Montana State University Computer Science Department

Graduating Senior Exam

Spring Semester 2022, 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 Cody Flynn

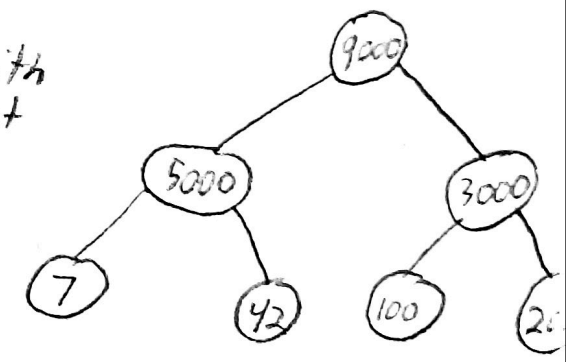
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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, so that customers with higher scores are served first but if two customers have the same score, the one who arrived first will be served first.

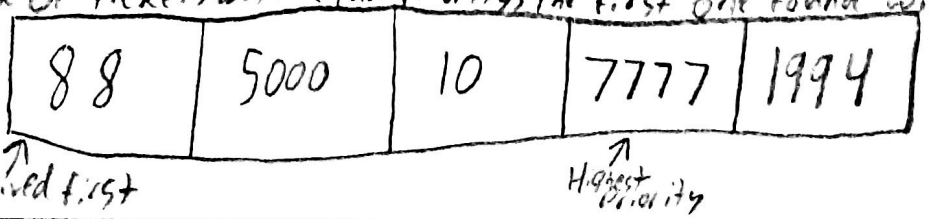
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

The priority queue could be implemented with a binary heap where the ticket with highest priority is at the top of the tree and will be removed first.



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

The priority queue can also be implemented with an array where each objelt in the array represents a ticket with a sequential value that is incremented every time a ticket is created and with a priority value based on the urgency score. The array can be traversed to find the highest priority which will be removed. In the case of tickets with equal priority, the first one found will be removed first.



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 num_appearances(a_string, a_char):
    test_list = list(a_string)
    count = 0
    for i in test_list:
        if i == a_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:

In the best case, the numbers can be added in constant time if each number added is less than the current head of the list.

Worst case time complexity of algorithm:

O(n)

Explanation of worst case time complexity:

The worst case would be linear time if each number added is greater than the current tail since the entire list would have to be traversed.

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)*
Board game club	Playing tabletop games	40
Outdoor rec trips	Rafting, hiking	30
Intramural tennis	Tennis	20
Four corners. life	Web development	30

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when an algorithm unexpectedly favors a certain outcome repeatedly even with varied inputs.

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

One example could be an admissions program that unreasonably favors standardized test scores over any other attribute of a potential admit. Through this bias, the college could end up with students who are not well rounded but know how to perform well on tests.

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:
Increased protection of intellectual property

Second possible impact:
Individuals and companies are fairly compensated for the software they develop

Third possible impact:
Less collaboration between developers could result in slowed progress throughout the industry.

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:
The software might not correctly determine the classification of the environment so that an accident is caused and people are injured.

Second type of harm:
The autonomous software could replace jobs that humans depend on to make a living such as truck driving.

Third type of harm:
If autonomous vehicles and human-driven vehicles are allowed on roads simultaneously, there could be conflicts in the way edge cases in driving are handled by each group that results in accidents and delays that could otherwise be avoided by either banning or mandating the use of AV software.

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 continue working a job here in Bozeman that is outside of the computing industry as I apply for jobs in software engineering. I have applied to General Motors (Associate Engineer), Docusign (Rotating Entry Level Program), Commerce Architects (Associate Developer), 200T Enterprises (IT technician). I have not yet received an offer.

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)*
Board game Club	40
Outdoor Rec Trips	30
Intramural Tennis	20

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)*
Multi-disciplinary Engineering	Full semester
Working in restaurants	20×52×6 = ~6000

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:

keeping entire version history on each local machine that is part of the distributed system

Non-trivial feature 2:

Allowing different branches to be developed independently and simultaneously until a merge is required.

Non-trivial feature 3:

Tracking commits by timestamp and user ID allowing for easier rollbacks and conflict resolution.

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)*
Zoot open house	2
Career fairs	4
Udacity courses	30
LinkedIn Learning courses	20
YouTube instructional videos	300
Speaking with industry professionals	15
Hackerrank problems	80
Other, interview prep, e.g. reading	40

Best wishes wrapping up the semester and in the future!