

WEEK 1 PRACTICE – BASIC C PROGRAMMING AND CONTROL FLOW

1. temperature
2. power
3. cylinder
4. speed
5. distance
6. linearSystem
7. computeNetPay
8. computeSalaryGrade
9. computeCarPrice
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11. computeSeries

Basic C Programming

1. **(temperature)** Write a C program that reads the user input on temperature in degrees Fahrenheit, and then converts the temperature from degrees Fahrenheit into degrees Celsius. The relevant formula is given as follows: Celsius = $(5/9) * (\text{Fahrenheit} - 32)$.

A program template is given below.

```
#include <stdio.h>
int main()
{
    float fahrenheit, celsius; // declare variables

    printf("Enter the temperature in degree F: \n");
    scanf("%f", &fahrenheit);

    /* Write your program code here */

    printf("Converted degree in C: %.2f\n", celsius);
    return 0;
}
```

Sample input and output sessions are given below:

(1) Test Case 1:
Enter the temperature in degree F:
45
Converted degree in C: 7.22

(2) Test Case 2:
Enter the temperature in degree F:
-12
Converted degree in C: -24.44

2. **(power)** Write a C program that reads the user input on the current and resistance, and displays the power loss of the cable on the screen. The relevant formula is $P = I^2R$, where P is the power loss in watts, I is the current in amperes and R is the resistance in ohms.

A program template is given below.

```
#include <stdio.h>
int main()
{
    /* Write your program code here */
    return 0;
}
```

Sample input and output sessions are given below:

(1) Test Case 1:
 Enter the current:
12
 Enter the resistance:
1.5
 The power loss: 216.00

(2) Test Case 2:
 Enter the current:
5
 Enter the resistance:
0.5
 The power loss: 12.50

3. **(cylinder)** Write a C program that computes the volume and surface area of a cylinder. The program reads the user input on the radius and height of the cylinder, and then computes the volume and surface area of the cylinder. The relevant formulas are volume = $\pi r^2 h$ and surface area = $2\pi r h + 2\pi r^2$, where r is the radius and h is the height.

A program template is given below.

```
#include <stdio.h>
#define PI 3.1416
int main()
{
    /* Write your program code here */
    return 0;
}
```

Sample input and output sessions are given below:

(1) Test Case 1:
 Enter the radius:
5
 Enter the height:
8
 The volume is: 628.32
 The surface area is: 408.41

(2) Test Case 2:
 Enter the radius:
1
 Enter the height:
5
 The volume is: 15.71
 The surface area is: 37.70

4. **(speed)** Write a C program to read the time (in seconds) and distance (in kilometers) covered by a moving object, calculate the speed in kilometers per second, and display the speed on the screen. The relevant formula is: speed = distance/time. The output should be in the following format: "The speed is [the speed value] km/sec."

A program template is given below.

```
#include <stdio.h>
int main()
{
    /* Write your program code here */
    return 0;
}
```

Sample input and output sessions are given below:

- (1) Test Case 1:
 Enter distance (in km):
1
 Enter time (in sec):
10
 The speed is 0.10 km/sec
- (2) Test Case 2:
 Enter distance (in km):
10
 Enter time (in sec):
5
 The speed is 2.00 km/sec

5. **(distance)** The distance between two points (x_1, y_1) and (x_2, y_2) is given by

$$\text{distance} = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Write a C program that reads the (x, y) coordinates for two points, computes the distance between the two points.

A program template is given below.

```
#include <stdio.h>
#include <math.h>
int main()
{
    /* Write your program code here */
    return 0;
}
```

Sample input and output sessions are given below:

- (1) Test Case 1:
 Enter first point x1 y1:
1 5
 Enter second point x2 y2:
2 7
 The distance is 2.24
- (2) Test Case 2:
 Enter first point x1 y1:
1 1
 Enter second point x2 y2:
5 5
 The distance is 5.66

6. **(linearSystem)** Write a C program that computes the solutions for x and y in the linear system of equations:

$$\begin{aligned} a_1x + b_1y &= c_1 \\ a_2x + b_2y &= c_2 \end{aligned}$$

The solutions for x and y are given by:

$$x = \frac{b_2c_1 - b_1c_2}{a_1b_2 - a_2b_1} \quad \text{and} \quad y = \frac{a_1c_2 - a_2c_1}{a_1b_2 - a_2b_1}$$

The program reads in a_1, b_1, c_1, a_2, b_2 and c_2 , and then computes and prints the solutions. In your program, you may assume that the denominator ($a_1b_2 - a_2b_1$) of the above equations is not zero. Therefore, there is no need to check whether the denominator is zero or not.

A program template is given below.

```
#include <stdio.h>
#include <math.h>
int main()
{
    /* Write your program code here */
    return 0;
}
```

Sample input and output sessions are given below:

- (1) Test Case 1:
Enter the values for $a_1, b_1, c_1, a_2, b_2, c_2$:
1 1 1 5 7 9
 $x = -1.00$ and $y = 2.00$
- (2) Test Case 2:
Enter the values for $a_1, b_1, c_1, a_2, b_2, c_2$:
1 1 2 2 3 3
 $x = 3.00$ and $y = -1.00$

Control Flow

7. (**computeNetPay**) Write a C program that reads the hours an employee worked in a week, computes the gross pay and income tax, and prints the gross pay, income tax and net pay on the screen. Assume that the pay structure and tax rate are given as follows: (1) the basic pay rate is \$6.00 per hour; (2) the over-time pay rate (in excess of 40 hours) is one and a half time of the basic pay rate; and (3) the tax rate is 10% of the first \$1000 of the gross pay, 20% of the next \$500 and 30% of the rest.

A sample program is given below:

```
#include <stdio.h>
int main()
{
    int hours;
    float tax, grossPay, netPay;

    printf("Enter hours of work: \n");
    scanf("%d", &hours);

    /* Write your program code here */

    printf("Gross pay = %.2f\n", grossPay);
    printf("Tax = %.2f\n", tax);
    printf("Net pay = %.2f\n", netPay);
    return 0;
}
```

Sample input and output sessions are given below:

- (1) Test Case 1:
Enter hours of work:
37
Gross pay = 222.00
Tax = 22.20

```
Net pay = 199.80
```

- (2) Test Case 2:
 Enter hours of work:
50
 Gross pay = 330.00
 Tax = 33.00
 Net pay = 297.00

8. (**computeSalaryGrade**) The salary scheme for a company is given as follows:

```
Salary range for grade A: $700 - $899
Salary range for grade B: $600 - $799
Salary range for grade C: $500 - $649
```

In addition, a person whose salary is between \$600 and \$649 is in grade C if his merit points are below 10, otherwise he is in grade B. A person whose salary is between \$700 and \$799 is in grade B if his merit points are below 20, otherwise he is in grade A. Write a program to read in a person's salary and his merit points, and displays his grade.

A sample program is given below:

```
#include <stdio.h>
int main()
{
    int salary, merit;

    printf("Enter the salary: \n");
    scanf("%d", &salary);
    printf("Enter the merit: \n");
    scanf("%d", &merit);

    /* Write your program code here */

    return 0;
}
```

Sample input and output sessions are given below:

- (1) Test Case 1:
 Enter the salary:
700
 Enter the merit:
20
 The grade: A

- (2) Test Case 2:
 Enter the salary:
500
 Enter the merit:
20
 The grade: C

9. (**computeCarPrice**) Write a program to calculate the actual cost of buying a car in Singapore. Your program should input the list price and the category of a car, and print out the actual cost. Based on the list price, assuming that the car dealer will give a discount of 10%. You should also consider that there is a 10% luxury tax on the amount over \$100,000 (after the discount), and that the G.S.T. tax is 3%. All taxes are computed based on the discounted price. Certificate of Entitlement (COE) must be obtained for every car in Singapore. The amount you bid for the COE is based on the category your car belongs to. COE is not taxed. The categories and their COE prices are given below:

- (1) Car (1600 c.c. & below) & Taxi: COE = 70,000
- (2) Car (above 1600 c.c.): COE = 80,000
- (3) Goods Vehicle & Bus: COE = 23,000
- (4) Motorcycle - COE: 600

A sample program is given below:

```
#include <stdio.h>
int main()
{
    int list, coe = 0, cat;
    double discounted, luxury = 0, gst, total;

    printf("Please enter the list price: \n");
    scanf("%d", &list);
    printf("Please enter the category: \n");
    scanf("%d", &cat);

    /* Write your program code here */

    printf("Total price is $%.2lf\n", total);
    return 0;
}
```

Sample input and output sessions are given below:

(1) Test Case 1:
 Please enter the list price:
30000
 Please enter the category:
1
 Total price is \$97810.00

(2) Test Case 2:
 Please enter the list price:
50000
 Please enter the category:
2
 Total price is \$126350.00

10. **(countChars)** Write a C program that reads in character by character from an input source, until '#' is entered. The output of the program is the number of English letters and the number of digits that appear in the input.

A sample program is given below:

```
#include <stdio.h>
int main()
{
    int ccount = 0, dcount = 0;
    char ch;
    printf("Enter your characters (# to end): \n");

    /* Write your program code here */

    printf("The number of digits: %d\n", dcount);
    printf("The number of letters: %d\n", ccount);
    return 0;
}
```

Some sample input and output sessions are given below:

(1) Test Case 1:
 Enter your characters (# to end):
happy 34567 fans#
 The number of digits: 5
 The number of letters: 9

(2) Test Case 2:
 Enter your characters (# to end):
1a2b3c#
 The number of digits: 3
 The number of letters: 3

11. **(computeSeries)** Write a C program that computes the value of e^x according to the following formula:

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots + \frac{x^{10}}{10!}$$

A sample program template is given below.

```
#include <stdio.h>
int main()
{
    int n, denominator = 1;
    float x, result = 1.0, numerator = 1.0;

    printf("Enter x: \n");
    scanf("%f", &x);

    /* Write your program code here */

    printf("Result = %.2f\n", result);
    return 0;
}
```

Sample input and output sessions are given below:

(1) Test Case 1:
 Enter x:
0.9
 Result = 2.46

(2) Test Case 2:
 Enter x:
0
 Result = 1.00

(3) Test Case 3:
 Enter x:
-0.9
 Result = 0.41