Essential Computing 1

Operators
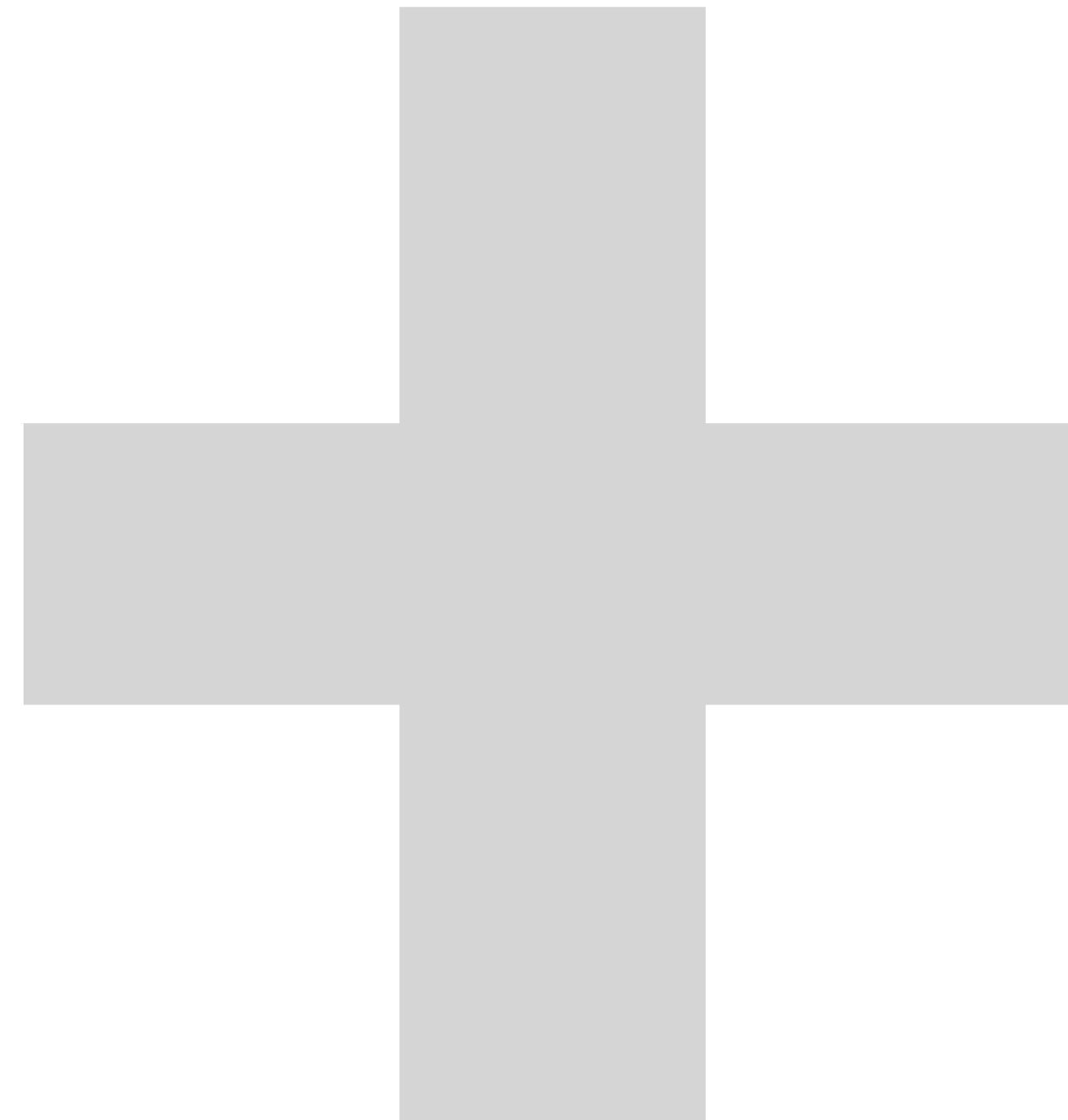
Arithmetic Operators

Addition	value = value + 2;
Subtraction	value = value - 2;
Multiplication	value = value * 2;
Division	value = value / 2;
Modulo	value = value % 2;

Arithmetic Operators

Compressed syntax, does the same thing.

Addition	value = value + 2;	value += 2;
Subtraction	value = value - 2;	value -= 2;
Multiplication	value = value * 2;	value *= 2;
Division	value = value / 2;	value /= 2;
Modulo	value = value % 2;	value %= 2;

Arithmetic Operators

Special shorthands

Add one	value = value + 1;	value++;
Subtract one	value = value - 1;	value--;

Arithmetic Operators

Special shorthands

Add one before dividing	value = ++value / 2;
Add one, after dividing	value = value++ / 2;

Precedence

Order of operations

1	**++value, --value**
2	***, /, %**
3	**+, -**

Operators in same group are ordered from left to right in the expression they appear

Precedence

Order of operations

1 * 2 + 12 / 2 % 4

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \quad\quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

Precedence

Order of operations

1 * 2 + 12 / 2 % 4

2 + 12 / 2 % 4

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \qquad 6 \qquad \% \quad 4$$

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \qquad 6 \qquad \% \quad 4$$

Precedence

Order of operations

```
1   *   2   +   12   /   2   %   4

2       +   12   /   2   %   4

2       +        6      %   4

2       +                    2
```

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \qquad 6 \qquad \% \quad 4$$

$$2 \qquad + \qquad\qquad\qquad 2$$

Precedence

Order of operations

$$1 \quad * \quad 2 \quad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \quad 12 \quad / \quad 2 \quad \% \quad 4$$

$$2 \qquad + \qquad 6 \qquad \% \quad 4$$

$$2 \qquad + \qquad\qquad 2$$

$$4$$

Precedence

Order of operations

```
1   *   2   +   12   /   2   %   4
━━━━━━━━━

    2       +   12   /   2   %   4
                ━━━━━━━━━

    2       +        6      %   4
                     ━━━━━━━━━

    2       +                   2
    ━━━━━━━━━━━━━━━━━━━━━━━━

                4
```

Precedence

Forcing order

1   *   (2   +   12   )   /   2   %   4

Precedence

Forcing order

$$1 \quad * \quad (\quad 2 \quad + \quad 12 \quad) \quad / \quad 2 \quad \% \quad 4$$

Precedence

Forcing order

$$1 \quad * \quad (\quad 2 \quad + \quad 12 \quad) \quad / \quad 2 \quad \% \quad 4$$

$$1 \quad * \quad (\quad \quad 14 \quad \quad) \quad / \quad 2 \quad \% \quad 4$$

$$14 \quad \quad \quad \quad \quad / \quad 2 \quad \% \quad 4$$

$$7 \quad \quad \% \quad 4$$

$$3$$

Integer divisions

Dividing by a integer always produces an integer

14 / 5

Integer divisions

The decimal numbers are thrown away

```
14 / 5 => 2
```

Integer divisions

You can force the result to be floating point by casting

```
14 / (double) 5 => 2.8
```

Integer divisions

Or simply divide by a floating point value

```
14 / 5.0 => 2.8
```

Floating point errors

Arithmetics on floats and double produce errors

Example

```
System.out.println( 0.1 * 10 );
System.out.println( 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 );
```

```
1.0
0.9999999999999999
```

Floating point errors

Use integers where precision is important