## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Carter Bartz

Major (Circle One): Computer Science B.A. or (Computer Science B.S.)

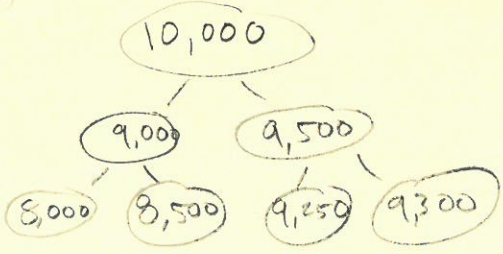
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's 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 be best to use. We can store the tickets in a order based on priority so most important will be handled first.

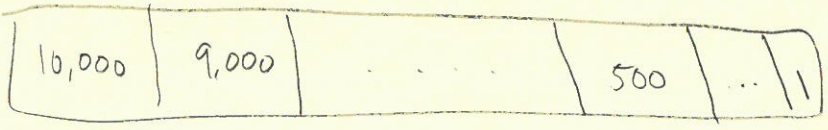
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

This can be implimented using a max heap. The parent node ≥ child nodes.




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

Another way it could be implimented could be an array that needs to be sorted in decending order.



**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 counter(str, char):
    count = 0
    for character in str:
        if character == 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 algorithm:*

O(1)

*Explanation of best case time complexity:*

In the best case adding to a linked list, we will add to the end of the list. All we have to do is hook up some pointers. There is no need to shift any elements.

*Worst case time complexity of algorithm:*

O(1)

*Explanation of worst case time complexity:*

Inserting into a linked list is always constant time because unlike an array there is no need to shift elements in memory. It is not contigous so we just move pointers.

**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)* |
|---|---|---|
| MSU Track & Field | Athletics | 20+ hours/week |
| PFL | Software support intern | 40 hrs/week - 7 months |
| Zoot Enterprises | Product Dev Intern | 40 hrs/week - 3 months |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

The Algorithim is biased in a way that doesn't allow it to see all sides of something. It might be biased toward outputing certain results or will always avoid another.

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

For college admissions, the bias could reject certain applicants due to yearly income, or race if not implimented in away to avoid such things. It could be biased in a way that reflects its implimentor unknowingly.

**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:* If oracle wins this could make open source less accessible. This could set a precident that software should alway be kept private and not open source slowing advancement.

*Second possible impact:*

Another impact could be a monopoly formation of certain software like mobile platforms leading to less options for consumers.

*Third possible impact:*

Another impact could be the case where this actually helps the industry in protecting against personal intellect being stolen.

**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:* This could cause physical harm. If the software is not perfect the vehicles can be driver without case or safety of patrons or riders.

*Second type of harm:* This could harm the taxi or uber business leaving lots of people out of jobs.

*Third type of harm:* this could also cause harm to other vehicle manufacturers that cant make these types of products, or even just financial harm to people being able to afford such things

**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 in the bozeman or gallatin valley area working as a Software engineer or something similar. I have reached out to companies like Zoot Enterprises, but currently have no offers.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| MSU Track & Field | 20+ hrs/week |
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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)* |
|---|---|
| Group projects in class | usually a couple per class |
| Internships (Zoot, PFL) | 10 months |
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**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:* abbility to revert to a previous version of the repo.

*Non-trivial feature 2:* abbility to clone a remote repository to local machine and cook on it.

*Non-trivial feature 3:* Abbility to cherry pick certain changes from a commit, and not have to completely revert.

**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)* |
|---|---|
| Learned javascript online | 80 hours |
| personal projects to learn material in summer | ~ 100 hours |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

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Name STEPHEN BROOK

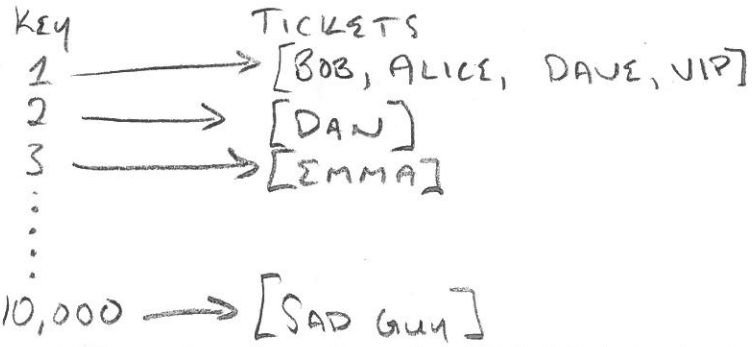
Major (Circle One): Computer Science B.A. or (Computer Science B.S.)

**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.

HASH SET . IT ALLOWS US TO ADD THINGS OF ANY PRIORITY AT ANY TIME, BUT ALSO FIND & REMOVE TICKETS BASED ON THEIR PRIORITY.

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




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

PRIORITY QUEUE, EACH ITEM IS ASSIGNED A PRIORITY, AND PLACED IN A FIRST-IN-FIRST-OUT QUEUE FOR THAT PRIORITY

QUEUE 1: BOB → ALICE → DAVE → VIP

QUEUE 2: DAN

QUEUE 3: EMMA

⋮

QUEUE 10,000: SAD GUY

THE QUEUES COULD BE STORED IN AN ARRAY SINCE WE HAVE EXACTLY 10,000

**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 count (String S, CHAR c) {
   int result = 0;
   For (int i = 0;  i < S.length - 1;  i++) {
        for (int j = 1;  j < S.length;  j++) {
            if ( S.SubString (i, j).equals(c)) {
                result ++ i
            }
        }
   }
   return result;
```

**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:*

SAY $X$ IS THE SET YOU'RE ADDING. IF $X$ SORTED BIGGEST → SMALLEST, WHERE THE BIGGEST $\in X$ IS SMALLER THAN THE LARGEST IN THE ORIGINAL LINKED LIST, $x_1 \in X$ GOES AT THE HEAD $(O(1))$, THEN $x_2 \in X$ GOES AT THE HEAD $(O(1))$, ... AND SO ON. THUS, BEST CASE IS

$O(k)$

NOTE $|X| = k$

*Worst case time complexity of algorithm:*

$O(nk)$

*Explanation of worst case time complexity:*

LET $N$: THE SET ORIGINALLY IN THE LIST, LET $X$ = THE NEW LIST. NOTE $|N| = n$, AND $|X| = k$.

IF $X$ IS SORTED SMALLEST → BIGGEST WHERE THE SMALLEST $\in X$ IS BIGGER THAN THE BIGGEST $\in N$, WE HAVE TO TRAVERSE ALL OF $N$ $(O(n))$ TO PLACE $x_1 \in X$ $(O(1))$, THEN REPEAT FOR EACH $x \in X$ = $O(n) \cdot O(k) = O(nk)$.

**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)* |
|---|---|---|
| UNIVERSITY HOUSING | DESK CLERK | 700 |
| PARSONS CORPORATION | SOFTWARE ENGINEER | 600 |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

WHEN AN ALGORITHM SELECTS FOR CERTAIN TRAITS IT (WRONGLY) ASSUMES FAVORIBLE.

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

MINORITIES COULD BE LESS LIKELY TO 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.

*Side you choose to win:* ORACLE

*First possible impact:*
CODE IS BETTER PROTECTED, PEOPLE CANT STEAL IT WITHOUT CONSEQUENCES

*Second possible impact:*
GOOGLE HAS TO STOP USING STOLEN CODE

*Third possible impact:*
MAY IMPACT OPEN SOURCE SOFTWARE NEGATIVELY, PEOPLE BECOME SCARED THEY MAY GET SUED IF THEY USE IT WRONG.

**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:* PEDESTRIANS COULD GET HURT IF THE CAR DOES NOT HAVE ADEQUATE SENSORS OR THE SOFTWARE ISNT GOOD.

*Second type of harm:* OTHER DRIVERS MAY BE HURT IF THE CAR DRIVES IN A WAY THEY CANT ANTICIPATE & CAUSES AN ACCIDENT.

*Third type of harm:* THE USER COULD GET HURT IF THE CAR MAKES A MISTAKE.

**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 AM MOVING TO COLORADO SPRINGS TO TRANSITION MY INTERNSHIP TO FULL TIME AS A SPACE OPERATIONS SOFTWARE ENGINEER AT PARSONS CORPORATION.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| BOWLING CLUB | 40 |
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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)* |
|---|---|
| INTERNSHIP | 600 |
| AI GROUP PROJECTS | 300? |
| OTHER CLASS GROUP PROJECTS | 230 |
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**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:* BRANCHES

*Non-trivial feature 2:* HELPS W/ MERGE CONFLICTS

*Non-trivial feature 3:* BLAME

**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)* |
|---|---|
| LEARNING RUST | 60 |
| PERSONAL WEBSITE | 100 |
| ML PROJECTS | 300 |
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Best wishes wrapping up the semester and in the future!

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Name Owen Cool

Major (Circle One): Computer Science B.A. or Computer Science B.S.

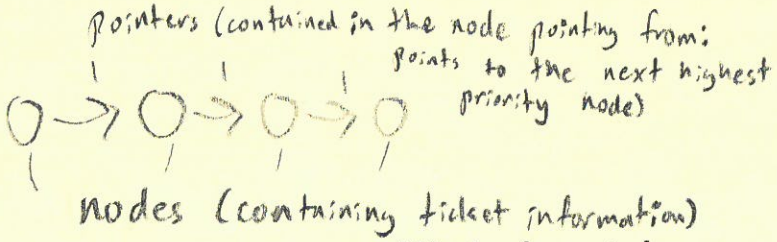
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

Priority Queue: Urgency scores represent the priority in the queue, and tickets are addressed in order of priority.

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

This data structure could be implemented using a linked list:




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

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):*

*Your solution:*

```
def myFunc(s: string, c: char):
    int count = 0
    for i in range(len(s)):
        if s[i]==c:
            count= 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 algorithm:*

If new numbers are sorted, $k+n$ ($O(n)$). If they are not sorted and can be sorted $k \cdot \log(k) + k + n$ ($O(n)$). If they cannot be sorted, $k \cdot n$ ($O(kn)$).

*Explanation of best case time complexity:*

Already sorted:

- iterate through k and n in ascending order. If current number in k is less than n+1 insert it in the list just before n. (Add first number of k as head, if it's less than all in original list

*Worst case time complexity of algorithm:*

see above. $O(kn)$.

*Explanation of worst case time complexity:*

Have to iterate through the whole original list to insert each of the k elements

**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)* |
|---|---|---|
| Sigma Phi Epsilon | Treasurer 1 year, scholarship selection committees | 10/week for 1.5 years, 20/week for 1 year, 5/week for 1 year. |
| Probabilistic Machine Learning Lab | reading groups | 5/week for 1 semester |
| Montana State REU | researcher | 40/week for 1 summer |
| Engineering Amb. | tours, meetings | 1.5/week for 2 years |
| ePALS | meetings | 1/week for 2 years |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias is when a software system causes different outcomes for different groups, or fails to consider/account for the needs of some groups.

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

Not providing enough options for how a person might enter their name - some people may have unexpected characters or # of spaces, etc.

**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 and explain 3 possible impacts to the computing industry of this win.

*Side you choose to win:* Google

*First possible impact:* Higher rate of copying others' code

*Second possible impact:* AI companies scrape everyone's code and regurgitate it in an LLM

*Third possible impact:* Companies try to hide their code from the public so it doesn't get copied.

**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:* Damage to other vehicles

*Second type of harm:* Injuring pedestrians

*Third type of harm:* Violating traffic laws

**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 accepted to MSU as a master's student in CS. I plan to do that for a year (accelerated) then get a job.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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. I included these in question 4.

| *Organization Name* | *Estimate Total Hours Spent* |
|---|---|
| Sigma Phi Epsilon | |
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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)* |
|---|---|
| Study Abroad (Bergen, Norway) | 6 months |
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**Question 11:** Name the most sophisticated version control system that you use and describe three nontrivial features it has. - really? If I learned this from you, it was thanks only to Carson Gross

*Name of most sophisticated version control system:*

git

*Non-trivial feature 1:*

branching - creating a new version of the repository separate from the "main" branch.

*Non-trivial feature 2:*

Cloning a repository to your system

*Non-trivial feature 3:*

resolving merge conflicts

**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)* |
|---|---|
| TAILS | 15 |
| PML lab | 5/week for 1 semester |
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Best wishes wrapping up the semester and in the future!

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Name Alexander Ellingsen

Major (Circle One): Computer Science B.A. or (Computer Science B.S.)

**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.

Priority queue. This would allow for Non-VIP customers to be processed in order, with VIP-customers "cutting" the line

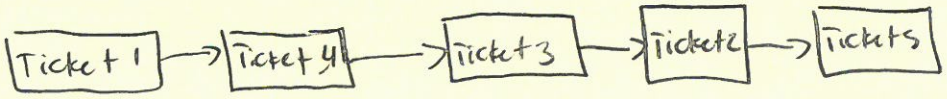
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

This could be implemented with two arrays, one for the VIP Queue and one for the regular customers. When inserting, the queue would be organized by Urgency. Ex. VIP Queue: [Ticket 1, Ticket 4, Ticket 3]

Regular Queue: [Ticket 2, Ticket 5]

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

It could also be implemented as a linked list We Could also sort by urgency, with VIP tickets at the front Ex



**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 char_counter(text:str, char:str) -> int:
    no_times = 0
    for i in text:
        if i == char:
            no_times += 1

    return no_times
```

**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:*

$O(k) = O(1)$

*Explanation of best case time complexity:*

The best case would be adding each k to the beggining of the list, meaning connections do not have to be broken, only added.

*Worst case time complexity of algorithm:*

$O(k) = O(1)$

*Explanation of worst case time complexity:*

Insertion into a linked list is always O(1)

**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)* |
|---|---|---|
| MSU UCA | Helped teach courses | 3 years, ~700 hrs(?) |
| MSU Research Assist. | Helped Pr. Nazemi in several research projects | 2.5 years, ? hours |
| Quiq AI engineer intern | Developed AI Agents | ~400 hours |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias occurs when algorithms are unfair towards specific groups, usually unintentionally

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

College admissions software could show Algorithmic bias by favoring people from specific high-end private highschools. This could be due to inflated grades or extracurriculars. This is a form of bias as many private schools charge a tuition, creating economic barriers to many people.

**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:*

Protecting Open-Source development

*Second possible impact:*

Allowing developers to create with pre-developed tools, not making them develop everything in-house

*Third possible impact:*

letting people use Programming languages like Java for non-oracle projects

**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:* Physical harm to pedestrians, other cars

*Second type of harm:* Societal harm by using unfair or biased algorithms

*Third type of harm:* Economic harm by putting rideshare drivers/taxi drivers out of work

**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 continue my employment at Quiq as an AI Engineer. I have also applied to University of Washington's Masters of Computational linguistics, but I have not received a response.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| NA | |
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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)* |
|---|---|
| Research Assistant | 2.5 years, unknown hours |
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**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:* Creation of different development branches

*Non-trivial feature 2:* pull requests, allowing for code reviews

*Non-trivial feature 3:* Easy sharing of development across a team

**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)* |
|---|---|
| learning NLP tools (NLTK, Spacy) | ~50 hours |
| Huggingface LLM tutorials | ~50 hours |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Cody Hager

Major (Circle One): Computer Science B.A. or Computer Science B.S.

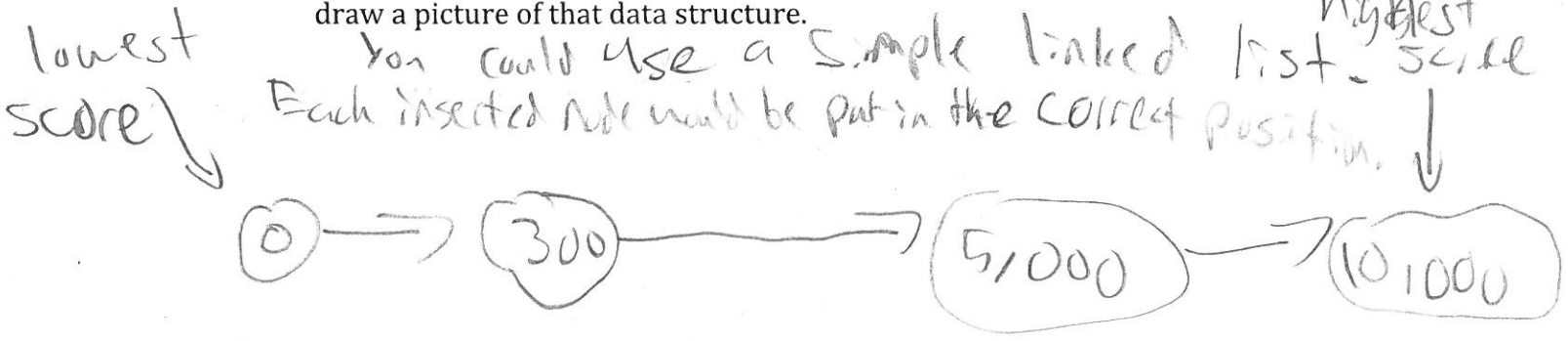
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's 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 be ideal. Specifically you could implement a maximum PQ based on the urgency score. This would allow for great performance.

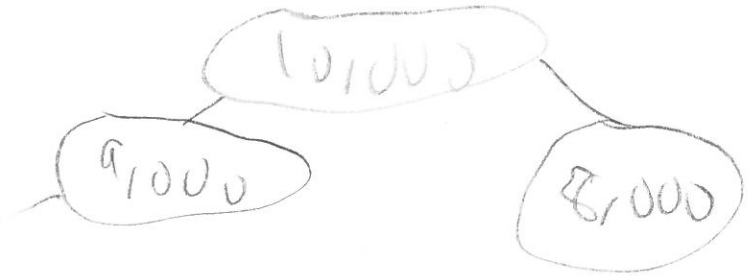
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

You could use a simple linked list. Each inserted node would be put in the correct position.




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 maximum heap.

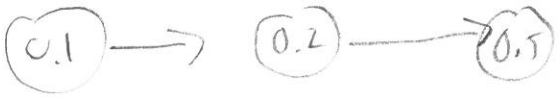


**Question 2:** Write a function in a language of your choice that has two parameters: a string and a character. The function should return the number of times that the character occurs in the string.

*Your language of choice (e.g. Python):* Go

*Your solution:*

```
func numOccurs(char, string) int {
    numOccurs := 0
    for _, c := range string {
        if c == char {
            numOccurs++
        }
    }
    return numOccurs
}
```




**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:*

$O(k \cdot 1) = O(k)$

*Explanation of best case time complexity:*

If all of the values are inserted at the start of the list, then that is a single operation (creating a new pointer) and is constant time O(1).

*Worst case time complexity of algorithm:*

$O(kn)$

*Explanation of worst case time complexity:*

If all values are inserted at the end of the list, then the entire list must be traversed for each element of k. This is a O(n) operation for each k, thus O(kn).

**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)* |
|---|---|---|
| Raft LLC | Software Engineer | 20 hrs/week |
| Hackercats | treasurer/member | 3 hrs/week |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Algorithmic bias describes the scenario of when an algorithm (often AI or ML software) puts people at certain advantages/disadvantages when it should not.

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

Algorithmic bias is often caused by biased training data. For example, if the college admissions software's job is to decide how successful a student could be, it could output inaccurate calculations for under-represented groups (e.g. people from a demographic that has insufficient training data).

**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:*

People in the computing industry feel more free to use code from projects like Java under the correct licensing.

*Second possible impact:*

More attention is given to open-source projects rather than attempting to create proprietary software.

*Third possible impact:*

Oracle is framed upon for trying to prohibit use of their software in this way.

**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:* Obviously, if the car is buggy and gets in car accidents it could hurt or kill people.

*Second type of harm:* The car could have some type of algorithmic bias towards certain people, areas, or other vehicles on the road.

*Third type of harm:*

The car could brake or accelerate too aggressively damaging the roads or the tires of the car itself.

**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 currently work as an Associate Software Engineer for a federal contractor called Raft LLC. I plan to work full time there after graduation. I have already accepted an offer with a start date of January 3rd.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| CRU | 20 total |
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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)* |
|---|---|
| Hackercats - working on CTF challenges | 30 |
| working with others in Math and Stats center | 50 |
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Hackercats

**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 / Github

*Non-trivial feature 1:* Github actions - used for CI to run unit and end-to-end tests with every commit.

*Non-trivial feature 2:* interactive rebasing - used to pick which commits to keep when merging with another branch.

*Non-trivial feature 3:* Deployments/Builds - creates a deployment (ex: a website) or a build (ex. a docker container) for commits automatically.

**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)* |
|---|---|
| Installing Linux on burner laptop | 15 |
| Following youtube videos to write programs | 15 |
| Creating my own WEB applications | 30 |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Danie Huelva

Major (Circle One): Computer Science B.A. or Computer Science B.S.

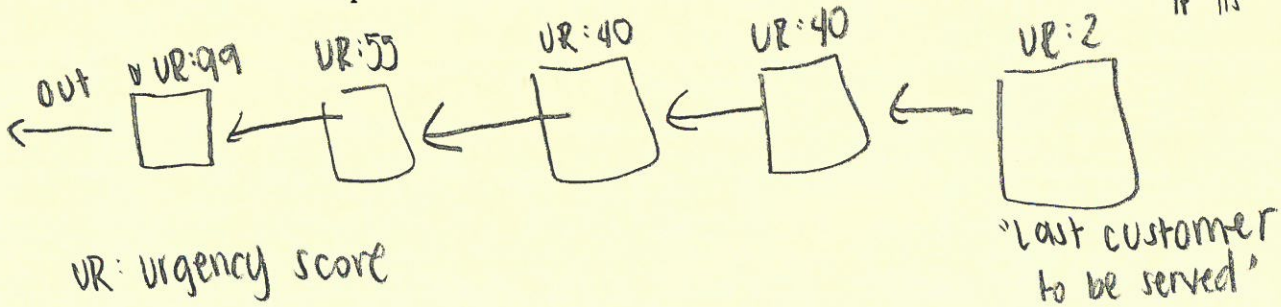
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's 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 work best for this because it's a first in first out system and "priority" makes it more accurate since depending on the urgency we can push the customer at the head of the queue

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

when a customer is added to the queu if its




UR: urgency score

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

A hashmap. have a customer to UR mapping and get the customer with the highest UR and remove it from the mapping.

{ CUS1 : 2
CUS 2 : 100
CUS 3 : 200 }

**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 num_times( word, char ):
    count = 0
    while word.contains(char):
        i=word.index(char)
        word = word[i: len(word)]
        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 algorithm:*

O(k)

*Explanation of best case time complexity:*

if the k floating point is in ascending order the we just have to add all k to the list at the end

*Worst case time complexity of algorithm:*

O(kn)

*Explanation of worst case time complexity:*

we will have through the list every k times to find all k numbers where all belon

**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)* |
|---|---|---|
| AWC | Tech Networking Night | ↖ |
| AWC | secretary & treasurer | 75 hours |
| Undergrad CA | TA | 40 hours |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

#rwhere the algorithm leads more into

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

if the majority of the software has been trained on previous datasets where people come from wealthy private schools. This software could bias and choose people from these schools

**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 would be more carefull w/ intellectual property

*Second possible impact:*

More laws abt intellectual property especially w/ the rise of AI

*Third possible impact:*

More caution w/ writing 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:*

Run into a pedestrian

*Second type of harm:*

crash to a semi

*Third type of harm:*

run off a cliff

**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.

Gap year

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| AWC | 75 |
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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)* |
|---|---|
| Hackathon | 10 hours |
| Core classes | 30 |
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**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:*

look at status of repo

*Non-trivial feature 2:*

collaborate w/ developers

*Non-trivial feature 3:*

pull and push

**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)* |
|---|---|
| Leetcode | 20 |
| Python Projects | 20 |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 80 minutes.**

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Name Matthew Ivankovich

Major (Circle One): Computer Science B.A. or Computer Science B.S.

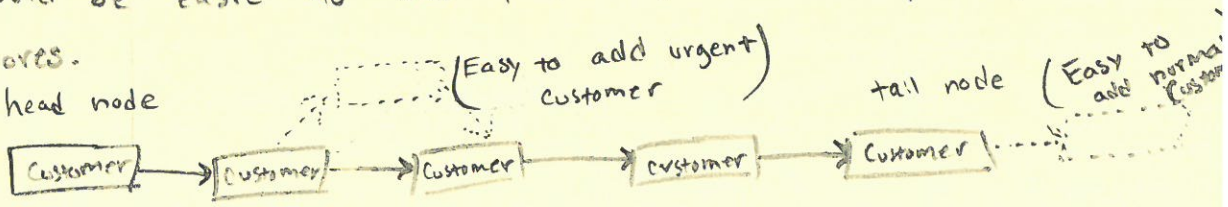
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

Priority Queue. With this data structure we would be able to easily keep track of customers with a last in first out flow with being able to add people based off of urgency.

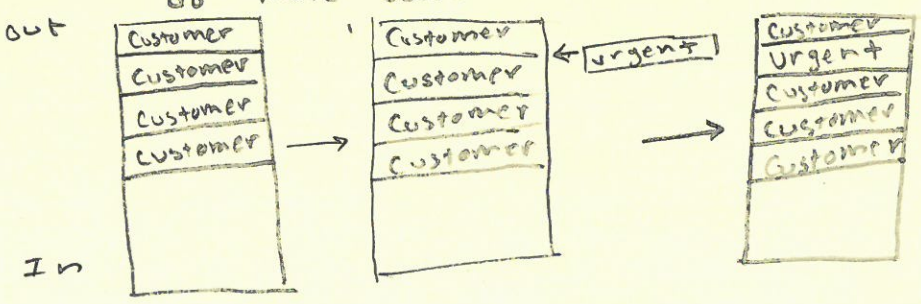
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

I would implement this with a linked list because it would be easier to add people that have high urgency scores.




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

A second way in which this structure could be implemented is with an array. We would just have to do more work with inserting urgent customers.



**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 countCharInString(string, char):
    count = 0
    for i in range(len(string)):
        if string[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 algorithm:*

$O(k)$ k = number of numbers to add.

*Explanation of best case time complexity:*

Best case time complexity would be that every floating point number would be added to the front of the list causing the algorithm to run in constant time, needing to only create the node and one pointer to the next node.

*Worst case time complexity of algorithm:*

$O(kn)$ Could be reduced down

k = # of items to add n = # of items to search through

*Explanation of worst case time complexity:*

This is the worst case dropping constants because we may need to search through the whole linked list to see where to insert our numbers.

**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)* |
|---|---|---|
| GSOC | UCA | 300 |
| Smarty Cats | Tutor | 400 |
| Community Gardening (Forgot name) | Helping on farm | 10 |
| | | |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Letting your own human bias slip into your code & algorithms.

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

For example if you had set up your college admission software to accept students sorted by state, unintentionally, and you had a cap of students that you could admit, you may keep some students out just because their state is further back in alphabetic order. Just because of your bias towards sorting students by state you could have bad outcomes.

**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's systems aren't fully complete so their algorithms don't fully work leading to failure.

*Second possible impact:*

Google fails as a company due to money reasons. and we are delayed in having a great search engine.

*Third possible impact:*

We set precident that no one can use other peoples code and we get a stagnent market.

**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:*

Due to negligence, an error causes the car to crash and someone is hurt.

*Second type of harm:*

Self driving cars are very good and cheap and puts every commercial driver out of business.

*Third type of harm:*

The software favors certain types of people, picking up only people it wants to, causing ethical issues.

**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.

Hopefully travel and get a job I enjoy. I may have a potential internship this summer with a company in Sweden/Germany. I look to apply elsewhere as well.

I have also applied for a masters here at MSU for if I am not able to get a job.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| Journey Church | 100 |
| School Soccer | 10 |
| | |
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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)* |
|---|---|
| Study Abroad | 100 |
| | |
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**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:*

restoring repository from previous commit

*Non-trivial feature 2:*

Pull requests to comment & receive feedback on teammates code.

*Non-trivial feature 3:*

Integrated CI/CD tests

**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)* |
|---|---|
| Various meetings | 30 |
| Personal Projects | 100 |
| LinkedIn | 50 |
| Job Search | 50 |
| | |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

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Name Lucy Lewis

Major (Circle One): Computer Science B.A. or Computer Science B.S.

**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.

Priority Queue where the ticket with a higher urgency score is placed toward the front of the queue. This makes it easy to arrange tickets by urgency and address the most urgent tickets first

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

a priority queue in Java

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

a Linked List in which tickets with higher urgency are placed at the head

**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 (str, char):
    count = 0
    for i in range(0, len(str)):
        if str[i] == char:
            count ++

    return count
```

for k ... O(k)
check O(1)
insert O(1)
sort

**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 additional k floating point number is already greater than all previous n floating point numbers and is added to the linked list in ascending order, then running time should be O(k) for each check and insertion

*Worst case time complexity of algorithm:* O(n+2k)

*Explanation of worst case time complexity:*

if each additional k floating point number is less than a previous number in the list, the list will need to be resorted to maintain an ascending order

including all and additional k floating numbers point that were inserted previously

**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)* |
|---|---|---|
| Association of Women in Computing | meetings — weekly recruitment | 80 |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

algorithms being designed or trained upon biased data

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

say the college admissions software is trained on past applicants who are historically white and middle-class, the software could throw out applications ~~with~~ where the applicants do not possess Caucasian names

**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:*

code is owned by who writes it

*Second possible impact:*

loss of open source code

*Third possible impact:*

standard for how many lines of code violates copyright/patent ownership

**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:*

physical harm by having faulty breaking detection and hitting other cars or people

*Second type of harm:*

mental harm due to stress if software is faulty and fails to perform how it is meant to

*Third type of harm:*

legal/financial harm by causing car accidents with others

**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

I have applied to
Speridian, New Wave Training Program
Fast, Implementation Consultant
Quiq
Computers Unlimited, Software Tester
State of MT, Application Developer

I have not received any offers

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| AWC | 80 |
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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)* |
|---|---|
| coarse projects | 50 |
| tutoring | 500 |
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**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:* branching

*Non-trivial feature 2:* push/pull request

*Non-trivial feature 3:* code review

**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)* |
|---|---|
| NA | NA |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Jeremiah MacKey

Major (Circle One): Computer Science B.A. or (Computer Science B.S.)

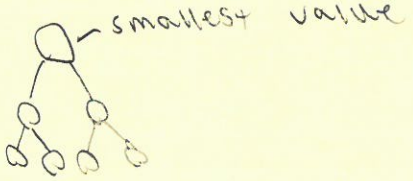
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

Priority queue

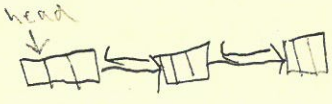
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

It can be implemented using a Minimum heap




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

A doubly linked list



**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:*

```
funct Count (String, Char){
    String[] = new String.array   //turn the String into array with n elements
    int count = 0
    for (i=0, i<=n, i++){         //n is length of string
      if String[i] == Char {
        count++;
      }
    }

    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 algorithm:*

O(1)

*Explanation of best case time complexity:*

If it is the start or end of the linked list, you simply add it directly on which is O(1)

*Worst case time complexity of algorithm:*

O(n)

*Explanation of worst case time complexity:*

If it is in the middle, you must transverse from the head to that section, insert K, and move the rest of the chain which is O(n).

**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)* |
|---|---|---|
| ACM | projects and career prep | 25 |
| Wolfssl (internship) | Software engineering, cybersecurity, networking. | 700 |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

When an algorithm favors a specific type of data or stems it in some unequal way.

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

It may look for students above a certain gpa only which doesn't factor in all the situations which may have affected that and some more than academically qualified students may get rejected.

**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 and explain 3 possible impacts to the computing industry of this win.

*Side you choose to win:* Google

*First possible impact:* It sets a precedent that publicly available code can be used by others freely which can lead to good and bad circumstances.

*Second possible impact:* Code will be more likely to be private, potentially stifling innovation.

*Third possible impact:* Stricted and clearer copyright laws would be implemented.

**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.

*Second type of harm:* Harm to pedestrians/those outside the vehicle.

*Third type of harm:* Harm to the general safety of the road.

**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 will likely continue working for Wolfssl here in Bozeman as a software engineer for a few years. I already have an internship and they have offered me the full time position.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| None | |
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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)* |
|---|---|
| None | |
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**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:* Tracking history of commits (local) and pushes (cloud)

*Non-trivial feature 2:* Tracking which changes came from which files and from who.

*Non-trivial feature 3:* Controlling commit history via rebase and reflog.

**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)* |
|---|---|
| FPGA use and design | 80 |
| Server setup and infrastructure | 200 |
| Machine learning on FPGAs | 200 |
| Online Cybersecurity competitions | 100 |
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Best wishes wrapping up the semester and in the future!

# Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Diego Moylan

Major (Circle One): Computer Science B.A. or Computer Science B.S.

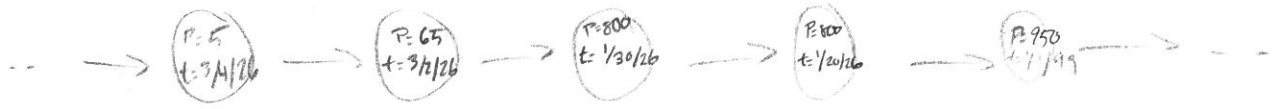
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

Priority queue because you want each ticket of a given level to be FILO, and higher priorities to be processed first

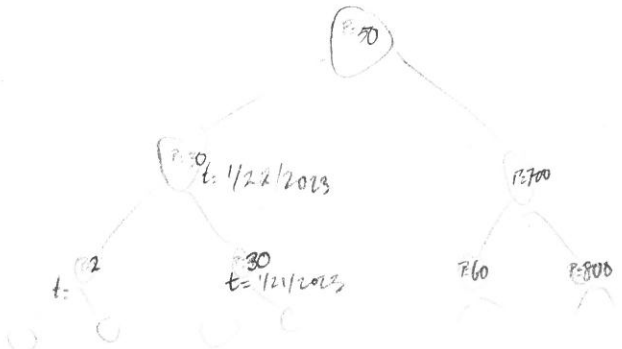
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

A linked list sorted on first priority then time entered




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

A B-tree sorting on first priority then entrance time



**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 num_occurs( s, char):
    count = 0
    for letter in s:
        if letter == 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 algorithm:* $O(k)$

*Explanation of best case time complexity:*

Every insert is the new lowest number, giving $O(1)$ single insert time. Do this k times for $O(k)$.

*Worst case time complexity of algorithm:*

$O(k \cdot n)$

*Explanation of worst case time complexity:*

Every insert is the new highest number, giving $O(n)$ single insert time. Do this k times for $O(k \cdot n)$

**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)* |
|---|---|---|
| MSU Bridge club | Playing bridge | ~150 |
| Hoplite Industries | SOC analyst | ~200 |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Some data/people/information is prioritized or processed first due to the algorithm used.

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

If the admissions office was shown applicants in alphabetical order, they might be biased towards/against the first portfolios they saw.

**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:*
Software trends toward being open source because if people take it there aren't any ramifications anyway

*Second possible impact:*
Software trends toward being less open source because that's the only way for companies to protect their intellectual property.

*Third possible impact:*
Code becomes uncopyrightable.

**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:*
Killing pedestrians

*Second type of harm:*
Killing passengers by avoiding pedestrians and driving into a wall.

*Third type of harm:*
Getting stuck in traffic with a horde of self-driving cars that get stuck in a livelock.

**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 want to get a job using my CS degree. I applied to a few places a while ago and didn't hear anything back, so I'm going to go on an application spree soon.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| MSU bridge club | ~150 hrs. |
| | |
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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)* |
|---|---|
| Job at Hoplite Industries | ~200 |
| Study abroad in Seoul | ~6,000 |
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**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:* Actions (automation)

*Non-trivial feature 2:* Projects (tickets)

*Non-trivial feature 3:* Pull requests

**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)* |
|---|---|
| Bouldering | ~ 300 |
| Strength Training | ~ 300? |
| Leetcode | ~ 10 |
| Video games about/using programming | ~ 100 |
| Typing speed training | ~ 50 |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Owen O'Brien

Major (Circle One): Computer Science B.A. or Computer Science B.S.

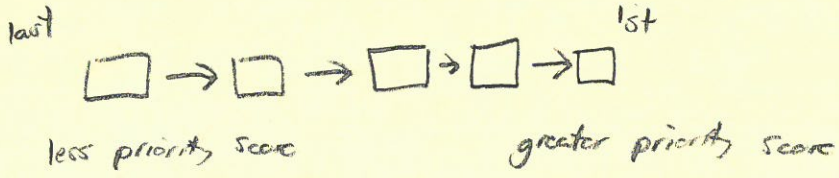
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

Priority queue, this way it is first come first serve however there is a component of priority.

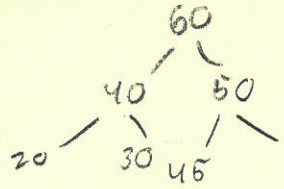
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

a linked list where the first node is the highest priority ticket




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

a balancing max heap where they always take the first top node



**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 number_of_times(string, char):
    Times = 0
    List_of_string_chars = string.split()

    for i in Len(list_of_string_chars):
        if list_of_string_chars[i] == char:
            Timaes = Times + 1

        Else:
            Pass

    Return Times
```

**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(1)

*Explanation of best case time complexity:*

The item k being added appears at the bessining of the list being the smallest number each time.

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

*Explanation of worst case time complexity:*

The items k have to go through each item in the list to find if is the largest item.

**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)* |
|---|---|---|
| 4x4 club | offroading | a lot >1000 |
| UIT student Employment | Computer Tech Support | a lot >1000 |
| Baseball club | Baseball | 100 |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

When a algorithm does not take into account all the variables that it should use.

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

If a software is setup to only look at GPA and nothing else, this might decline people who should get in even if their GPA was not the best

**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:* Code copyright laws become easier to enforce

*Second possible impact:* Google still has access to the code and can just change it a little bit and then Open Source it themselves

*Third possible impact:* Large companies will not develop software as fast if small bits of codebases get cherrypicked.

**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:* may choose to kill one person to avoid killing multiple

*Second type of harm:* emotional harm to someone who was in the car if an accident occured

*Third type of harm:* if the software glitches and damages the car, and the person who owns the car has to pay, this causes financial harm.

**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 went to work, and have applied to

WolfSSL - Denied

Crowdstrike - Denied

Land ID

Fast Enterprises

Some other small software companies

I have no offers however

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| 4x4 club | ~100 |
| Baseball club | 100 |
| Hacksack club | 100 |
| | |
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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)* |
|---|---|
| 4x4 club, offroading with mechanics | >1000 |
| | |
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**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:* Creating seperate branches of a repository

*Non-trivial feature 2:* Pushing and pulling repositories to a central location

*Non-trivial feature 3:* Automated workflows with Github actions

**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)* |
|---|---|
| Taught myself Cybersecurity (hacking) | 250 |
| watched many CS Related presentations | 30 |
| Taught myself C++ | 100 |
| Built a few personal Projects | 30 |
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Best wishes wrapping up the semester and in the future!

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**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Oscar Oropeza

Major (Circle One): Computer Science B.A. or Computer Science B.S.

**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.

Urgency

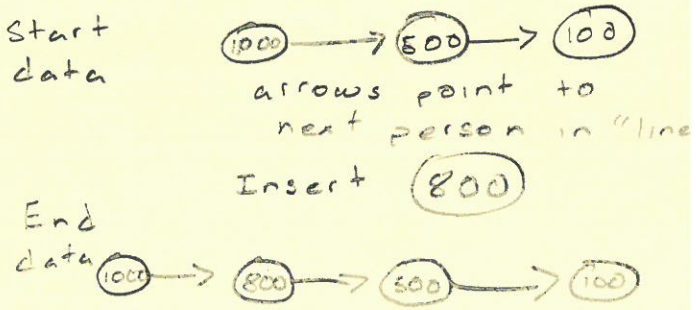
a) What simple data structure would best model this situation? Explain.

Priority Queue

We can insert customers in order of their assigned urgency score.

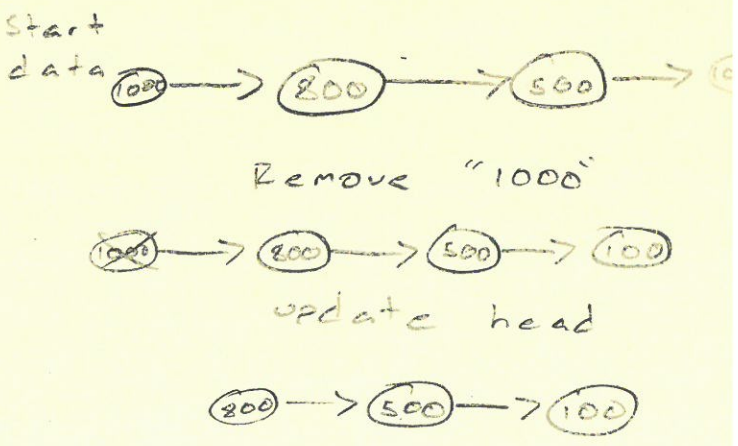
b) Describe one way in which this data structure could be implemented and draw a picture of that data structure.

Assuming no customers, read in a new and place it accordingly. If a customers score is high compare until you find a higher one.




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

Removing a customer
Look at the beginning of the "line" and remove.
Update the new highest score.

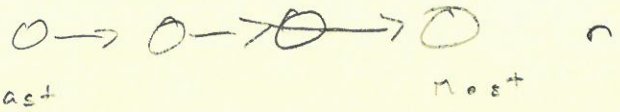


**Question 2:** Write a function in a language of your choice that has two parameters: a string and a character. The function should return the number of times that the character occurs in the string.

*Your language of choice (e.g. Python):* Python

*Your solution:*

```
def occur(text: str, char: str) -> int:
    occ = 0
    for c in text:
        if c == char:
            occ += 1
    return occ
```




**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.**

Alg:
Insert k nums into linked list.

*Best case time complexity of algorithm:*

$\Theta(k)$

*Explanation of best case time complexity:*

k floating points are in descending order (2.22, 1.22, 0.22) and the head of the linked list contains a number greater than all k numbers. (3.22, 4.22, 5.22)
All k numbers will be inserted into in $\Theta(1)$ time, and we do this k number of times.

*Worst case time complexity of algorithm:*

$\Theta(nk)$

*Explanation of worst case time complexity:*

Inverse of best case

k numbers
(0.22, 1.22, 2.22)

list:




Adding 0.22 will force us to reach the end of our list.




Traverse all n numbers and we do it k times.

**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)* |
|---|---|---|
| Engineering Amb. | Meetings & Tours | 20 |
| Intramural sports | soccer & basketball | 20 |
| TA | Grade & Teach | 150 |
| | | |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

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

**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:*

better team dynamic

*Second possible impact:*

less financial pressure ?

*Third possible impact:*

safer environment

**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:*

Create hazards (run red lights, not stop for pedestrians, drive recklessly)

*Second type of harm:*

Relax our human awareness of dangers on the road

*Third type of harm:*

kill people

**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.

Working as a "technologist" for Black Cape.
Will work and save money for future expenses.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| Intramural Sports basketball | 10 |
| Soccer | 10 |
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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)* |
|---|---|
| NA | |
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**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:*

It has a history of all commits ever made on a project

*Non-trivial feature 2:*

You can remove commits from it history.

*Non-trivial feature 3:*

Using rebase, you can safely pull from main branch in batches of commits (if on branch)

**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)* |
|---|---|
| NA | |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Nathan Ritchlin

Major (Circle One): Computer Science B.A. or (Computer Science B.S.)

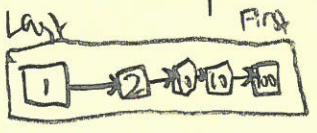
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

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

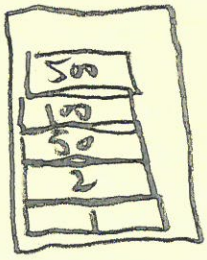
~~The priority of items would be based on how~~ ~~urgent they are~~




Linked list, where items are added to the front of the list if they have a higher priority.

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

A stack where items are added based on priority



**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 countChars(string, character):
    total = 0
    for c in string:
        if c == character:
            total += 1
    return total
```

**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 added number is exactly at the start of the linked list (lowest value), it will only take k operations to add all the numbers.

*Worst case time complexity of algorithm:*

O(kn)

*Explanation of worst case time complexity:*

If each added number is exactly at the end of the linked list, the entire list will be traversed before the number is added. meaning k numbers will all take n operations

**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)* |
|---|---|---|
| ~~MSU Esports Club~~ | ~~Played Valorant w/ a team~~ | ~~500~~ |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

I have not learned that in any of my classes. If I had to guess, I would say bias against a group of people (unintentionally) through an algorithm's design

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

If a college admissions software's algorithm gave an extra score to users with a different race, members of other races could be less looked at/promoted by the software.

**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 would need to source their code more thoroughly

*Second possible impact:*
Open source code would become more common, as users would want to promote their skills to large companies.

*Third possible impact:*
Google would look to hire more employees to write their code in-house

**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:*
Harming the user by crashing

*Second type of harm:*
Harming others by not having proper vision detection

*Third type of harm:*
Harming wildlife due to slow reaction between sensors and action (e.g. when a deer hops out)

**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 in yosemite national park for the summer (non-CS related) and then look to find a job in my hometown. The industry has not been kind to my applications so far.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| MSU esports team | ~500 |
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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)* |
|---|---|
| N/A | |
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**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:*

Can work independently with other users and merge branches after

*Non-trivial feature 2:*

Can fully revert to a previous version

*Non-trivial feature 3:*

Can create multiple branches for differing paths during production.

**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)* |
|---|---|
| Taught myself how to maintain a website w/ a SQL database | ~50 |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Theodore Vander Wall

Major (Circle One): Computer Science B.A. or Computer Science B.S.

**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.

priority queue.

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

Array based implementation:

[VIP, 99999], [patient, 500] [child, 750]

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

Linked List:

[VIP, 99999] → [patient, 500] → [child, 750]

**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 coolFunction(str, str[:1]) -> int :
    counter = 0
    for char in string:
        if char == str[:1]:
            counter++

    return counter
```

**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:* because in the best case scenario, every additional K floating point numbers are less than the first value of the original linked list. So, don't have to go through each element to find correct position.

*Worst case time complexity of algorithm:*

$O(n^K)$

*Explanation of worst case time complexity:* because in worst case scenario, the new elements being added are higher than every value in the original linked list, so would have to go thru. the entire L.L. to insert for every new K floating point number.

**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)* |
|---|---|---|
| Montana State Maker Space | Lab assistant | ~1000 hrs. |
| Montana State (Dr. Whitaker) | Research assistant | ~300 hrs. |
| Robocats | Software team | ~150 hrs. |
| Cisco | intern | ~1500 hrs |
| Silicon Steam Academy | Senior instructor | ~500 hrs. |
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

Not sure: Algorithmic bias is when a developer tends to use an algo/data structure because they prefer it personally, without considering potentially better options.

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

The college Admissions software devs prefer an inefficient graph algorithm for calculating the route from the local airport of the city to the college testing facility instead of using dikstra's.

**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:* code becomes more 'open source', ideas/execution becomes more prioritized.

*Second possible impact:* Google's mobile platform O.S. becomes more reliable.

*Third possible impact:* Oracle is forced to innovate.

**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:* hit a person/civilian while driving.

*Second type of harm:* car owners don't want their personal driving data used for unknown ways (training a model, etc.)

*Third type of harm:* civilians don't trust all car makers, and all car makers revenue is affected.

**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 do ~~software~~ engineering at Cisco.

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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* | *Estimate Total Hours Spent* |
|---|---|
| Robo cats | ~ 150 hrs. |
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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)* |
|---|---|
| Research assistant | ~ 300 hrs. |
| Makerspace lab assistant | ~ 1000 hrs. |
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**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:* branch support, allow multiple users to work on same project simultaneously.

*Non-trivial feature 2:* feature rollback, allow buggy version bumps to be rolled back seamlessly.

*Non-trivial feature 3:* CI/CD Pipeline support via github actions.

**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)* |
|---|---|
| Leetcode | ~ 200 hrs |
| Career fair | ~ 5 hrs |
| Personal projects | ~ 600 hrs |
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Best wishes wrapping up the semester and in the future!

## Montana State CS Graduating Senior Exam

**Academic Year 2025-2026, 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 to provide a carefully reasoned answer to each question. This information will help us make improvements.

Name Cooper Wollschlager

Major (Circle One): Computer Science B.A. or (Computer Science B.S.)

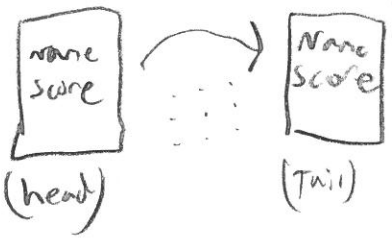
**Question 1:** A company uses a ticket system for customer service. Each ticket is given an urgency score when it is entered into the system. For example, a VIP customer would receive a higher urgency score than a regular customer. Assume that the urgency scores range from 1 to 10,000. The company's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

Linked List, can contain multiple data points, and easy insertion

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

biggest score

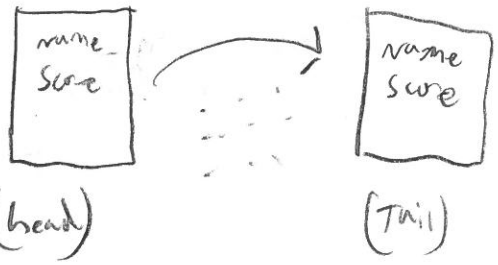



Smallest score

insert in order of score and Pop off head

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

Smallest score




biggest score

insert in order of score and pop off tail

**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:*

* basic sudocode. Def not syntactically correct. Strings usually have funny methods I always forget

```
function charCount(String w, Char C)
    int count=0
    For I in range len(w){
        if w[I] == C :
            Count ++
    }
    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 algorithm:* $O(k) \approx O(1)$

*Explanation of best case time complexity:*

best case everything goes in 1st slot. so $O(1)$ k times or $O(k)$ which we can describe as $O(1)$

*Worst case time complexity of algorithm:* $O(kn) \approx O(n)$

*Explanation of worst case time complexity:*

worst case everything is at end of list or $O(n)$ k times $O(kn)$

**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)* |
|---|---|---|
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**Question 5:** IEEE P7003 defines the Algorithmic Bias Standard.

a) Describe briefly what algorithmic bias is.

algorithmic bias is when something gets put before another just due to algorithm, not intended design.

The algorithm favors X on its own

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

algorithm bias could accidentally sort people by age within their groups giving older people a harder time at getting in

↑ * after intended sorting has been done

**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:*

longer dev cycles

*Second possible impact:*

re writing what is already made. At what point is something actually different?

*Third possible impact:*

better intellectual rights to the software you/companies wrote

**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:*

ignorance. will the self driving car realize it needs to divert to save passengers life

*Second type of harm:*

injuries. can cause injuries to passengers w/ no repurcussion as is a program

*Third type of harm:*

monetary. will it efficiently provide a route that does not take time and money to complete excess

**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.

apply to grad school at MSU (Here!!)
- not yet accepted

**Question 9:** List any organized social activities (e.g. SwingCats or some other MSU student club, church, a residence hall volleyball team, etc.) 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.

freshman year

| *Organization Name* | *Estimate Total Hours Spent* |
|---|---|
| MSU Hockey Club | 100+ |
| adult league hockey | 150+ |
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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)* |
|---|---|
| adult league Hockey | 150 + |
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**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:* Collaborator — based Change-log (See who did what when)

*Non-trivial feature 2:* easy UI to use/navigate

*Non-trivial feature 3:* easy to see Change log, see changes w/ out reverting to older versions

**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)* |
|---|---|
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Best wishes wrapping up the semester and in the future!