# Homework 2

CP119L 110-2 2022/2/22

1. (exercise 3.10 in the textbook, p.135)
   For each sub-problem, you are required to write a corrected and completed program and named it as xxx_xxx_q1_a.c, xxx_xxx_q1_b.c …etc. Use // to write your annotation of the error you fixed.

   **3.10** Identify and correct the errors in each of the following. [*Note*: There may be more than one error in each piece of code.]

   a)
   ```
   if ( sales => 5000 )
     puts( "Sales are greater than or equal to $5000" )
   else
      puts( "Sales are less than $5000 )
   ```
   b)
   ```
   int x = 1, product = 0;

   while ( x <= 10 ); {
      product *= x;
      ++x;
   }
   ```
   c)
   ```
   While ( x <= 100 )
      total =+ x;
      ++x;
   ```

2. (exercise 3.23 in the textbook, p.139) (Use the while iteration)
   Write a complete program, rather than a pseudocode.

   **3.23** ***(Find the Largest Number)*** The process of finding the largest number (i.e., the maximum of a group of numbers) is used frequently in computer applications. For example, a program that determines the winner of a sales contest would input the number of units sold by each salesperson. The salesperson who sells the most units wins the contest. Write a pseudocode program and then a program that inputs a series of 10 non-negative numbers and determines and prints the largest of the numbers. [*Hint:* Your program should use three variables as shown below.]

   | | |
   |---|---|
   | `counter:` | A counter to count to 10 (i.e., to keep track of how many numbers have been input and to determine when all 10 numbers have been processed) |
   | `number:` | The current number input to the program |
   | `largest:` | The largest number found so far |

3. (exercise 3.24 in the textbook, p.139)

**3.24** *(Tabular Output)* Write a program that uses looping to print the following table of values. Use the tab escape sequence, `\t`, in the `printf` statement to separate the columns with tabs.

| N | $N^2$ | $N^3$ | $N^4$ |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| 2 | 4 | 8 | 16 |
| 3 | 9 | 27 | 81 |
| 4 | 16 | 64 | 256 |
| 5 | 25 | 125 | 625 |
| 6 | 36 | 216 | 1296 |
| 7 | 49 | 343 | 2401 |
| 8 | 64 | 512 | 4096 |
| 9 | 81 | 729 | 6561 |
| 10 | 100 | 1000 | 10000 |

4. (exercise 3.37 in the textbook, p.142)

**3.37** *(Detecting Multiples of a Number)* Write a program that prints 500 dollar signs ($) one after the other, separated by a space. After every fiftieth dollar sign, the program should print a newline character. [*Hint*: Count from 1 to 500. Use the remainder operator to recognize when the counter reaches a multiple of 50]

5. (exercise 3.45b in the textbook, p.143) (Use the while iteration, not recursive function call; the last term is 1/(n!), where n is specified by the user and is entered from the keyboard. )
[**Hint**] calculate each term using the result of the previous term, for example, 1/(3!) = 1/(2!) /3 )

**3.45** *(Factorial)* The factorial of a nonnegative integer $n$ is written $n!$ (pronounced "$n$ factorial") and is defined as follows:

$n! = n \cdot (n - 1) \cdot (n - 2) \cdot \ldots \cdot 1$ (for values of $n$ greater than or equal to 1)

and

$n! = 1$ (for $n = 0$).

For example, $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$, which is 120.

a) Write a program that reads a nonnegative integer and computes and prints its factorial.

b) Write a program that estimates the value of the mathematical constant $e$ by using the formula:

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \ldots$$

c) Write a program that computes the value of $e^x$ by using the formula

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots$$

**3.20** *(Salary Calculator)* Develop a program that will determine the gross pay for each of several employees. The company pays "straight time" for the first 40 hours worked by each employee and pays "time-and-a-half" for all hours worked in excess of 40 hours. You're given a list of the employees of the company, the number of hours each employee worked last week and the hourly rate of each employee. Your program should input this information for each employee and should determine and display the employee's gross pay. Here is a sample input/output dialog:

```
Enter # of hours worked (-1 to end): 39
Enter hourly rate of the worker ($00.00): 10.00
Salary is $390.00

Enter # of hours worked (-1 to end): 40
Enter hourly rate of the worker ($00.00): 10.00
Salary is $400.00

Enter # of hours worked (-1 to end): 41
Enter hourly rate of the worker ($00.00): 10.00
Salary is $415.00

Enter # of hours worked (-1 to end): -1
```

**3.21** *(Preincrementing vs Postincrementing)* Write a program that demonstrates the difference between preincrementing and postincrementing using the increment operator ++.

**3.22** *(Checking if a Number is Prime)* A prime number is any natural number greater than 1 that is divisible only by 1 and by itself. Write a C program that reads an integer and determines whether it is a prime number or not.

**3.23** *(Find the Largest Number)* The process of finding the largest number (i.e., the maximum of a group of numbers) is used frequently in computer applications. For example, a program that determines the winner of a sales contest would input the number of units sold by each salesperson. The salesperson who sells the most units wins the contest. Write a pseudocode program and then a program that inputs a series of 10 non-negative numbers and determines and prints the largest of the numbers. [*Hint:* Your program should use three variables as shown below.]

| | |
|---|---|
| `counter:` | A counter to count to 10 (i.e., to keep track of how many numbers have been input and to determine when all 10 numbers have been processed) |
| `number:` | The current number input to the program |
| `largest:` | The largest number found so far |

**3.24** *(Tabular Output)* Write a program that uses looping to print the following table of values. Use the tab escape sequence, `\t`, in the `printf` statement to separate the columns with tabs.

```
N    N2    N3     N4

1    1     1      1
2    4     8      16
3    9     27     81
4    16    64     256
5    25    125    625
6    36    216    1296
7    49    343    2401
8    64    512    4096
9    81    729    6561
10   100   1000   10000
```

Your program must use only three output statements, one of each of the following forms:

```
printf( "%s", "* " );
printf( "%s", " " );
puts( "" ); // outputs a newline
```

**3.40** *(Powers of 3 with an Infinite Loop)* Write a program that keeps printing the powers of the integer 3, namely 3, 9, 27, 91, 273, and so on. Your loop should not terminate (i.e., you should create an infinite loop). What happens when you run this program?

**3.41** *(Diameter, Circumference and Area of a Cirle)* Write a program that reads the radius of a circle (as a `float` value) and computes and prints the diameter, the circumference and the area. Use the value 3.14159 for π.

**3.42** What's wrong with the following statement? Rewrite it to accomplish what the programmer was probably trying to do.

```
printf( "%d", --( x * y ) );
```

**3.43** *(Sides of a Triangle)* Write a program that reads three nonzero integer values and determines and prints whether they could represent the sides of a triangle.

**3.44** *(Sides of a Right Triangle)* Write a program that reads three nonzero integers and determines and prints whether they could be the sides of a right triangle.

**3.45** *(Factorial)* The factorial of a nonnegative integer $n$ is written $n!$ (pronounced "$n$ factorial") and is defined as follows:

$n! = n \cdot (n - 1) \cdot (n - 2) \cdot \ldots \cdot 1$ (for values of $n$ greater than or equal to 1)

and

$n! = 1$ (for $n = 0$).

For example, $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$, which is 120.

a) Write a program that reads a nonnegative integer and computes and prints its factorial.

b) Write a program that estimates the value of the mathematical constant $e$ by using the formula:

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \ldots$$

c) Write a program that computes the value of $e^x$ by using the formula

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots$$

## Making a Difference

**3.46** *(World-Population-Growth Calculator)* Use the web to determine the current world population and the annual world population growth rate. Write an application that inputs these values, then displays the estimated world population after one, two, three, four and five years.

**3.47** *(Target-Heart-Rate Calculator)* While exercising, you can use a heart-rate monitor to see that your heart rate stays within a safe range suggested by your trainers and doctors. According to the American Heart Association (AHA), the formula for calculating your *maximum heart rate* in beats per minute is 220 minus your age in years. Your *target heart rate* is a range that's 50–85% of your maximum heart rate. [*Note:* These formulas are estimates provided by the AHA. Maximum and target heart rates may vary based on the health, fitness and gender of the individual. *Always consult a physician or qualified health-care professional before beginning or modifying an exercise program.*] Create a program that reads the user's birthday and the current day (each consisting of the month, day and year). Your program should calculate and display the person's age (in years), the person's maximum heart rate and the person's target-heart-rate range.