

TUTORIAL 3 (WEEK 3)

1. Consider the following recursive function:

```
int mystery(int number)           //Line 1
{
    if (number == 0)               //Line 2
        return number;            //Line 3
    else                           //Line 4
        return(mystery(number + 1) - number); //Line 5
}
```

- Identify the base case.
- Identify the general case.
- What valid values can be passed as parameters to the function mystery?
- If mystery(0) is a valid call, what is its value? If not, explain why.
- If mystery(10) is a valid call, what is its value? If not, explain why.
- If mystery(-3) is a valid call, what is its value? If not, explain why.

2. Consider the following recursive function:

```
void funcRec(int u, char v)       //Line 1
{
    if (u == 0)                   //Line 2
        cout << v;               //Line 3
    else                           //Line 4
    {                               //Line 5
        char w;                   //Line 6
        w = static_cast<char>    //Line 7
            (static_cast<int>(v) + 1);
        funcRec(u - 1, w);        //Line 8
    }                             //Line 9
}                                 //Line 10
```

Answer the following questions:

- Identify the base case.
- Identify the general case.
- What is the output of the following statement?
funcRec(5, 'A');

3. Consider the following recursive function:

```
void recFun(int x)
{
    if (x > 0)
    {
        cout << x % 10 << " ";
        recFun(x / 10);
    }
    else if (x != 0)
        cout << x << endl;
}
```

What is the output of the following statements?

a. `recFun(258);` b. `recFun(7);` c. `recFun(36);` d. `recFun(-85);`

4. Consider the following recursive function:

```
void recFun(int u)
{
    if (u == 0)
        cout << "Zero! ";
    else
    {
        cout << "Negative ";
        recFun(u + 1);
    }
}
```

What is the output, if any, of the following statements?

a. `recFun(8);` b. `recFun(0);` c. `recFun(-2);`

5. Consider the following recursive function:

```
void exercise(int x)
{
    if (x > 0 && x < 10)
    {
        cout << x << " ";
        exercise(x + 1);
    }
}
```

What is the output of the following statements?

a. `exercise(0);` b. `exercise(5);` c. `exercise(10);` d. `exercise(-5);`

6. Consider the following function:

```
int test(int x, int y)
{
    if (x <= y)
        return y - x;
    else
        return test(x - 1, y + 1);
}
```

What is the output of the following statements?

a. `cout << test(3, 100) << endl;`
b. `cout << test(15, 7) << endl;`

7. Consider the following function:

```
int func(int x)
{
    if (x == 0)
        return 2;
    else if (x == 1)
        return 3;
    else
        return (func(x - 1) + func(x - 2));
}
```

}

What is the output of the following statements?

- a. `cout << func(0) << endl;`
- b. `cout << func(1) << endl;`
- c. `cout << func(2) << endl;`
- d. `cout << func(5) << endl;`

8. Suppose that `intArray` is an array of integers, and `length` specifies the number of elements in `intArray`. Also, suppose that `low` and `high` are two integers such that $0 \leq \text{low} < \text{length}$, $0 \leq \text{high} < \text{length}$, and $\text{low} < \text{high}$. That is, `low` and `high` are two indices in `intArray`. Write a recursive definition that reverses the elements in `intArray` between `low` and `high`.
9. Write a recursive algorithm to multiply two positive integers `m` and `n` using repeated addition. Specify the base case and the recursive case.
10. Consider the following problem: How many ways can a committee of four people be selected from a group of 10 people? There are many other similar problems in which you are asked to find the number of ways to select a set of items from a given set of items. The general problem can be stated as follows: Find the number of ways `r` different things can be chosen from a set of `n` items, in which `r` and `n` are nonnegative integers and $r \leq n$. Suppose $C(n, r)$ denotes the number of ways `r` different things can be chosen from a set of `n` items. Then, $C(n, r)$ is given by the following formula:

$$C(n, r) = \frac{n!}{r!(n-r)!}$$

in which the exclamation point denotes the factorial function. Moreover, $C(n, 0) = C(n, n) = 1$. It is also known that $C(n, r) = C(n-1, r-1) + C(n-1, r)$.

- a. Write a recursive algorithm to determine $C(n, r)$. Identify the base case(s) and the general case(s).
 - b. Using your recursive algorithm, determine $C(5, 3)$ and $C(9, 4)$.
11. Write a recursive function that takes as a parameter a nonnegative integer and generates the following pattern of stars. If the nonnegative integer is 4, then the pattern generated is:

```
****
***
**
*
*
**
***
****
```

Also, write a program that prompts the user to enter the number of lines in the pattern and uses the recursive function to generate the pattern. For example, specifying 4 as the number of lines generates the above pattern.