CSE 142, Summer 2014

Lecture 2: Static Methods
Expressions

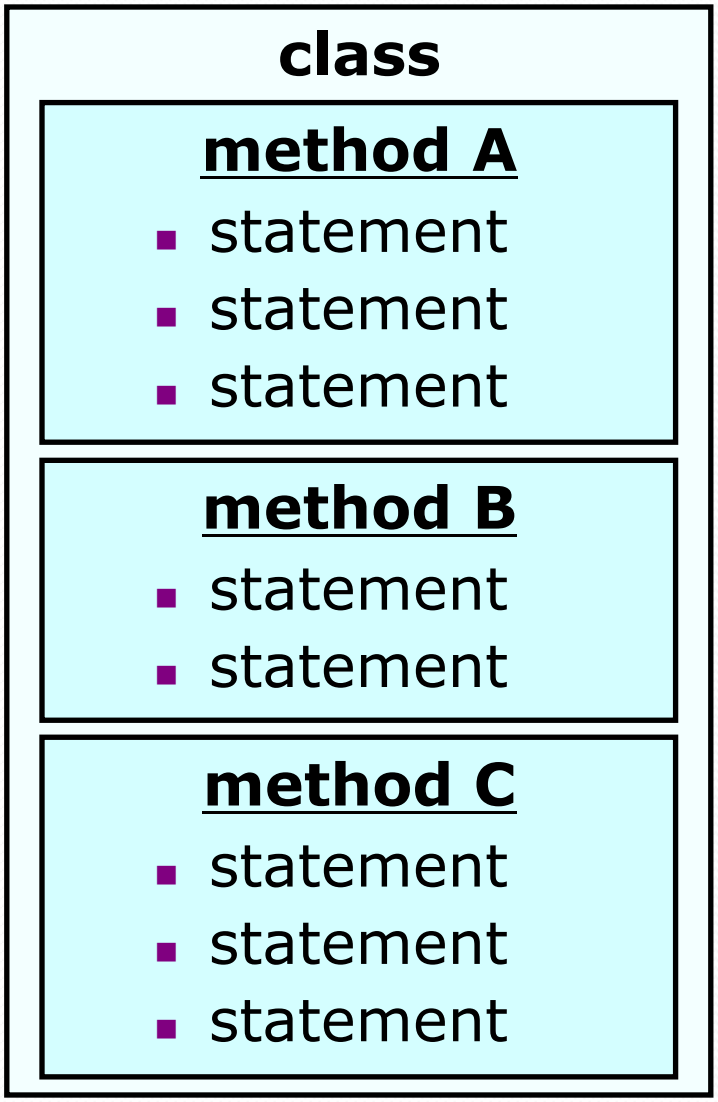
reading: 1.4 – 2.1

Algorithms

- **algorithm**: A list of steps for solving a problem.
- Example algorithm: "Bake sugar cookies"
  - Mix the dry ingredients.
  - Cream the butter and sugar.
  - Beat in the eggs.
  - Stir in the dry ingredients.
  - Set the oven temperature.
  - Set the timer for 10 minutes.
  - Place the cookies into the oven.
  - Allow the cookies to bake.
  - Spread frosting and sprinkles onto the cookies.
  - ...

Static methods

- **static method**: A named group of statements.
  - denotes the *structure* of a program
  - eliminates *redundancy* by code reuse
  - **procedural decomposition**: dividing a problem into methods
- Writing a static method is like adding a new command to Java.



Declaring a method

Gives your method a name so it can be executed

- Syntax:

```
public static void name() {
    statement;
    statement;
    ...
    statement;
}
```

- Example:

```
public static void printWarning() {
    System.out.println("This product causes cancer");
    System.out.println("in lab rats and humans.");
}
```

Calling a method

Executes the method's code

- Syntax:

```
name();
```

  - You can call the same method many times if you like.

- Example:

```
printWarning();
```

  - Output:

```
This product causes cancer
in lab rats and humans.
```

Methods calling methods

```
public class MethodsExample {
    public static void main(String[] args) {
        message1();
        message2();
        System.out.println("Done with main.");
    }

    public static void message1() {
        System.out.println("This is message1.");
    }

    public static void message2() {
        System.out.println("This is message2.");
        message1();
        System.out.println("Done with message2.");
    }
}
```

- Output:

```
This is message1.
This is message2.
This is message1.
Done with message2.
Done with main.
```

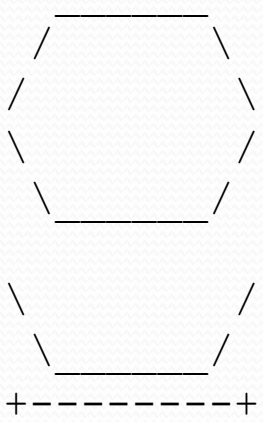
When to use methods

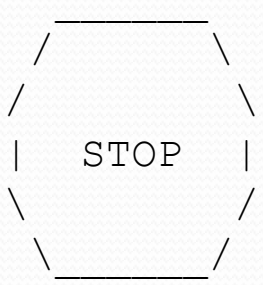
- Place statements into a static method if:
  - The statements are related structurally, and/or
  - The statements are repeated.

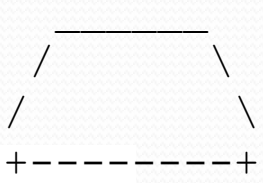
- You should not create static methods for:
  - An individual `println` statement.
  - Only blank lines. (Put blank `println`s in `main`.)
  - Unrelated or weakly related statements.
    (Consider splitting them into two smaller methods.)

Static methods question

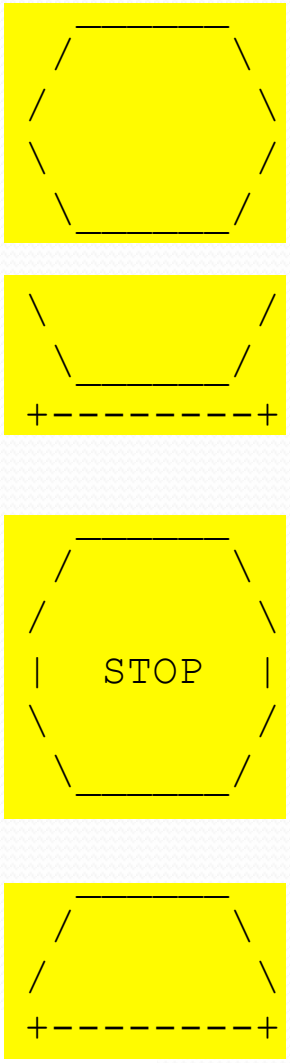
- Write a program to print these figures using methods.







Output structure



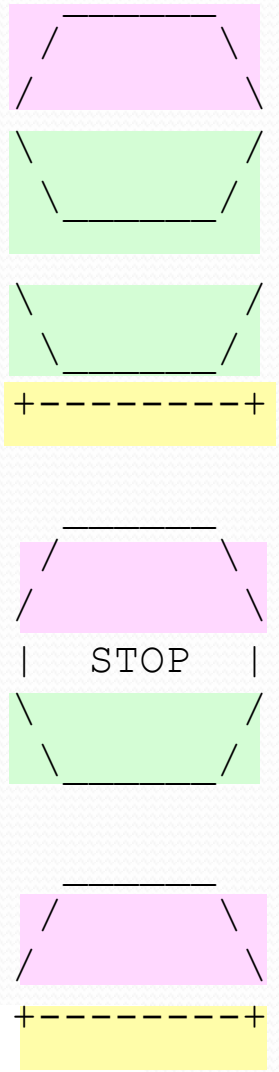
The structure of the output:

- initial "egg" figure
- second "teacup" figure
- third "stop sign" figure
- fourth "hat" figure

This structure can be represented by methods:

- `egg`
- `teaCup`
- `stopSign`
- `hat`

Output redundancy

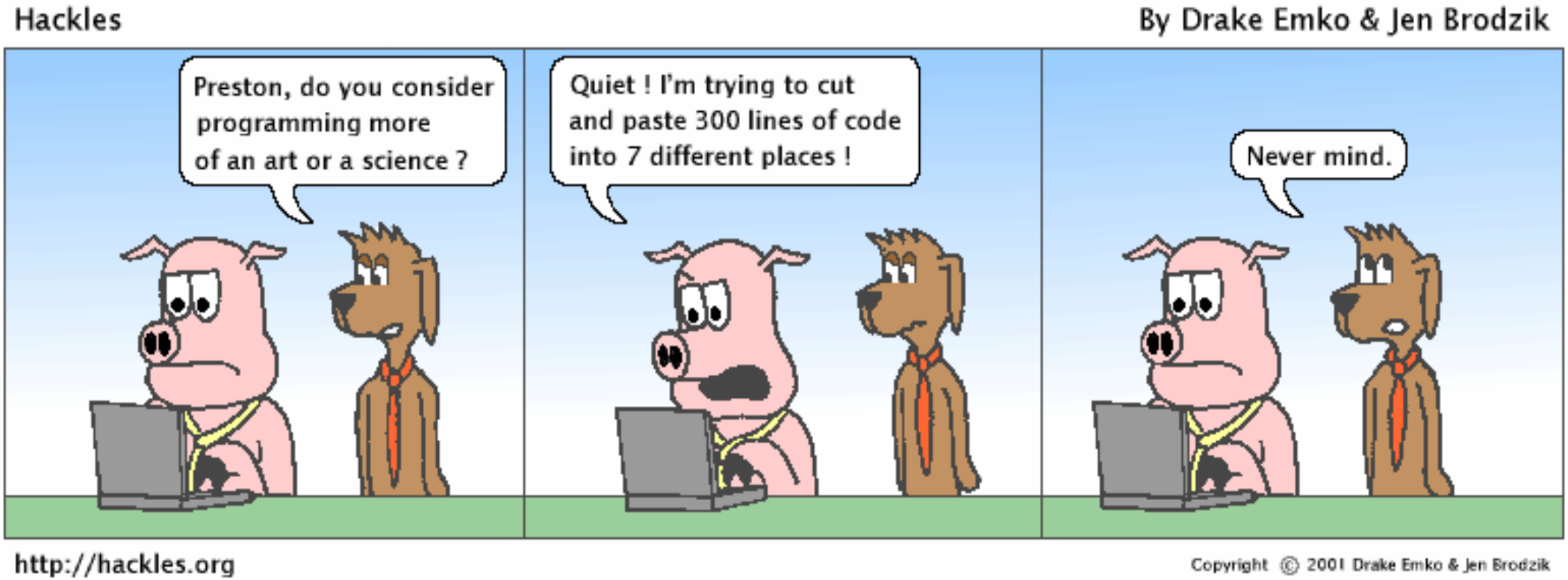


The redundancy in the output:

- egg top: reused on stop sign, hat
- egg bottom: reused on teacup, stop sign
- divider line: used on teacup, hat

This redundancy can be fixed by methods:

- `eggTop`
- `eggBottom`
- `line`



Data and expressions

reading: 2.1

Data types

- Internally, computers store everything as 1s and 0s

```
104    → 01101000
"hi"   → 0110100001101001
h      → 01101000
```

- How are `h` and `104` differentiated?

- **type**: A category or set of data values.
  - Constrains the operations that can be performed on data
  - Many languages ask the programmer to specify types
  - Examples: integer, real number, string

Java's primitive types

- **primitive types**: 8 simple types for numbers, text, etc.
  - Java also has **object types**, which we'll talk about later

Name	Description		Examples
`int`	integers	(up to $2^{31} - 1$)	`42, -3, 0, 926394`
`double`	real numbers	(up to 10^{308})	`3.1, -0.25, 9.4e3`
`char`	single text characters		`'a', 'X', '?', '\n'`
`boolean`	logical values		`true, false`

  - Why does Java distinguish integers vs. real numbers?

Integer or real number?

- Which category is more appropriate?

integer (`int`)	real number (`double`)

1. Temperature in degrees Celsius
2. The population of lemmings
3. Your grade point average
4. A person's age in years
5. A person's weight in pounds
6. A person's height in meters
7. Number of miles traveled
8. Number of dry days in the past month
9. Your locker number
10. Number of seconds left in a game
11. The sum of a group of integers
12. The average of a group of integers

- credit: Kate Deibel, http://www.cs.washington.edu/homes/deibel/CATs/

Expressions

- **expression**: A value or operation that computes a value.
  - Examples:

```
1 + 4 * 5
(7 + 2) * 6 / 3
42
```

  - The simplest expression is a *literal value*.
  - A complex expression can use operators and parentheses.

Arithmetic operators

- **operator**: Combines multiple values or expressions.

`+`	addition
`-`	subtraction (or negation)
`*`	multiplication
`/`	division
`%`	modulus (a.k.a. remainder)

- As a program runs, its expressions are *evaluated*.
  - `1 + 1` evaluates to `2`
  - `System.out.println(3 * 4);` prints `12`
    - How would we print the text `3 * 4` ?

Integer remainder with %

- The % operator computes the remainder from integer division.
  - 14 % 4 is 2
  - 218 % 5 is 3

```
    3
4 ) 14
    12
    2
```

```
   43
5 ) 218
   20
   18
   15
   3
```

What is the result?

```
45 % 6
2 % 2
8 % 20
11 % 0
```

- Applications of % operator:
  - Obtain last digit of a number: 230857 % 10 is 7
  - Obtain last 4 digits: 658236489 % 10000 is 6489
  - See whether a number is odd: 7 % 2 is 1, 42 % 2 is 0

Precedence

- **precedence**: Order in which operators are evaluated.
  - Generally operators evaluate left-to-right.
    `1 - 2 - 3` is `(1 - 2) - 3` which is `-4`
  - But `* / %` have a higher level of precedence than `+ -`

```
1 + 3 * 4                  is 13

6 + 8 / 2 * 3
6 +   4   * 3
6 +     12                 is 18
```

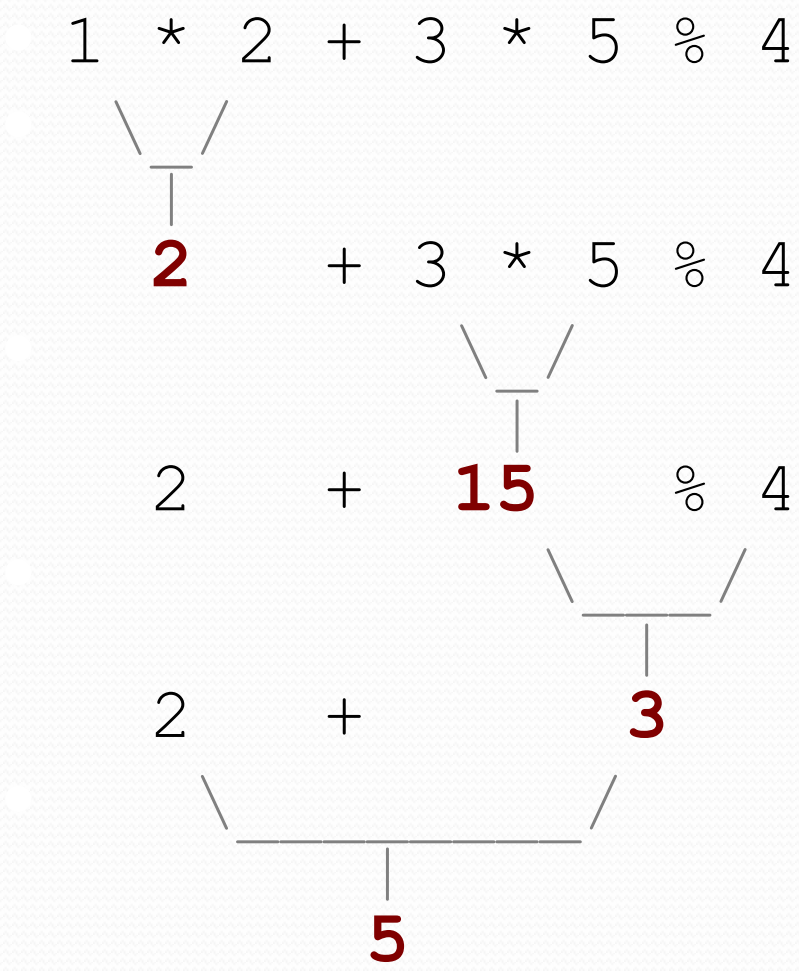
  - Parentheses can force a certain order of evaluation:

```
(1 + 3) * 4                is 16
```

  - Spacing does not affect order of evaluation

```
1+3 * 4-2                  is 11
```

Precedence examples



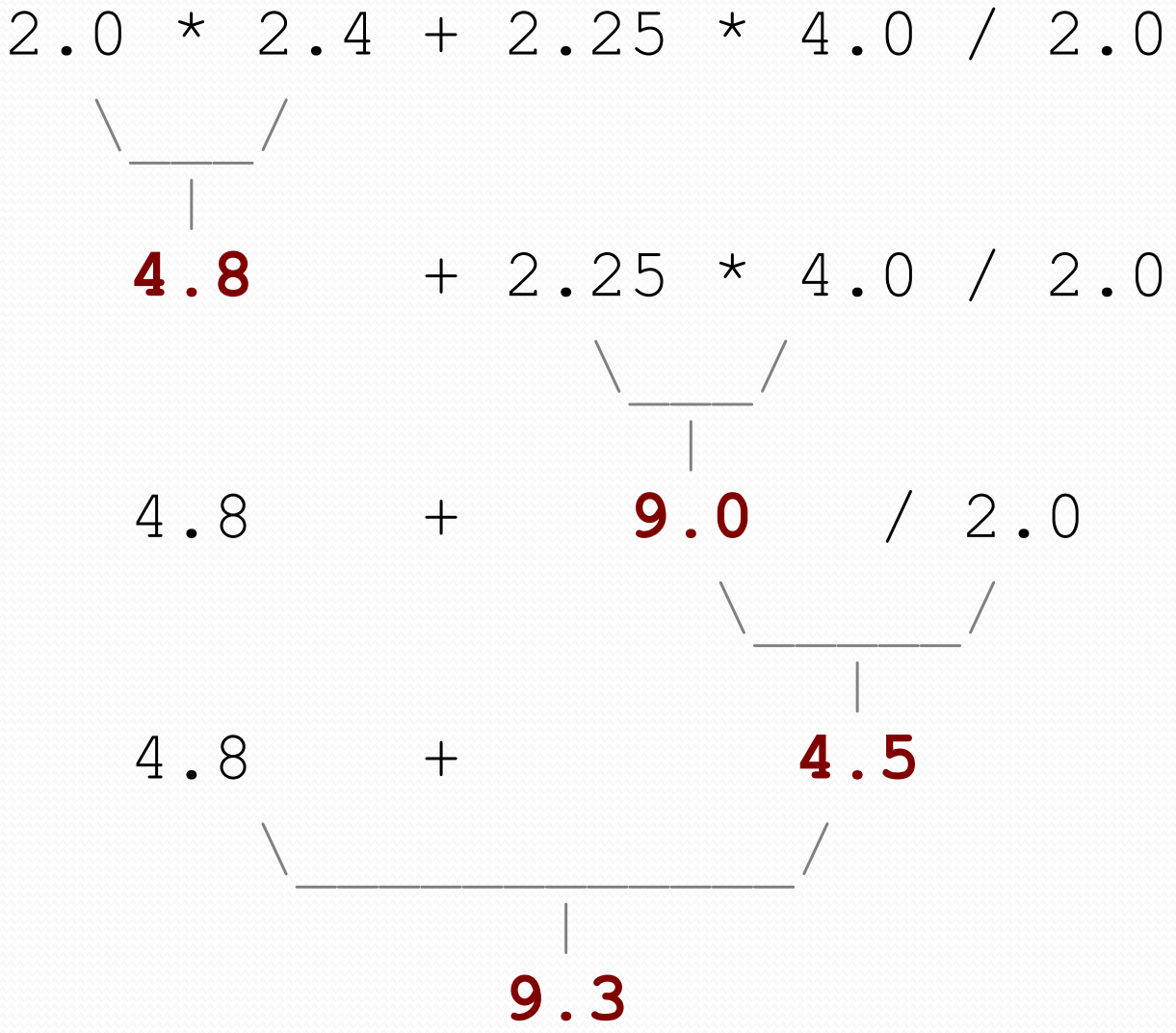
Precedence questions

- What values result from the following expressions?
  - `9 / 5`
  - `695 % 20`
  - `7 + 6 * 5`
  - `7 * 6 + 5`
  - `248 % 100 / 5`
  - `6 * 3 - 9 / 4`
  - `(5 - 7) * 4`
  - `6 + (18 % (17 - 12))`

Real numbers (type `double`)

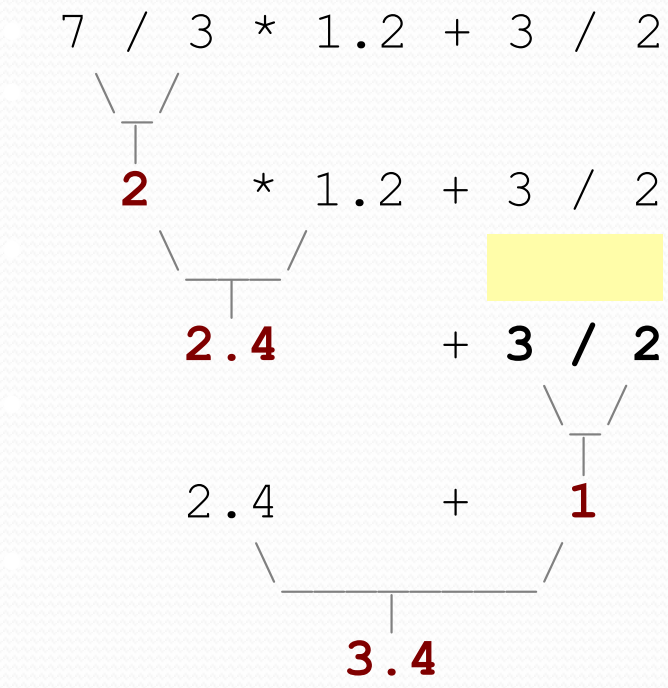
- Examples: `6.022`, `-42.0`, `2.143e17`
  - Placing `.0` or `.` after an integer makes it a `double`.
- The operators `+ - * / % ()` all still work with `double`.
  - `/` produces an exact answer: `15.0 / 2.0` is `7.5`
  - Precedence is the same: `()` before `* / %` before `+ -`

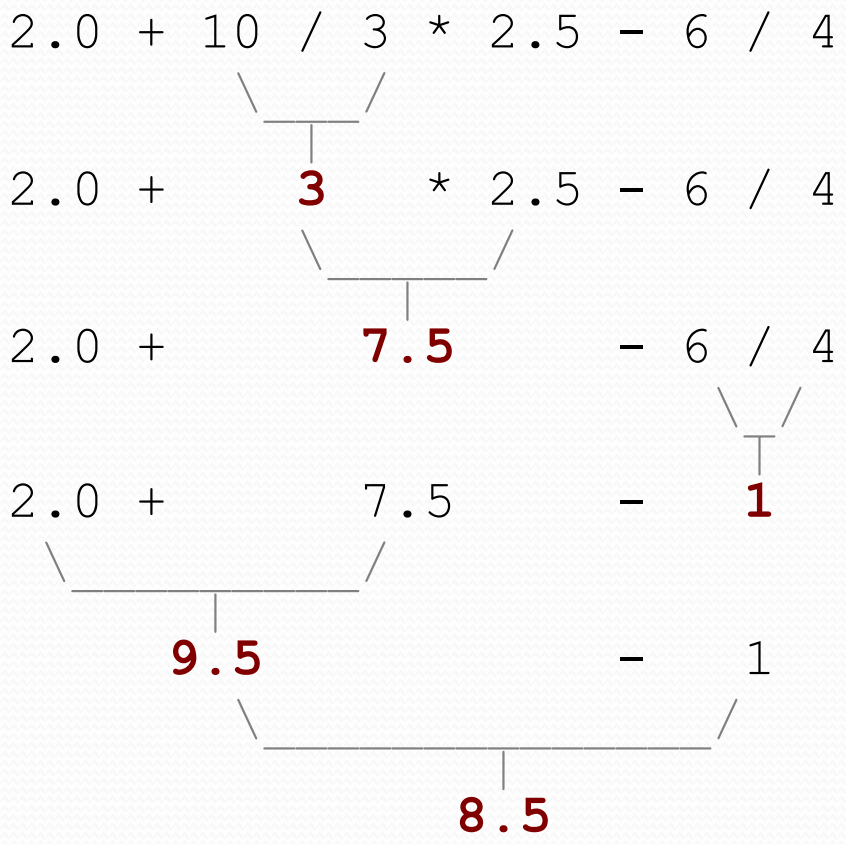
Real number example



Mixing types

- When `int` and `double` are mixed, the result is a `double`.
  - `4.2 * 3` is `12.6`
- The conversion is per-operator, affecting only its operands.





  - `3 / 2` is `1` above, not `1.5`.

String concatenation

- **string concatenation**: Using + between a string and another value to make a longer string.

```
"hi" + "hello"     is "hihello"
"hello" + 42       is "hello42"
1 + "abc" + 2      is "1abc2"
"abc" + 1 + 2      is "abc12"
1 + 2 + "abc"      is "3abc"
"abc" + 9 * 3      is "abc27"
"1" + 1            is "11"
4 - 1 + "abc"      is "3abc"
```

- Use + to print a string and an expression's value together.
  - `System.out.println("Grade: " + (95.1 + 71.9) / 2);`
  - Output: `Grade: 83.5`