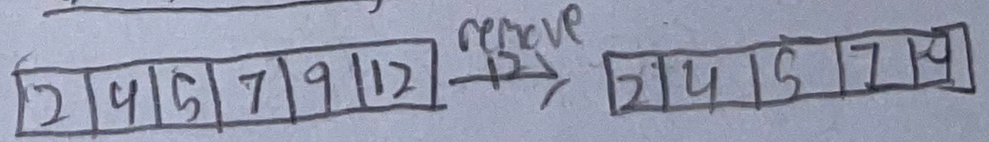
c) Describe a second way in which this data structure could be implemented and draw a picture of that data structure.

A Priority queue can also be implemented using a linked list

ex of adding a ticket



ex of removing a ticket



*this is all simplified. Within the actual software, I would store a key-value pair representing a unique user ID along with the urgency score associated with that ID. I would have a database where I could query for a user based on their ID to get more information on that user

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:

```
def characterCounter(input_str, input_char):
    return input_str.count(input_char)
```

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:

Finding the index in which to insert a new float would be a simple linear search, which has time complexity of O(n)
Inserting the new node in the linked list takes O(1) time.
O(n) outweighs O(1)
∴ the time complexity is O(n)

Worst case time complexity of algorithm: O(n)

Explanation of worst case time complexity:

See explanation above.
The worst is the same as the best. The process of inserting a new node will not change. Also, the number of nodes that will be added does not matter overall since only one node is inserted at a time.

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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)*
sellcut	software engineer	400
Midtech	software engineer	1600
biprox1	software engineer	1700

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is the term used to describe errors in a system that create 'unfair' outcomes that may privilege one group over another.

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

Hypothetically, this college admissions software could use a database that has very dated admission decision data that could reduce opportunities for students with a minority background

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:

First, this decision reaffirms what the doctrine of "fair use" covers within the realm of software.

Second possible impact:

This decision also makes software more accessible for developers

Third possible impact:

This decision makes the evolution of software more viable

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:

Obviously, Physical harm could be an issue. To safely drive autonomously, the vehicle would have to be able to handle any possibility that could arise within the unpredictable nature of driving. All it would take is a single miscalculation for Physical harm to the driver, and/or others on the road, to occur.

Second type of harm:

Much like with the development of AI in any sector/field; Perfect, autonomous vehicles could cause millions of people (such as truck drivers) to lose their jobs.

Third type of harm:

While unlikely, within any computer system, there is potential for vulnerability to hacking of these self-driving vehicles

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 as a software engineer at a startup called Biprexi. My plan is to stay here until we get acquired, cash out, then join the other developers of this team in another startup venture.

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:

Git

Non-trivial feature 1:

Simplified collaboration between peers/teammates on projects

Non-trivial feature 2:

Branching. Git allows users to work on a line that runs parallel to the main project files. This allows users to make changes to the project without actually changing the original code.

Non-trivial feature 3:

Github is a provider of internet hosting for Git. I am not sure if including this counts as it doesn't apply directly to Git. But Github recently released a beta project called Github Copilot. Copilot is an OpenAI driven project that analyzes your code that you have committed through Git to basically write code for you. Kind of cool but also worrying

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)*
N/A	

Best wishes wrapping up the semester and in the future!