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 Jay Van Alstyne

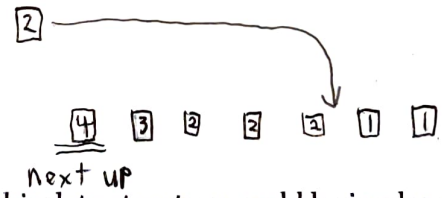
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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! We can then override the default FIFO behavior of a queue as needed.

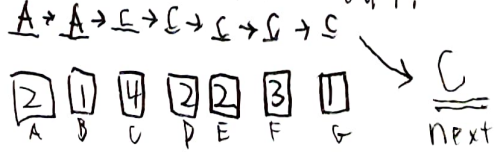
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

A normal queue but, as things are added, they are sorted by priority instead of just slapped on the end. The queue naturally stays in order, forever.



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

A normal queue but you don't just pull from the front. When you need to take an item, make a variable pointer. From front to back, look at each item in the queue. If the priority is greater than whatever is in the variable, point to it instead. Whatever the variable points to by the end is the next out.



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): Ruby

Your solution:

```
def char_count (stringy, character)
    count = 0
    stringy.each_char do |c|
        if character == c
            count += 1
        end
    end
    return count
end
```

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:

In the best scenario, each number is added to the head of the list with no need for traversal. It doesn't matter how large the list is, just how many numbers we need to add!

Worst case time complexity of algorithm: O(n·k)

Explanation of worst case time complexity:

The worst scenario would put each number at the end of the list. We'd need to traverse each of the n elements every single time we go to add a number.

You could probably just say O(1) + O(n) if k is so small, but why even mention it then?

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)*
o STEM club member	professional development	100
Datamine intern	infrastructure / deployment tooling	280
MSU ResNet student worker	IT + Network support, computer repair	2,702 hr 38 min

These were tracked, so I have records! How helpful.

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

An algorithm might regard certain traits held most commonly by certain groups of people as desirable or undesirable, leading to unintentional descrimination.

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

We built a new machine learning algorithm to handle MSU applications and scholarships! Unfortunately, ML can pick up on patterns that any human programmer would recognize as being a Very Bad Idea to judge people by. For example, MSU wants a better graduation rate. since students from low-income families have had to abort their educations before due to the situation back home, the magical black box decides it's best to just avoid most poor people, and nobody might ever recognize it's using that logic for years.

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 invest less in developing languages, as they feel competitors could freely gain the benefits they funded.

Second possible impact:
To counter this, companies agree to contribute to a common project intended to be stolen and reused.

Third possible impact:
Open-source projects more seriously consider Java, as they feel less afraid of legal issues or being shut down.

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 to the user by being less competant than a human driver.

Second type of harm:
Harm to others by prioritizing the user's life when making difficut decisions.

Third type of harm:
Harm to society by worsening traffic, if needing more space from unpredictable human drivers and/or encouraging more people to choose cars over public transit.

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.

My internship with Dataminr ends at the new year. I've liked working there just as much as I hated job searching, so I will gladly take a full-time position there if my team wants me around. They have benefits that would help with my gender transition, so hopefully I could properly get going with that.

My capstone, UX, and (music) composition classes have all shared a common project: a videogame and its soundtrack. It has been my dream for so long, but the allure of real money has made me put it down for now. I worry I'll never find the time to finish it.

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)*
International student buddy program	40

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:

You can revert to any point in history!

Non-trivial feature 2:

Multiple branches! git identifies only the spots with possible conflicts!

Non-trivial feature 3:

I honestly don't know. I barely know git. A grad student taught me the basics, once. That's it.

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)*
CompTIA A+ certification	10
Basic crossplatform LibGDX game	80
My server!! Linux, email, + much more.	200

Best wishes wrapping up the semester and in the future!

