

FINAL EXAM F24 EARLY FINAL
CSCI 13500: Software Analysis and Design 1
Hunter College, City University of New York
Dec 16, 2024, 1:45 PM - 3:45 PM, North Building Lab 1001B

Exam Rules

- Show all your work. Your grade will be based on the work shown.
- The exam is closed book and closed notes with the exception of a provided cheat sheet.
- When taking the exam, you may bring pens and pencils.
- Scratch paper is provided. For your convenience, you may take the scratch paper and cheat sheet off. But make sure **not** to put solutions to the scratch paper.
- You may not use a computer, calculator, tablet, phone, earbuds, or other electronic device.
- **Do not open this exam until instructed to do so.**

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

I understand that all cases of academic dishonesty will be reported to the Dean of Students and will result in sanctions.

Name:

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1 (30 points) Answer the following questions.

- (1) Given `string groceries[] = {"milk", "apple pie", "onion"}`, what is `groceries[1].substr(3, 5)`?

- (2) Given a declaration `std::vector<int> v(3, 1);`, what is the value of `v.size()`?

- (3) What possible numbers does code `1 + rand() % 7` generate?

- (4) Given `string numStr = std::to_string(-21) + "0";`, where `to_string` converts an integer to a string. What is the value for `numStr`?

- (5) What is the value of `(4 + 7 % 3) / 2` in C++?

- (6) Write **header** of a function called min, given an array of characters (type `char`) with *size* many elements, return the smallest ASCII code of all the elements in the array.

- (7) Declare class `Coord` as follows.

```
1 class Coord {  
2 public:  
3     double x;  
4     double y;  
5 };
```

Declare a `Coord` object `point` and initialize its `x` as 2 and `y` as 3.

(8) Given `int grades[] = {73, 99, 100, 62};` What is the value of `*grades + 2`?

(9) Given the following code segment.

```
1 void foo(string *ps, string *pt);
2
3 int main() {
4     string s = "hello";
5     string t = "hi";
6
7     //TODO: write a statement to call foo using appropriate attributes of s and t.
8
9     return 0;
10 }
```

(10) Suppose we have main function defined as follows. And calling `foo(m, n)`, the values of `m` and `n` are swapped. That is, `m` becomes 2 and `n` becomes 1.

```
1 int main() {
2     int m = 1;
3     int n = 2;
4     foo(m, n);
5     return 0;
6 }
```

What is the **header** of function `foo`? Suppose its return type is `void`.

(11) What is output for the following code?

```
1  int a = 2;
2  int* p = &a;
3  a++;
4  cout << *p << endl;
```

(12) What is the output for the following code?

```
1  vector<int> nums = {1, 2, 0};
2
3  int count = 0;
4  for (int i = 0; i < nums.size(); i++)
5      if (nums[i] % 2 == 0)
6          count++;
7
8  cout << count << endl;
```

(13) What the output of the following code?

```
1  #include <iostream>
2  #include <string>
3  using namespace std;
4
5  int main() {
6      for (int row = 0; row < 3; row++) {
7          for (int col = 0; col < 2; col++) {
8              if (row >= 1)
9                  cout << "#";
10                 else cout << "-";
11             }
12             cout << endl;
13         }
14         return 0;
15     }
```

(14) What is panel after slide up operation?

1	6	3
2		7
4	5	8

(15) Suppose in Project 3, data member `bins` have the following values,

`{{2, 1, 3}, {1, 1, 3}, {2, 2}, {3}}`,

After moving eligible element(s), according to rules listed in Project 3, from the second to the left bin to the rightmost bin, what are the elements in the rightmost bin?

2 (15 points) Answer the following questions.

- (1) Define function `countSuccessiveBackElms`, for an given array of integers with its size, return the number of successive elements in the end of this array.

For example, call the function with array with values 1, 0, -1, 0, 0, the size of array is 5. There are two zeros residing successively (aka consecutively) on the end of array, the return is 2. Note that the second zero to the left is not adjacent with other zeros at the end, so it is not counted as part of the results.

In main function, write the following statements. No need to write the full definition of main function.

Define an int array with elements 1, 0, -1, 0, 0.

Call and print the number of successive back elements of the above array.

- (2) Write a function, given an array of integers, its size, and a target (an integer), return a pointer to the first occurrence of the target in an array, or nullptr if there is no match.

For example, suppose an array has elements 1, 2, 3, 2, if the target is 2, then the return of the function is a pointer to the second element to the left. if the target is 4, then the return is nullptr.

3 (10 points) Programming exercise on class

1. Define class for representing time in the 24-hour format. It is reasonable to define it to have two integer fields:

h for the number of hours, and m for the number of minutes.

```
1 class Time {  
2 public:  
3     int h;  
4     int m;  
5 };
```

Define Time minusMinutes(Time curr, int mins);

The function should create and return a new moment of time that is mins minutes before curr.
Example:

minusMinutes({8, 10}, 75) // should return {6, 55}

(We will not test how your function behaves if the new returned time will be on the previous day, feel free to assume that it will remain withing the same day, $\leq 23:59$.)

2. In main function, do the following,

- Define `curr` as a Time object with h equals 8 and m equals 10.
- Call `minusMinutes` to find out and return a Time object that is 75 minutes before `curr`.

4 (10 points) Write codes of vector

Define a function called **choose**, for a vector **v** of characters (type **char**), return a vector with all the elements from **v** that are alphanumerical, in the same order. In English, alphanumeric characters are the 26 letters of the alphabet and the 10 Arabic numerals.

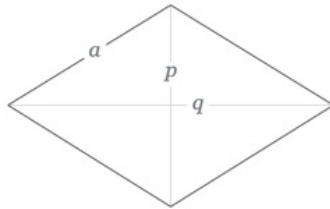
For example, given a vector of characters with elements **'a'**, **'b'**, **'#'**, **'1'**, **'?'**, the return is a vector with elements **'a'**, **'b'**, **'1'**.

Hint: `int isalnum (int c);` Check if character is alphanumeric. A value different from zero (i.e., true) if indeed **c** is either a digit or a letter. Zero (i.e., false) otherwise.

`isalnum` is from `cctype` library.

5 (15 points) Define class for diamond shape.

1. In a diamond shape, also called rhombus, all the sides are equal in length, and the diagonals bisect each other at right angles. It has two parameters:



- (a) side **a**
 - (b) a short diagonal **p**
2. Assume that **Diamond.hpp** is provided where data members **a** and **p** are declared as double types. Your job is to define **Diamond.cpp** with the following requirement.
 3. Define a default constructor, set data members a to be 1 and p to be 1.

4. Define a non-default constructor, which takes formal parameters a and p, both are double types.
 - (a) If both a and p are positive and $2\underline{a} > \underline{p}$, set data member **a** by given parameter a and set data member **p** by given parameter p.
 - (b) otherwise, set data members **a** and **p** to be 1.

5. Define method **getSide**, return the value of **a**.

6. Define method **getArea**, which defined by $\frac{1}{2}p\sqrt{4a^2 - p^2}$, where **sqrt** is a function from **cmath** library.

7. Define method **getPerimeter**, which returns the product of 4 times a.

Define **DiamondTest.cpp**, do the following:

1. Create an Diamond object named **dia** from its default constructor.

2. Find out and print the area of **dia**.

3. Find out and print the perimeter of **dia**.

6 (10 points) function on vectors

Given two vectors of integers, if they have the same number of elements, find out whether every element in the first is smaller than the corresponding element in the second vector, if yes, return true, otherwise, return false. If these vectors do not have the same number of elements, return false.

For example, if the first vector is $\{1, 2, 3\}$ and the second vector is $\{2, 3, 6\}$, return true.

If the first vector is $\{1, 2\}$ and the second vector is $\{2, 3, 4\}$, the return is false.

7 (10 points) Define recursive function

Define a recursive function `printRangeRev`, given two integers `left` and `right`, representing the left and right boundary of a range. Print all numbers in range $\text{left} \leq x \leq \text{right}$ in reverse order, separated by a space, in the same line. (Don't use loops, global or static variables.)

For example, if `left` is 1 and `right` is 3, the print is

3 2 1

Hint: what if `left > right`?

Warning: If you do not use recursion, you will not get any point. No repetition statement is allowed in this function.