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 Emilia Bourgeois

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 would fit perfectly because every item has a priority associated with it and the highest priority is removed first.

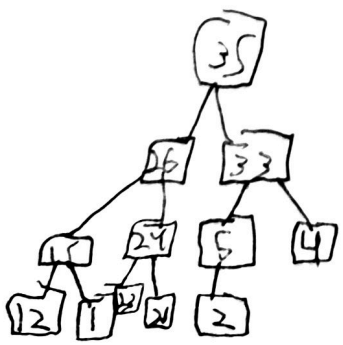
b) **Describe one way in which this data structure could be implemented and draw a picture of that data structure.**

Actually a linked list, (suboptimal), elements are inserted by finding a node close by pseudo randomly and then properly placed. End is first one



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

A heap, sorted with highest node at top, end at rightmost leaf, fufills shape property, stored in array.



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 func( s, c):
    t=0
    for ch in s:
        if c in ch:
            t+=1

    return t
```

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:

insertion sort: given only one element
out of place takes O(n) time because it is
simply a linear search

Worst case time complexity of algorithm: O(n²)

Explanation of worst case time complexity:

1st element: no traversal
2nd element: 1 comparison
3rd: 2

n: n-1 comparisons

$0+1+2+\ldots+(n-1) = \frac{n(n-1)}{2}$ which is O(n²)

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)*
Swing Cats	Full stack development	640
KMA Senate	Senator, attend meetings, plan	fall sem 300 hrs

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a) **Describe briefly what algorithmic bias is.**

Describes systematic and repeatable errors that create unfair outcomes. like privelaging a group of people over others.

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

Hypothetically a machine learning algorithm that selects PhD candidates unfairly between groups has algorithmic bias.

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: copyright laws are more lax essentially allowing others to borrow as much as they want from any public code.

Second possible impact:

Interoperability of systems maintains its integrity

Third possible impact:

The owners of any api cannot sue since using the code was ruled under fair use.

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 may discriminate in a life or death situation where no deaths are avoidable.

Second type of harm: Imperfections in the code can have the car think there are no unavoidable deaths when there are.

Third type of harm: If a car doesn't know local driving norms it can cause many accidents.

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.

Following graduation I plan to take a few months while working with my contacts at dell and oracle and hopefully work at pretty much anything. If not I will move back to WI with my parents until then.

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)*
Smash Society	1,000

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)*
EGEW 310	200
AI Projects	100
RA Class	50

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:

able to share bare repo with a local server

Non-trivial feature 2:

Able to squash branches together and roll that back

Non-trivial feature 3:

multiple work flows

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)*
ladder tournament injava	160

Best wishes wrapping up the semester and in the future!