



OLLSCOIL NA GAILLIMHE  
UNIVERSITY OF GALWAY

# CT2106

## Object Oriented Programming



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# Overview

## How Java Works?

Different types of languages

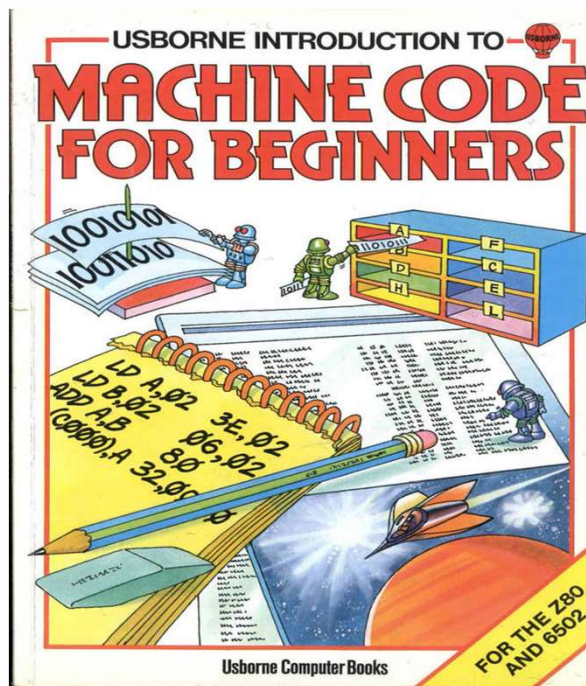
Compilation

Interpretation



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# Machine Code



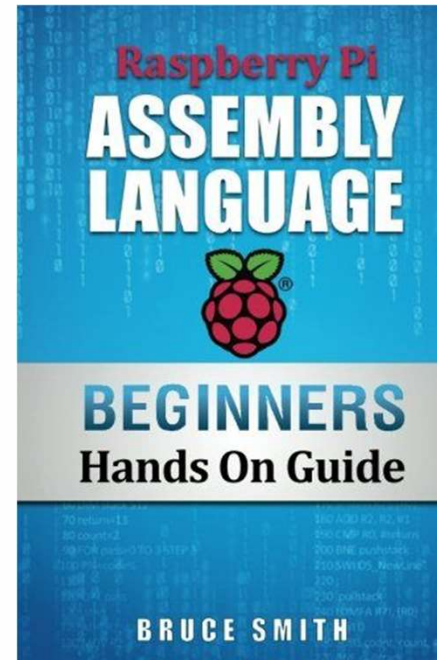
```
ba 0c 01
b4 09
cd 21
b8 00 4c
cd 21
48 65 6c 6c 6f 2c
20 57 6f 72 6c 64
21 0d 0a 24
```



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# Assembly

```
mov dx, 010ch
mov ah, 09
int 21h
mov ax, 4c00h
int 21h
db 'Hello, World!', '$'
```



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## Java

```
public class Greeting
{
    public Greeting()
    {
        System.out.println("Hello World");
    }

    public static void main(String[] args)
    {
        new Greeting();
    }
}
```

## Assembly

```
mov dx, 010ch
mov ah, 09
int 21h
mov ax, 4c00h
int 21h
db 'Hello, World!', '$'
```

## C

```
1 #include <stdio.h>
2
3 int main() {
4     /* my first program in C */
5
6     char hello[] = "Hello, World! \n";
7
8     printf(hello);
9
10    return 0;
11 }
```

## Machine Code

```
ba 0c 01
b4 09
cd 21
b8 00 4c
cd 21
48 65 6c 6c 6f 2c
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21 0d 0a 24
```



# High-level vs Low-level

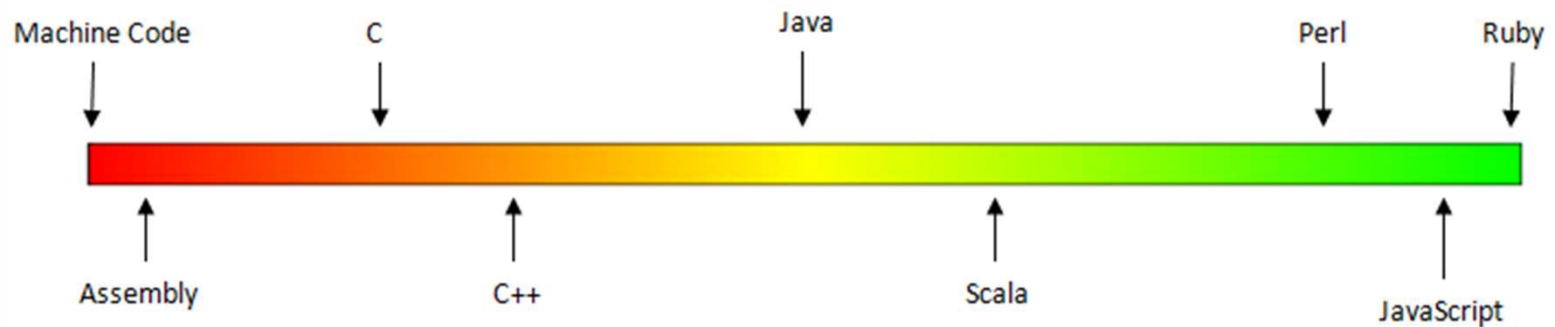
- Both Java and C are **high-level languages** and assembly is a **low-level language**
- What does that mean?



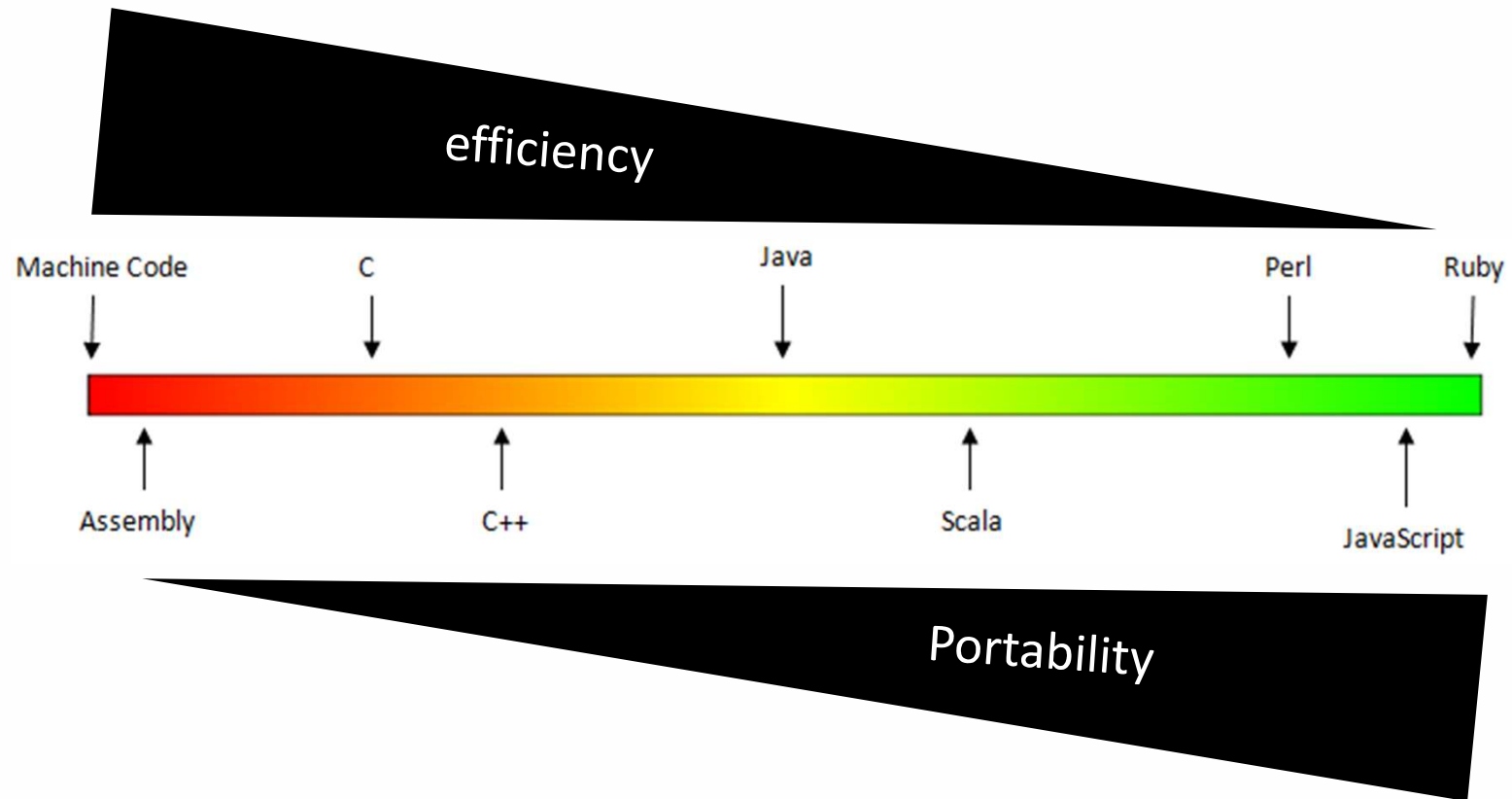
# High Level Language

'High level' is a *relative* term - the level of abstraction above a **low level language**

A **low level language** has little or no abstraction over the machine code of a particular processor.

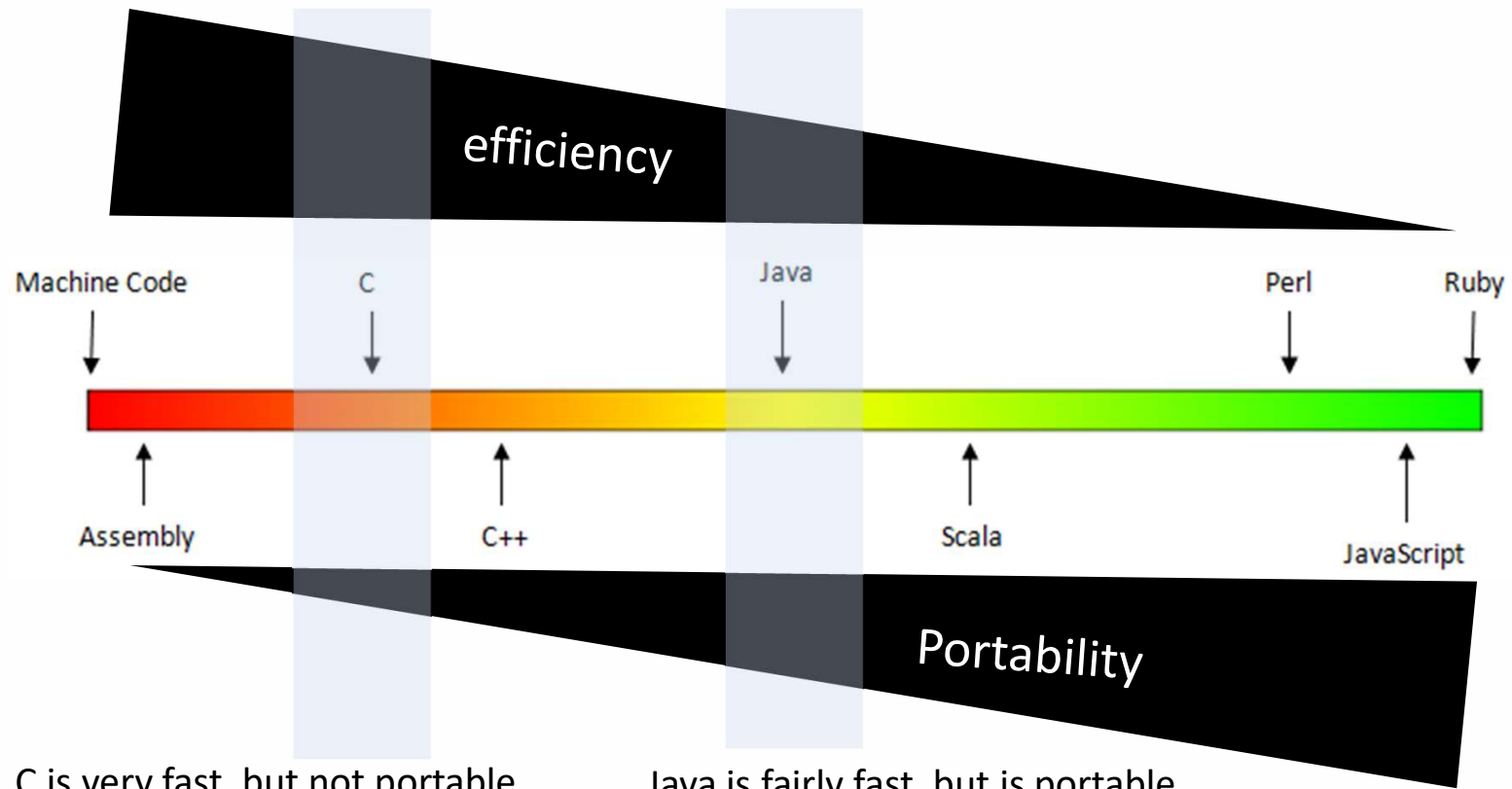


# High-level vs Low-level Language





# High Level vs Low level Language



C is very fast, but not portable

Java is fairly fast, but is portable



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# High Level Programming Languages

- Easier to program in a high- level language
- Syntax can be understood by people
- Program takes less time to write, shorter and easier to read, more likely to be correct.
- Portable – they can be run on different kinds of computers



# Translating your code so that it runs

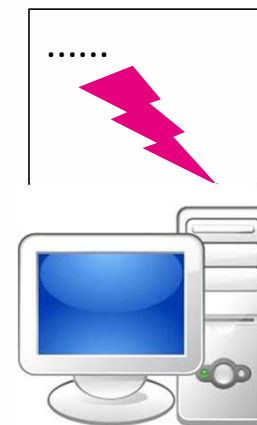
- Unless you are writing machine code (!) – your code has to be translated into machine code to run on your computer

Code

```
1 #include <stdio.h>
2
3 int main() {
4     /* my first program in C */
5
6     char hello[] = "Hello, World! \n";
7
8     printf(hello);
9
10    return 0;
11 }
```

Translation

Machine code



# Two Types of Translation

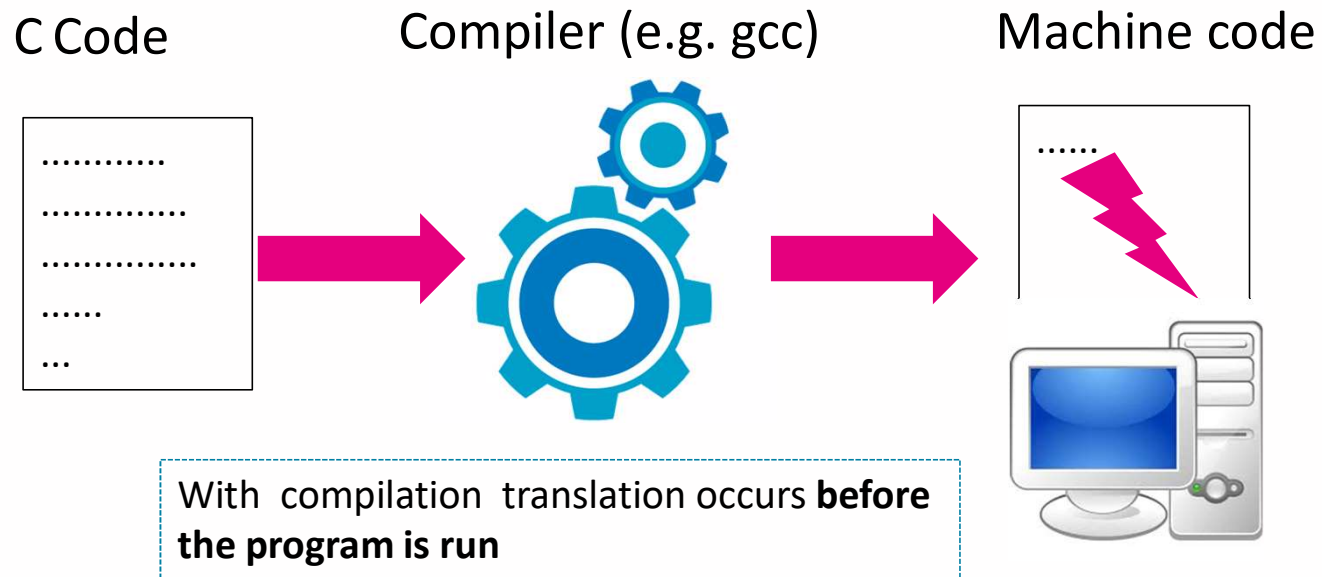
Compilation

Interpretation



# C is a compiled language

- A compiler is a program that takes human readable source code and translates it **in one go** into machine code using a Compiler



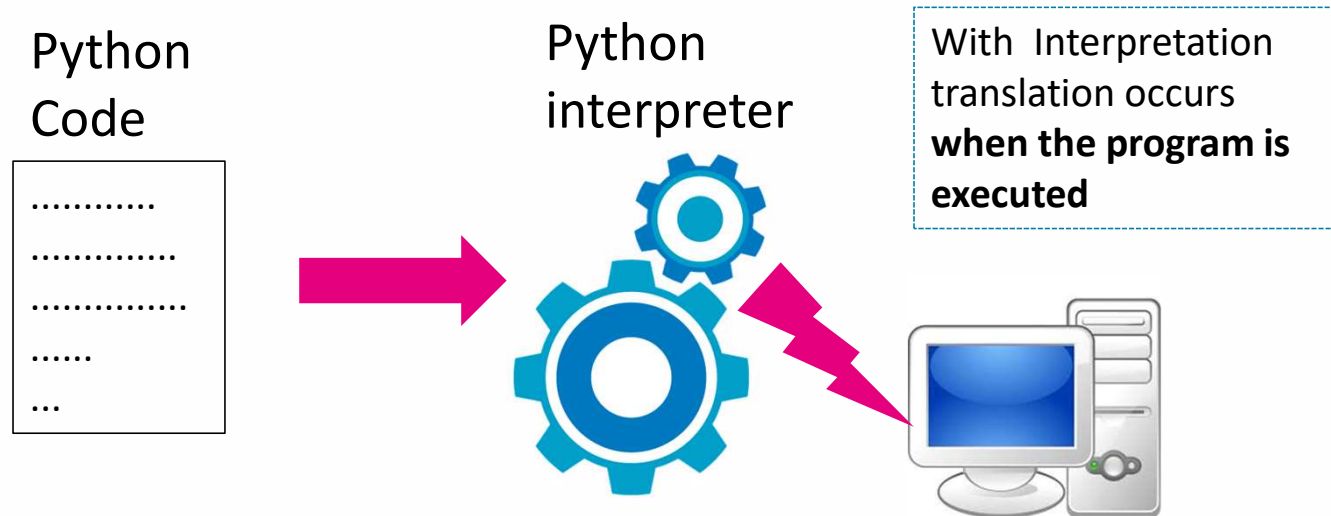
# Compilation

- A compiler translates source code **in one go** into machine code for a particular machine
- However, **the machine code generated is not portable**
- You have to compile the code again if you want it to run on a different type of machine.
- However, the generated code typically executes very efficiently



# Interpretation

- The second type of translation approach
- Code is **translated on-the-fly at runtime** into commands that can be executed on the machine.



# Compilation vs Interpretation

## Compilation

- A compiler translates source code **in one go** into machine code before the programme is run
- Typically, translating to native machine code means **very efficient run-time speed**
- For big projects, compile time can be slow

## Interpretation

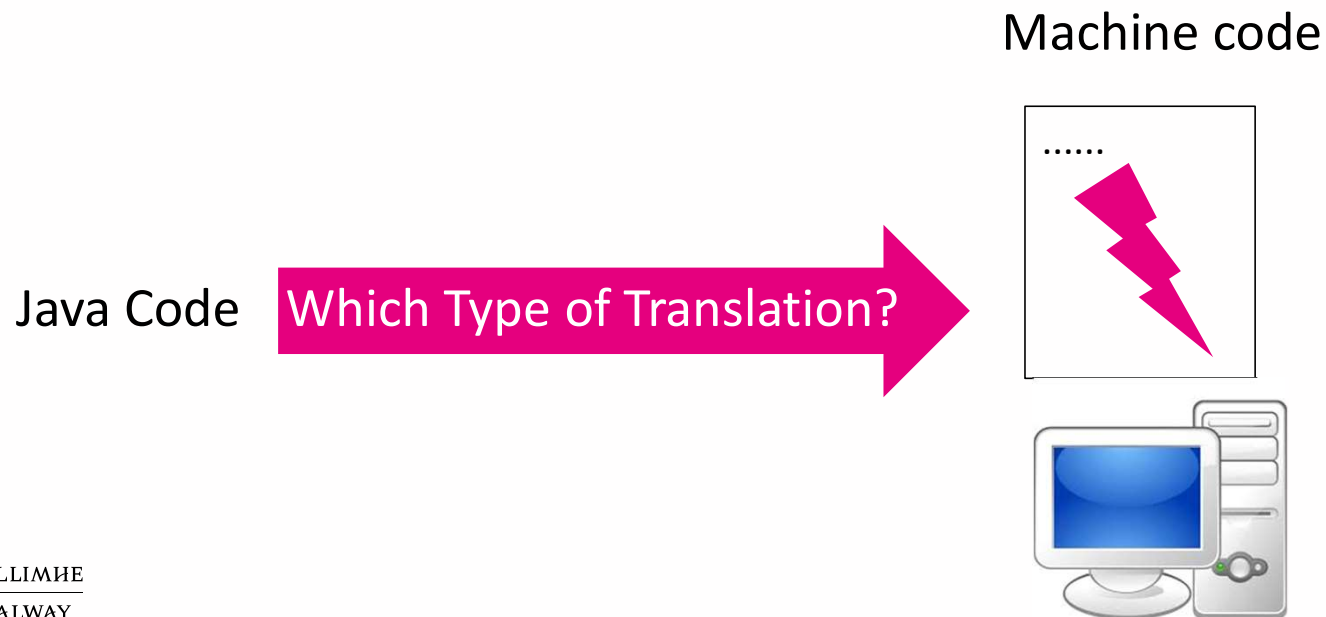
- Code read and executed by another program (the interpreter) when the program is run
- This makes the code **portable** (as long as there is an interpreter)
- Typically, slower to run as each statement has to be interpreted into machine code **on-the-fly**
- Greater chance of run-time errors





# Translating Java Code

It is important to understand how and why Java does this differently



## Java's Design Goals include:

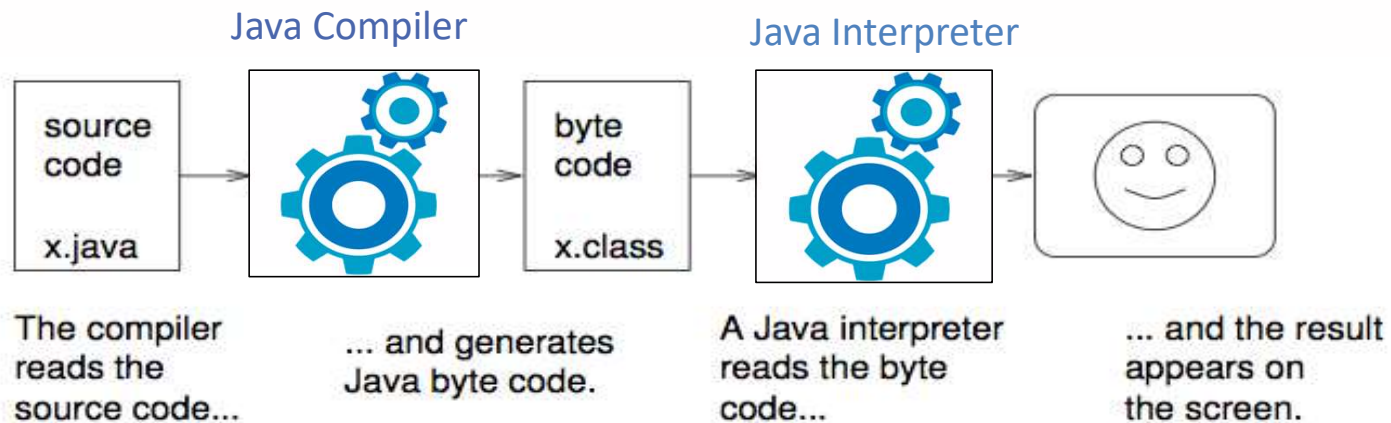
- **Portability** (typically interpreted languages)
- **High Performance** (typically compiled languages)
- How does Java achieve both?



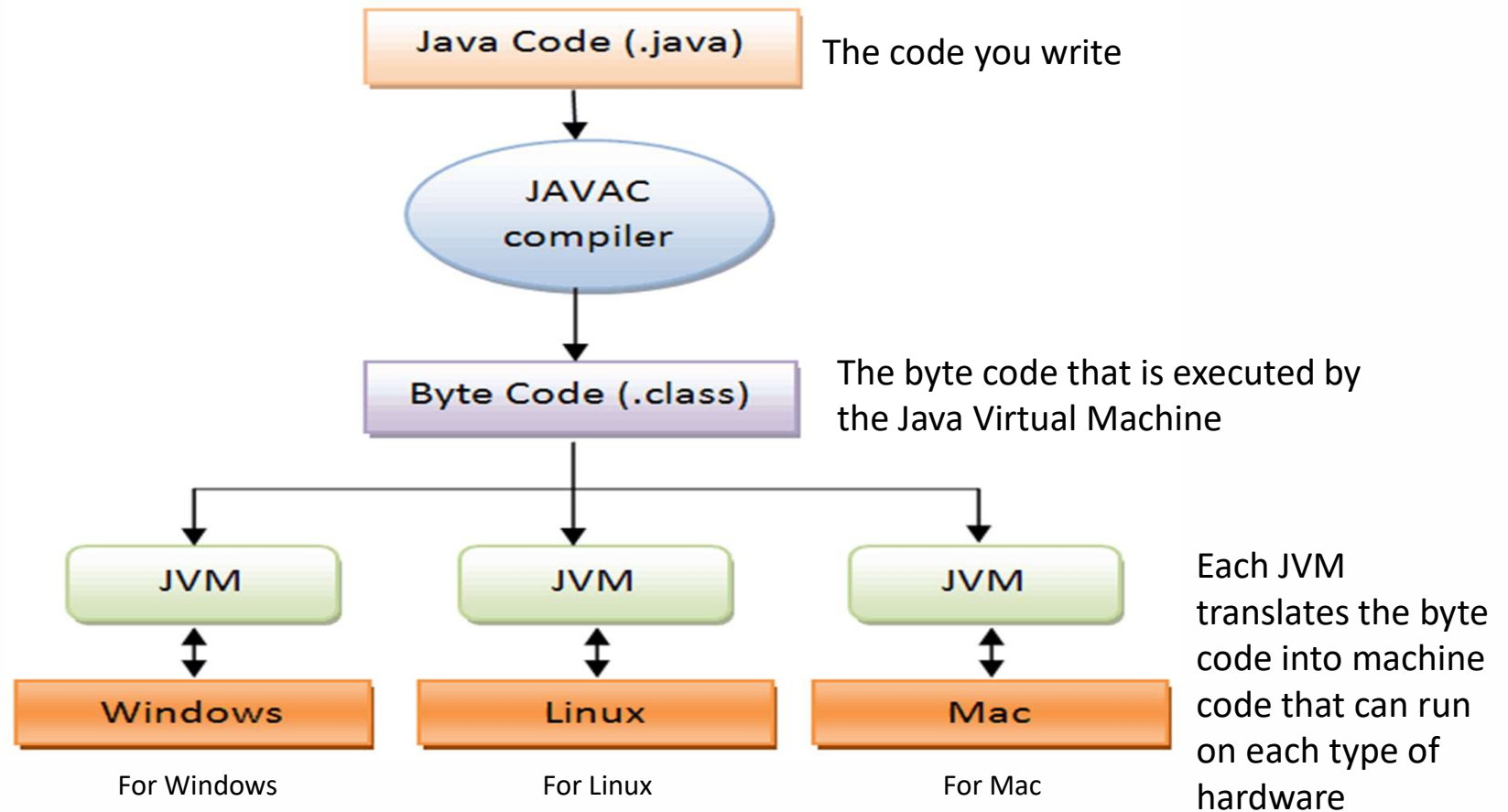
# Java Translation

Java is typically both *compiled* and *interpreted*.

1. Java is **compiled** to *Byte Code* – *an intermediate language* which is portable
2. Then a Java **interpreter** reads and executes the Byte Code



# Java Architecture



# Java Virtual Machine (JVM)

- JVM is a piece of software not hardware
- A virtual computer on which Java byte code is executed
- Oracle provide a JVM abstract specification and a concrete implementation for each operating system type (e.g. Windows, OSX, Linux)
- There are multiple other specialised JVMs that all run
- See: [https://en.wikipedia.org/wiki/List\\_of\\_Java\\_virtual\\_machines#ActiveJava](https://en.wikipedia.org/wiki/List_of_Java_virtual_machines#ActiveJava)



# Java Runtime Environment (JRE)

- JRE contains the JVM and all libraries required to run the Java Program



# What happens when you compile code?

- Open BlueJ
- Compile an existing or new project
- Go to your Project Folder
- You will see 5 **files**

Name	Date modified	Type	Size
GreetingAll.class	19/09/2018 11:45	CLASS File	1 KB
GreetingAll.ctxt	19/09/2018 11:45	CTXT File	1 KB
GreetingAll.java	13/09/2018 09:50	Java Source File	1 KB
package.bluej	19/09/2018 11:45	BlueJ Project File	1 KB
README.TXT	10/09/2018 17:04	Text Document	1 KB



# Summary of How Java Works

- Java is a high-level language.
- Its source code is compiled to intermediate level bytecode
- Bytecode is executed on the Java Virtual Machine





# Learning exercise

In Blue J:

Create a Bicycle class and a Car class

Each Bicycle object should its own speed and gear (.e.g. 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> etc) state

What type of variable in Java could be used to represent speed and gear (look it up on the Web)?

Create **setSpeed** and **setGear** method that can set the speed /gear state of a bicycle and a car object **and print out the current speed of each**

Then Create 3 Bicycle and 3 Car objects

Using the methods above set and print different speed and gear values for each

