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 Matthew Hoffman

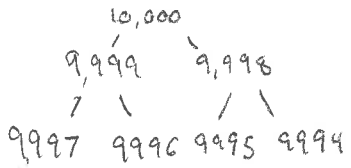
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

I think the best data structure for this would be a binary heap priority queue. This would allow us to have a max heap that keeps the max priority at the top, while also allowing us to add and remove new tickets that come in, and maintain the max heap.

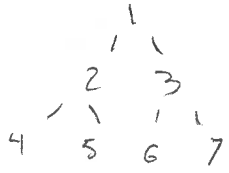
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

We could implement it as a max heap, and have the top one be the most important, and can be implemented with a binary tree.



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

Another way could be to make it a min heap, and have the lowest priority at the top, and highest at the bottom. Implementation is the same, just in reverse. This just means when grabbing the top priority, grab from 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

Your solution:

```
def counting_function (sentence, character):
    ans = sentence.count(character)
    return ans
```

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:

Because in a singly linked list you can only be traversed in a forwards direction and is implemented on the stack, this means at best in traversing we would insert near or at the beginning and have O(1).

Worst case time complexity of algorithm: O(n)

Explanation of worst case time complexity:

At worst, we would have to traverse the length of the stack, checking every index along the way. This would result in O(n+k)

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)*
Food Bank	Sorting Noodles	10-15
Crosslife @ GBC	Ministry Volunteer	hundreds

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic Bias is when there are systemic errors in an algorithm that continually favors one group over another.

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

An example is in an article I read earlier this week, how many universities are using software to allocate scholarships to those who they deem need them, not based on actual need, but on student's perceived willingness to pay. The algorithm rates how much it thinks a student will be willing to pay, and then allocates scholarships to bridge that.

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:

Oracle removes all open-source content and patents everything they can so as to to have intellectual property stolen.

Second possible impact:

Google proceeds to copy and use more code they should not as there seem to be no consequences for actions.

Third possible impact:

Other companies, emboldened by Google's success, proceed to steal and use other companies code w/out fear of repurcussions. Everything is then made open source

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:

In a crash scenario, it might choose that it's driver's life is most important, and proceed to hit pedestrians to save it's driver.

Second type of harm:

In the same scenario, it might deem human life as the most valuable, and proceed to take out animals in the way

Third type of harm:

In the same scenario, it might see a no-win scenario, and pick who to hit based on race, age, gender, and more

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 work for the spring and summer, saving money for a while, and then go to seminary after that. I am looking at Master's & Expository seminary to get a masters or doctorate in pastoral studies. I am not sure I will look for a job in CS, and am currently apply for grad school so I haven't been accepted 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)*
Cross life @ Grace	10 hrs a week for 4 years

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)*
EGEN 310	50 hrs

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: GitHub

Non-trivial feature 1: You can pull from a master repo and push to another repo to maintain the integrity of the master while messing w/code in the other repo.

Non-trivial feature 2: Git ignore files are very helpful to have files untracked by Git, and lets you ignore files for awhile and then use them when you are ready.

Non-trivial feature 3: Ability to keep your branch of the master continually up to date so you don't have errors when you try to merge later.

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)*
n/a	n/a

Best wishes wrapping up the semester and in the future! Thanks!