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 Mariafe Ponce

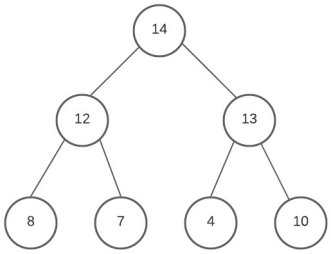
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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.

Max-heap (if a higher urgency score corresponds to the most urgent ticket)

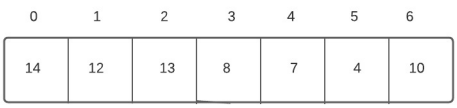
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

Using a complete binary tree



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

Using an array



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 char_count(a_string, a_char):
    count = 0
    for char in a_string:
        if char == 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(k)

Explanation of best case time complexity:

If the k numbers are all smaller than the smallest n number and are all added into the single linked list starting from the end (starting with the largest k number), hen we will only need to do k * O(1) insert operations since no shifting will be required.

Worst case time complexity of algorithm:

O(k*n)

Explanation of worst case time complexity:

If every number k is larger than every n number, then it must traverse through all n numbers to do an insert operation. With every k number added, it must traverse all n numbers plus any additionally added k numbers. At the most it will have to traverse k * (n + k) nodes which is kn + k^2. Since k << n, then kn >> k^2 and the time complexity is bounded by 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)*
Foundant Technnologies	Customer service intern, then SWE intern	320
Google	Software Engineer Intern	960
AWC	Member then VP	50
ACM	Member	30
Human Interaction Lab-MSU	Research Lab Assistant	30
Type text here		

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Systematic errors in computer algorithms that create unfair results that typically results in perpetuating privileging already priviledged groups

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

Data may show that a privileged group of college applicants (eg. white people) have more success after college and make more money later in life. This could lead college admissions software into thinking these students will succeed more in college, and thus admiting more students of that group into the college. The reasons behind this might have nothing to do with how well someone might do in school or how good of an applicant that student actually is, but instead could be due to systemic racial inequality.

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:

Free use of APIs allows for more development and innnovationn

Second possible impact:

Weaker copyright protections of code, sets precedents, so companines may be more reluctant to release code.

Third possible impact:

More reliable systems, as open source leads to more collaboration

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:

Harm by hitting a pedestrian

Second type of harm:

Harm by saving a pedestrian but in turn hurting the driver

Third type of harm:

Harm by saving the driver and hurting the passenger while in an accident

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 accepted an offer with Google and will be starting in February as a fulltime software enginneer in a backend team working with Google Drive.

I also applied to Microsoft, Amazon, Stripe, Coinbase, Asana, Robinhood for software engineer roles.
From the list above, I received offers from Stripe and Coinbase, I got rejected from Amazon and Robinhood, and I withdrew from Microsoft and Asana.

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)*
Tennis League	300

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)*

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: branching

Non-trivial feature 2: remote capabilities

Non-trivial feature 3: commit history

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)*
Watched lectures on YouTube on distributed systems	30
Taught myself Go	30

Best wishes wrapping up the semester and in the future!