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 Grayson O'Leary

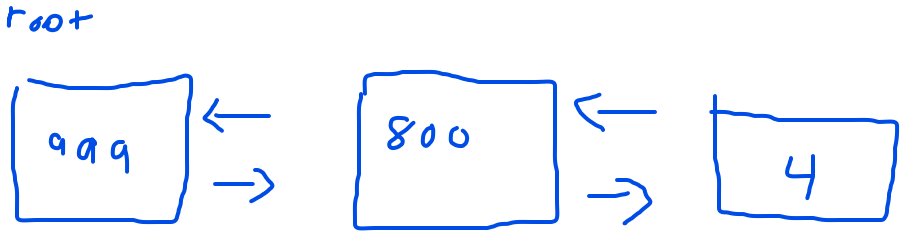
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 doubly (o linked list would be an ideal data structure for this situation because it can be easily iterated based on the particular urgency score, and a ticket can also be easily removed.

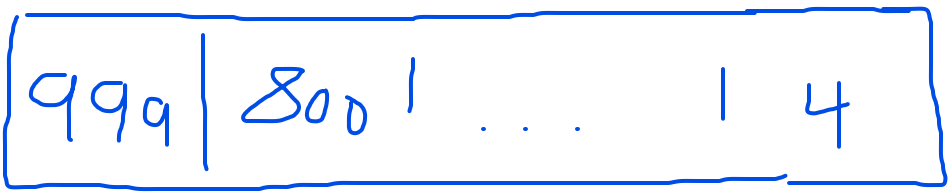
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

A linked list implementation would look like so:



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

An array implementation would look like so:



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 occurrence(string, char):
    int count = 0
    for i in string:
        if(i == char):
            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:

O(length of k)

Explanation of best case time complexity:

In a best case scenario, the first number of k (k[0]) is less than the root of n and each number proceding is less than the previous. Thus, k[0] becomes the root and the process repeats for as many numbers there are in k.

Worst case time complexity of algorithm:

O(length of k * length of n)

Explanation of worst case time complexity:

In a worst case scenario, each number in k is bigger than any number in n and each proceding k is bigger than the last. In this scenario, k is placed at the end of the list each time, with the process going until every number is inserted. As a result, the full list must be iterated through each time for every number in k.

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)*
Knights of Columbus	Cooking for church breakfast	30
MSU CS Help Center	Helped CS students	10 (not including for practicum)

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is essentially when an algorithm consistently favors one arbitrary group over another.

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

Let's suppose an algorithm for a college admissions software is coded to increase an applicant's perceived value based on certain parameters, and those parameters are set in such a way as to value community service, GPA, and whether or not they were in a sport. If an applicant then comes in with much less community service, a lower GPA, and is not in a sport, but their SAT score is high, and they are taking a lot of AP or IB classes, then this algorithm would not take into account those aspects of that student. This student could potentially be given much less value despite being deserving of a value much greater than if those elements were taken into account.

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:

Code copying could potentially become illegal regardless of circumstance, as code cannot be utilized under fair use

Second possible impact:

Programmers must prove their code is written by them, from first impact

Third possible impact:

Far slower innovation within the industry due to slower programming from first and second impact. In addition, companies would be bogged down from potential code licensing fees, leading to less innovation.

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:

Potential damage to people

Second type of harm:

Potential damage to property

Third type of harm:

Potential damage to industry (ex taxi drivers, uber drivers, truckers, etc)

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'm pretty much going straight into the industry. I do not intend on going to grad school. Currently, I'm looking for jobs in Denver and the greater Montana area for prospects. If opportunities are small, which I personally doubt, I will look in more and more states until I find a company.

I graduate in the Fall, so I haven't applied to too many places yet. Currently looking at WolfSSL, a web streaming company a friend of mine is in, some of the big names like Google, Microsoft, and so on just to see if I get an interview, and anything else that I find through Handshake.

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)*
Roman Catholic Church	50 at least
Knights of Columbus	20

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)*
EGEN310 working with two Pakistani (?) students	15

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:

Branch creation and branch merging

Non-trivial feature 2:

Ability to push/pull changes from an external repo

Non-trivial feature 3:

Multi-user collaboration via this external repo

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)*
Learned a bit of web dev	10
Miscellaneous server administration	5

Best wishes wrapping up the semester and in the future!