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 Bryndon Wilkerson

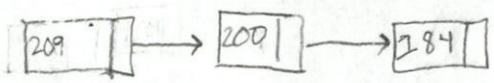
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

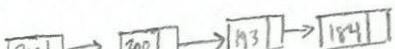
a) What simple data structure would best model this situation? Explain.

A linked list would best model this situation. Because the size of a linked list is dynamic, adding/removing tickets wouldn't cost a lot of memory. Additionally, adding/removing tickets is fairly quick

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

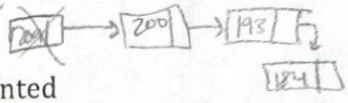
The nodes would be ordered by the urgency scores, highest to lowest, so the customer service team could just look at the front of the linked list to see the tickets with the highest urgency. New nodes will be inserted before a node that has a lower score.





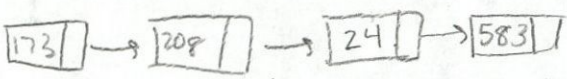
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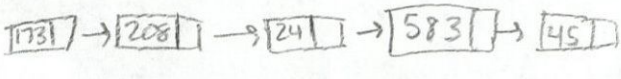
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c) Describe a second way in which this data structure could be implemented and draw a picture of that data structure.

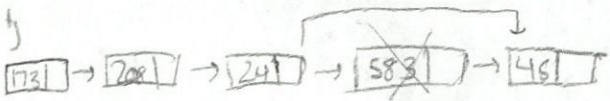
This The nodes could be unordered, so the linkedlist would need to be fully traversed to find the highest urgency ticket. All new tickets would be added to the end of the linked list





insert 45

remove top 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): Python

Your solution:

```
def count_characters(string, char):
    count = 0
    for s in string:
        if s == char:
            count += 1

    return count
```

1, 2, 3, 5

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:

The best case scenario is that every additional number being added is smaller than the other numbers in the linked list. Since the smaller numbers are at the front of the linked list, it just needs to insert the new number, it doesn't need to traverse through the list at all so the time complexity is O(1)

Worst case time complexity of algorithm:

O(n)

Explanation of worst case time complexity:

If every number added is larger than all of the other numbers in the linked list, we'd need to traverse to the end of the linked list every time, which is length n so the time complexity is 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)*
BYEP volunteer	Youth mentor	~200 hrs
Data minr Intern	Paid internship - FE software engineer	~600 hrs
AWC	member	~10 hrs
ACM	member	~10 hrs
FIRST LEGO	volunteer	~ 8 hrs
Mountain Hot Tub empolyee	updating website, misc. projects	~ 40 hrs

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when bias is present in an algorithm. The algorithm can unfairly discriminate against certain characteristics, such as gender and race, because of the data provided or how it is created.

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

If the algorithm removes/de-prioritizes applications where the students have no extracurriculars, it could be ~~biased~~ biased against students from low-income/divorced families, or students with mental illnesses. Students from a low-income family might not have time for extracurriculars because they have to work to help support their family. Students from divorced families might not have time because they have to help take care of their siblings. Students with mental illnesses might not do extracurriculars because of depression or anxiety

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 used w/out fear of violating copyrights

Second possible impact:

Certain code is not copyrightable because it is basic and intuitive

Third possible impact:

There's less to worry about when using an API in a new way for a new innovative project.

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 software could malfunction and cause physical harm by hitting someone

Second type of harm:

The software could cause unjustified damage to property by malfunctioning and hitting a building

Third type of harm:

The Software could cause unjustified damage to the environment by malfunctioning and driving off a cliff and hitting lots of trees/animals at the bottom

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 received an offer from Datamine, which I accepted. I will be starting full-time this summer. I did not apply anywhere else

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)*
None	

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 → come up with own project, not the car project	~40 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: GitLab

Non-trivial feature 1: Pipeline automatically runs w/every push, which ensures code quality / tests pass

Non-trivial feature 2: Integration with Slack, which can ping ~~you~~ if the pipeline fails

Non-trivial feature 3: Blocking code reviews until they've gotten approval from certain people

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)*
Grace Hopper 2019	~ 20 hrs

Best wishes wrapping up the semester and in the future!