Arithmetic expressions and operators

Learn how to compute expressions in Java, and how to convert between different types of data using casting. Be careful of the difference between integer and floating-point division!

WE'LL COVER THE FOLLOWING

- Integer and floating point division
- Typecasting operators
- Exercise: casting
- Implicit vs. explicit casting
- Combined assignment and arithmetic operators
- Increment operators `--` and `++`

Computing values in Java works much like you'd expect from most other languages:

```
class ExpressionOperand {
        public static void main(String args[]) {
    int x;
    x = (3 * 6) + 24;
    System.out.println(x);
  }
}
```

There are two things to be aware of:

1. Like in C or C++, but unlike Javascript or Python3, division of two integers yields an integer.

2. Operators given two different types (like `2 + 1.7`) promote, or automatically convert, the more limited type. `2` will be converted to the floating point `2.0`, and the resulting value will be a floating point that

must be stored in a variable of type `float` or `double`.

Integer and floating point division

There are two types of division, and each is sometimes useful. **Integer division** takes two *integers* and evaluates to an integer. **Floating-point** division takes two *floating-point numbers* (numbers with a decimal point) and evaluates to a floating-point number.

Let's say I have 18 cents and 5 nieces. How much money should I give to each? With floating point division, 18/5 = 3.6, but it's hard to distribute .6 cents in cash, and my nieces prefer hard currency. Integer division would give the value 3. If both operands of `/` are integers, Java uses integer division. If either operand is a floating point value, then Java uses floating point division.

You can ensure floating point division by adding a decimal point and a zero:

```
class DivisionTypes {
  public static void main(String args[]) {
    System.out.println(18 / 5);
    System.out.println(18.0 / 5.0);
  }
}
```

If you want the remainder that would be left over after integer division, you can use the **modulus operator** `%`:

Modulus.java

```
class Modulus {
  public static void main(String args[]) {
    // Three cents left over after distributing
    // three pennies to each of my five nieces:
    System.out.println(18 % 5);
  }
}
```

Typecasting operators

Sometimes, you need to force Java to convert one type of data to another. For example, if you have two `int` variables and would like to divide them to get a fractional number, you might convert those values into `double` values. You can do this by typecasting the values, or **casting**, for short. A cast operator is written using parentheses and the name of the target type, and precedes the value to be cast. For example, `(double) 5` yields the value `5.0`.

For now, we'll mostly cast between numerical types. Unlike in Javascript or Python, you cannot cast an `int` or `double` to or from a string, but must rather use special methods of the `String`, `Integer`, or `Double` class.

Exercise: casting

Use casting to print out the floating point result of dividing the value in the variable `numerator` by `denominator` in the code below.

Cast.java | Sample solution

```
class Cast {
  public static void main(String args[]) {
    int numerator = 18;
    int denominator = 5;

  }
}
```

Implicit vs. explicit casting

Sometimes, Java does casting for you automatically. For example, if you write `18.0 / 5`, then Java will decide to cast `5` into a floating point `5.0`, an *implicit* cast. Another example is `double x = 5`. The `5` on the right is an integer data type, but Java knows to cast it into a double.

On the other hand, `int x = 5.6` will not work. Java will notice that you are trying to put a floating point into an `int`, and warn you that this may entail a loss of precision. You can reassure Java by using a casting operator: `int x = (int) 5.6`. Notice that when casting to an integer, the part after the decimal is

truncated, not rounded, so this expression will compute the value 5, not 6.

Combined assignment and arithmetic operators

Like many other languages, Java permits arithmetic and assignment to be combined, with the operators `+=`, `-=`, `/=`, `*=`. Thus, `x += 4` would increase the value of `x` by `4`.

Increment operators `--` and `++`

Java, Javascript, C, and C++ all have increment operators that work the same way; Python does not. The `++` operator adds one to a value, `--` subtracts. These operators are very useful in Java `for` and `while` loops, which we will see soon.

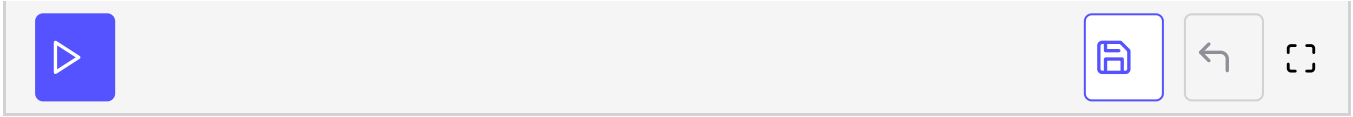
These operators are most cleanly used like the combined assignment operators in Python: you can replace the line of code `x += 1` with `x++`.

Increment.java

```
class Increment {
  public static void main(String[] args) {
    int x;

    x = 5;
    x += 1;
    System.out.println("x = " + x);

    x++;
    System.out.println("x = " + x);
  }
}
```



Variable assignments like `x = 4` change the value of a variable. In C and Java, these assignments also produce a value that can be used. `x = 4` produces the value `4`. So `y = (x = 4)`. would set `y` to have the value `4`. (The parentheses are not needed, but clarify what is happening.)

Similarly, `x++` produces a value: the value of `x` before adding `1` to `x`. This is called the **post-increment operator**, since the value is produced, and then the variable is incremented.

On the other hand, `++x` increments the variable first, and then produces the value: the **pre-increment operator**.

Overly-clever use of `++` and `--` operators are a common source of hard-to-find errors. I almost always write `x++` on its own line of code, and never use `++x`.

Just because you can write hard-to-read code like `x += ( y-- - (x = 4) )` doesn't mean you should.

Preincrement.java

```
class Preincrement {
  public static void main(String[] args) {
    int x = 5;
    int y = 5;

    // The ++ operator changes the value
    //  of the variable, but you can also
    //  use the result in an expression:

    System.out.println(x++);  // post-increment
    System.out.println(++y);  // pre-increment

    // assignment statements are also expressions.
    //  However, the code below is bad: it's too likely
    //  to be a typo; probably you wanted ==, the
    //  the equality comparison.
    System.out.println(x = y);

    // Truly horrible programming style:
    System.out.println(x += (y-- - (x = 4) ));
  }
}
```