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.

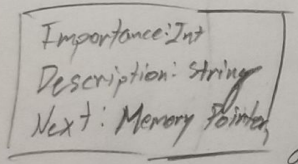
Name Michael Radwin

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.

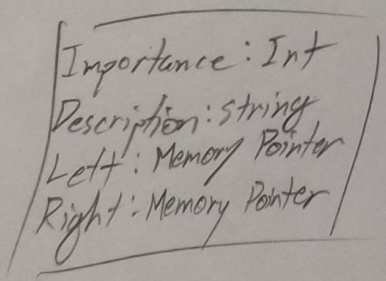
A linked list as you can have it go in descending importance and remove the front one when it has been addressed but since new tickets can be added at any time it needs to be organized and expandable.

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



By using the struct to the left you could organize by Importance with higher preceding lower connected by a linked list connecting the structs in one direction allowing easy access to the front but much slower access to the later sections

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



You could implement a binary linked list starting at the center reducing access time to add new tickets in the future but as a trade off increasing access time to front section. Much more efficient average access time though making it more practical for large scales.

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 character_occurances(string, character):
    occurances = 0
    for letter in string:
        if letter is character:
            occurances += 1
    return occurances
```

or using python string object functions

```
def get_occurances(string, character):
    return string.count(character)
```

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 each value of k is in descending order and all values of k are less than the first value of n then each value of k will be added to the front taking $1 \times k$ operations and since k is largest complexity it is $O(k)$

Worst case time complexity of algorithm:

$O(k^2)$

Explanation of worst case time complexity:

If each value of k had to be added to the end of n then it would take $\frac{n+(n+k)}{2} \cdot k$ total accesses

so $\frac{2nk+k^2}{2}$ accesses leading to $O(k^2)$ as k^2 has the largest complexity

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)*
Boeing	Data mining internship	1000
Bounty of Bridger	Assisting food bank	10

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Software algorithms that do not consider enough data during development or for some other reason do not treat all individuals equally. An example of this is facial recognition software and how poorly it works for minority groups

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

For a majority white school or all white school & a machine learning algorithm determines acceptance using only previous records as learning criteria it could choose based on race as a parameter.

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:
Google removes Java API from their mobile platform OS limiting what OS users are able to do and restructures how google apps or web apps are made
Second possible impact:
Full copyright and patent for software can be taken by another company if any of the code is copied risking more extreme software lawsuit cases
Third possible impact:
Java could be weeded out by google in place incentivising other languages causing a massive downscale of java development

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 driver/ passengers or bystanders
- Failure to follow roadways correctly could risk harm to self or others

Second type of harm:
- Harm to property or surroundings
- Code could prioritize safety of passengers by damaging property to protect them

Third type of harm:
- Disclosing Information
- If the system remotely updates then remote connections could be grabbed for information on the driver's driving skills, where they have been, and other info

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 at Boeing Mesa on the embedded systems for the apache helicopters as I was offered a position as an Embedded Systems Software Engineer for the position. I intend to be in this position for a full year after graduation and have already accepted the offer

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)*
Family Graduate Housing	30

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)*
Tutoring High School CS Students	120
Teaching High School Students	20
Family Graduate Housing CA	240

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 is very fast compared to other systems I have used so it is much quicker and faster to pass code around.

Non-trivial feature 2:

Branching versioning, the ability to pretty much infinately branch and merge allowing branching of branches and control of multiple versions at once

Non-trivial feature 3:

Ability to track and revert repository history if someone makes a mistake

4: Git is free which is massively beneficial for startups and students

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)*
IT/Classroom Software Development	120

Best wishes wrapping up the semester and in the future!