The `Math` Class

Providing Common Mathematical Functions

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The Math Class

Common math methods

- The Math class is a Java standard class which provides a range of common mathematical methods.

Method	Description
`int abs(int x)`	returns the absolute value
`double abs(double x)`	returns the absolute value
`int max(int a, int b)`	returns the greater of a and b
`int min(int a, int b)`	returns the lesser of a and b
`double sqrt(double x)`	returns the square root of x
`double random()`	returns a positive double value, $0.0 \leq \text{num} < 1.0$
`double pow(double b, double e)`	returns b raised to the power of e

The Math Class

Common math methods

- The data type in front of the method name indicates the type of data that is returned by the calculation.
- All of these methods are declared as static, so you must use the name of the class when invoking them: `Math`

Examples of math methods

```
int n = 0;
double d = 0.0;
n = Math.abs(-17);
d = Math.abs(-39.65);
```

```
d = Math.pow(10, 3);
n = Math.max(25, 50);
n = Math.min(100, 75);
d = Math.sqrt(81);
```

The Math.random() Method

Generating random numbers

- Java's random number generator returns numbers chosen at random for a particular set number interval.
- The `Math.random()` method creates a random double value which is greater than or equal to 0.0, and less than 1.0.
- In other words: $0.0 \leq \text{num} < 1.0$

```
double num = Math.random();
System.out.println("Random number = " + num);
```

- This range can be modified through type casting, multiplication, and addition.

The `Math.random()` Method

Expanding the interval

- If you multiply `Math.random()` by an integer `x`, the range of the random number interval will expand to: $0.0 \leq \text{num} < x$
- Consider the expansion to: $0.0 \leq \text{num} < 6.0$

```
double num = Math.random() * 6;
```

Shifting the interval

- If you add an integer to `Math.random()`, the range of the random number will be shifted by that amount.
- Consider the shift to: $2.0 \leq \text{num} < 3.0$

```
double num = Math.random() + 2;
```

The `Math.random()` Method

Creating random integers using `Math.random()`

- I want to create a random number in the range:
  $1 \leq \text{num} < 21$
- To accomplish this, I will modify the random number by multiplying it by 20, type casting it to an `int`, and then adding 1.

```
int num = (int) (Math.random() * 20) + 1;
```

The `Math.random()` Method

Creating random integers using `Math.random()`

- First, `Math.random()` creates a random `double` number in the range: $0.0 \leq \text{num} < 1.0$
- Then, the random number is modified by multiplying it by 20.
- This changes the range of the random number to: $0.0 \leq \text{num} < 20.0$
- Type casting the random number to an `int` removes the decimal portion of the answer. This converts the random number to an integer.
- Adding 1 shifts the range of the random number to: $1 \leq \text{num} < 21$
- This shift affects both the lower and upper bounds of the range.

The `Math.random()` Method

Creating random integers using `Math.random()`

- In general, to produce a random number in the range: $p \leq num \leq p + k - 1$
- Use the following code:

```
int num = (int) (Math.random() * k) + p;
```