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 Timothy Bender

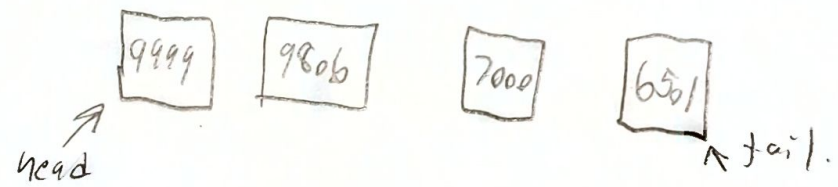
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 priority queue. Tickets would be inserted into the que based on their urgency. This would place the most urgent at the top of the queue where it can be popped off when completed.

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

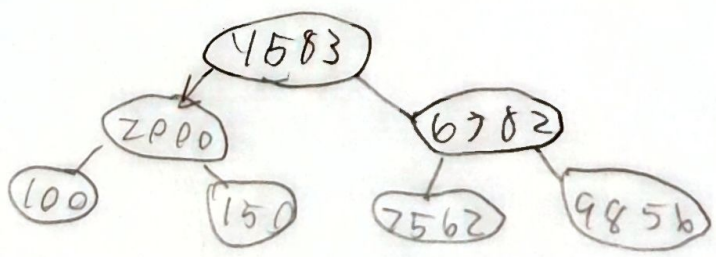
A priority queue can be implemented either with a sorted array or linked list.



when the highest priority has been addressed, it may be popped off by moving the head pointer to head.next.

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

we could also implement this with a binary tree where the urgency scores are used to insert and sort the tree. The largest score would always be in the bottom right.



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 3.8+

Your solution:

```
def countchar(string:str, char:str) -> int:
    return string.count(char) if len(char) = 1 else 0

# Please note I used annotations to document object types.
# This is valid in Python 3.8+. I am also returning 0
# if the char has len > 1
```

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:

Assume that k=1, and let x be the one float we want to insert. If x is smaller than the head of the linked list, our time will be the time to insert at the head, which is O(1)

Worst case time complexity of algorithm:

O(kn + kc), $k(n+c) = kn + kx$

Explanation of worst case time complexity:

Our worst case time complexity is if each additional float must be inserted at the back of the linked list. Each insertion will cost us O(n+c) where c is a counter to track how many have been inserted.

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)*
Spudnik LLC	Internship	640
Oracle	Internship	800
Smarty Cats	Tutor	150

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

The collective result of repeated errors in an algorithm when favors a specific group.

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

Assume universities use a machine learning software to generate a generic aptitude score for each applicant. Since most applicants to college are female, 55/45, if the software recieves gender as an input it may incorrectly give women a higher score based on the simple statistic that there are more female applications.

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:
Allows the current status quo of apis to be open, and allows open innovation and

Second possible impact:
Protects the software community from basic logic being copywrighted, and forcing engineers to invent entirely new systems to solve old problems.

Third possible impact:
Will protect the inter-optability of new and current solutions from being open for possible copywright lawsuits.

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: A bug or unintended decision by a self driving car could lead to serious injury.

Second type of harm:
Software vulnerabilities: An unsecure self driving system could cause series issues.

Third type of harm:
Unemployment: The adaption of self driving cars will likely cause the loss of millions of transportation 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 will hopefully secure my job at Oracle as a software engineer. I plan on taking a year off, and then returning to MSU for graduate school. I have recieved an offer from Oracle, and have not applied to graduate school yet.

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	
I'm not that social.	

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 / Gitlab

Non-trivial feature 1:

cherry-pick. allows you to apply specific changes onto your current branch.

Non-trivial feature 2:

merge: Allows you to merge two working branches together.

Non-trivial feature 3:

diff: Allows you to view the differences between two files / branches / commits etc.

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)*
Taught myself android dev	100
Taught myself kotlin	50
Linux	150
Python / Flask	100
Bootstrap	50
Tensorflow keris	50

Best wishes wrapping up the semester and in the future!

thank you!