Math in Java

Random Numbers

#### The Importance of Randomness

- modern computers will often attempt to simulate real-life
- the real world has many phenomena that are random, or have an element of chance
- for example,
  - gambling (dice, cards, etc.)
  - weather (movement & interaction of air particles)
  - human responses (as simulated in games)

# Generating a Random Number Math.random()

Java provides a special <u>method</u> called Math.random() for producing random numbers.

This method produces a very specific and limited output. It is then up to the programmer to turn that into something more appropriate to their application.

The result is between 0.000000 and 0.999999

```
System.out.println(Math.random());
```

A single die has six sides. Assuming it is a <u>fair die</u>, the odds of getting any roll (from 1 to 6) will be the same.

How can we simulate this result using a random number generator from 0.000000 to 0.999999?

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Step 1: Multiply by the number of possible outcomes

A six-sided die has 6 possible outcomes (1, 2, 3, 4, 5, 6).

<u>Low Value</u> <u>High Value</u>

Before: 0.000000 0.999999

After: 0.000000 5.999999

How can we simulate this result using a random number generator from 0.000000 to 0.999999?

Step 2: Change the result to an integer

So far we have decimal values, but a die is integers. We convert to an integer by chopping off the decimal part (this is NOT rounding... the decimal part is just cut away).

<u>Low Value</u> <u>High Value</u>

Before: 0.000000 5.999999

After: 0 5

How can we simulate this result using a random number generator from 0.000000 to 0.999999?

Step 3: Add or subtract the starting value

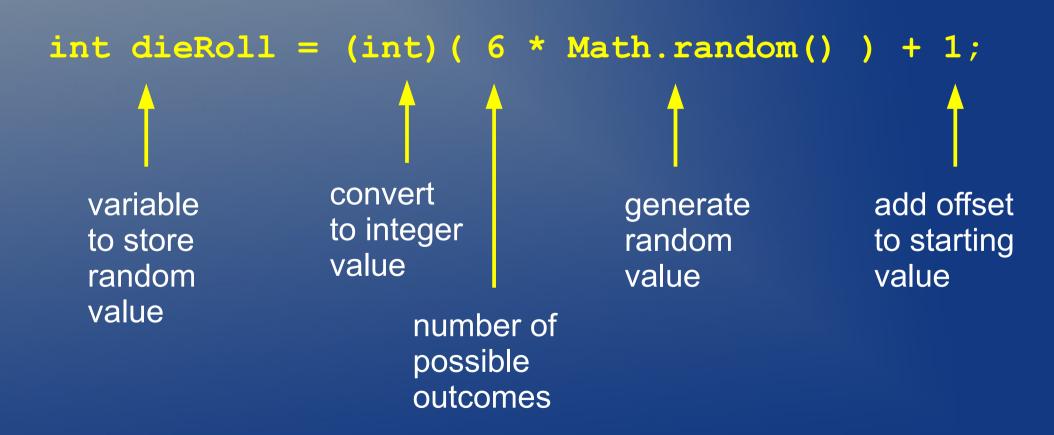
We now have 6 values (0, 1, 2, 3, 4, 5). For our example, we want these values to start at 1, not zero. Add 1 and we should have the correct range of values.

Low Value	High Value
<u>Low valuo</u>	<u>i ngii vaiao</u>

Before: 0 5

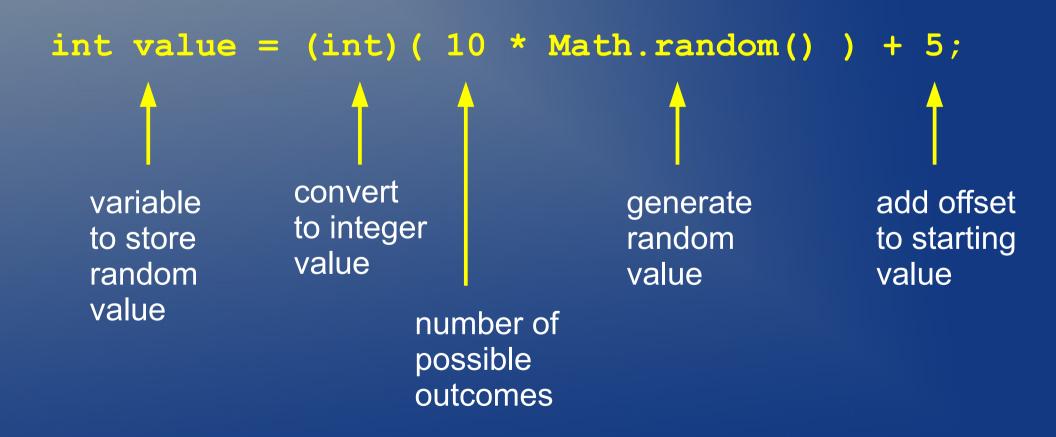
After: 1 6

The code to produce this result would be:



# Example: Random Numbers determine the possible results

Consider the following code:



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