Answer:

Row:	Seat:

Final Exam F23 V1
CSCI 13500: Software Analysis and Design 1
Hunter College, City University of New York

December 14, 2023, 9:00 - 11:00 AM, North Building 118

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.**

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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 greetings[] = {"Hello", "Hi", "How are you"}`, what is greetings[0][4]?

(2) Given Employee class, declare that class Nurse as subclass of Employee class with public inheritance.

(3) Write code to generate a random int between 3 and 10, where both ends are included. No library is needed.

Explanation:

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(4) Given `string greeting = "Hello";` What is the value for greeting.substr(2,3)?

(5) Write a command to compile and link TestBoard.cpp and Board.cpp to generate a runnable file **prog**.

(6) What is the value of 1 / 2 * 5.6 in C++?

(7) Write **header** of a function called average to return the average of an array of double numbers with size n.

(8) Given `int arr[] = {4, 3, 2, 1};` What is the value of `*(arr + 1)`?

(9) Declare and initialize a two-dimensional strings array called **synonyms** with two rows, each row with three columns. The first row is “kind”, “gentle”, “nice”, the second row is “big”, “large”, “huge”.

(10) What is output for the following code?

```
vector<int> nums;
for (int i = 12; i >= 0; i--)
    nums.push_back(i);

for (int i = 0; i < nums.size(); i++)
    if (i % 5 == 0)
       cout << nums[i] << " ";

cout << endl;
```

(11) What is the output of the following code?

```
#include <iostream>
using namespace std;

int main() {
    int result = 0;
    for (int num = 3; num < 11; num += 4)
        result += num;

    cout << result << endl;
    return 0;
}
```

You can also think in tabular format.

int result = 0;

num	$num < 11$?	result += num	num += 4
3	yes	result is increased by 3, changes from 0 to 3	num is increased by 4, and num changes to 7
7	yes	result is increased by 7, changes from 3 to 10	num is increased by 4, and num changes to 11
11	no, stop		

(12) What is output for the following code?

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

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

```
1  void foo(int& a);
2
3  int main() {
4      int num = 1;
5      foo(num);
6      cout << num << endl;
7      return 0;
8  }
9
10 void foo(int& a) {
11     if ( a % 2 != 0 )
12        a++;
13     else a += 2;
14 }
```

(14) What the output when input is 81?

```
cout << "Enter a number: ";
double num;
cin >> num;
switch ((int)num / 10) {
    case 10:
    case 9:  cout << "excellent" << endl;
             break;
    case 8: cout << "good" << endl;
             break;
    case 7: cout << "ok" << endl;
             break;
    case 6: cout << "work hard" << endl;
             break;
    default: cout << "do not give up" << endl;
}
```

(15) What is the panel like when press down in game 1024? The empty cell is 0.

1		1
	1	1
1		1

2 (10 points) Answer the following questions.

(1) Define a function, for an given array of integers with its size, return number of elements that is not zero.
For example, call the function with array with values 1, 0, 2, 0, 1, the size of array is 5, then the return is 3.

(2) Define function `void sortByLen(string* a, string* b)`, if the length of $*a$ is larger than the length of $*b$, swap $*a$ with $*b$, otherwise, do nothing. Note that dereference operator * has lower precedence than dot operator.

3 (20 points) Programming exercises

(1) Define a function, for a given string, if it contains at least a letter **and** a digit, return true, otherwise, return false.

For example, for string “abc”, the return is false. For string “12”, the return is false. For “a2”, the return is true. For “2ab”, the return is true.

Hint: you might use isalpha to check whether a charcter is a letter (alphabetic) or not. Use isdigit to check whether a character is in [’0’, ’9’].

int isalpha (int c); Check if character is alphabetic

int isdigit (int c); Check if character is decimal digit

You can count the number of occurrences of letters and number of occurrences of digits.

(2) Question on dynamically allocated memory

(a) Define **panel** to be int** type.

(b) Allocate memory of panel to be a two-dimensional array with 3 rows, each row has 2 columns.

(c) Initialize the element of panel indexed at (row)th row and (col)th column to be row * col, where row and col are indices and $0 <= row < 3$ and $0 <= col < 2$.

(d) Release the dynamically allocated memory and avoid dangling pointer problem.

4 (10 points) Write codes of vector

Define a function, for a given vector of strings, return a vector of all strings with even length.

For example, call the above function on a vector of strings with values “ab”, “ccd”, “abcd”, the return is a vector of strings with values “ab” and “abcd”.

5 (10 points) Define a class.

Here is Course.hpp of class **Course**.

```
#include <string>
class Course {
public:
    ...//omitted
private:
    std::string name; //represent course name
    int credit; //represent number of credit hour
};
```

Your job: define Course.cpp with the following requirement.

1. Include necessary library and header file.
2. Define a default constructor, which sets data member **name** to be "CS 135" and set data member **credit** to be 4.
3. Define a non-default constructor, which takes formal parameters name, a string, and credit, an int. Set data member **name** by given parameter name. If given parameter credit is positive, use it to set data member **credit**, otherwise, set data member **credit** to be 3.
4. Define method **getCredit** to return the value of data member **credit**.

6 (10 point) Define a subclass

Here are part of Person.hpp of Person class.

```
class Person {
public:
    Person(string name, int age); //non-default constructor of Person class
    virtual string toString() const; //return a textual information of name and age.
    ...//omit other constructors and methods
private:
    string name;
    int age;
};
```

Declare Employee as a subclass of Person. Each employee is a person, with additional data member **salary**, which may contain decimal numbers. Suppose Employee.hpp is declared. In Employee.cpp, do the following:

Define non-default constructor of Employee, which takes parameters name (a string), age (an int), and salary (a double) to initialize the corresponding data members. This constructor can invoke the corresponding constructor of its super class, then initialize data member unique to the subclass. Data member salary should be positive. If parameter salary is not positive, set data member salary to be 1000.

Override toString method inherited from Person class to return a string representing the employee's information like name, age, and salary. You may use `string to_string (double val);` from std namespace to convert double number val to a string. Also, you can call toString method in the superclass.

7 (10 points) Define recursive function

Define a recursive function to check whether an array of strings is palindrome or not. An array of strings is palindrome if the elements read from left to right and from right to left are the same.

For example, array of strings with values “hi”, “how are you”, “hi” is palindrome, but array of strings wth values “hi”, “how are you” is not palindrome.

Hint: an array is a palindrome if and only the leftmost element equals the rightmost element and the subarray from the second element to the second-to-last element is palindrome. Think what are the initial address and size of that subarray?

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