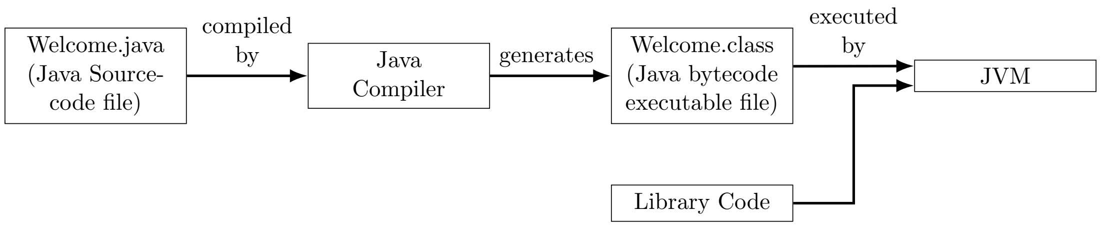
# 1 Introduction to Java

- What is Java?
  - An object-oriented language invented by James Gosling in 1994 at Sun Microsystems
  - Write once, run anywhere (WORA)
  - Widely-used in industry
  - Used to develop software running on:
    - Desktop Computers
    - Servers
    - Mobile devices
- Java Programs
  1. Writing the source code using a text editor
  2. Translating the source code into Java bytecode using a compiler
     - Bytecode is similar to machine instructions but is architecture neutral and can run on any platform that has a Java Virtual Machine (JVM)
  3. Executing the bytecode
     - The JVM is an interpreter: it translates bytecode into the target machine language code one at a time rather than the whole program as a single unit
     - Each step is executed immediately after it is translated


Welcome.java (Java Source-code file)
compiled by
Java Compiler
generates
Welcome.class (Java bytecode executable file)
executed by
JVM
Library Code

- Integrated Development Environment
  - A system comprising several tools that facilitate software development and testing
  - Popular IDEs:
    - Eclipse
    - NetBeans
    - IntelliJ
- Data Types
  - Eight primitive types
    - byte, char, short, int, long, float, double, boolean
  - Objects
    - Defined using **classes**
    - Java provides wrapper classes to use primitive types as objects (e.g. Integer, Double, etc)
- Numeric Primitive Types

| *Name* | *Range* | *Storage Size* |
|---|---|---|
| **byte** | $-2^7$ to $2^7-1$ $(-128$ to $127)$ | 8-bit signed |
| **short** | $-2^{15}$ to $2^{15}-1$ $(-32768$ to $32767)$ | 16-bit signed |
| **int** | $-2^{31}$ to $2^{31}-1$ $(-2147483648$ to $2147483647)$ | 32-bit signed |
| **long** | $-2^{63}$ to $2^{63}-1$ (i.e., $-9223372036854775808$ to $9223372036854775807$) | 64-bit signed |
| **float** | Negative range: $-3.4028235\text{E}+38$ to $-1.4\text{E}-45$ <br> Positive range: $1.4\text{E}-45$ to $3.4028235\text{E}+38$ | 32-bit IEEE 754 |
| **double** | Negative range: $-1.7976931348623137\text{E}+38$ to $-4.9\text{E}-324$ <br> Positive range: $4.9\text{E}-324$ to $1.7976931348623137\text{E}+38$ | 64-bit IEEE 754 |

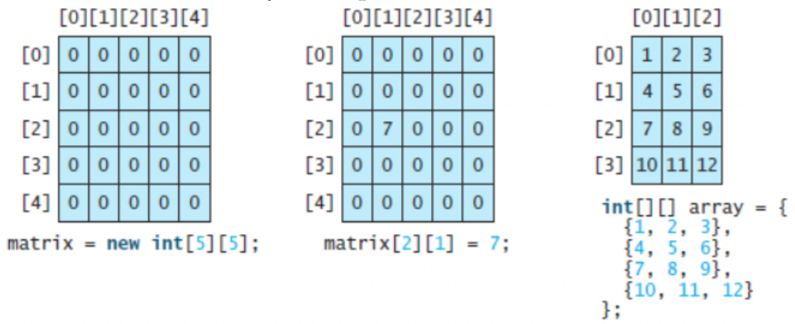
- Classes
  - A typical Java class includes the following:
    - Data fields to represent the state of an object
    - Methods to represent the behavior of an object. Each method has:
      - A return type (**void** if nothing is returned)
      - Zero or more arguments
    - Special type of methods, known as constructors, that perform initialization actions. A constructor:
      - Has no return type (not even **void**)
      - Has zero or more arguments
      - Should have the same name as the class
      - Is invoked using the **new** operator
  - Instantiation is creating an object (or an instance of a class)
- The *main* method
  - The main method is the entry point where the program begins execution
  - Should have the following form:

```
public static void main(String [] args) {
        //write your code here
}
```

- Default values
  - The default value of a data field is:
    - ***null*** for a reference type
    - **0** for a numeric type
    - **false** for a boolean type
    - **'\u0000'** for a char type
  - Java assigns no default value to a local variable inside a method
- Scope
  - The scope of fields and methods is the entire class
  - The scope of a local variable starts from its declaration until the end of the block that contains it
- Differences between Variables of Primitive Types and Reference Types
  - Every variable represents a memory location that holds a value
  - For a variable of a primitive type, the value is of the primitive type
  - For a variable of a reference type, the value is a reference to where an object is located (i.e. a pointer)
  - When you assign one variable to another:
    - For a variable of a primitive type, the real value of one variable is assigned to the other variable
    - For a variable of a reference type, the reference of one variable is assigned to the other variable.
- The *this* reference
  - The **this** *keyword* is the name of a reference that an object can use to refer to itself
  - It can be used to reference the object's instance members
- The *static* modifier
  - Static fields/methods can be accessed from a reference variable or from their class name
  - Non-static (or instance) fields/methods can only be accessed from a reference variable
- Arrays

- An array is a data structure that represents a collection of the same types of data
- Once an array is created, its size is fixed
  - e.g. **int [] A = new int[10];**
- The size of an array A can be found using **A.length**
- When an array is created, its elements are assigned the default value
- Array elements could be initialized individually
  - e.g. **A[0] = 5;**
- Array initializer (combines declaration, creation, and initialization)
  - e.g. **double[] myList = 1.9, 2.9, 3.4, 3.5;**

- Two-dimensional Arrays
  - The syntax for declaring a two-dimensional array is:
    - **elementType [][] arrayRefVar;** (e.g. **int[][] matrix;**)
  - For a two-dimensional array A, **A.length** returns the number of rows
  - Two-dimensional array examples:



```
matrix = new int[5][5];
```

```
matrix[2][1] = 7;
```

```
int[][] array = {
  {1, 2, 3},
  {4, 5, 6},
  {7, 8, 9},
  {10, 11, 12}
};
```

| | [0] | [1] | [2] | [3] | [4] |
|---|---|---|---|---|---|
| [0] | 0 | 0 | 0 | 0 | 0 |
| [1] | 0 | 0 | 0 | 0 | 0 |
| [2] | 0 | 0 | 0 | 0 | 0 |
| [3] | 0 | 0 | 0 | 0 | 0 |
| [4] | 0 | 0 | 0 | 0 | 0 |

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matrix = new int[5][5];
```

| | [0] | [1] | [2] | [3] | [4] |
|---|---|---|---|---|---|
| [0] | 0 | 0 | 0 | 0 | 0 |
| [1] | 0 | 0 | 0 | 0 | 0 |
| [2] | 0 | 7 | 0 | 0 | 0 |
| [3] | 0 | 0 | 0 | 0 | 0 |
| [4] | 0 | 0 | 0 | 0 | 0 |

```
matrix[2][1] = 7;
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| | [0] | [1] | [2] |
|---|---|---|---|
| [0] | 1 | 2 | 3 |
| [1] | 4 | 5 | 6 |
| [2] | 7 | 8 | 9 |
| [3] | 10 | 11 | 12 |

```
int array = {
```