Introduction to Programming

Java – Basics

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What is Java?

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Then what it turns out?

Java is a general-purpose, platform-independent, object-oriented programming language

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Influenced by: Ada 83, C++, C#, Eiffel, Generic Java, Mesa, Modula-3, Oberon, Objective-C, UCSD Pascal, Smalltalk, etc.

Why java is called java?

Java means

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Java means coffee!!!

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The limitations of java

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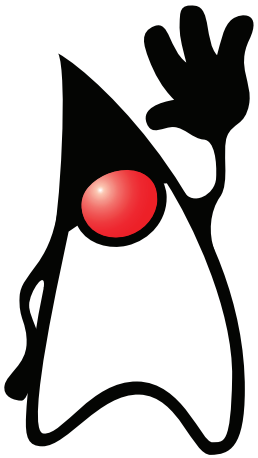
- Does not support operator overloading
- No 'Templates' yet
- No 'Function pointers' or 'blocks'
- Basic classes in class library are lacking important features

Features of java

- General-purpose
- Platform-independent
- Object-oriented
- Robust and secure
- Distributed
- Multithreaded
- Dynamic
- Extensible
- etc.



General-purpose

Simple and diverse applications – works on PCs, Laptops, mobiles, etc.

But NOT iPad/iPhone!!!

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"Java's not worth building in. Nobody uses Java anymore. It's this big heavyweight ball and chain."

– Steve Jobs.

Platform-independent

Source code $\xrightarrow{\textit{compiler}}$ **bytecode** $\xrightarrow{\textit{interpreter}}$ **machine code**

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The size of the primitive data types are machine-independent

Object-oriented

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Objects are the basic runtime entities in an object-oriented system ... objects encapsulate data and method

Other features

- **Robust and secure:** Java has strict compile time and run time checking for data types and it is strongly typed

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- **Distributed:** It has the ability to share both data and programs and access remote objects
- **Multithreaded:** It can handle multiple tasks simultaneously through multiprocess synchronization
- **Dynamic:** It can dynamically link new class libraries
- **Extensible:** It supports functions (known as *native methods*) written in other languages

The java virtual machine (JVM)

Source code → **(Java compiler)** → **Bytecode**
Java program JVM

Bytecode → **(Java interpreter)** → **Machine code**
JVM Real Machine

The first java program

Source: Welcome2Java.java

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class Welcome2Java{
    public static void main(String args[]){
        System.out.print("Welcome2Java");
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Welcome2Java**(cursor here!!!)**

Dissecting the code

```
import java.*;
class C1{
    statement;
    method1(){  statement;  }
}
class C2{
    main(){ }
}
class C3{
    method2(){  statement;  }
}
```

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```

Note: the program name should be **C2.java**.

Specifying main()

`public static void main()` specifies:

- main method should be unprotected i.e. accessible to all other classes (denoted by the access specifier `public`)
- main method belongs to the entire class and not a part of any objects of the class (denoted by the type `static`)
- main method does not return any value (denoted by the return type `void`)

* Remember that a main method is always `static`.

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- main method does not return any value (denoted by the return type `void`)

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Note: The position of `public` and `static` can be interchanged.

Command line arguments

`String args[]` allows the program to take command line arguments. E.g., the execution with

java Welcome2Java First Year MTech CS

assigns the following:

$$\begin{aligned} \text{args}[0] &\leftarrow \text{First} \\ \text{args}[1] &\leftarrow \text{Year} \\ \text{args}[2] &\leftarrow \text{MTech} \\ \text{args}[3] &\leftarrow \text{CS} \\ \text{args}[4] &\leftarrow \text{NULL} \\ &\vdots \end{aligned}$$

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Note: `String args[]` can also be written as `String[] args`.

The comments

Single-line comment:

```
// ...
```

Multi-line comment:

```
/* ...
...
... */
```

Documentation comment:

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/** ... */
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Note: Comments cannot be nested.

Basic characteristics

- A java program (except applets) name should be the class name containing the main method
- There should be at most one class (except for applets having no) that contains the main method
- Every statement must end with a semicolon
- Java is case sensitive

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Note: Applets are obsolete since 2017.

Freeform language

A java statement can be broken into multiple lines. E.g., the statements

```
System.out.print("Welcome2Java");
```

and

```
System.out.print
("Welcome2Java");
```

are both same producing the same output

Strongly typed language

```
char c;
int i;
float f;
```

Here, the data types of c, i, f become fixed. They cannot be used interchangeably.

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However, the following conversions are possible with type casting:

`byte` to `short`, `char`, `int`, `long`, `float`, `double`
`short` to `int`, `long`, `float`, `double`
`char` to `int`, `long`, `float`, `double`
`int` to `long`, `float`, `double`
`long` to `float`, `double`
`float` to `double`

E.g., `int i = 10; float f = (float)i;`

Class

Classes are the building blocks of a java program

A class is like a template that describes the behaviors/states that objects of its type support.

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Defining a class:

```
class Summation{
    int first, second;
    void Receive(int a, int b){
        first = a; second = b;
    }
    int Add(){
        int result = first + second;
        return(result);
    }
}
```

Object

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Creating an object:

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Summation s; // Declaration of object
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Accessing class elements with object:

```
s.first; // Accessing the variable 'first'
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Accessing class elements with object:

```
s.first; // Accessing the variable 'first'
s.Receive(10, 20); // Accessing the method 'Receive()'
```

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Constructor

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class Summation{
    int first, second;
    Summation(int a, int b){          // No return type
        first = a; second = b;
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        return(first + second);
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    }
}
```

Calling a constructor:

```
Summation s = new Summation(6, 28);
```

Immutable classes and objects

Immutable classes are java classes whose objects can not be modified once created, and such objects are known as immutable objects. E.g., `String` is immutable in java.

Any modification in immutable objects results into a new object.

Mostly, the immutable classes are also final in java, in order to prevent subclass from overriding methods in java which can compromise immutability.

Polymorphism

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```
class Summation{
    int first, second;
    void Receive(int a){          // Function overloading
        first = a;
    }
    void Receive(int a, int b){ // Function overloading
        first = a; second = b;
    }
    int Add(){
        int result = first + second;
        return(result);
    }
}
```

Polymorphism

```
class Summation{
    int first;
    double second;
    void Receive(int a){    // Function overloading
        first = a;
    }
    void Receive(double b){ // Function overloading
        second = b;
    }
}
```

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Note: Polymorphism is possible by differentiating the number of arguments or their types but not just by differentiating the return types.

Inheritance

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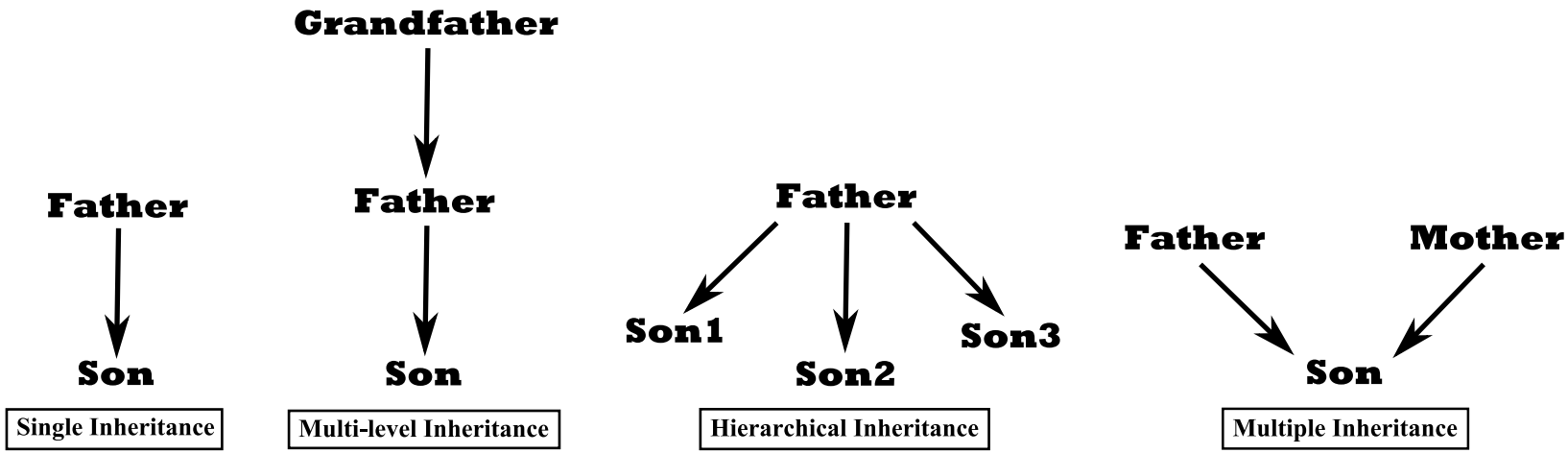

Note: subclass (child class/derived class) inherits the properties of the superclass (parent class/base class).

Inheritance

Single Inheritance:

```
class Father{
...
}
class Son extends Father{ ... }
```

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Multi-level Inheritance:

```
class Grandfather{
...
}
class Father extends Grandfather{ ... }
class Son extends Father{ ... }
```

Inheritance

Hierarchical Inheritance:

```
class Father{
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class Son1 extends Father{ ... }
class Son2 extends Father{ ... }
class Son3 extends Father{ ... }
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Multiple inheritance: Not possible in general, but with interfaces

Inheritance

Priority of a subclass is always more than the superclass. This is reflected through *function overriding*.

```
class Father{
    Show(){ System.out.print(‘‘Flip overrides Flop’’); }
}
class Son extends Father{
    Show(){ System.out.print(‘‘Flop overrides Flip’’); }
}
class FunOver{
    public static void main(String args[]){
        Son s = new Son();
        s.Show();
    }
}
```

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}
```

Output: `Flop overrides Flip`

Inheritance

Super method:

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```
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where `x` and `y` are arguments

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Final class:

It is a special class for which no subclass can be defined is known as a final class and it is declared as

```
final class FClass{ ... }
```

Encapsulation

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An object = data + method