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 Wes Robbins

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.

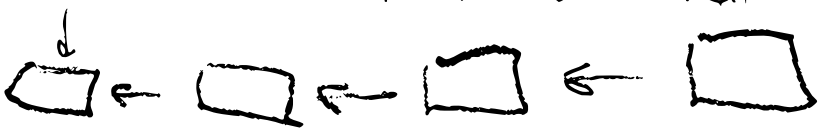
a) What simple data structure would best model this situation? Explain.

A linked-list that we operate on like a stack.
- when a ticket is addressed it is removed from end of LL
- when item is added, we traverse list until the item can be entered while maintaining order

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

most urgent

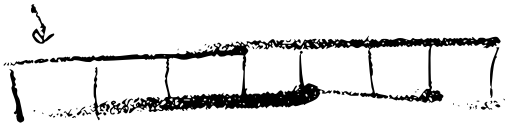
each box contains a value, and a pointer to the next value



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

most urgent

Contiguous in memory. Accesses are faster, but inserts take more time.



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 occurence(c, s):
    return s.count(c)
```

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:

If each new number is the smallest number we can immediately insert (i.e. $O(1)$). For k elements this is $O(k)$.

Worst case time complexity of algorithm:

$O(kn)$

Explanation of worst case time complexity:

If each new number is largest, we realize worst case by scanning all elements which is $O(n)$. For k elements this $O(kn)$.

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)*
UCCS	Research Intern	~500 hours
Course TA, MSU	Grading, teaching in lab	~ 150 hours
Independent Study	Meetings, Implementations	~ 50 hours
Securing Research Group	Group Meetings	~ 30 hours

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Optimizing algorithm performance during development leads to algorithm that unfairly treats certain people.

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

Colleges find that students who have volunteered in HS to better candidates, and use an algorithm to remove candidates whom did not volunteer. Students of low socioeconomic status often do not get the chance to volunteer. The algorithm is biased against low socio-economic students.

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:

companies are more diligent about patents

Second possible impact:

companies hide code

Third possible impact:

companies are more likely to default to open source model

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 (e.g crash)

Second type of harm:

- financial (disrupt current automanufacturers)

Third type of harm:

- hurt taxi industry causing many to lose jobs

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 been offered a research assistantship at UCCS where I will start graduate school in Spring 2022.

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)*

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)*
Outdoor Activities (often in teams)	2,000
Independent study w/ peer	100
Group Projects	600
Security Research Group	50

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: different remotes for a repo

Non-trivial feature 2: branching commitment scheme

Non-trivial feature 3: tagging completed features

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)*
Online Course: CUDA	20
Online Courses: Deep Learning	40
Online Course: Pytorch	30

Best wishes wrapping up the semester and in the future!