Python: Random Numbers

Computer Science ICS20

Random Module

Random numbers are numbers that one cannot predict until they come into existence. For example, when you roll a 6-sided die, you do not know which of the 6 possible numbers will show up unless you actually perform the roll. Flipping a coin could also produce a random value of 2 possibilities which we can then interpret as being heads or tails, true or false or 0 or 1. Picking a random card from a standard 52-card deck could be viewed as choosing a number between 1 and 52. There are infinitely many examples where we can use random numbers to simulate various events. But how do we get the computer to generate a truly random number?

Luckily, Python has functions that can do just that and more. In order to use these functions, we will need to import the random module:

```
import random
```

Generating Random Integers

If we want to generate a random **integer**, we can use the randint() function. It accepts two parameters: a lower bound and a higher bound in order to generate a random number within that range defined by (lower, higher).

For example if we wanted to print a random integer between 1 and 10 we could write the following:

```
import random

num = random.randint(1, 10)
print(num)
```

The output will be 1,2,3,4,5,6,7,8,9 or 10.

Generating Decimal Numbers

The following code will generate a random **decimal** number r, where 0 <= r < 1.

```
import random

num = random.random()
print(num)
```

Notice that the random() function does not use any parameters. This is because it always returns a random number between 0 and just less than 1. (ie. 0.0 to .9999999999)

But what if we want to generate a random decimal number? The answer is that we would still use the above random() function to generate a number between 0-1 and then simply multiply it by an integer number to increase the range of the random number. For example, say that we want to generate a random decimal number between 0.0 and 10.0:

```
import random
num = random.random() * 10      # num is a decimal number between 0 and < 10
```

And what if we want a decimal number between 6 and 11? We could take the range by subtracting the lower from the higher:

11– 6 = 5

Then the following code would produce a decimal number between 6 and 10.999999999:

```
import random
num = 6 + random.random() * 5    # num is a decimal number between 5 and < 11
```

The second part of the above command will generate a number between 0 and 4.99999999. Adding a 6 to this results in a number between 6 and 10.99999999.

Generating Random Objects Using Lists

In the examples above, we have been generating random numbers, be it integers or decimal numbers. But what if we want to generate a random name from a raffle draw? Or a random colour? Or choose a random question in a game of Trivial Pursuit®? In this case we can use lists and generate random index values to choose a certain item in our list.

Suppose that we want the computer to pick a random person from a group of people. We can do this by placing all of the people's names in a list and randomly choosing an index into the list:

```
import random

peopleList = [“Daniel”, “Alex”, “Shirley”, “Misha”, “Stephen”, “Julia”, “Salwa”]
i = random.randint(0, len(peopleList)-1)

print(peopleList[i])      # prints a random person from the above list
```

There are other ways to choose a random item from a list. The random.choice() function does exactly this:

```
import random

colours = [“Red”, “Green”, “Yellow”, “Blue”, “Black”, “White”]
randomColour = random.choice(colours)

print(randomColour)
```

There is even a function called random.shuffle() which rearranges or shuffles the items in a list so that they are in random order:

```
import random

list = [0,1,2,3,4,5,6,7,8,9]
random.shuffle(list)
print(list)
```

The above could print something like this:

[5, 2, 8, 1, 0, 2, 3, 9, 4, 7]

Exercises

1. Write a program to generate a random integer number between 10 and 100.

2. Write a program to generate a random decimal number between 5 and 65.

3. Write a Python program that helps to teach elementary kids multiplication. The kids are asked to multiply 2 random numbers and provided an answer. The random numbers can range from 1 to 12. Once the program has asked them 10 questions, it prints the percentage they got correct.

4. Write a Python game called Hi-Lo which asks the player to guess a number between 1 and 10. The player has three chances to guess correctly. If the player wins, the program prints out "Correct guess...you won the game!" and if the player loses it prints "You had 3 wrong guesses. You Lose!".

5. Modify the Hi-Lo game in question 4 to provide feedback to the player after each guess. The game prints "Too low...try again." when the player's guess is too low or "Too high...try again." when the player's guess is too high.

6. Write a Python program that simulates the rolling of a die n times. Then print out the number of times that each side came up. For example, say that you rolled the die 10 times and the result of the rolls was [2, 5, 1, 6, 4, 2, 3, 1, 4, 4]. The program would then output:

   1: 2
   2: 2
   3: 1
   4: 3
   5: 1
   6: 1

   Run your program for the following values of n:

   a) n = 10, n = 100, n = 1000, n = 10 000, n=100 000, n = 1 000 000

   b) For each run, also print the number of occurrences of each side divided by the total number of rolls.

   c) What do you notice about the ratios printed in part b)?

7. Write a Python program that simulates the rolling of a loaded die. A loaded die will roll a six twice as likely as any of the other sides. Repeat parts a), b) and c) from question 6 with this new loaded die.

8. Write a Python program that simulates the 6/49 Lottery. The player chooses six different numbers from 1 to 49. The computer then randomly chooses six winning numbers and the program outputs the following:

   - "You're a grand prize winner of a Million dollars!" if all six numbers match.
   - "You're a second place winner of $10 000!" if any five numbers match.
   - "You're a third place winner of $1000!" if any four numbers match.
   - "You've won $10." if any three numbers match.

   a) Extend your program to calculate the chances of winning the grand prize using the ideas from question 7.

   b) Extend your program to calculate the chances of winning **any** of the above prizes by once again using the ideas from question 7.