

# 1 Introduction

These exercises are all dealing with C++ decisions and repetition structures. Each exercise should be its own separate project.

**Remember to follow the coding and documentation standards for the class listed on the MyClasses pages.**

## 1.1 Submitting Your Work

When you are ready to submit your work create a folder called Lab03 in that folder have separate folders for each project, one folder per project. Put all the code files needed for that project in its respective folder. Do not include the files that the IDE creates, I just want the code files. Zip the entire Lab03 folder up into a single zip file and submit it.

## 2 Exercises

1. Write a program that asks the user to enter two numbers. The program should use the conditional operator to determine which number is the smaller and which is the larger. Three runs are below.

```
Enter two numbers: 5 90
Smaller number: 5
Larger number: 90
```

```
Enter two numbers: 7 -4.2
Smaller number: -4.2
Larger number: 7
```

```
Enter two numbers: 23 23
The two number are equal.
```

2. Write a program that calculates and displays a person's body mass index (BMI). The BMI is often used to determine whether a person with a sedentary lifestyle is overweight or underweight for his or her height. A person's BMI is calculated with the following formula:

$$BMI = weight \cdot 703 / height^2$$

where weight is measured in pounds and height is measured in inches. The program should display a message indicating whether the person has optimal weight, is underweight, or is overweight. A sedentary person's weight is considered to be optimal if his or her BMI is between 18.5 and 25. If the BMI is less than 18.5, the person is considered to be underweight. If the BMI value is greater than 25, the person is considered to be overweight. Three runs are below.

```
Enter your weight in pounds: 155
Enter your height in inches: 71
```

```
Your Body Mass Index is 21.6158
You are at an optimal weight.
```

```
Enter your weight in pounds: 125
Enter your height in inches: 70
Your Body Mass Index is 17.9337
You are underweight.
```

```
Enter your weight in pounds: 190
Enter your height in inches: 72
Your Body Mass Index is 25.7658
You are overweight.
```

3. Write a program that asks the user to enter a number of seconds.

- There are 60 seconds in a minute. If the number of seconds entered by the user is greater than or equal to 60, the program should display the number of minutes in that many seconds.
- There are 3,600 seconds in an hour. If the number of seconds entered by the user is greater than or equal to 3,600, the program should display the number of hours in that many seconds.
- There are 86,400 seconds in a day. If the number of seconds entered by the user is greater than or equal to 86,400, the program should display the number of days in that many seconds. Four runs are below.

```
Enter the number of seconds: 128
128 is equivalent to 2.13333 minutes.
```

```
Enter the number of seconds: 10000
10000 is equivalent to 2.77778 hours.
```

```
Enter the number of seconds: 12.43
12.43 is equivalent to 12.43 seconds.
```

```
Enter the number of seconds: 1000000
1e+06 is equivalent to 11.5741 days.
```

4. Write a program that asks the user to enter a number of seconds. The program will output the number of days, hours, minutes, and seconds in that number of seconds. The program should not display any unit if the number of seconds input is lower than that unit. For example, if the number of seconds is 225, then the program will print out the minutes and seconds but not the hours or days. Four runs are below.

```
Enter the number of seconds: 128
128 seconds is equivalent to 2 minutes 8 seconds.
```

```
Enter the number of seconds: 12345.67
12345.7 seconds is equivalent to 3 hours 25 minutes 45.67 seconds.
```

```
Enter the number of seconds: 12.34567
12.3457 seconds is equivalent to 12.3457 seconds.
```

```
Enter the number of seconds: 1000000
1e+06 seconds is equivalent to 11 days 13 hours 46 minutes 40 seconds.
```

5. The Fast Freight Shipping Company charges the following rates:

Weight of Package (in Kilograms)	Rate per 500 Miles Shipped
2 kg or less	\$1.10
Over 2 kg but not more than 6 kg	\$2.20
Over 6 kg but not more than 10 kg	\$3.70
Over 10 kg but not more than 20 kg	\$4.80

Write a program that asks for the weight of the package and the distance it is to be shipped, and then displays the charges. Input Validation: Do not accept values of 0 or less for the weight of the package. Do not accept weights of more than 20 kg (this is the maximum weight the company will ship). Do not accept distances of less than 10 miles or more than 3,000 miles. These are the company's minimum and maximum shipping distances. Three runs are below.

```
Enter the weight of the package in kg: 12.4
Enter the distance to ship in miles: 1539
Shipping Cost: $14.77
```

```
Enter the weight of the package in kg: 19.27
Enter the distance to ship in miles: 3000
Shipping Cost: $28.80
```

```
Enter the weight of the package in kg: 40
Weight must be greater than 0 and less than or equal to 20 kg.
Enter the weight of the package in kg: -21
Weight must be greater than 0 and less than or equal to 20 kg.
Enter the weight of the package in kg: 12
Enter the distance to ship in miles: 4000
Can only ship between 10 and 3000 miles.
Enter the distance to ship in miles: 5
Can only ship between 10 and 3000 miles.
Enter the distance to ship in miles: 3001
Can only ship between 10 and 3000 miles.
Enter the distance to ship in miles: 2500
Shipping Cost: $24.00
```

- Write a program that calculates how much a person would earn over a period of time if his or her salary is one penny the first day and two pennies the second day, and continues to double each day. The program should ask the user for the number of days. Display a table showing how much the salary was for each day, and then show the total pay at the end of the period. The output should be displayed in a dollar amount, not the number of pennies. Input Validation: Do not accept a number less than 1 for the number of days worked. Two runs are below.

```
Enter the number of days worked: 30
Day      Salary
1         0.01
2         0.02
3         0.04
4         0.08
5         0.16
6         0.32
7         0.64
```

8	1.28
9	2.56
10	5.12
11	10.24
12	20.48
13	40.96
14	81.92
15	163.84
16	327.68
17	655.36
18	1310.72
19	2621.44
20	5242.88
21	10485.76
22	20971.52
23	41943.04
24	83886.08
25	167772.16
26	335544.32
27	671088.64
28	1342177.28
29	2684354.56
30	5368709.12

Total Salary: \$10737418.23

Enter the number of days worked: 0  
Days must be at least 1.  
Enter the number of days worked: -3  
Days must be at least 1.  
Enter the number of days worked: 10

Day	Salary
1	0.01
2	0.02
3	0.04
4	0.08
5	0.16
6	0.32
7	0.64
8	1.28
9	2.56
10	5.12

Total Salary: \$10.23

7. Write a program that will predict the size of a population. The program should ask the user for the starting number of people, their average annual population increase (as a percentage), and the number of years they will multiply. A loop should display the size of the population for each year. Input Validation: Do not accept a number less than 2 for the starting size of the population. Do not accept a negative number for average annual population increase. Do not accept a number less than 1 for the number of years they will multiply. Two runs are below.

Enter the starting number of people: 1000  
Enter the annual population increase as a percentage: 2.3  
Enter the number of years: 25

Year	Population
1	1023.000
2	1046.529
3	1070.599
4	1095.223
5	1120.413

6	1146.183
7	1172.545
8	1199.513
9	1227.102
10	1255.325
11	1284.198
12	1313.734
13	1343.950
14	1374.861
15	1406.483
16	1438.832
17	1471.925
18	1505.780
19	1540.413
20	1575.842
21	1612.086
22	1649.164
23	1687.095
24	1725.898
25	1765.594

```
Enter the starting number of people: 0
Starting population should be at least 2.
Enter the starting number of people: 1
Starting population should be at least 2.
Enter the starting number of people: 1000000
Enter the annual population increase as a percentage: -3
The annual population increase must be positive.
Enter the annual population increase as a percentage: 5
Enter the number of years: 0
The number of years must be at least 1.
Enter the number of years: -5
The number of years must be at least 1.
Enter the number of years: 20
```

Year	Population
1	1050000.000
2	1102500.000
3	1157625.000
4	1215506.250
5	1276281.562
6	1340095.641
7	1407100.423
8	1477455.444
9	1551328.216
10	1628894.627
11	1710339.358
12	1795856.326
13	1885649.142
14	1979931.599
15	2078928.179
16	2182874.588
17	2292018.318
18	2406619.234
19	2526950.195
20	2653297.705

8. Write a program that generates a random number between 1 and 100 and asks the user to guess what the number is. If the user's guess is higher than the random number, the program should display "Too high, try again." If the user's guess is lower than the random number, the program should display "Too low, try again." The program should use a loop that repeats until the user correctly guesses the random number or the number of guesses has been 7. That is, the user only gets 7 guesses in total but

the program should end if the user guesses the correct number before the guesses are exhausted. If the user guesses correctly within the 7 guesses the program should print out that they win and if they do not guess correctly within the 7 guesses the program should print out that they lost. Two runs are below.

```
Enter your guess: 50
Too high, try again.
Enter your guess: 25
Too high, try again.
Enter your guess: 12
Congratulations, your guess was correct.
```

```
Enter your guess: 93
Too high, try again.
Enter your guess: 12
Too low, try again.
Enter your guess: 43
Too low, try again.
Enter your guess: 43
Too low, try again.
Enter your guess: 44
Too low, try again.
Enter your guess: 45
Too low, try again.
Enter your guess: 46
Your 7 guesses are up, you lose.
```