

7. Briefly describe how the `&&` operator works.
8. Briefly describe how the `||` operator works.
9. Why are the relational operators called “relational”?
10. When does a constructor execute? What is its purpose?

Programming Challenges

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1. Roman Numerals

Write a program that prompts the user to enter a number within the range of 1 through 10. The program should display the Roman numeral version of that number. If the number is outside the range of 1 through 10, the program should display an error message.

2. Magic Dates

The date June 10, 1960, is special because when we write it in the following format, the month times the day equals the year:

6/10/60

Write a program that asks the user to enter a month (in numeric form), a day, and a two-digit year. The program should then determine whether the month times the day is equal to the year. If so, it should display a message saying the date is magic. Otherwise, it should display a message saying the date is not magic.

3. Body Mass Index

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

$$\text{BMI} = \text{Weight} \times 703/\text{Height}^2$$

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 optimal if his or her BMI is between 18.5 and 25. If the BMI is less than 18.5, the person is considered underweight. If the BMI value is greater than 25, the person is considered overweight.

4. Test Scores and Grade

Write a program that has variables to hold three test scores. The program should ask the user to enter three test scores and then assign the values entered to the variables. The program should display the average of the test scores and the letter grade that is assigned for the test score average. Use the grading scheme in the following table:

Test Score Average	Letter Grade
90–100	A
80–89	B
70–79	C
60–69	D
Below 60	F

5. Mass and Weight

Scientists measure an object's mass in kilograms and its weight in Newtons. If you know the amount of mass that an object has, you can calculate its weight, in Newtons, with the following formula:

$$\text{Weight} = \text{Mass} \times 9.8$$

Write a program that asks the user to enter an object's mass, and then calculate its weight. If the object weighs more than 1,000 Newtons, display a message indicating that it is too heavy. If the object weighs less than 10 Newtons, display a message indicating that the object is too light.

6. Time Calculator

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.

7. Sorted Names

Write a program that asks the user to enter three names, and then displays the names sorted in ascending order. For example, if the user entered "Charlie", "Leslie", and "Andy", the program would display:

Andy
Charlie
Leslie

8. Software Sales

A software company sells a package that retails for \$99. Quantity discounts are given according to the following table:

Quantity	Discount
10–19	20%
20–49	30%

Quantity	Discount
50–99	40%
100 or more	50%

Write a program that asks the user to enter the number of packages purchased. The program should then display the amount of the discount (if any) and the total amount of the purchase after the discount.

9. Shipping Charges

The Fast Freight Shipping Company charges the following rates:

Weight of Package	Rate per 500 Miles Shipped
2 pounds or less	\$1.10
Over 2 pounds but not more than 6 pounds	\$2.20
Over 6 pounds but not more than 10 pounds	\$3.70
Over 10 pounds	\$3.80

The shipping charges per 500 miles are not prorated. For example, if a 2-pound package is shipped 550 miles, the charges would be \$2.20. Write a program that asks the user to enter the weight of a package and then displays the shipping charges.

10. Fat Gram Calculator

Write a program that asks the user to enter the number of calories and fat grams in a food item. The program should display the percentage of the calories that come from fat. One gram of fat has 9 calories; therefore:

$$\text{Calories from fat} = \text{Fat grams} * 9$$

The percentage of calories from fat can be calculated as follows:

$$\text{Calories from fat} \div \text{Total calories}$$

If the calories from fat are less than 30 percent of the total calories of the food, it should also display a message indicating the food is low in fat.



NOTE: The number of calories from fat cannot be greater than the total number of calories in the food item. If the program determines that the number of calories from fat is greater than the number of calories in the food item, it should display an error message indicating that the input is invalid.

11. Running the Race

Write a program that asks for the names of three runners and the time, in minutes, it took each of them to finish a race. The program should display the names of the runners in the order that they finished.

15. Bank Charges

A bank charges a base fee of \$10 per month, plus the following check fees for a commercial checking account:

- \$.10 each for less than 20 checks
- \$.08 each for 20–39 checks
- \$.06 each for 40–59 checks
- \$.04 each for 60 or more checks

Write a program that asks for the number of checks written for the month. The program should then calculate and display the bank's service fees for the month.

16. Book Club Points

Serendipity Booksellers has a book club that awards points to its customers based on the number of books purchased each month. The points are awarded as follows:

- If a customer purchases 0 books, he or she earns 0 points.
- If a customer purchases 1 book, he or she earns 5 points.
- If a customer purchases 2 books, he or she earns 15 points.
- If a customer purchases 3 books, he or she earns 30 points.
- If a customer purchases 4 or more books, he or she earns 60 points.

Write a program that asks the user to enter the number of books that he or she has purchased this month and then displays the number of points awarded.

17. Wi-Fi Diagnostic Tree

Figure 3-23 shows a simplified flowchart for troubleshooting a bad Wi-Fi connection. Use the flowchart to create a program that leads a person through the steps of fixing a bad Wi-Fi connection. Here is an example of the program's output:

```
Reboot the computer and try to connect.  
Did that fix the problem? no [Enter]  
Reboot the router and try to connect.  
Did that fix the problem? yes [Enter]
```

Notice that the program ends as soon as a solution is found to the problem. Here is another example of the program's output:

```
Reboot the computer and try to connect.  
Did that fix the problem? no [Enter]  
Reboot the router and try to connect.  
Did that fix the problem? no [Enter]  
Make sure the cables between the router & modem are plugged in firmly.  
Did that fix the problem? no [Enter]  
Move the router to a new location.  
Did that fix the problem? no [Enter]  
Get a new router.
```