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 Lin Shi

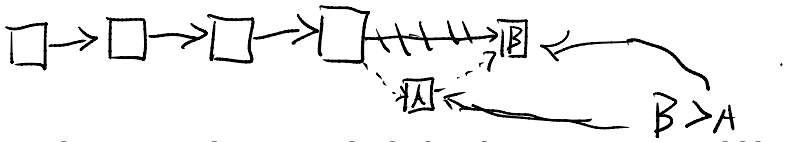
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 linked list would be best for this situation. We could append node as the tickets come and we do not need to worry about priority, just need to take care of the first in line.

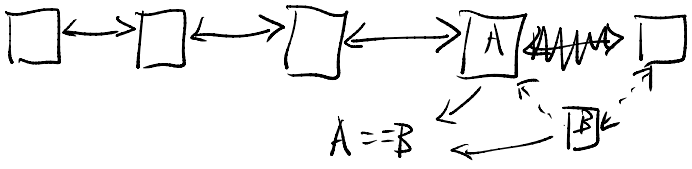
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

The first implementation uses a single linked list. We will iterate through until we find the one greater than our new ticket based on urgency score. Then we will add to the linked list.



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

The second implementation will use a doubly linked list. Where we will iterate from the back until we find the urgent score that is equal to our new ticket. Then we will add it to the back.



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 foo(character, testString):
    count = 0
    for element in testString:
        if element == character:
            count += 1
    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:

$\Omega(k)$ or $\Omega(n)$

Explanation of best case time complexity:

We will call the linked list A and the list of numbers we would like to add B. In the best case, B would be in descenting order where $B_0 < A_0$. Since B is in descenting order, we will add it to the first position of A every time. Therefore, we will do the action k times. Thus, our best case is $\Omega(k)$.

Worst case time complexity of algorithm:

$O(n^2)$ or $O(kn)$

Explanation of worst case time complexity:

Using the same naming as above, For the worst case, in each iteration to add to a node, we need to iterate through all elements of A. Thus we have $O(n)$. Additionally, we need to complete that k times and since $k << n$, we know our worst case run time is $O(n^2)$.

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)*
Engineering Ambassadors	tours for potential students	48 hours
Undergraduate Course Assistant	TA for lower-division labs	72 hours

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

An undetected error in the computer system that creates unfair advantage.

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

Suppose we are using the software to give the students a score, so the admission does not have to dig through every application and it would be more fair. However if the training set is biased, for example, have less female or rural applicants. The software might give these students a lower score if their hometown is small or if their name looks female.

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:
All code on APIs would be reusable with no restrictions.

Second possible impact:
Other platforms using code from APIs would not worry about rewriting their platform or portions of it.

Third possible impact:
The copyright of these code would be free use and the companies is not allowed to make profit from the code.

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:
If detected incorrectly, the self-driving car might make the wrong decision that could harm those in the car.

Second type of harm:
The car would not be energy efficient since it is doing everything it can to avoid harm.

Third type of harm:
When the car has to decide between 2 harms, the car might not know what to do.

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.

After graduation, I plan to attend graduate school. Since many of them only has fall admission, I plan to continue for another semester. I plan to apply for University of Utah, Wisconsin at Madison, University of Arizona, University of Oregon, Colorado at Boulder, and a few more still at consideration.

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)*
EGEN 310; spent time working with others from different disciplines	144 hours

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:

Create different local hosts to add to the Github directory.

Non-trivial feature 2:

Others could add to stream and the owner could decide whether to accept or not.

Non-trivial feature 3:

We could create different branches if we do not know which one works, we could always revert back to the version.

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)*
Learn Swift during the summer	120 hours

Best wishes wrapping up the semester and in the future!