Types
A *type* is a name for a set of properties that apply to a specific variable. For example, if we say something is of type *int* then it has integer values that can be represented in 32 bits (roughly plus or minus 2 billion), it has a specific set of arithmetic operators (including +, -, *, / and %, where the last two are for integer division), and so forth. If we say something is of type *char* then it takes up only 8 bits and has values that are single characters, such as 'a' or '7'.
In Java variables must be declared before they can be used. A *declaration* has the form

```
<type name> <variable name>;
```

or

```
<typename> <list of variable names>;
```

such as

```
int x;
```

or

```
int x, y, z;
```
In many situations you can include with the declaration the initial value of the variable:

```java
int x = 10;
```
Java has 8 primitive types: boolean, char, byte, short, int, long, float, double. We will primarily use only 4 of these: boolean, char, int and double.
The *boolean* data type has values true and false (which must be written in lowercase).

The two common boolean operators are

\[ \&\& \text{ for } \text{and} \]

and

\[ \|\| \text{ for } \text{or} \]

For example \((x < 10) \&\& (x \geq 0)\) means that variable \(x\) has a value between 0 and 9.
The *int* data type has 32-bit integer values. The largest value this holds is $2^{31}-1$, which is roughly 2 billion:

$$2^{10} \text{ is } 1024, \text{ which is roughly } 10^3.$$  
So $2^{31}$ is roughly $2*(2^{10})^3$  
  or $2*(10^3)^3$,  
  which is $2*10^9$.

(There; don't you feel better knowing that?)

Powers of 2 come up a lot; it is useful to be able to estimate large powers of 2.
The *double* datatype consists of 64-bit floating point values. The system will automatically convert ints to floats or doubles, but not vice versa:

    double x = 34; // this is fine
    int y = 3.14;  // this is an error

Sometimes you need to change the type of an object. This is called *casting* the object into a new type. To do this, put the new type in parentheses in front of the value:

    int y = (int) 3.14; // this sets y to 3

Note that when you cast a float into an int, it is truncated rather than rounded.
The \textit{char} datatype represents single text characters. You may not have worked with char before; Python treats single characters as strings of length 1. In Java the char 'a' is a very different critter from the String "a".

Here are some typical char values:

```java
char x = 'a';
char y = '3';
char z = '\n'; // the newline character;
    // useful for printing
char w = '\t'; // the tab character
char v = '\''; // the single quote character
```
There is a class Character that serves as a wrapper for char values for times when you need a reference value that holds a single character. The character class has a number of useful static methods.

```
String toString(char ch)
boolean Character.isLetter(char ch);
boolean Character.isDigit(char ch);
boolean Character.isWhitespace(char ch);
boolean Character.isUpperCase(char ch);
boolean Character.isLowerCase(char ch);
char Character.toUpperCase(char ch);
char Character.toLowerCase(char ch);
```