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.

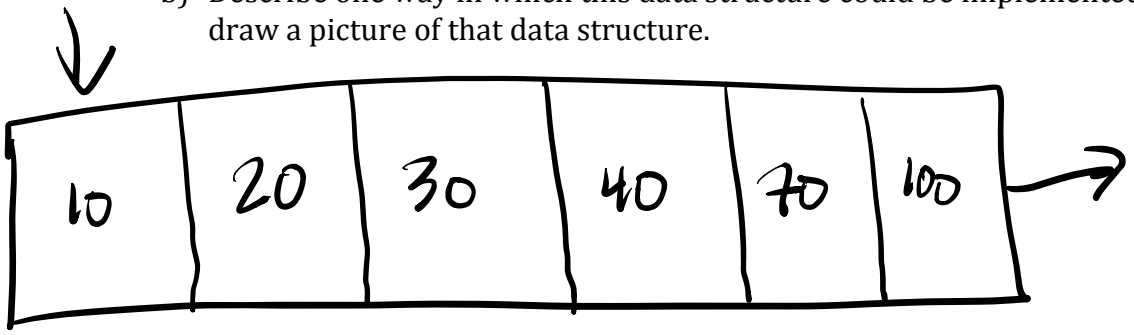
Name Alan Tang

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.

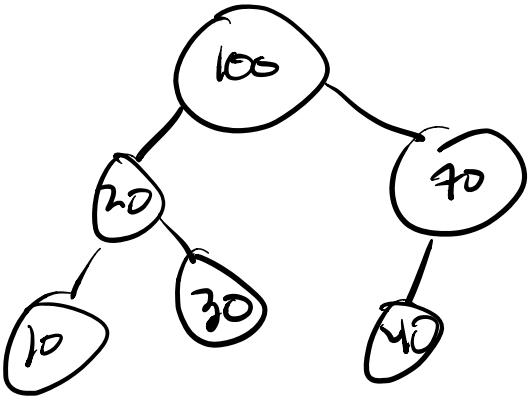
Queue. A queue, with priority, (priority queue) would fit this model as it gives each element a priority but allows for a simple way to remove them in the queue with FIFO.

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



The queue can be sorted using binary insert and sort on priority.

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



Heap implementation of a priority queue to sort/insert while popping the root node as 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):

Your solution:

```
def count_char(character, string):
    count = 0
    for value in string :
        if value == 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:

$O(1)$

Explanation of best case time complexity:

All remaining k values are always smaller than the first element of the singly linked list. Therefore, the time complexity is constant as it goes into the first index every time.

Worst case time complexity of algorithm:

$O(n^k)$

Explanation of worst case time complexity:

All remaining k values are always bigger than the last element of the singly linked list. Therefore, all remaining k values will need to be inserted at the end of the singly-linked list. Therefore, the time complexity is $O(n^k)$

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)*
UCA	TA	4 semesters
ORTEC	SWE Intern	2 summers

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

How bias can be in an algorithm based on how the training set was collected.

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

Using historical data from past applicant may influence the model used in the college admissions software. Algorithmic bias can allow for manifestation in college admission software if the historical data was collected in an unfair or bias way, leading to acceptance errors of certain roups from the algorithm

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:

Proprietary software will be much more regulated

Second possible impact:

Open source projects will be restricted

Third possible impact:

IP protection will be stronger.

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:

Endangerment of passengers in the vehicle

Second type of harm:

Endangerment of pedestrians.

Third type of harm:

Endangerment of property if the software for autonomous, self-driving cars fail.

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.

In one year, I plan on applying Software engineering roles in Seattle but have a good connection w/ ORTEC in Houston as backup. I have yet to apply to SWE roles though.

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)*
ACM	100
Intramural Sports	40

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)*
Honors College	200

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:

Rebasing

Non-trivial feature 2:

Static hosting websites

Non-trivial feature 3:

Project Board Integration

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)*
Code 24	48
AEM Spring Road Trip	Week

Best wishes wrapping up the semester and in the future!