Random Number Generation in Scratch:

Generate 5 random values in Scratch, displaying each value for 1 second...

Sample run:

The above code is rather awkward, it would be far better to generate all five random values and print them out together:

Sample Run:

Important Notes:

1. The use of the repeat statement to produce a looping action
   a. In both loops above, two statements are executed multiple times

2. How random values are generated; in these programs between 1 - 10, inclusive

3. Use of the “join” statement to perform string concatenation
   a. The variable randomValues “grows” each time through the loop

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Random Number Generation in Java:

```java
import java.util.Random;

public class tenRands {
    public static void main(String[] args) {
        Random rnd = new Random();
        // Generate ten random values between 0 - 9
        for (int i = 0; i < 10; i++)
            System.out.print(rnd.nextInt(10) + " ");
        System.out.println();   // put a blank line after the output
    }
}
```

Sample runs:
```
$ java tenRands
0 7 2 9 3 5 4 4 9 7
$ java tenRands
9 7 8 2 5 1 4 0 6 8
$ java tenRands
5 8 9 0 2 8 7 1 9 2
$ java tenRands
4 0 4 1 0 9 3 3 1 3
```

What if we want to generate random values between 1 - 10?

```java
import java.util.Random;

public class tenRandsV2 {
    public static void main(String[] args) {
        Random rnd = new Random();
        // Generate ten random values between 1 - 10
        for (int i = 0; i < 10; i++)
            System.out.print((rnd.nextInt(10) + 1) + " ");
        System.out.println();   // put a blank line after the output
    }
}
```

Sample runs:
```
$ java tenRandsV2
4 3 8 9 2 1 2 6 8 5
$ java tenRandsV2
9 1 10 10 5 4 9 4 8 3
$ java tenRandsV2
2 10 2 10 3 2 5 4 8 3
```

Notes:
- The `nextInt(x)` will generate random values 0 - (x-1)
- The statement `rnd.nextInt(10)` in the top-most listing will generate values 0 - 9
- The statement `rnd.nextInt(10) + 1` in the second listing will generate values 1 - 10
import java.util.Random;
public class dice {
    public static void main(String[] args) {
        int numberOfTwos = 0; // declare and initialize counters
        int numberOfSevens = 0;
        int numberOfTwelves = 0;
        Random rnd = new Random();
        for (int i = 0; i < 100; i++) {
            int die1 = rnd.nextInt(6) + 1;
            int die2 = rnd.nextInt(6) + 1;
            int roll = die1 + die2;
            if (roll == 2)  // numberOfTwos++ => numberOfTwos = NumberOfTwos + 1;
                numberOfTwos++;
            else if (roll == 7)
                numberOfSevens++;
            else if (roll == 12)
                numberOfTwelves++;
        }
        System.out.println("Out of 100 rolls, two, seven, and twelve were rolled:");
        System.out.println("  Number of twos:    ");
        System.out.println("  Number of Sevens:  ");
        System.out.println("  Number of twelves: ");
    }
}

Sample run:
% java dice
Out of 100 rolls, two, seven, and twelve were rolled:
    Number of twos: 4
    Number of Sevens: 16
    Number of twelves: 3

Notes:
- The method nextInt(x) returns pseudo-random values between 0 and x-1 which are guaranteed to be uniformly distributed over that range, in the long run
- Why use die1 and die2, instead of just one equation that generates values between 2 and 12?

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Random number generators generate random values that are uniformly distributed over some range. Many use an equation similar to (from Texas Instruments):

\[ X_{n+1} = (a \times X_n + c) \mod m; \]

Where:

- \( X_n = \text{Seed} \)
- \( a = 24298 \)
- \( c = 99991 \)
- \( m = 199017 \)

Note that the seed may be set by the user, in Java we can use a value “passed” to Random, or setSeed(long seed)

More Simulations

A six-year-old has an opaque bag that contains 30 green, red, and blue marbles, specifically:

- There are 15 green marbles.
- There are 10 red marbles.
- There are 5 blue marbles.

Accurately simulate picking a marble out of the bag. Which marble, on the average, will the six-year-old select?

To solve this problem, we must make a mapping that reflects the chances of picking a given colored marble.

For example, the chances of picking a blue marble is:

\[
\text{(number of blue marbles)/(total number of marbles)} = 5/30 = 1/6.
\]

In other words, for every six marbles taken out of the bag, one (on the average) will be blue.

The following is a program that simulates picking a marble out of the bag:

```java
import java.util.Random;

public class pickMarble {
    public static void main(String[] args) {
        Random simulator = new Random();
        int marble = simulator.nextInt(NUMBER_OF_MARBLES) + 1;
        if (marble <= 15) System.out.println("You picked a green marble.");
        else if (marble <= 25) System.out.println("You picked a red marble.");
        else System.out.println("You picked a blue marble.");
    }
    public static final int NUMBER_OF_MARBLES = 30;
}
```

Sample runs:

```
% java pickMarble
You picked a red marble.

% java pickMarble
You picked a green marble.
```