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 Dave Miller

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.

priority queue - ticketing system → queue

urgency score → priority

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

linked list of tickets { int ticket_no;
int urgency; }

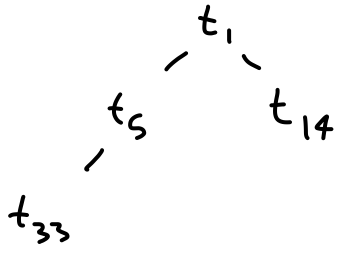
$t_1 \rightarrow t_{33} \rightarrow t_{14} \rightarrow t_5$

add new ticket to end

O(n) lookup most urgent

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

heap of tickets



O(log n) lookup most urgent

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 fun(s, c):
    i = 0
    for char in s:
        if char == c:
            i += 1
    return i
```

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:

$O(k)$

Explanation of best case time complexity:

All k numbers are smaller than the head of the linked list, and are added in descending order. Then each new number becomes the new head after a $O(1)$ comparison $\rightarrow O(1 \cdot k) = O(k)$

Worst case time complexity of algorithm:

$O(kn)$

Explanation of worst case time complexity:

All k numbers are greater than the tail of the list, and added in ascending order. It takes $O(n)$ work for each number to traverse the entire list comparing and $O(1)$ to insert at the end. (This could be helped by using binary search, reducing the time to $O(k \log n)$

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)*
N/A		

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

When an algorithm perpetuates bias against certain protected groups, harming wellbeing of those groups.

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

An algorithm is made to screen college applications, promoting some to the top to be looked at by people in charge, while demoting other applications. The algo. looks at the race + socioeconomic categories of applicants + promotes white dudes while demoting poor minorities

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: Bad

Code theft becomes more common, programmers are not rewarded when someone uses their work.

Second possible impact: Good

Companies are not required to re-write boiler plate API code for the sake of the law.

Third possible impact: ?

Open source becomes more common since people will copy code anyway, potentially different economy for code

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:

It could harm drivers or pedestrians in an unavoidable crash.

Second type of harm:

It could harm people's jobs as self-driving becomes more widespread - taxi/uber drivers, auto factory workers,

Third type of harm:

Since these cars are entirely controlled by software, they could have bugs and/or be hacked for malicious purposes.

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 get a job in Bozeman. Hopefully going to be working with Devin at Reposit (still up in the air). I would go to grad school if someone else payed for it.

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)*
N/A	

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)*
General Schooling	4 yrs

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: versioning

Non-trivial feature 2: forking / branches

Non-trivial feature 3: merging (GitKraken)

handles merge conflicts

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)*
Solidity (Eth smart contracts)	20
Self-driving rover	40

Best wishes wrapping up the semester and in the future!

Thanks!