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 Michael Heidel

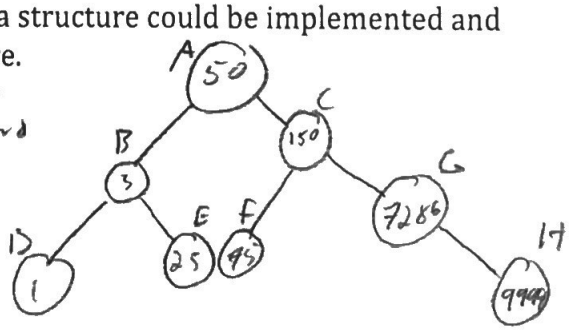
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 binary tree could store this, with higher values stored in the right child of a node.

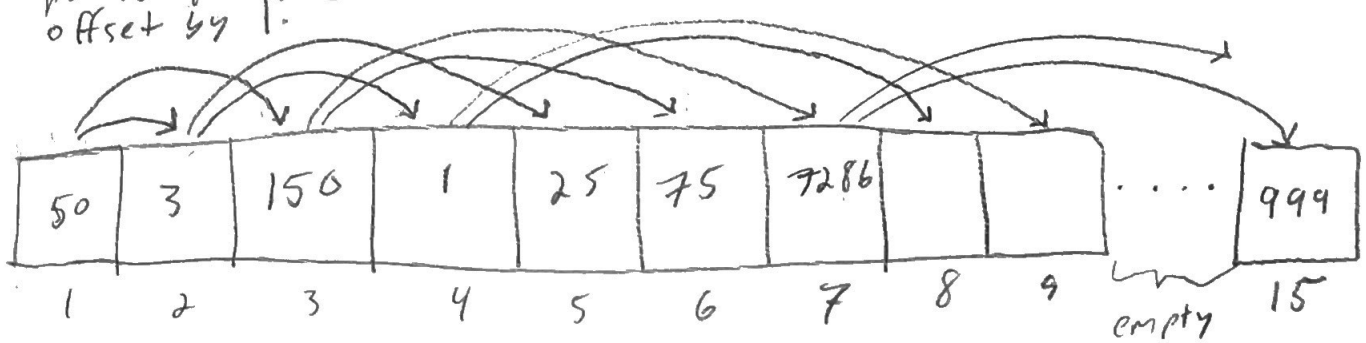
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

Make a linked list of nodes:
Node A stores value '50' and points to B, C.



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

Use an array, where the i^{th} index in the array points to the indices $(2i, 2i+1)$. Indices must start at or be offset by 1.



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:

Language: Python.

```
def num_occurances_in_string(char, string):
    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:

$O(1)$

Explanation of best case time complexity:

If k=1, and the number to be added to the list is lower than any other numbers in the list, then it can simply be added to the beginning of the linked list. This is a constant time operation.

Worst case time complexity of algorithm:

$O(n \cdot k)$

Explanation of worst case time complexity:

If each of the k new values to be added are greater than every other value in the list, then adding each will require traversal of the entire list. This requires n steps to be performed k times.

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)*
ACM	Attended	5
Datamine	Internship	340 (to be)

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is the usage of biased/unfair/inaccurate data sets in algorithms whose results discriminate against a group of people.

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

If a minority group is disproportionately poor, they are likely to have lower than average test scores in high school. If a college uses an algorithm which bases admissions on test scores, then its algorithm may show bias against the poor/ that minority group.

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:
Weaker copyright protection of code: since 'methods of operation' may be freely copied,

Second possible impact:
More open source code: Without the incentive of being the sole profiteer from any particular code, companies may be more inclined to make their source code openly available.

Third possible impact:
Less software innovation: if code can be copied freely, there may be less incentive for corporations to develop their own software, leading to fewer innovations in the field.

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:
Physical harm: the driving software might fail, causing the car to crash and passengers to die.

Second type of harm:
Disclosure of information: the car might share information on the location of its passengers, which could violate their privacy.

Third type of harm:
Physical harm: the driving software might run as intended but make an incorrect choice, such as prioritizing the life/safety of one person over another.

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 plan to work for Datamine, the company at which I am currently interning. I have not yet applied for a job there, since I have only just begun the internship.

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)*
Tabletop Brigade	750

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)*
N/A	

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:

Git

Non-trivial feature 1:

Remote hosting: git has servers on which code is stored, including old versions of code.

Non-trivial feature 2:

Commits: git allows editing of code freely without affecting the code stored on their hosting servers. Commitment of code is required in order to change the remote code.

Non-trivial feature 3:

Merge features: if there are multiple conflicting versions of the same code, git describes how they differ and provides tools to merge them.

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)*
Personal project: Java game	20
Personal project: Python number conversion	10

Best wishes wrapping up the semester and in the future!