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 John Hultman

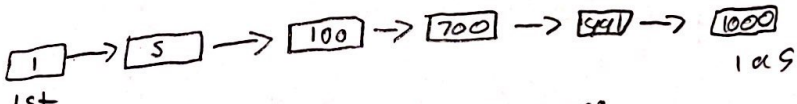
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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, because you can remove and add tickets as needed and they will be removed based on priority which could be determined by the urgency score.

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

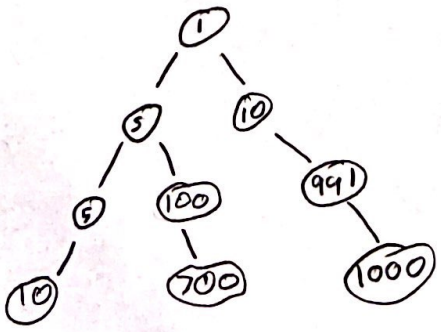
you could use a linked list that is sorted based on its urgency score.



new inserts will re-sort based on urgency score

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

you could use a heap where parent nodes are higher or equal priority to its children



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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): Java

Your solution:

```
public int numOfC(String inString, char c) {
  int count=0;
  char[] chars = inString.toCharArray();
  for(i=0;i<chars.length;i++){
      if(chars[i] == c){
          count++;
      }
  }
  return count;
}
```

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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(n)

Explanation of best case time complexity: the best case is when the list is already sorted

Worst case time complexity of algorithm: O(n log n)

Explanation of worst case time complexity: with the height of the merge tree being log n if you had to sort each level at a speed of O(n) it gives you a time complexity of O(n log n) if you have to sort at each level of the merge tree.

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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)*
none	n/a	n/a

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.
repeated errors that can create unintended or unfair outcomes such as privileging an arbitrary group over another.

b) Provide a hypothetical example of how algorithmic bias could manifest itself in college admissions software.
Depending on the data set used it could favor one ethnicity or gender over others.

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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: companies may implement deliberate incompatible standards in an attempt to prevent litigation

Second possible impact: it may negatively impact interoperability between different services

Third possible impact: it may decrease the amount of code that can be reuse increasing the time and expense to write new code.

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: it can lure the user into a false sense of security making them less likely to be alert if the software fails

Second type of harm: cyber attacks could prove to be a serious threat if a vehicle could be hacked

Third type of harm: moral dilemas like if the vehicle has to make a desicion between harming the passenger or a bystander

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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 find a job, ideally somewhere in Montana, but I have not applied anywhere specific 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)*
none	n/a

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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 310R project	75

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: Git has good security down to the relationships between files.

Non-trivial feature 2: Git is open source meaning it can be tweaked to an individual user's preference and it can be scrutinized to maintain its quality.

Non-trivial feature 3: Git is a distributed system, so users can work simultaneously on the same project without interfering with each other

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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)*
none	n/a

Best wishes wrapping up the semester and in the future!

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