Hello, world!

```
/* HelloWorld.java
 * Purpose:
 *   The classic "Hello, world!" program.
 *   It prints a message to the screen.
 * Author: Jane Programmer
 *       as derived from Kernighan and Richie
 */
class HelloWorld {
  public static void main (String[] args) {
    System.out.println("Hello, world!");
  }
}
```

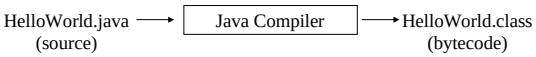
Compiling a program

- Source code - HelloWorld.java
  - viewed with an editor
  - understandable by a human
- Object code - HelloWorld.class
  - for Java, this is machine independent byte code
  - compilers for other languages produce machine code
  - this is also called the binary form or executable

Compiling

- Create HelloWorld.java with an editor
- Execute the command:

```
javac HelloWorld.java
```



Running your Java program

- Once it compiles with no errors, type:

```
java HelloWorld
```

- Notice it is not `HelloWorld.class`.
- The name here must be the name found after the keyword `class` in your programs source file. In general it should be the same as the name of the file, minus the extension.

Keywords vs Identifiers

- Keywords cannot be used for any other purpose. Examples include: class, int, public, static, void
- Identifiers are the names for things that you get to make up. They must start with a letter and then may include digits. $ and _ (underscore) can be used but should be avoided.

Literals

These are strings of symbols that represent "literal" data values.

`123` is an integer literal

`1.23` is a floating point literal

`"123"` is a String literal as is `"class"`

but `class` is a keyword and `Class` is an identifier

Operators and punctuation

- Operators are symbols like: +, -, / (division), and * (multiply)
- Punctuation includes symbols like: (,), {, }, and ; (semicolon)

Data types and variables

- Data types - simple to complex
  - int - for integers or whole numbers
  - double - for numbers with fractional parts
  - String - for text
  - Button - a button on a GUI
  - Point - for representing points in a plane
- Variables store data in named locations
  - every variable must have a declared type

Primitive types vs Classes

- Java has eight primitive types: `byte`, `short`, `int`, `long`, `float`, `double`, `char`, `boolean`
- Primitive types have literal values and can be manipulated with built-in operators. E.g.

```
2 + 3
```

- Class type values are created with the operator new.

```
new Button("Quit")
```

Declaring Variables

```
int count, total;
String sentence;
boolean done;
Button clickToExit;
```

Initializing Variables

```
int count = 10, total = 0;
String sentence = "Hello there.";
boolean done = false;
Button clickToExit =
           new Button("Exit");
```

```
// HelloWorld2.java - variable declarations
class HelloWorld2 {
  public static void main (String[] args) {
    String word1, variable;
    String word2, sentence;

    word1 = "Hello, ";
    word2 = "world!";
    sentence = word1.concat(word2);
    System.out.println(sentence);
  }
}
```

```
// StringVsId.java
// contrast strings and identifiers
class StringVsId {
  public static void main(String[] args) {
    String hello = "Hello, world!";
    String stringVary;
    stringVary = hello;
    System.out.println(stringVary);
    stringVary = "hello";
    System.out.println(stringVary);
  }
}
```

User Input

- Dissect SimpleInput.java
  - tio
  - use + to break up long string literals
  - be sure an include a prompt
  - use meaningful variable names
  - * is multiplication

```
// SimpleInput.java-reading numbers from the keyboard
import tio.*;    // use the package tio

class SimpleInput {
  public static void main (String[] args) {
    int width, height, area;

    System.out.println("type two integers for" +
              " the width and height of a box");
    width = Console.in.readInt();
    height = Console.in.readInt();
    area = width * height;
    System.out.print("The area is ");
    System.out.println(area);
  }
}
```

Calling predefined methods

- method - a group of instructions with a name. E.g. main(), println(), readInt().
- Some methods require some data values upon which to operate.
  E.g `System.out.println(width);`
- These data values are called *parameters.*
- Parameters are *passed* to methods.
- Some also return a value.
  E.g. `x = Math.sqrt(y);`

`print()` and `println()`

```
System.out.println("type two integers for" +
         " the width and height.");

System.out.print("type two integers for the");
System.out.println(" width and height.");
```

Illegal

```
System.out.println("type two integers for
  the width and height.");
```

Inserting newlines in a string

```
System.out.println("One\nword\nper\line.");
```

Output

```
One
word
per
line.
```

Numeric Types

- byte - 8 bits
- short - 16 bits
- char - 16 bits (no sign)
- int - 32 bits - +/-2 billion
- long - 64 bits - 19 decimal digits
- float - 32 bits - $+/-10^{-45}$ to $+/-10^{+38}$ - 7 digits
- double - 64 bits - $+/-10^{-324}$ to $+/-10^{+308}$ - 15 digits

Numbers vs Strings

- The bit pattern in the computers memory is different for `"1234"` and `1234`.
- The computer needs to know how to interpret the bits, hence the type for variables.
- This is just like needing to know what language is being used. Does “pie” mean something good to eat (English), or foot (Spanish)?

Integer arithmetic

- Dissect MakeChange.java
  - variable declaration
  - user input
  - simple expression
  - integer division
  - remainder or modulo

```
// MakeChange.java - change in dimes and pennies
import tio.*;     // use the package tio

class MakeChange {
  public static void main (String[] args) {
    int price, change, dimes, pennies;

    System.out.println("type price (0:100):");
    price = Console.in.readInt();
    change = 100 - price;        //how much change
    dimes = change / 10;         //number of dimes
    pennies = change % 10;       //number of pennies
    System.out.print("The change is : ");
    System.out.println(dimes + " dimes " +
                       pennies + " pennies");
  }
}
```

Precedence and associativity

- * and / have higher precedence than + and -
  - What is the value of 7 + 5 * 3?
- For equal precedence operators, most are left associative.
  - What is the value of 100 / 5 * 2?
- Use parentheses can be used to override the normal rules. E.g. 100 / (5 * 2)