CS 106A, Lecture 4
Introduction to Java

suggested reading:
Karel, Ch. 5-6

Plan For Today

- Announcements
- Bye, Karel!
- Console Programs
- Variables
- Expressions
- Practice: Receipt

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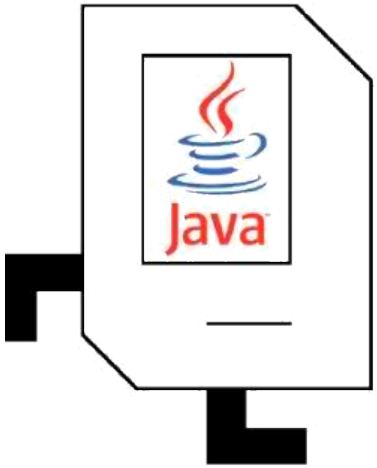
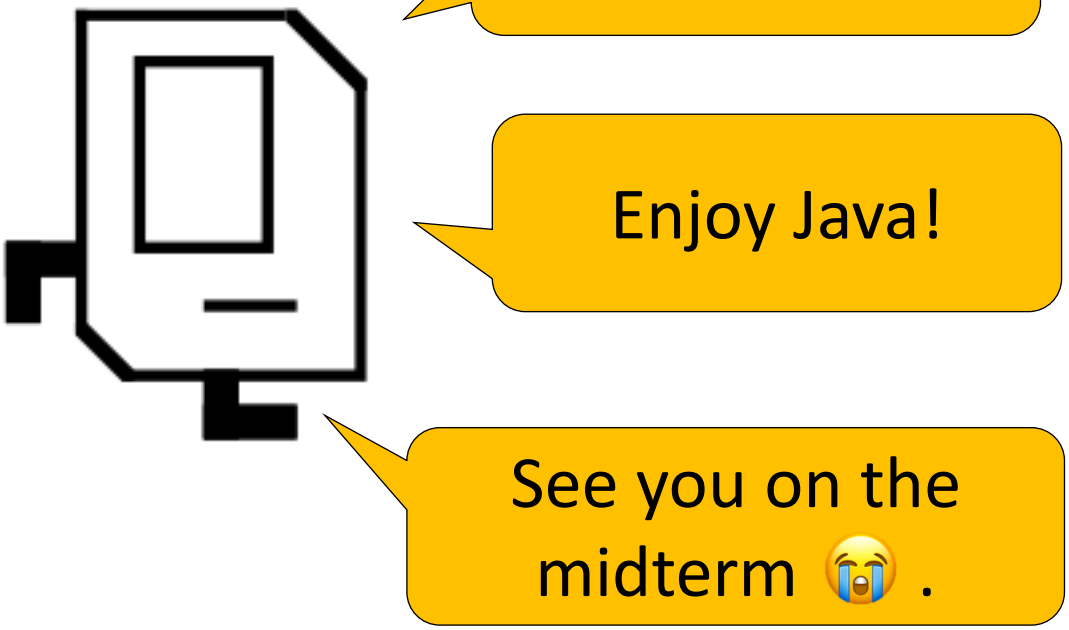


Bye, Karel!



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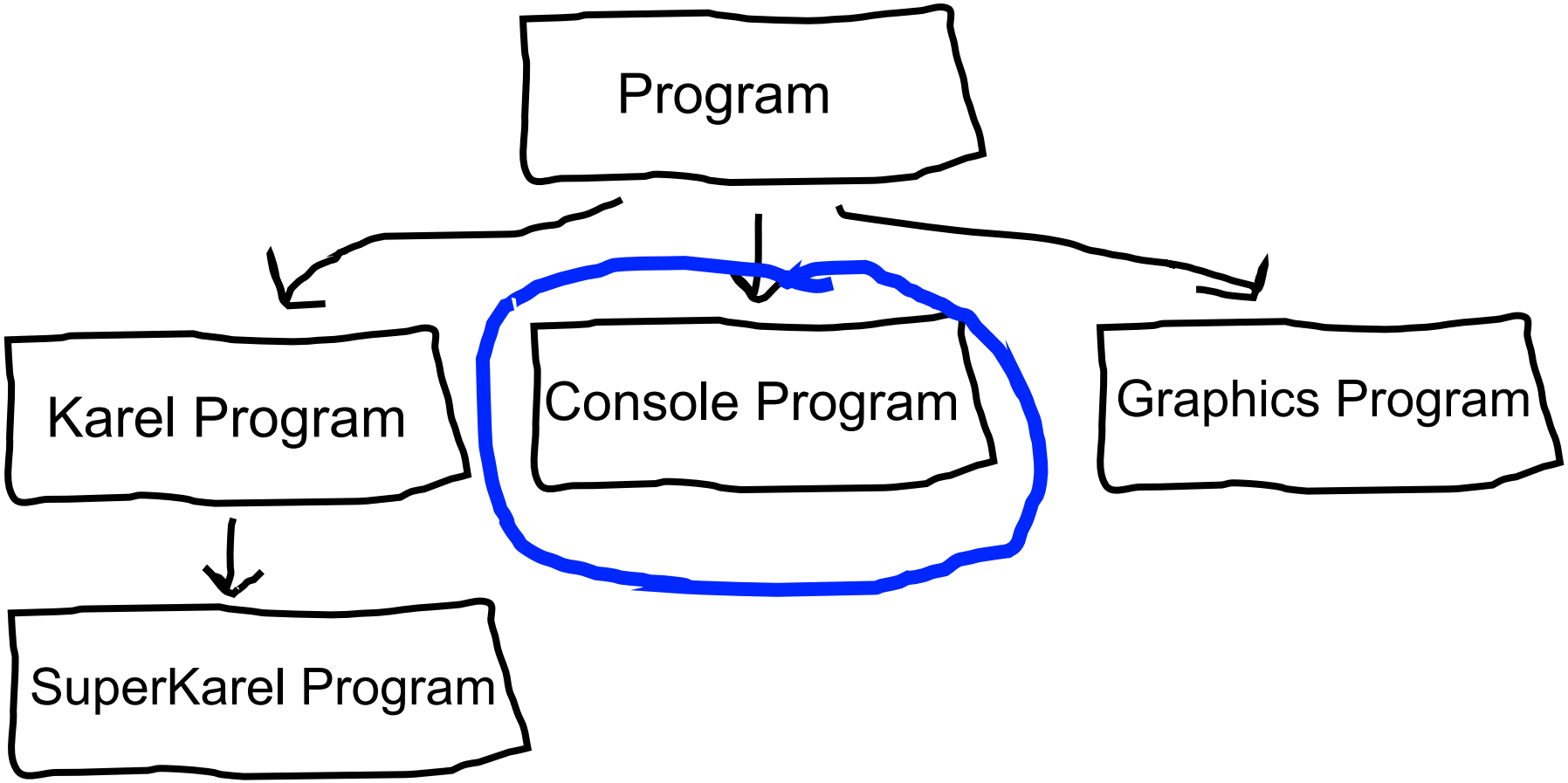
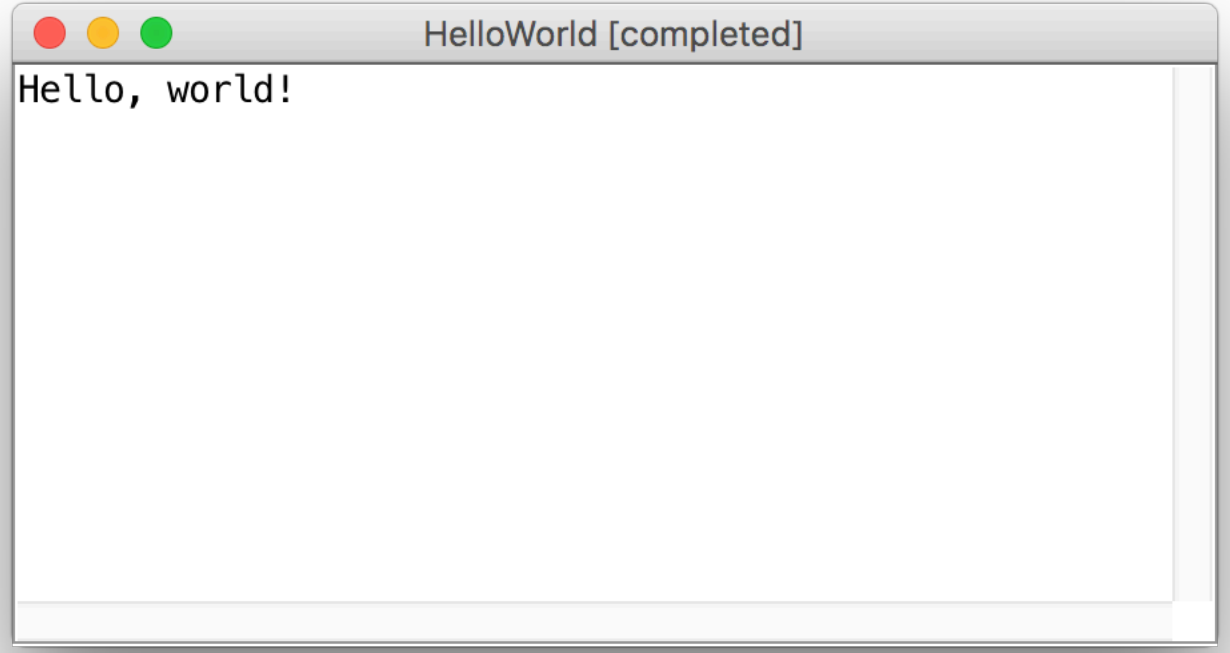
Java


Program
Karel Program
Console Program
Graphics Program
SuperKarel Program

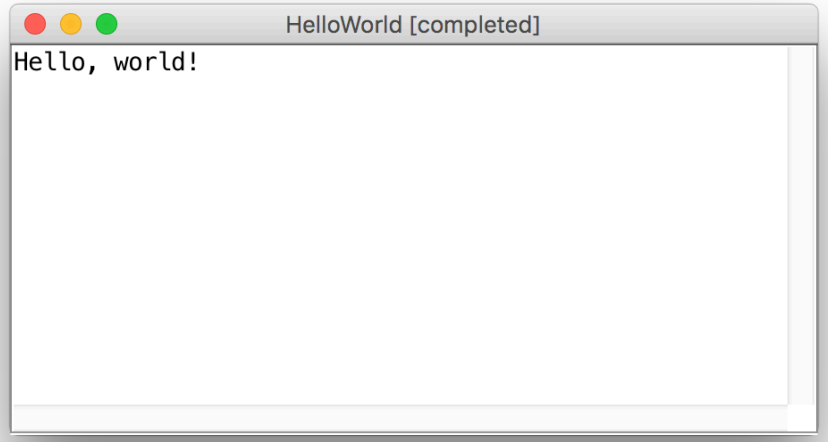
Our First Java Program



Our First Java Program

```
import acm.program.*;

public class HelloWorld extends ConsoleProgram {
      public void run() {
            println("Hello, world!");
      }
}
```



Console Programs

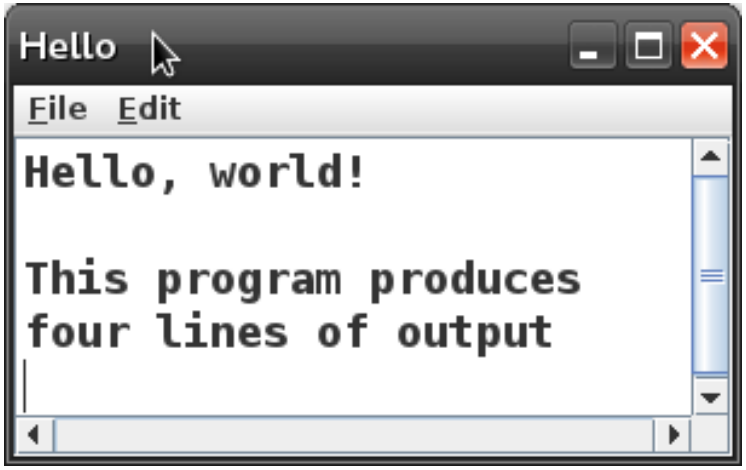
```
import acm.program.*;

public class Name extends ConsoleProgram {
    public void run() {
        statements;
    }
}
```

- Unlike Karel, many programs produce their behavior as text.
- **console**: Text box into which the behavior is displayed.
  - *output:* Messages displayed by the program.
  - *input:* Data read by the program that the user types.

Console Programs

```
public class Hello extends ConsoleProgram {
    public void run() {
        println("Hello, world!");
        println();
        println("This program produces");
        println("four lines of output");
    }
}
```



println

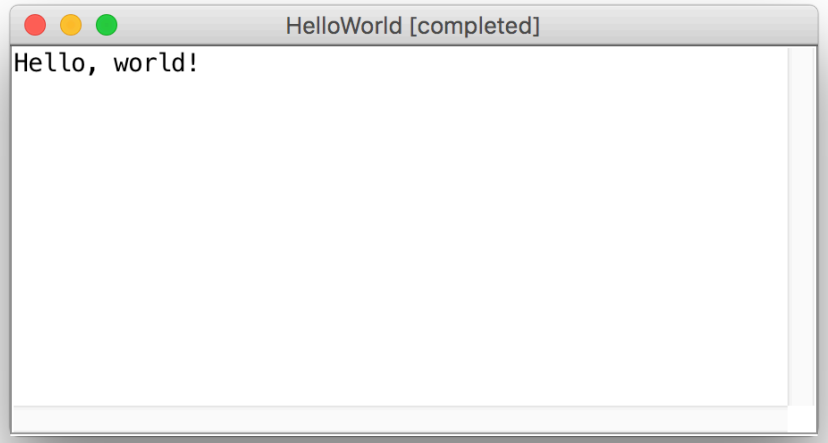
- A statement that prints a line of output on the console, and goes to the next line.
  - pronounced "print-linn"

- Two ways to use `println` :
  - `println("`***`text`***`");`
    - Prints the given message as output, and goes to the next line.
    - A message is called a *string*; it starts/ends with a `"` quote character.
    - The quotes do not appear in the output.
    - A string may not contain a `"` character.
  - `println();`

    Prints a blank line of output.

print

```
public class HelloWorld extends ConsoleProgram {
    public void run() {
        print("Hello, ");
        print("world!");
    }
}
```



Same as `println`, but does not go to the next line.

Escape sequences

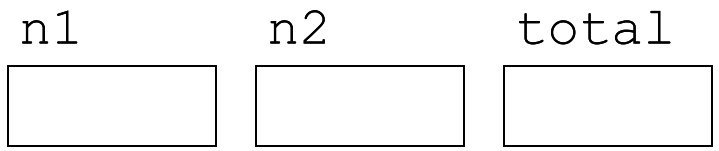
- **escape sequence**: A special sequence of characters used to represent certain special characters in a string.

`\t`	tab character
`\n`	new line character
`\"`	quotation mark character
`\\`	backslash character

  - Example:
```
println("\\hello\nhow\tare \"you\"?\\\\");
```
  - Output:
```
\hello
how     are "you"?\\
```

Add2Integers

```
class Add2Integers extends ConsoleProgram {
   public void run() {
      println("This program adds two numbers.");
      int n1 = readInt("Enter n1: ");
      int n2 = readInt("Enter n2: ");
      int total = n1 + n2;
      println("The total is " + total + ".");
   }
}
```



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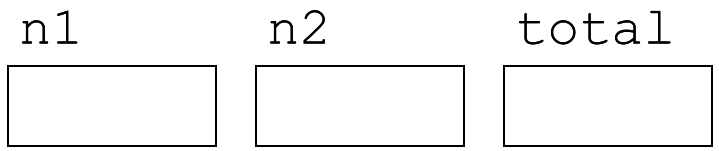

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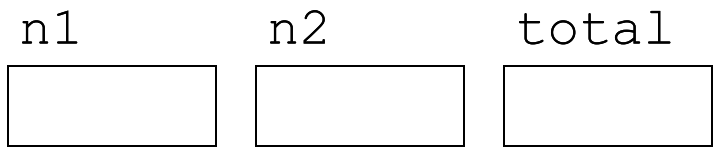

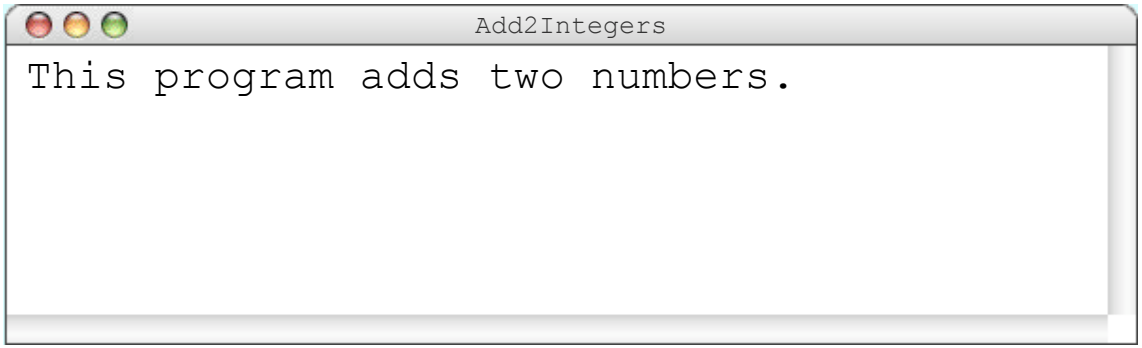

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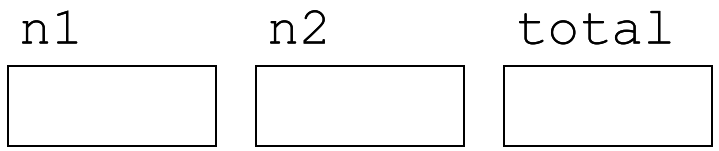

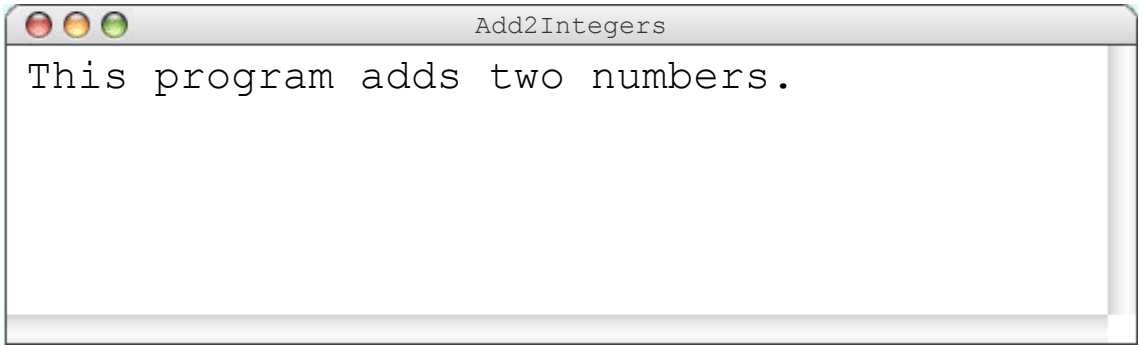

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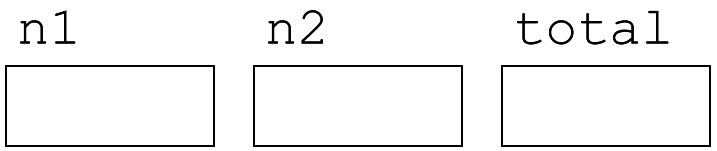

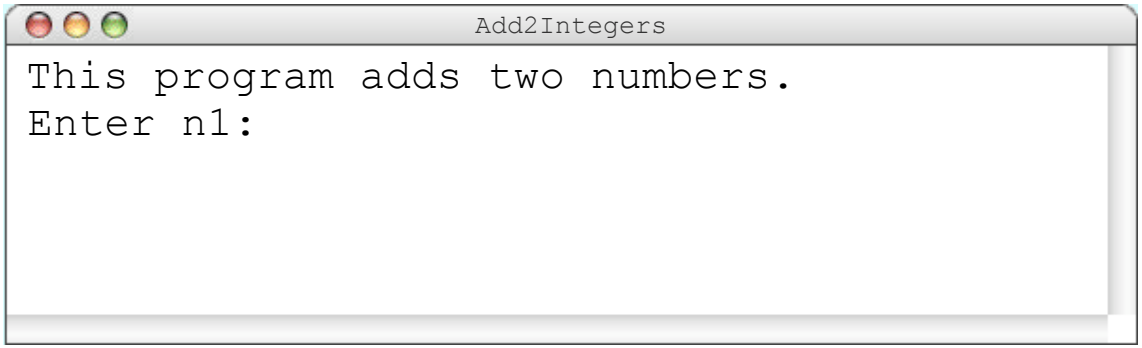

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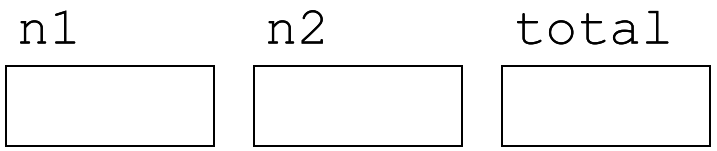

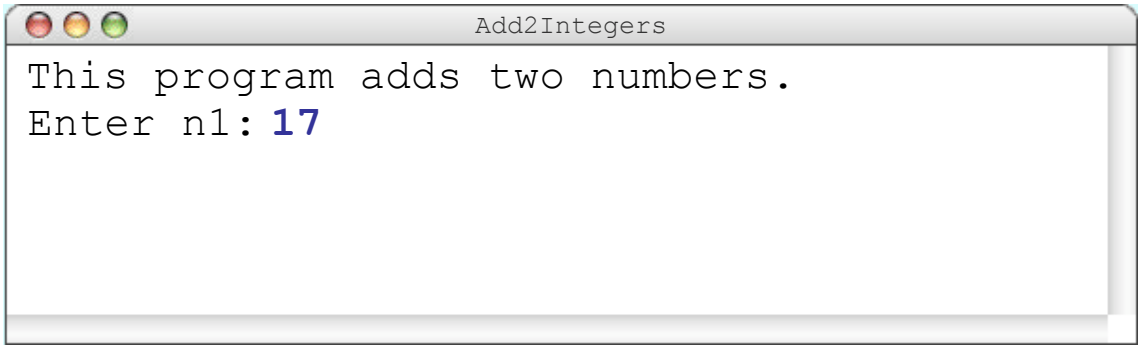

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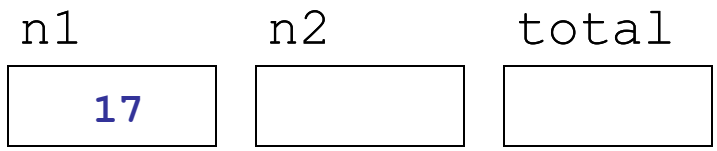

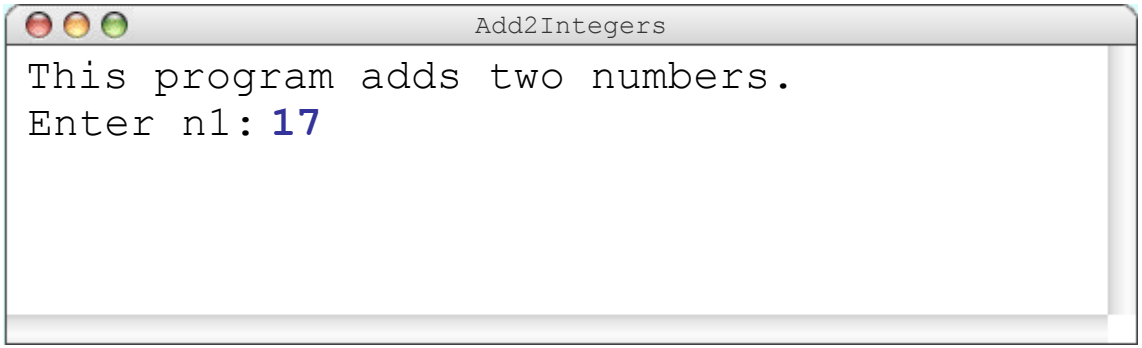

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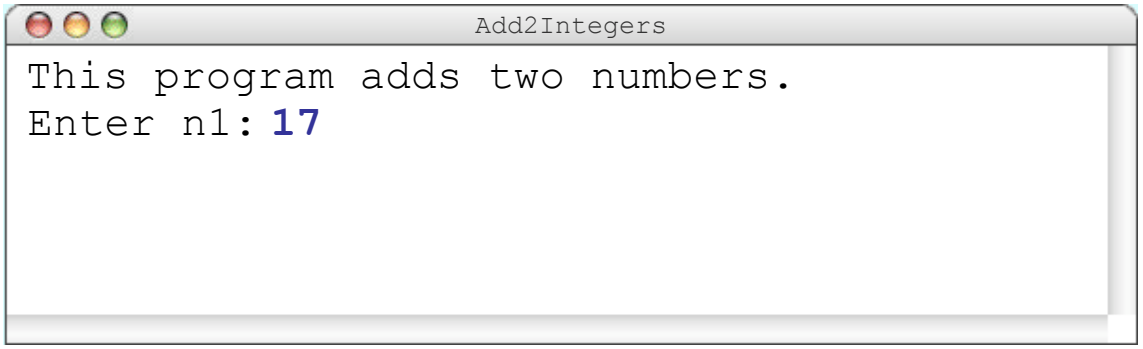
n1	n2	total
17		



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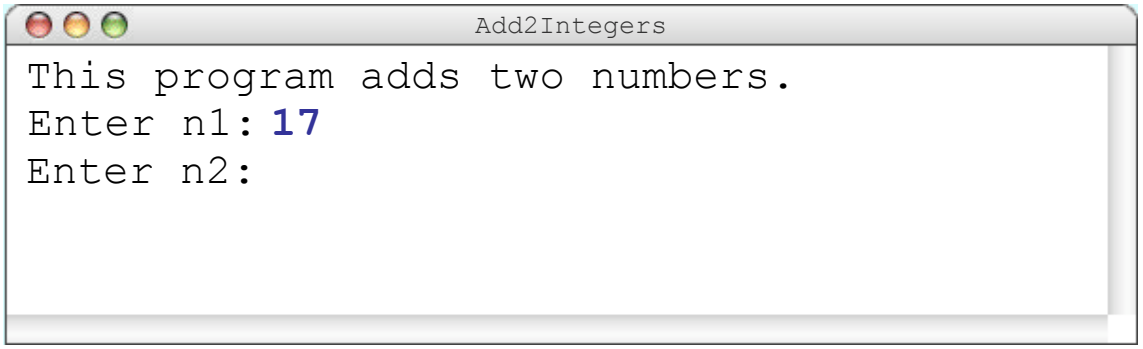

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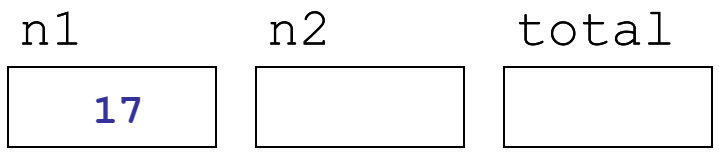

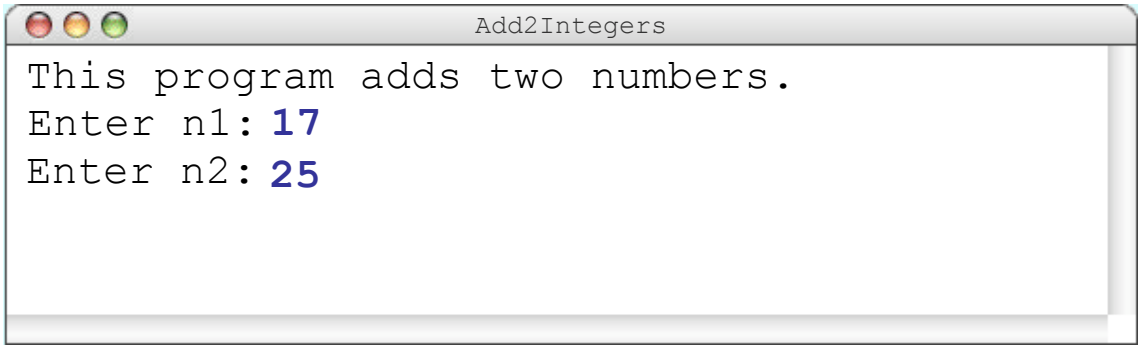

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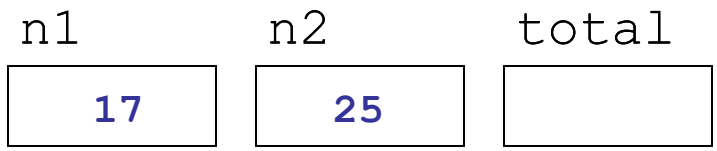

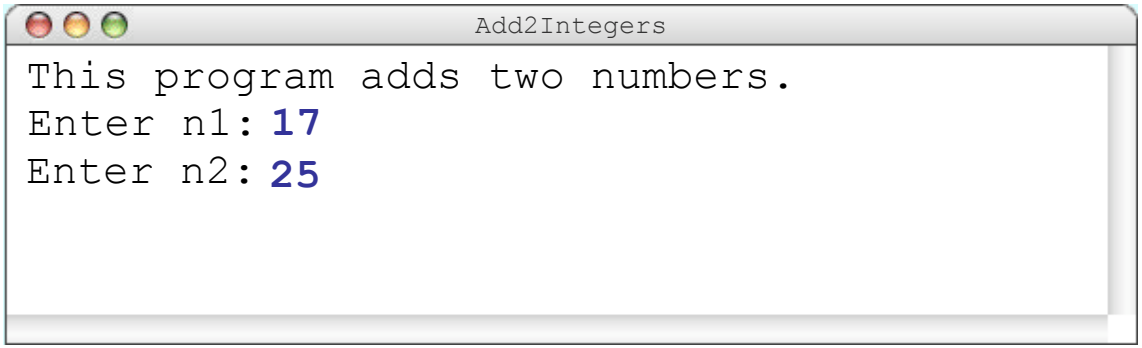

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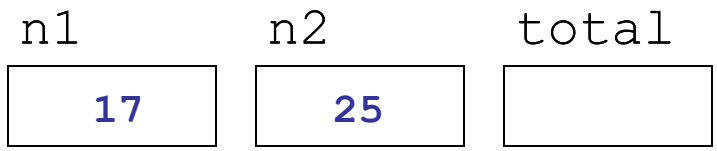

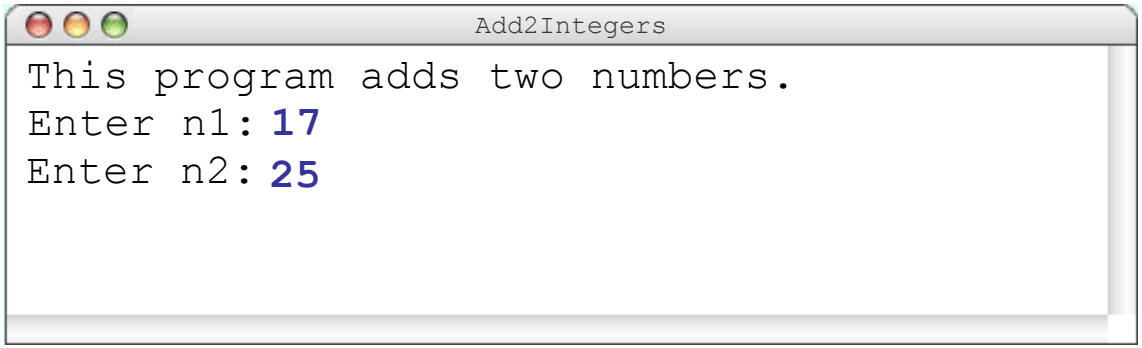

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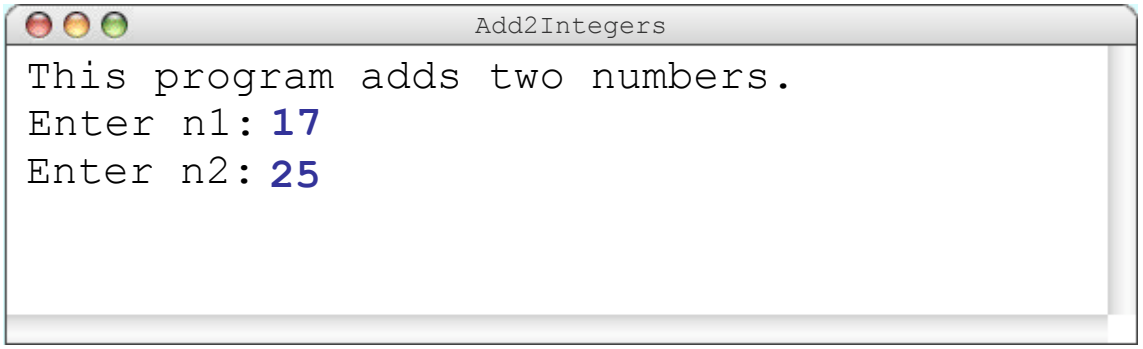
   }
}
```

n1	n2	total
17	25	42



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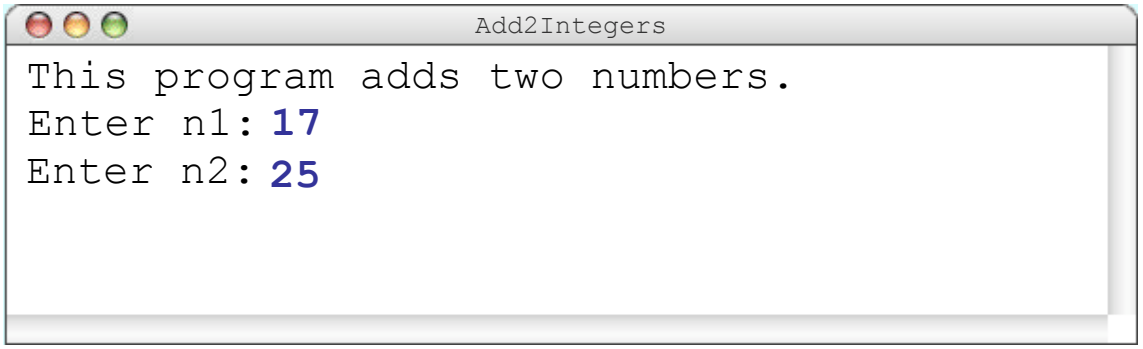

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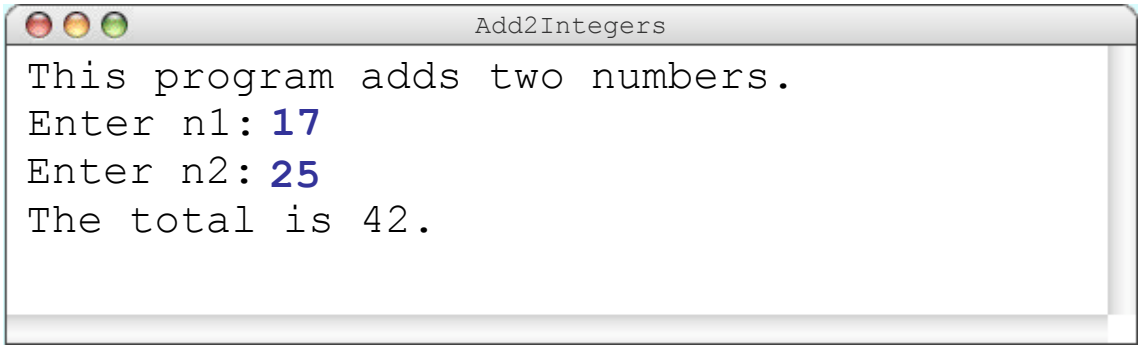

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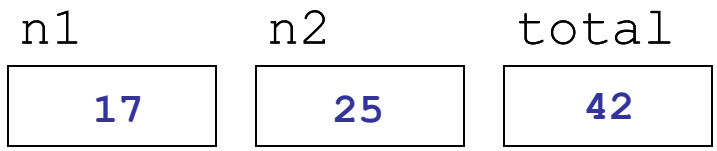

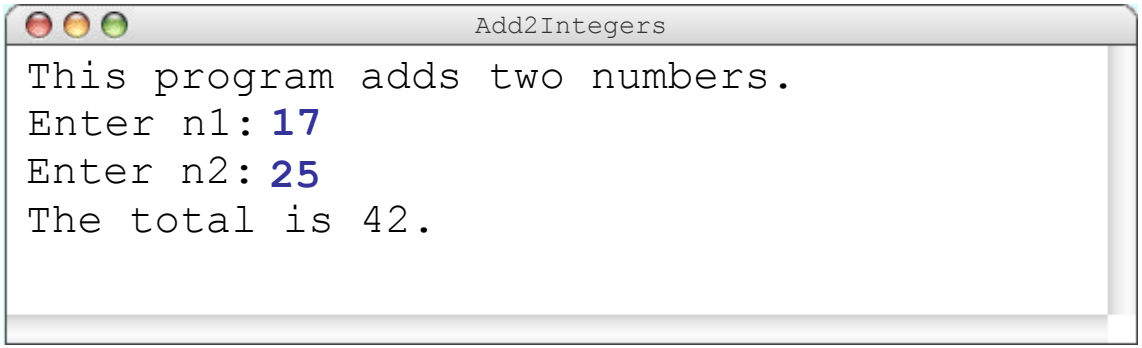

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Variables = Boxes

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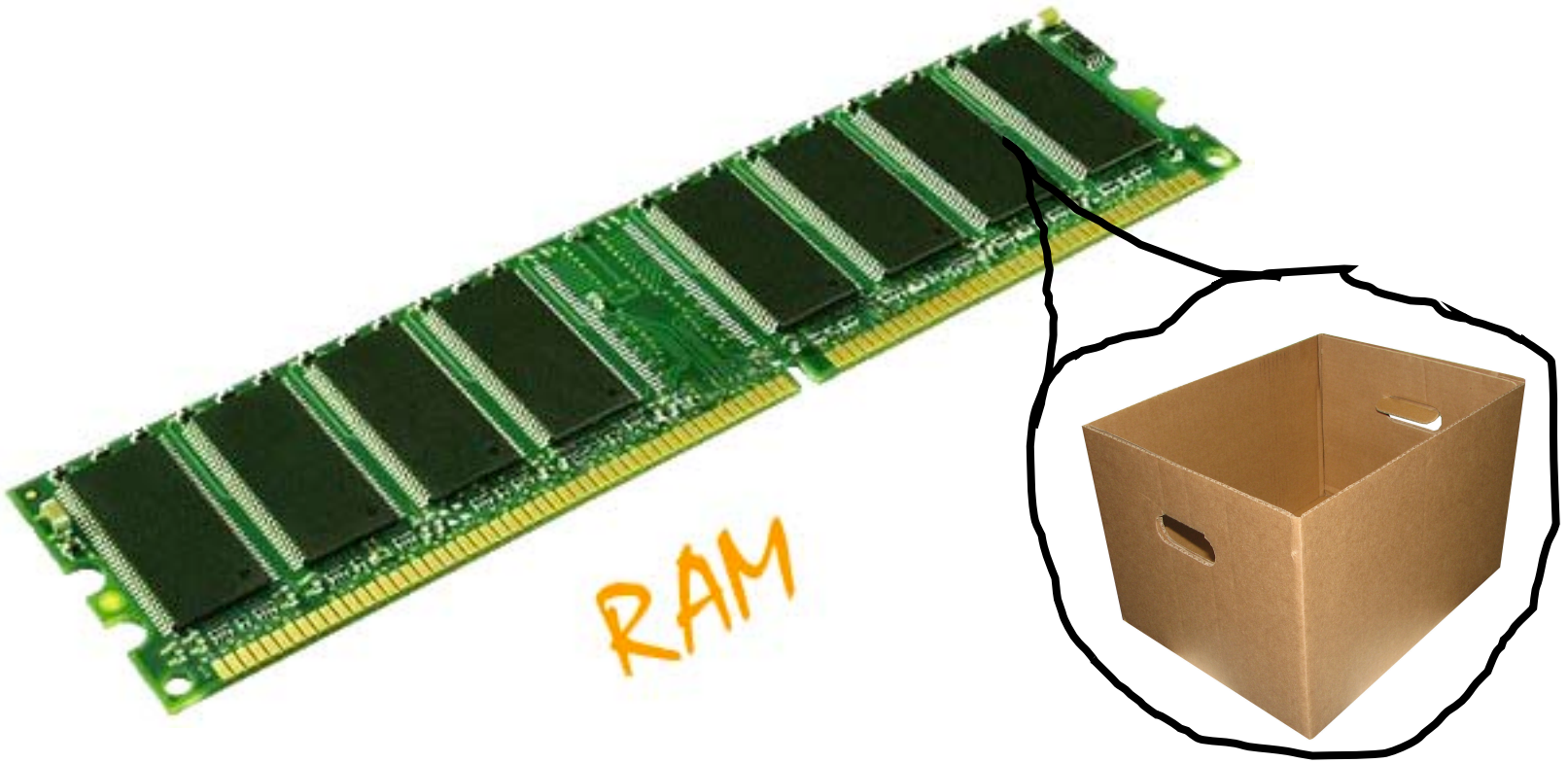


My computer has space for about 2 billion boxes

Making a new Variable

```
int myVariable;
```

Making a new Variable

Variable Types

`int` – an integer number

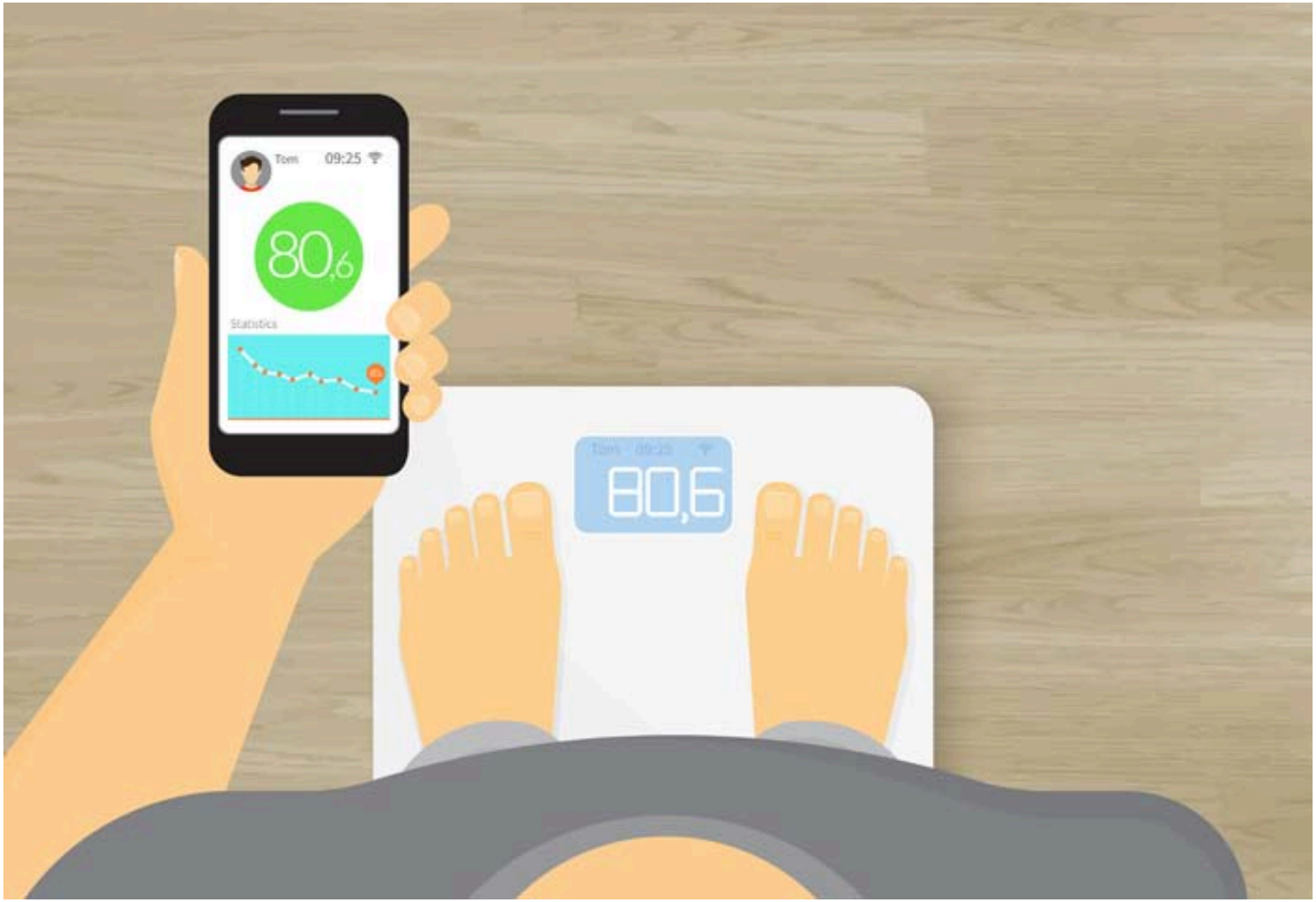
`double` – a decimal number

`char` – a single character

`boolean` – true or false

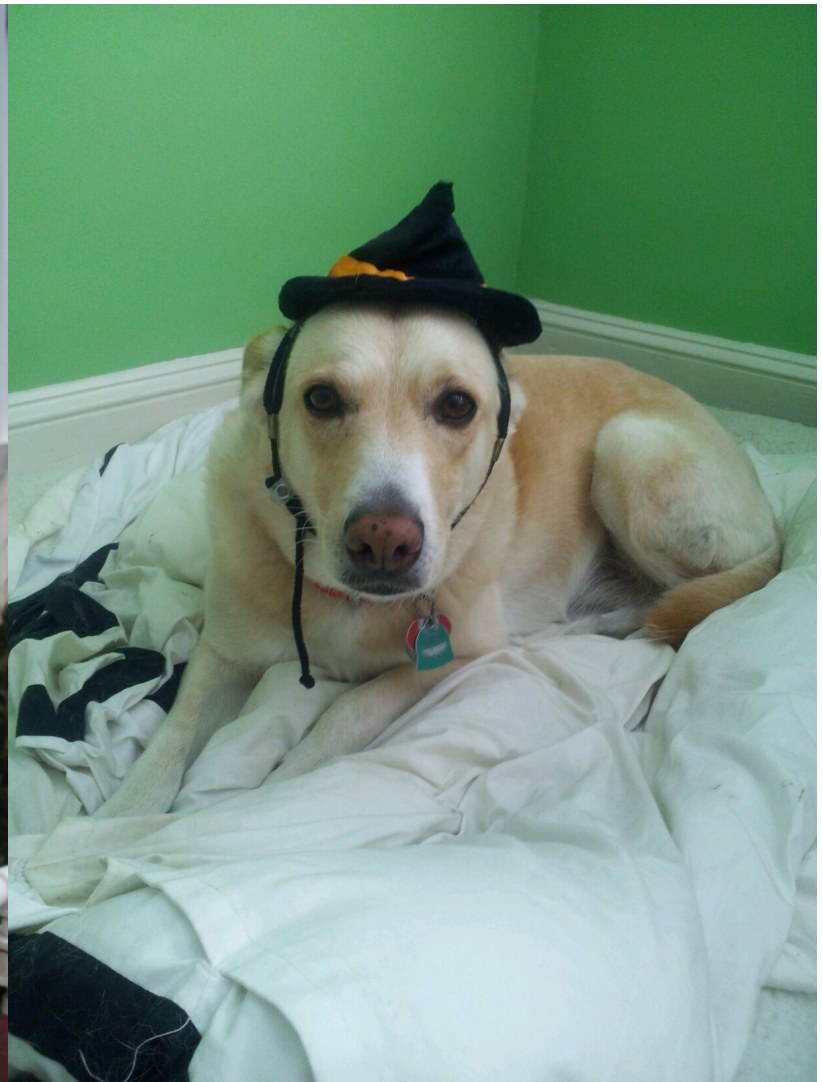
How much do I weigh?

`double` – answer is real number



How many pets do I have?

`int` – answer is an integer



double vs. int

How much vs. *how many*

Declaration

- **variable declaration**: Sets aside memory for storing a value.
  - Variables must be declared before they can be used.

- Syntax:

```
type name;
```

```
int zipcode;
```

zipcode 

```
double myGPA;
```

myGPA 

Assignment

Existing variable name

value

```
myVariable = 2;
```

Assignment

```
// integer values
int num;
num = 5;

// real values
double fraction;
fraction = 0.2;

// a single letter
char letter;
letter = 'c';

// true or false
boolean isLove;
isLove = true;
```

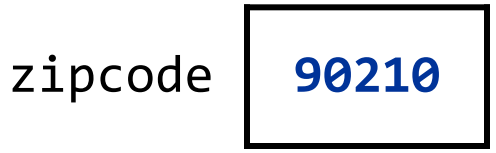
Assignment

- **assignment**: Stores a value into a variable.
  - The value can be an expression; the variable stores its result.

- Syntax:

```
name = expression;
```

```
int zipcode;
zipcode = 90210;
```




```
double myGPA;
myGPA = 1.0 + 2.25;
```

Declare / initialize

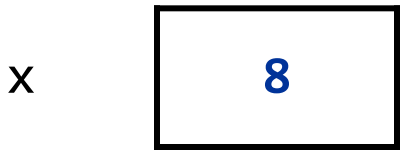
- A variable can be declared/initialized in one statement.
  - This is probably the most commonly used declaration syntax.

- Syntax:

```
type name = expression;
```

```
double tempF = 98.6;
```


```
int x = (11 / 2) + 3;
```



'=' Means Assignment

- Assignment uses = , but it is not an algebraic equation.

  = means, *"store the value at right in the variable at left"*

  - The right side expression is evaluated first,
    and then its result is stored in the variable at left.

- What happens here?

```
int x = 3;
x = x + 2;    // ???
```

Assignment and types

- A variable can only store a value of its own type.

```
int x = 2.5;    // Error: incompatible types
```

- An `int` value can be stored in a `double` variable.
  - The value is converted into the equivalent real number.

```
double myGPA = 4;
```

Compiler Errors

- A variable can't be used until it is assigned a value.

```
int x;
println(x);   // Error: x has no value
```

- You may not declare the same variable twice.

```
int x;
int x;        // ERROR: x already exists

int y = 3;
int y = 5;    // Error: y already exists
```

Using Variables

```
// Asks the user for an integer
// and stores it in the variable 'a'
int a = readInt(message);

// Asks the user for a double and
// stores it in the variable 'b'
double b = readDouble(message);
```

Using Variables

- Use + to print a string and a variable's value on one line.

```
double grade = (95.1 + 71.9 + 82.6) / 3.0;
println("Your grade was " + grade);

int enrolled = 11 + 17 + 4 + 19 + 14;
println("There are " + enrolled + " students.");
```

  - Output:

```
Your grade was 83.2
There are 65 students.
```

Using Variables

- Once given a value, a variable can be used in expressions:

```
int x = 3;
println("x is " + x);      // x is 3
println(5 * x - 1);        // 5 * 3 - 1
```

- You can assign a value more than once:

```
int x = 3;
println(x + " here");      // 3 here

x = 4 + 7;
println("now x is " + x); // now x is 11
```

x

Plan For Today

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Expressions

- You can combine literals or variables together into **expressions** using binary operators:

+	Addition	*	Multiplication
–	Subtraction	/	Division
		%	Remainder

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 alter order of evaluation, but spacing does not:

    `(1 + 3) * 4` is 16

    `1+3 * 4-2` is 11

Integer remainder %

- 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
```

- 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, but `42 % 2` is 0

String concatenation

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

```
"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.

```
println("Average: " + (95.1 + 71.9) / 2);
```

Output: `Average: 83.5`

What does this do?

```
println(1 / 2);
```

What does this do?

```
println(1 / 2);
```

0!

Integer division

- When we divide integers, the quotient is also an integer.

  `14 / 4` is `3`, not `3.5`. *(Java ALWAYS rounds down.)*

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

```
   4
10 ) 45
   40
    5
```

```
    52
27 ) 1425
   135
    75
    54
    21
```

- More examples:
  - `32 / 5` is `6`
  - `84 / 10` is `8`
  - `156 / 100` is `1`

  - Dividing by `0` causes an error when your program runs.

Type Interactions

`int` and `int` results in an `int`

`double` and `double` results in a `double`

`int` and `double` results in a `double`

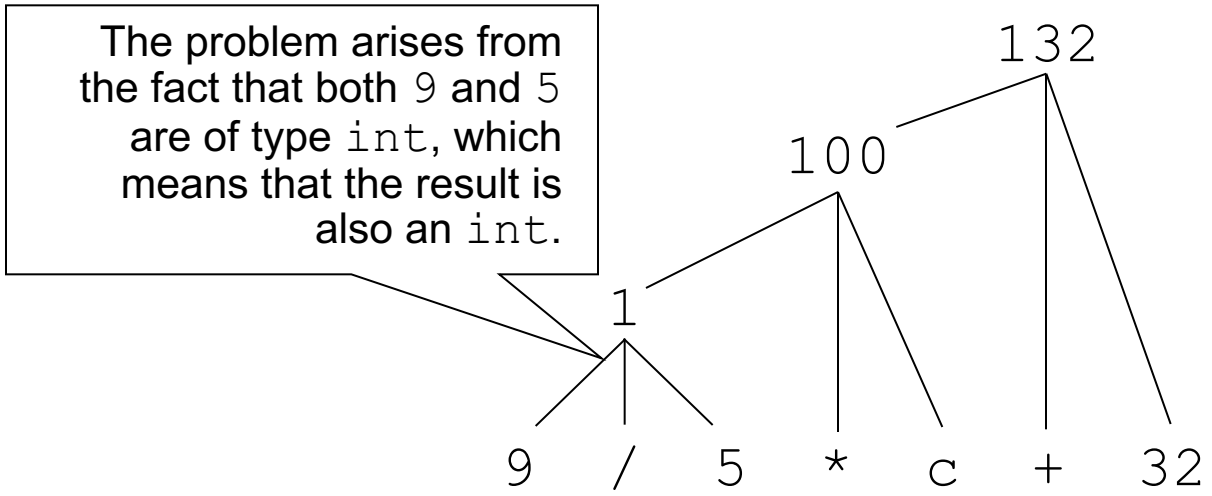
* The general rule is: operations always return the most expressive type

Type Interactions

Convert 100˚ Celsius temperature to its Fahrenheit equivalent:

```
double c = 100;
double f = 9 / 5 * c + 32;
```

The computation consists of evaluating the following expression:

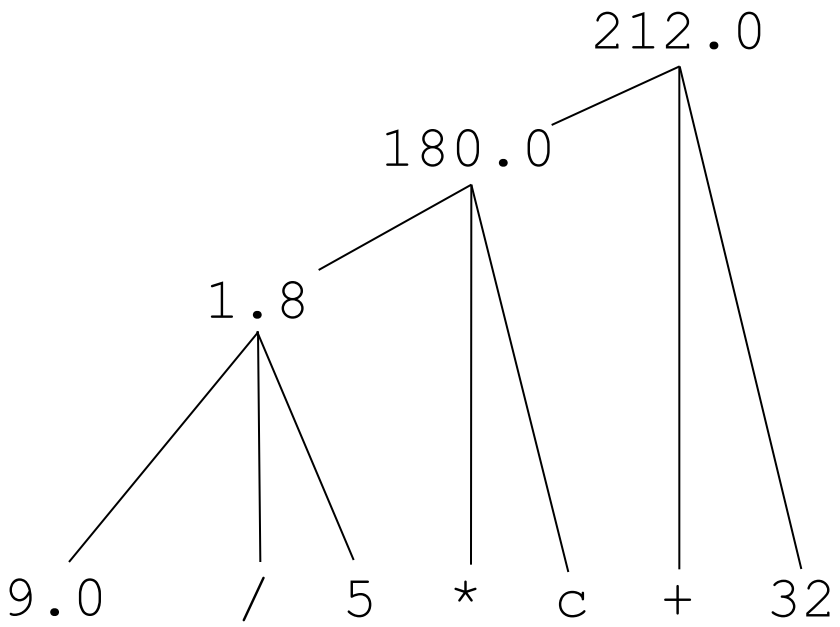


Pitfalls of Integer Division

You can fix this problem by converting the fraction to a `double`:

```
double c = 100;
double f = 9.0 / 5 * c + 32;
```

The computation now looks like this:



Practice

- 5 + 3 / 2 - 4
- 15 / 2.0 + 6
- 1 * 2 + 3 * 5 % 4
- “abc” + 1 + 2
- “abc” + (1 + 2)

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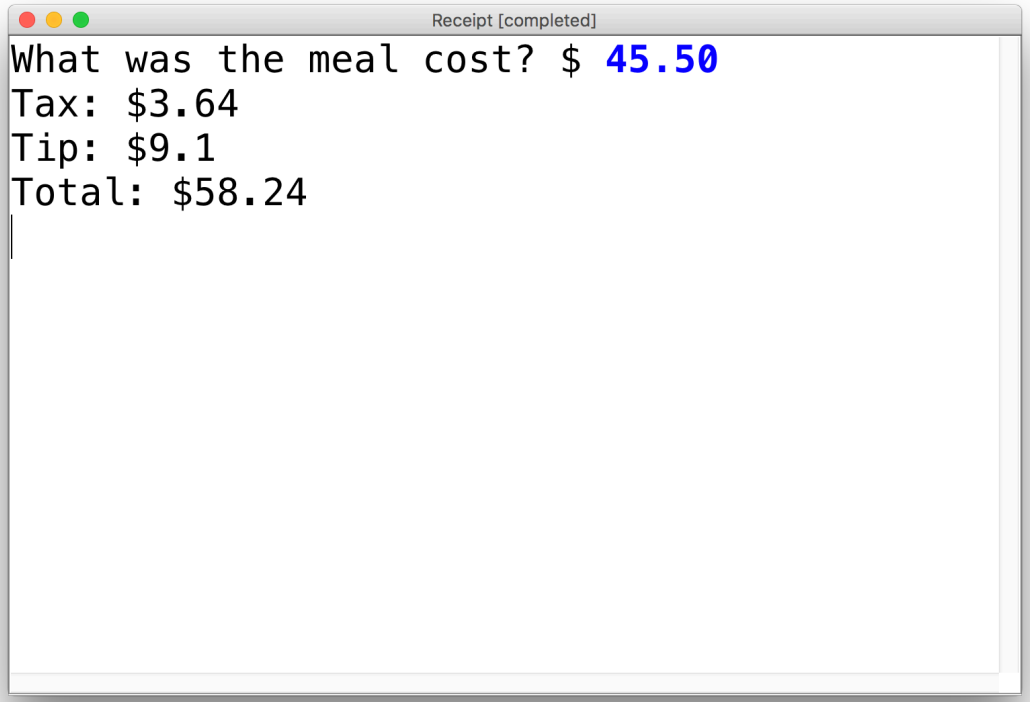
Practice: Receipt Program

- Let's write a ConsoleProgram that calculates the tax, tip and total bill for us at a restaurant.
- The program should ask the user for the subtotal, and then calculate and print out the tax, tip and total.



Practice: Receipt Program

```
public class Receipt extends ConsoleProgram {
  public void run() {
    double subtotal = readDouble(”Meal cost? $”);
    double tax = subtotal * 0.08;
    double tip = subtotal * 0.20;
    double total = subtotal + tax + tip;

    println("Tax : $” + tax);
    println("Tip: $” + tip);
    println(”Total: $" + total);
  }
}
```

Recap

- Announcements
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Next time: Control flow in Java