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 MILES NABERHAUS

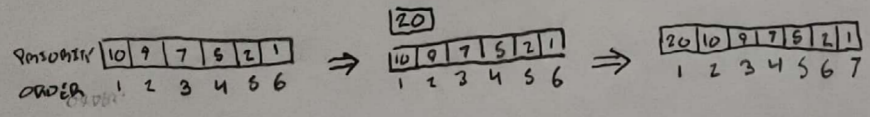
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer 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 COULD BE IMPLEMENTED, SINCE IT WILL STORE TICKETS BY BOTH TIME OF ARRIVAL AND VALENCY, MAKING QUEUEING AND DEQUEING EFFICIENT.

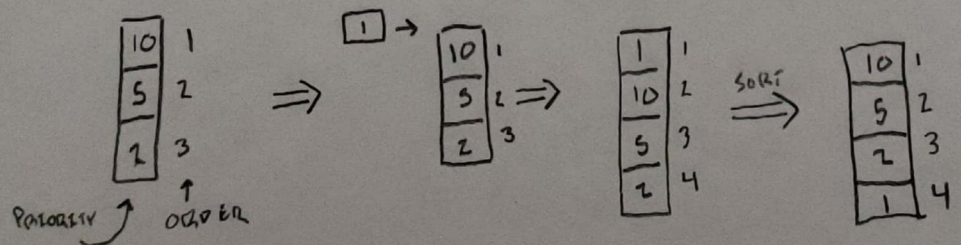
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

A QUEUE BASED FIRST ON PRIORITY AND SECOND ON A FIFO ORDER (SO OLDEST TICKETS OF HIGHEST PRIORITY ARE ADDRESSED FIRST).



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

A STACK, WHERE A NEW ELEMENT IS ADDED TO THE TOP, THEN ALL ELEMENTS ARE SORTED BY PRIORITY



Scanned with CamScanner

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):

Your solution:

```
DEF   COUNT_CHAR(WORD, CHAR):
    X = 0
    FOR C IN WORD:
        IF C == CHAR:
            X += 1
    RETURN X
```

Scanned with CamScanner

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:

IF EACH ELEMENT IS ALREADY SORTED, THEN WE SIMPLY NEED TO ITERATE THROUGH AND ADD THEM ONE BY ONE.

Worst case time complexity of algorithm:

$O(n^2)$

Explanation of worst case time complexity:

IF THE ELEMENTS ARE SORTED IN A REVERSED ORDER, THEN WE WILL NEED TO CHECK THROUGH ALL ELEMENTS PRIOR TO THEIR INSERTION, EACH TIME THEY ARE ADDED.

Scanned with CamScanner

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)*
MURDOCH'S RANCH AND HOME SUPPLY	WEB DEVELOPMENT INTERN	2000

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

AN ALGORITHM COULD MAKE SELECTIONS OR OBTAIN RESULTS THAT ARE "UNFAIR" OR PLACE IMPORTANCE ON UNINTENDED ASPECTS OF THE INPUT DATA.

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

THE ALGORITHM COULD SELECT AGAINST STUDENTS FROM A LOW-INCOME BACKGROUND BASED ON ACCESS TO RESOURCES OUTSIDE OF THEIR CONTROL (I.E. LACK OF ACCESS TO SPORTS OR OTHER EXTRACURRICULAR ACTIVITIES)

Scanned with CamScanner

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:

DEVELOPERS LESS LIKELY TO GIVE ACCESS TO CODE / MORE PROPRIETARY SOFTWARE

Second possible impact:

MORE COLLABORATION BETWEEN MAJOR DEVELOPMENT CORPORATIONS

Third possible impact:

A GREATER PUSH FOR STRICT COPYRIGHT AND PATENT ENFORCEMENT WITH REGARD TO CODE / INTELLECTUAL PROPERTY

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: INJURY TO PEDESTRIANS OR DAMAGE TO PROPERTY FROM FAILURE OF CAR TO AVOID COLLISIONS

Second type of harm: TRAFFIC ISSUES FROM LACK OF BODY LANGUAGE AND COMMUNICATION WITH OTHER DRIVERS

Third type of harm: PREFERENCE OF WHO / WHAT IS HARMED WHEN AN ACCIDENT IS UNAVOIDABLE (TROLLEY PROBLEM - ESQUE SITUATION)

Scanned with CamScanner

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 HAVE BEEN OFFERED THE OPPORTUNITY TO SWITCH MY INTERNSHIP TO A JOB OFFER AS A JUNIOR WEB DEVELOPER AT MURDOCH'S; AND PLAN TO CONTINUE WORKING THERE WHILE SCORING OUT THE FIELD AND CONTINUING TO BUILD MY RESUME AND HONE MY SKILLS.

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)*

Scanned with CamScanner

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)*
MULTI DISCIPLINARY ENGINEERING	60

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 / GIT

Non-trivial feature 1: EASY TO USE BRANCHING SYSTEM WITH PULL REQUEST TO QUICKLY MERGE BRANCHES

Non-trivial feature 2: REPOSITORY ACTIONS FOR AUTOMATICALLY BUILDING AND TESTING CODE

Non-trivial feature 3: POWERFUL DIFFERENTIATION SYSTEM TO QUICKLY COMPARE FILE VERSIONS

Scanned with CamScanner

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)*
VUE MASTERY	40
LINUX SYSTEM MANAGEMENT	100
DOCKER	40

Best wishes wrapping up the semester and in the future!

Scanned with CamScanner