MIDTERM EXAM 2

EMPLID

CSCI 135

NAME: FIRST LAST

1. Write a function: **`bool equals(char* a, int a_size, char* b, int b_size)`** that checks whether two **`char`** arrays are of equal length and have the same characters in the same order.

```
bool equals(char* a, int a_size, char* b, int b_size)
{


   if (a_size != b_size) {
      return false;
   }
   for (int i = 0; i < a_size; i++) {
      if (a[i] != b[i]) {
         return false;
      }
   }
   return true;


}
```

2. Write a function: **`void bar_chart(int* values, int size)`** that displays a bar chart of values in the array **`values[]`**, using asterisks and dashes, as below. Assume that all values in **`values[]`** are positive and no larger than **`30`**.

```
void bar_chart(int* values, int size) {


    for (int i = 0; i < size; i++) {
        for (int j = 0; j < values[i]; j++) {
            cout << "*";
        }
        for (int j = values[i]; j < 30; j++) {
            cout << "-";
        }
    cout << endl;
    }


}
int main() {
    const int SIZE = 6;
    int values[SIZE] = {9, 4, 15, 21, 14, 7};
    bar_chart(values, SIZE);
    return 0;
}
```

```
*********----------------------
****------------------------
***************--------------
**********************---------
**************----------------
*******-----------------------
```

3. Write a function that finds the first occurrence of a value in a two-dimensional array. Return an `int` array of length `2` with the indices of the row and column. The returned array must persist beyond the scope of your function, without using global or static variables -- use dynamic memory. Do the clean up in `main()`.

```
const int COLUMNS = 4;
int* find_value(int values[][COLUMNS], int target, int rows) {

    bool found = false;
    int * results = new int[2]{-1, -1}; // initialize to not-found
    for (int i = 0; i < rows && !found; i++) {
        for (int j = 0; j < COLUMNS && !found; j++) {
            if (values[i][j] == target) {
                results[0] = i;
                results[1] = j;
                found = true;
            }
        }
    }
    return results;

}
int main() {
    int array[3][COLUMNS] = {{ 2, 1, 4, 9 },{ 1, 0, 2, 7 },{ 7, 3, 6, 1}};
    int* results = find_value(array, 6, 3); // look for: 6
    cout << "6 found at: " << results[0] << " " << results[1];
    delete[] results; //deallocate dynamic memory
    results = nullptr; //fix dangling pointer
}
```

4. Write a code snippet that will initialize an "upside down" triangular array of characters with side 5, fill each element with character `'X'`, and print it out, so that it looks like this:

```
const int SIZE = 5;
char* counts[SIZE];
// Allocate arrays in dynamic memory
for (int i = 0; i < SIZE; i++) {
   counts[i] = new char[SIZE - i];
   for (int j = 0; j < SIZE - i; j++) {
      counts[i][j] = 'X';
   }
}
// Print all counts
for (int i = 0; i < SIZE; i++) {
   for (int j = 0; j < SIZE - i; j++) {
      cout << counts[i][j];
   }
   cout << endl;
}
// Deallocate the rows
for (int i = 0; i < SIZE; i++) {
   delete[] counts[i];
}
```

```
XXXXX
XXXX
XXX
XX
X
```

(This should remind you of the Galton Board example)

5. Design a simple class **`Person`** that contains (or "has") the **`name`** of a person and two pointers: to the person's father and mother. In the **`main()`** function define objects for yourself and your parents, correctly establishing the pointer links. Use **`nullptr`** for your parents' parents.

```
class Person {
public:
    string name;
    Person * father;
    Person * mother;
};
```

```
int main() {

    Person mom;
    mom.name = "Carol";
    mom.father = nullptr;
    mom.mother = nullptr;
    Person dad;
    dad.name = "Bob";
    dad.father = nullptr;
    dad.mother = nullptr;
    Person me;
    me.name = "Alice";
    me.father = & dad;
    me.mother = & mom;
    return 0;

}
```

6. Define an enum **`TimeOfDay`**, which can hold four possible values: **`MORNING`**, **`AFTERNOON`**, **`EVENING`**, and **`NIGHT`**. Write a **`main()`** function that will use a **`switch`** statement, which will hinge on a variable of this type to print the appropriate greeting: **`"Good mourning"`**, **`"Good afternoon"`**, etc.

```
enum TimeOfDay { MOURNING, AFTERNOON, EVENING, NIGHT };

int main() {
    TimeOfDay now = AFTERNOON;
    switch (now) {
        case MOURNING:
            cout << "Good mourning.";
            break;
        case AFTERNOON:
            cout << "Good afternoon.";
            break;
        case EVENING:
            cout << "Good evening.";
            break;
        case NIGHT:
            cout << "Good night.";
            break;
    }
}
```

Variable and Constant Definitions

```
int cans_per_pack = 6;

const double CAN_VOLUME = 0.335;
```

Type, *Name*, *Initial value*

Mathematical Operations

```
#include <cmath>
```

`pow(x, y)`	Raising to a power x^y
`sqrt(x)`	Square root $\sqrt{x}$
`log10(x)`	Decimal log $\log_{10}(x)$
`abs(x)`	Absolute value $\lvert x \rvert$
`sin(x)`, `cos(x)`, `tan(x)`	Sine, cosine, tangent of x (x in radians)

Selected Operators and Their Precedence

(See Appendix B for the complete list.)

`[]`	Array element access
`++ -- !`	Increment, decrement, Boolean *not*
`* / %`	Multiplication, division, remainder
`+ -`	Addition, subtraction
`< <= > >=`	Comparisons
`== !=`	Equal, not equal
`&&`	Boolean *and*
`||`	Boolean *or*
`=`	Assignment

Loop Statements

Condition

```
while (balance < TARGET)
{
   year++;
   balance = balance * (1 + rate / 100);
}
```

Executed while condition is true

Initialization, *Condition*, *Update*

```
for (int i = 0; i < 10; i++)
{
   cout << i << endl;
}
```

Loop body executed at least once

```
do
{
   cout << "Enter a positive integer: ";
   cin >> input;
}
while (input <= 0);
```

Conditional Statement

Condition

```
if (floor >= 13)
{
   actual_floor = floor - 1;
}
else if (floor >= 0)
{
   actual_floor = floor;
}
else
{
   cout << "Floor negative" << endl;
}
```

Executed when condition is true

Second condition (optional)

Executed when all conditions are false (optional)

String Operations

```
#include <string>
string s = "Hello";
int n = s.length(); // 5
string t = s.substr(1, 3); // "ell"
string c = s.substr(2, 1); // "l"
char ch = s[2]; // 'l'
for (int i = 0; i < s.length(); i++)
{
   string c = s.substr(i, 1);
   or char ch = s[i];
   Process c or ch
}
```

Function Definitions

Return type, *Parameter type and name*

```
double cube_volume(double side_length)
{
   double vol = side_length * side_length * side_length;
   return vol;
}
```

Exits function and returns result.

Reference parameter

```
void deposit(double& balance, double amount)
{
   balance = balance + amount;
}
```

Modifies supplied argument

Arrays

Element type, *Length*

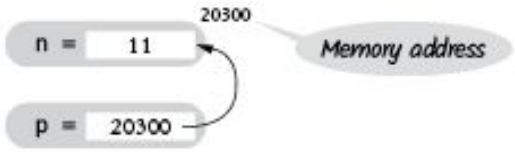
```
int numbers[5];
int squares[] = { 0, 1, 4, 9, 16 };
int magic_square[4][4] =
{
   { 16, 3, 2, 13 },
   { 5, 10, 11, 8 },
   { 9, 6, 7, 12 },
   { 4, 15, 14, 1 }
};

for (int i = 0; i < size; i++)
{
   Process numbers[i]
}
```

Enumerations, Switch Statement

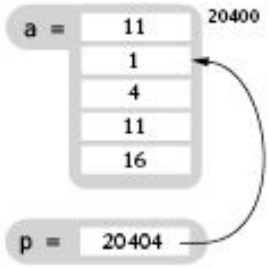
```
enum Color { RED, GREEN, BLUE };
Color my_color = RED;

switch (my_color) {
   case RED :
      cout << "red";   break;
   case GREEN:
      cout << "green"; break;
   case BLUE :
      cout << "blue";  break;
}
```

Pointers

```
int n = 10;
int* p = &n; // p set to address of n
*p = 11; // n is now 11
```




```
int a[5] = { 0, 1, 4, 9, 16 };
p = a; // p points to start of a
*p = 11; // a[0] is now 11
p++; // p points to a[1]
p[2] = 11; // a[3] is now 11
```



Input and Output

```
#include <iostream>
cin >> x; // x can be int, double, string
cout << x;

while (cin >> x) { Process x }
if (cin.fail()) // Previous input failed


#include <fstream>
string filename = ...;
ifstream in(filename);
ofstream out("output.txt");

string line; getline(in, line);
char ch; in.get(ch);
```

Range-based for Loop

```
for (int v : values)   // An array, vector, or other container (C++ 11)
{
   cout << v << endl;
}
```

Output Manipulators

```
#include <iomanip>
```

`endl`	Output new line
`fixed`	Fixed format for floating-point
`setprecision(n)`	Number of digits after decimal point for fixed format
`setw(n)`	Field width for the next item
`left`	Left alignment (use for strings)
`right`	Right alignment (default)
`setfill(ch)`	Fill character (default: space)

Class Definition

```
class BankAccount
{
public:
   BankAccount(double amount);          // Constructor declaration
   void deposit(double amount);         // Member function declaration
   double get_balance() const;          // Accessor member function
   ...
private:                                // Data member
   double balance;
};

void BankAccount::deposit(double amount)   // Member function definition
{
   balance = balance + amount;
}
```

Inheritance

```
class CheckingAccount : public BankAccount   // Derived class, Base class
{
public:
   void deposit(double amount);         // Member function overrides base class
private:
   int transactions;                    // Added data member in derived class
};

void CheckingAccount::deposit(double amount)
{
   BankAccount::deposit(amount);        // Calls base class member function
   transactions++;
}
```