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.

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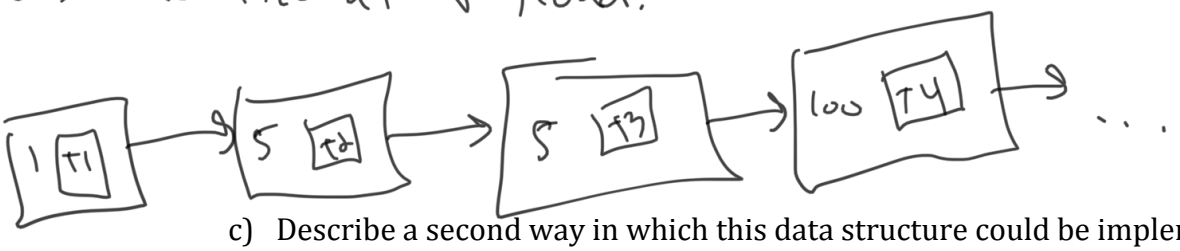
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

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

It could be a sorted linked list with the ticket as additional payload.



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

You could store them in a 2d array, the first index being the priority and second being the tickets.

```
[
0:[T1, T2]
1:[T3,]
:
10000:[T58]
]
```

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): Dart

Your solution:

```
int charOccuranceCount(String input, String char){
  assert(char.length == 1);
  var ans = 0;
  for(final currChar in input){
    if(char == currChar){
      ans += 1;
    }
  }
  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(K)

Explanation of best case time complexity:

Since the list is sorted, the best case is that every number goes at the beginning (ie smaller than the smallest element). That way, you only need to do one operation per number added, thus O(K)

Worst case time complexity of algorithm:

O(nK)

Explanation of worst case time complexity:

the worst case is every number added goes at the end of the list (ie every number is the largest). In this case, we need to traverse the list (O(n)) for every element added because we only directly keep reference to the first element. The complexity is O(n), K times, thus O(nK).

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 intern	test software	1,000
city Brew engineer	maintain all tech	8,000
campus minister	lead bible study	200
debate coach	practice drills	100

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when algorithms that help humans make decisions, either intentionally or not, make inconsistent decisions that disadvantage a particular group.

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

For example, a college admissions software could use a machine learning model to predict potential student's chance of graduating, since most students graduating from MSU are white, it could predict students of color are less likely to graduate.

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:

this could hurt the open source community because developers may be afraid to use external code for fear of lawsuits

Second possible impact:

It could slow innovation because more code would have to be written from scratch

Third possible impact:

It could hurt interopability between systems because you would have to pay for implementing an external API

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 obvious answer is that bugs in software could lead to crashes that could easily kill people

Second type of harm:

Autonomous vehicles could make us reliant on auto manufactures since after a few generations people will forget how to drive.

Third type of harm:

They could increase class divides as those who can afford the most sophisticated AIs will have more time for liesure or work while their car drives them.

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.

Currently I am planning to work at Very Good Ventures as a Senior Flutter engineer, which I have accepted an offer.

I will also continue building my Startup, Morel Technology, which I hope to make my full time job.

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)*
Resurrection Parish campus ministry	500

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)*

most everyone I worked with had a similar background to me

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:

pull requests with code review, which allow your team to make sure every change is approved by others on your team

Non-trivial feature 2:

dependabot, which scans your external dependencies for reported security vunerabilites.

Non-trivial feature 3:

Github actions, which is an integrated CI/CD. It allows you to easily enforce formating, tests pass, and code coverage thresholds are met before merging changes.

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)*
self taught Dart+flutter	1,000
Built fun websites + apps	200
youtube tutorials	500

Best wishes wrapping up the semester and in the future!