Programming Exercises

The exercises in this section are optional and do not report to the performance dashboard. Instructors can decide whether to assign these exercises and students can check the correctness of their programs using the Check Exercise tool.

Pedagogical Note

Instructors may ask you to document analysis and design for selected exercises. You should use your own words to analyze the problem, including the input, output, and what needs to be computed, and describe how to solve the problem in pseudocode.

Debugging Tip

Python usually gives a reason for a syntax error. If you don't know how to correct it, compare your program closely, character by character, with similar examples in the text.

Sections 2.2– 2.10

2.1 (*Convert Celsius to Fahrenheit*) Write a program that reads a Celsius degree from the console and converts it to Fahrenheit and displays the result. The formula for the conversion is as follows:

```
fahrenheit = (9 / 5) * celsius + 32
```

2.2 (*Compute the volume of a cylinder*) Write a program that reads in the radius and length of a cylinder and computes the area and volume using the following formulas:

```
area = radius * radius * π
volume = area * length
```

2.3 (*Convert feet into meters*) Write a program that reads a number in feet, converts it to meters, and then displays the result. One foot is `0.305` meters.

2.4 (*Convert pounds into kilograms*) Write a program that converts pounds into kilograms. The program prompts the user to enter a value in pounds, converts it to kilograms, and then displays the result. One pound is `0.454` kilograms.

***2.5** (*Financial application: calculate tips*) Write a program that reads the subtotal and the gratuity rate and computes the gratuity and total. For example, if the user enters `10` for the subtotal and `15%` for the gratuity rate, the program displays `1.5` as the gratuity and `11.5` as the total.

***2.6** (*Financial application: monetary units*) Rewrite Listing 2.5, ComputeChange.py, to fix the possible loss of accuracy when converting a float value to an int value. Enter the input as an integer whose last two digits represent the cents. For example, the input `1156` represents `11` dollars and `56` cents.

***2.7** (*Find the number of years and days*) Write a program that prompts the user to enter the minutes (e.g., 1 billion) and displays the number of years and days for the minutes. For simplicity, assume a year has `365` days.

2.8 (*Science: calculate energy*) Write a program that calculates the energy needed to heat water from an initial temperature to a final temperature. Your program should prompt the user to enter the amount of water in kilograms and the initial and final temperatures of the water. The formula to compute the energy is as follows:

```
Q = M * (finalTemperature – initialTemperature) * 4184
```

where `M` is the weight of water in kilograms, temperatures are in degrees Celsius, and energy `Q` is measured in joules.

***2.9** (*Science: wind-chill temperature*) How cold is it outside? The temperature alone is not enough to provide the answer. Other factors including wind speed, relative humidity, and sunshine play important roles in determining coldness outside. In 2001, the National Weather Service (NWS) implemented the new wind-chill temperature to measure the coldness using temperature and wind speed. The formula is given as follows:

$$t_{wc} = 35.74 + 0.6215t_a - 35.75v^{0.16} + 0.4275t_a v^{0.16}$$

where t_a is the outside temperature measured in degrees Fahrenheit and v is the speed measured in miles per hour. t_{wc} is the wind-chill temperature. The formula cannot be used for wind speeds below 2 mph or for temperatures below −58°F or above 41°F. Write a program that prompts the user to enter a temperature between −58°F and 41°F, a wind speed greater than or equal to `2` , and then displays the wind-chill temperature.

***2.10** (*Physics: find runway length)* Given an airplane's acceleration a and take-off speed v, you can compute the minimum runway length needed for an airplane to take off using the following formula:

$$length = \frac{v^2}{2a}$$

Write a program that prompts the user to enter v in meters/second (m/s), the acceleration a in meters/second squared (m/s^2), and then displays the minimum runway length.

***2.11** (*Financial application: investment amount*) Suppose you want to deposit a certain amount of money into a savings account with a fixed annual interest rate. Write a program that prompts the user to enter the final account value, the annual interest rate in percent, and the number of years, and then displays the initial deposit amount. The initial deposit amount can be obtained using the following formula:

$$initialDepositAmount = \frac{finalAccountValue}{(1 + monthlyInterestRate)^{numberOfMonths}}$$

2.12 (*Print a table*) Write a program that displays the following table:

***2.13** (*Split digits*) Write a program that prompts the user to enter a four-digit integer and displays the number in reverse order.

***2.14** (*Geometry: area of a triangle*) Write a program that prompts the user to enter the three points `(x1, y1)`, `(x2, y2)`, and (`x3`, `y3`) of a triangle and displays its area. The formula for computing the area of a triangle is

$$s = (side1 + side2 + side3)/2$$
$$area = \sqrt{s(s - side1)(s - side2)(s - side3)}$$

2.15 (*Geometry: area of a hexagon)* Write a program that prompts the user to enter the side of a hexagon and displays its area. The formula for computing the area of a hexagon is $Area = \frac{3\sqrt{3}}{2}s^2$, where s is the length of a side.

2.16 (*Physics: acceleration)* Average acceleration is defined as the change of velocity divided by the time taken to make the change, as shown in the following formula:

$$a = \frac{v_1 - v_0}{t}$$

Write a program that prompts the user to enter the starting velocity v_0 in meters/second, the ending velocity v_1 in meters/second, the time span t in seconds, and then displays the average acceleration.

***2.17** (*Health application: compute BMI*) Body mass index (BMI) is a measure of health based on weight. It can be calculated by taking your weight in kilograms and dividing it by the square of your height in meters. Write a program that prompts the user to enter a weight in pounds and height in inches and displays the BMI. Note that one pound is `0.45359237` kilograms and one inch is `0.0254` meters.

Sections 2.11– 2.12

***2.18** (*Current time*) Listing 2.7, ShowCurrentTime.py, gives a program that displays the current time in GMT. Revise the program so that it prompts the user to enter the time zone in hours away from (offset to) GMT and displays the time in the specified time zone.

***2.19** (*Financial application: calculate future investment value*) Write a program that reads in an investment amount, the annual interest rate, and the number of years, and then displays the future investment value using the following formula:

$$futureInvestmentValue = investmentAmount \times (1 + monthlyInterestRate)^{numberOfMonths}$$

For example, if you enter the amount `1000`, an annual interest rate of `4.25%`, and the number of years as `1`, the future investment value is `1043.33`.

***2.20** (*Financial application: calculate interest*) If you know the balance and the annual percentage interest rate, you can compute the interest on the next monthly payment using the following formula:

```
interest = balance × (annualInterestRate / 1200)
```

Write a program that reads the balance and the annual percentage interest rate and then displays the interest for the next month. Keep two digits after the decimal point.

**2.21 (*Financial application: compound value*) Suppose you save `$100` each month into a savings account with an annual interest rate of 5%. Therefore, the monthly interest rate is
$0.05 / 12 = 0.00417$. After the first month, the value in the account becomes

```
100 * (1 + 0.00417) = 100.417
```

After the second month, the value in the account becomes

```
(100 + 100.417) * (1 + 0.00417) = 201.252
```

After the third month, the value in the account becomes

```
(100 + 201.252) * (1 + 0.00417) = 302.507
```

and so on.

Write a program that prompts the user to enter a monthly saving amount and displays the account value after the sixth month. Keep two digits after the decimal point.

2.22 (Population projection) Rewrite Programming Exercise 1.11 to prompt the user to enter the number of years and displays the population after that many years. Use the hint in Programming Exercise 1.11 for this program.

***2.23** (*Slope of a line*) Write a program that prompts the user to enter the coordinates of two points (x1, y1) and (x2, y2) and displays the slope of the line connects the two points. The formula of the slope is
$(y_2 - y_1) / (x_2 - x_1)$.

***2.24** (*Cost of driving*) Write a program that prompts the user to enter the distance to drive, the fuel efficiency of the car in miles per gallon, and the price per gallon, and displays the cost of the trip.

****2.25** (*Sum the digits in an integer*) Write a program that reads an integer between `0` and `1000` and adds all the digits in the integer. For example, if an integer is `932`, the sum of all its digits is `14`. (Hint: Use the `%` operator to extract digits, and use the `//` operator to remove the extracted digit. For instance, `932 % 10 = 2` and `932 // 10 = 93`.)

Section 2.13

2.26 (*Turtle: draw four circles*) Write a program that prompts the user to enter the radius and draws four circles in the center of the screen, as shown in Figure 2.4a.

Figure 2.4

Four circles are drawn in (a) and four hexagons are drawn in (b).

(Screenshots courtesy of Apple.)

2.27 (*Turtle: draw four hexagons*) Write a program that draws four hexagons in the center of the screen, as shown in Figure 2.4b.

****2.28** (*Turtle: draw a rectangle*) Write a program that prompts the user to enter the center of a rectangle, its width and height, and then displays the rectangle, as shown in Figure 2.5a.

Figure 2.5

A rectangle is drawn in (a) and a circle and its area are displayed in (b).

(Screenshots courtesy of Apple.)

****2.29** (*Turtle: draw a circle*) Write a program that prompts the user to enter the center and radius of a circle, and then displays the circle and its area, as shown in Figure 2.5b.

Note

Additional programming exercises with solutions are provided to the instructors on the Instructor Resource Website.