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: River Kelly

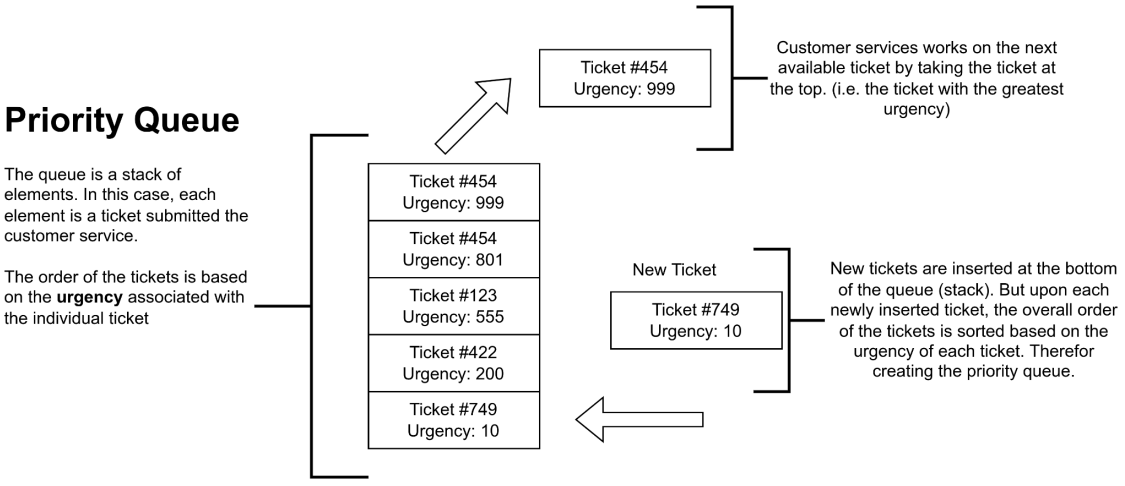
Question 1: A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's customer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

1. What simple data structure would best model this situation? Explain.

   The simple data structure that should be used is a Priority Queue.

   Like a traditional queue or stack, the elements in the data structure will be inserted and retrieved from one end of the queue. The priority queue is necessary for this problem because each customer service ticket has an urgency score. The priority queue will take into account this score and arrange the next ticket to be resolved by the highest urgency score.

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



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

   This data structure could also be implemented using a simple list. The order of the list based on urgency would be maintained upon the distinct insertion of new tickets. The new ticket would be examined and inserted before the next ticket in the list with an urgency score less than or equal to the newly inserted ticket.

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: **Python**

Your solution:

```
# Returns the number of occuances
# of a character is a string
def charCount(str, char):
    count = 0
    for index in range(len(str)):
        char_i = str[index]
        if char_i == char:
            count += 1
    return count
```

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 an algorithm: log2(n)

Explanation of best case time complexity: All of the floating-point numbers in k is less than any of the floating-point numbers in N. Upon insertion of a new number in K, it is inserted at the front of N. therefor it is simply inserting new number at the beginning of the ordered linked list.

Worst-case time complexity of algorithm: N^2

Explanation of worst-case time complexity: Each of the new numbers in k is greeter than each of the numbers in n. Upon inserting a new number for k, the algorithm has to check each element in n, thus appending the new number at the end (i.e. having to check each element in N for each K number inserted)

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)*
WealthVest	Automation Specialist	1,000

Question 5: IEEE P7003 defines the Algorithmic Bias Standard.

a. Describe briefly what algorithmic bias is.

   Flaws that are repeatable in an algorithm that result in errors.

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

   Some high schools have different GPA reporting systems. For example, some are on a scale from 0-4 and others are on the scale from 0-5. There are differences between weighted GPAs and unwirghted GPAs. If a collage admissions software does not correctly identify the scale used from the specific high school, some students may not be admitted.

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.

The side you choose to win: Google

First possible impact: Large distributed API would be considered open source, calling into question what other API can be used under open-source distribution protections.

Second possible impact: Companies that have API code they wish to keep private may have to pursue further patents to ensure greater protections seen as Oracle lost protections on their JAVA API code

Third possible impact: Oracle will not offer these API for free in the future. You may have to pay a premium for the future releases of JAVA.

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: Publishing personal driving data history to the public

Second type of harm: People overly trusting self-driving reliability resulting in physical harm such as a motor vehicle accident.

Third type of harm: Influencing the stock prices of traditional car manufacturers. Retirement 401K could be negatively impacted.

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 on working remotely. I want to spend time with my dog and skiing. I want to make money working to support what I truly want to do in life. The number one reason I choose computer science was to work remotely, this was well before the pandemic. I have not applied to any jobs 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)
Sigma Chi	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)
Sigma Chi	500

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: Rebasing branches

Non-trivial feature 2: Cache of recently checkout out commits

Non-trivial feature 3: Merging un-related histories

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)