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 Byron Norman

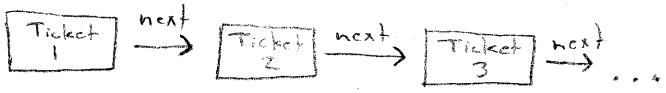
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 a pretty optimal data structure for this situation. Each list item would represent a ticket, and the list can be ordered by priority score. The highest scores can be kept at the beginning of the list so they can be easily found. The procedure for inserting and removing nodes is well defined but may be somewhat inefficient.

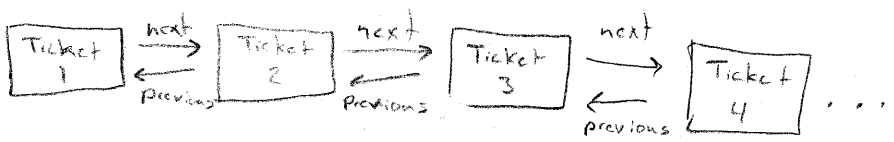
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

One way to implement the data structure would be a singly linked list. This means that the list item would only be linked to the next link in the list. There is only one link between items.



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

Another way to implement this data structure would be a doubly linked list. This mean that each list item is linked to the next item in the list and the previous item as well. There are two links between items.



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): Python

Your solution:

```
def instancesOfChar(s, c):
    numInstances = 0
    for ch in s:
        if ch == c:
            numInstances += 1
    return numInstances
```

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:

It is possible that every new list item is smaller than all the other items in the list. In this case, only one list item would have to be traversed in order to make the new insertion.

Worst case time complexity of algorithm:

$O(n+k)$

Explanation of worst case time complexity:

It's possible that every new list item is larger than every other item in the list. In which case, the $n+k-1$ items would have to be traversed in order to add the last item

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)*
Ridgeline Solutions	Software engineer intern	500 hours

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is unintentional learnt bias that arises from biased data or algorithms. The bias could result in certain factors "being given too much weight", unrelated factors being correlated and ultimately may result in unfair decisions.

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

An algothm that decides whether to admit students may consider and correlate unrelated demographic data with relevant data like transcript data. This could result in the algorithm unethically making admission decisions based on student's gender, ethnicity, or other demographic category.

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: Oracle

First possible impact:
Software companies become nervous about using open-source code in their projects and stop putting resources toward maintaining and developing these projects.

Second possible impact:
The owners of these open-source projects start looking for ways to monitize the projects so that they can be maintained and improved.

Third possible impact:
Software companies work independently to solve problems that could be solved much faster if they worked together on the same open-source project. The entire industry suffers as a result.

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:
The most obvious type of harm is the physical, emotional, and monetary damage that can be caused by a collision caused by faulty software.

Second type of harm:
Another type of harm is the possibility for someone else to take control of your car through security flaws in the car's software. Hackers or governments could theoretically take control of your car and disable it or control it with you inside it.

Third type of harm:
The software may allow the car's manufacturer to exploit the user in terms of privacy and money. The software can automatically send location and other data to the manufacturer. The software also allows the manufacturer to utilize a subscription based model to squeeze money out of their users for as long as the vehicle is on the road.

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 interned at a local software startup for a few years and they have expressed interest in bringing me on full-time after I graduate as a junior software developer. My plan is to work with them for the foreseeable future.

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)*

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	45

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:
Github has pretty decent issue tracking system.

Non-trivial feature 2:
It also has a great user interface on the website for seeing what has changed between commits.

Non-trivial feature 3:
In depth commit analytics and code make up analysis.

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)*

Best wishes wrapping up the semester and in the future!

I really enjoyed this program. Thank you!