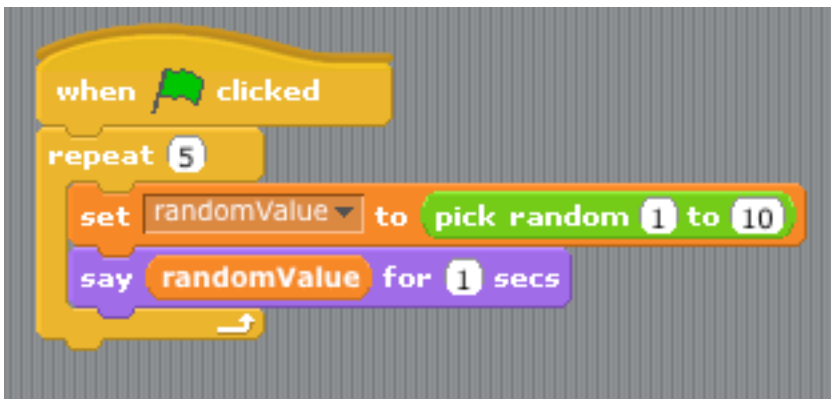
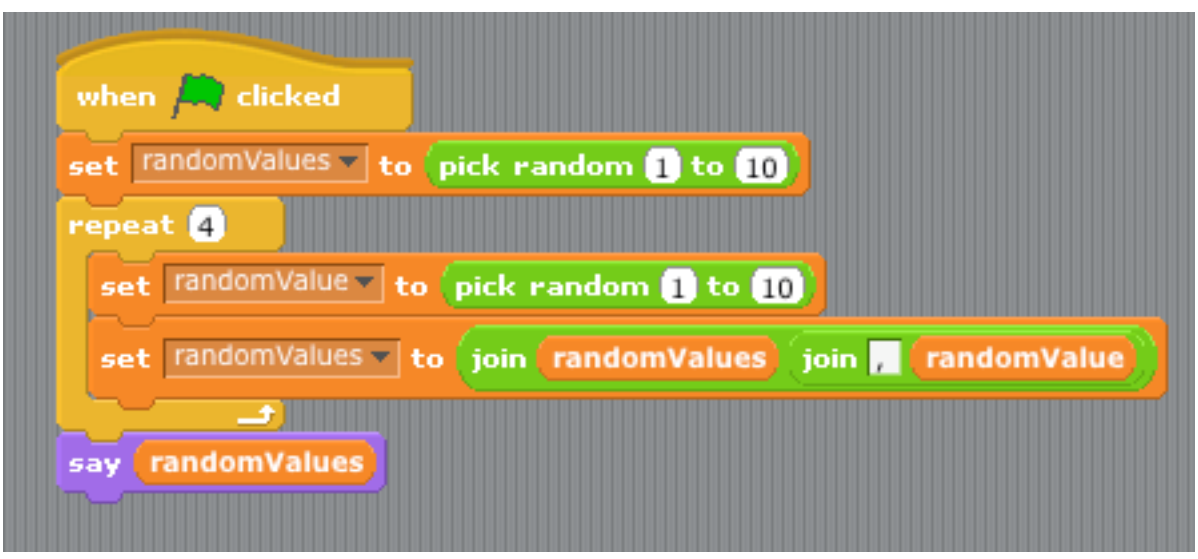
Random Number Generation in Scratch:

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

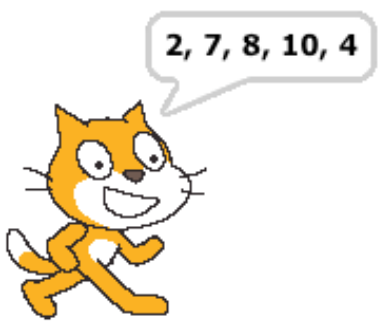


Sample run:

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:

```
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?

```
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

Listing 2:

```
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 = NumberOfTwos + 1;
            else if (roll == 7)
                  numberOfSevens++;
            else if (roll == 12)
                  numberOfTwelves++;
            }

      System.out.println("Out of 100 rolls, two, seven, and twelve were rolled:\n");

      System.out.println("  Number of twos:    " + numberOfTwos);
      System.out.println("  Number of Sevens:  " + numberOfSevens);
      System.out.println("  Number of twelves: " + numberOfTwelves);
      }
}
```

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):

$X_{n+1} = (a * X_n + c) \% m;$

Where:

X_n = Seed c = 99991
a = 24298 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:

(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:

```
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.
```