

Introduction to Programming

Labs – Week 3

Exercise 1

Write a program `Ordered.java` that reads in three integer inputs `x`, `y`, and `z`. Create a `boolean` variable `b` that is `true` if the three values are either in ascending order (i.e. $x \leq y \leq z$) or in descending order (i.e. $x \geq y \geq z$), and `false` otherwise. Print the variable `b`.

Note: Do not use `if` statement. Write a Boolean expression that compute the desired output and print it.

Exercise 2

Write a program `SumOfTwoDice.java` that prints the sum of two random integers between 1 and 6 (such as you might get when rolling dice). Use `Math.random()`.

Exercise 3

Write a program `Hurricane.java` that takes the wind speed (in miles per hour) as integer input and prints whether it qualifies as a hurricane, and if so, whether it is a Category 1, 2, 3, 4, or 5 hurricane. Below is a table of the wind speeds according to the *Saffir-Simpson* scale.

Category	Wind Speed (mph)
1	74 – 95
2	96 – 110
3	111 - 130
4	131 - 155
5	156 and above

Exercise 4

Write a program `Harmonic.java` that takes input an integer `n` from command line and output the n^{th} harmonic number $H_n = 1 + 1/2 + 1/3 + \dots + 1/n$.

Exercise 5

Write a program `FivePerLine.java` that, using one `for` loop and one `if` statement, prints the integers from 1000 to 2000 with five integers per line. Only last line may have less than 5 numbers.

Hint: use the `%` operator.

Exercise 6

Write a program `Hellos.java` that takes the number of lines to print as input. You may assume that the argument is less than 1000. Hint: consider using `i%10` and `i%100` to determine whether to use `"st"`, `"nd"`, `"rd"`, or `"th"` for printing the `i`th Hello.

Example

```
% java Hellos 4
```

```
1st Hello
2nd Hello
3rd Hello
4th Hello
```

Exercise 7

(Game: lottery) Write `Lottery.java` to play lottery. The program randomly generates a lottery of a three-digit number, prompts the user to enter a three-digit number, and determines whether the user wins according to the following rules:

1. If the user input matches the lottery number in the exact order, the award is 1 million rupees.
2. If all digits in the user input match all digits in the lottery number, the award is 5 lac rupees.
3. If one digit in the user input matches a digit in the lottery number, the award is 1 lac rupees.

Exercise 8

(Algebra: solve quadratic equations) The two roots of a quadratic equation $ax^2 + bx + c = 0$ can be obtained using the following formula:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$b^2 - 4ac$ is called the discriminant of the quadratic equation. If it is positive, the equation has two real roots. If it is zero, the equation has one root. If it is negative, the equation has no real roots.

Write a program `Quadratic.java` that prompts the user to enter values for `a`, `b`, and `c` and displays the result based on the discriminant. If the discriminant is positive, display two roots. If the discriminant is 0, display one root. Otherwise, display “The equation has no real roots.”

Note you can use `Math.sqrt(x)` or `Math.pow(x, 0.5)` to compute \sqrt{x} .

Here are some sample runs:

```
Enter a, b, c: 1.0 3 1 Enter
The equation has two roots -0.381966 and -2.61803
```

```
Enter a, b, c: 1 2.0 1 Enter
The equation has one root -1.0
```

```
Enter a, b, c: 1 2 3 Enter
The equation has no real roots
```

Exercise 9

Write a program `RollLoadedDie.java` that prints the result of rolling a loaded die such that the probability of getting a 1, 2, 3, 4, or 5 is $1/8$ and the probability of getting a 6 is $3/8$.

Hint: Generate an integer i uniformly at random in the range $\{1, 2, 3, \dots, 8\}$ and output i if $i \leq 5$ and 6 otherwise. Since every integer in the given range has probability $1/8$, we get 1, 2, 3, 4, or 5 with probability $1/8$ each, while 6 will be generated when $i = 6$ or $i = 7$ or $i = 8$, the probability of which is $3/8$.

Alternate solution: Generate a real number x uniformly at random in range $[0,1)$, and output the result based on the value of x as follows.

Value	Output
$x \in [\frac{0}{8}, \frac{1}{8})$	1
$x \in [\frac{1}{8}, \frac{2}{8})$	2
$x \in [\frac{2}{8}, \frac{3}{8})$	3
$x \in [\frac{3}{8}, \frac{4}{8})$	4
$x \in [\frac{4}{8}, \frac{5}{8})$	5
$x \in [\frac{5}{8}, \frac{6}{8})$	6

Reading from standard input using Scanner

Reading from *standard-input* is an alternate to getting input from command-line. To use it, we need to add two lines which are highlighted in the example below. Now we can use `sc.nextInt()`, `sc.nextDouble()`, and `sc.next()` methods to read `int`, `double`, or `String` values.

Following is a complete example:

```
import java.util.Scanner;

public class InputExample {
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter an integer number: ");
        int i = sc.nextInt();
        System.out.print("Enter a floating-point number: ");
        double x = sc.nextDouble();
        System.out.print("Enter a string: ");
        String s = sc.next();

        System.out.println("You have entered " + i + " \t" + x
                           + " \t and " + s);
    }
}
```