

What is Java? (Popular Perception)

Monday, October 19, 2020 11:36 AM




Popular Perception/Definition

- Java is an object oriented programming language
- Class based OO language
- High level programming language
- Multi-threaded
- Write once - run anywhere
- Cross platform language
- Platform Independent
- Robust and Secured
- Interpreted language
- It is an open source

Is this claim valid?

Contradictions/Challenges

- Does Android Phone support Java?
 - NO
 - A Java class doesn't run on Android Phones out of box
 - Although majority android application is written using java language.
- Does iOS support Java?
 - NO
- Have you heard the term — "This computer doesn't have Java?"
 - We havent installed Java.
 - What have we not installed — Java Programming lanuage?
 - Do everyone needs to program in Java?
- When you try to download "java", what are your actually downloading?

| Windows - Which should I choose? | | |
|--|--|------------------------------|
|  | Windows Online filesize: 1.99 MB | Instructions |
|  | Windows Offline filesize: 69.61 MB | Instructions |
|  | Windows Offline (64-bit) filesize: 79.19 MB | Instructions |
| If you use 32-bit and 64-bit browsers interchangeably, you will need to install both 32-bit and 64-bit Java in order to have the Java plug-in for both browsers. » FAQ about 64-bit Java for Windows | | |

- Why request for a Java download ended up downloading JRE?
- Is JRE and object oriented programming language?
- Is JRE platform independent
- Can you write an object oriented programming language using JRE?

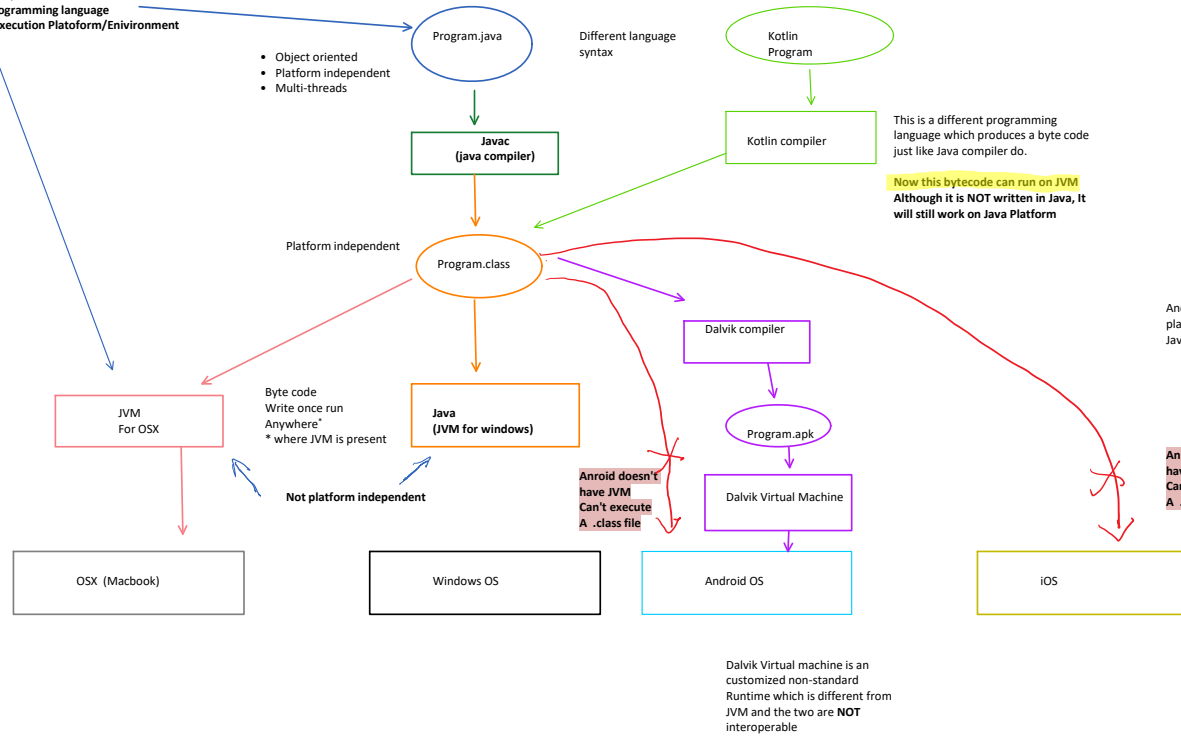


How many Java are there?

Monday, October 19, 2020 12:08 PM

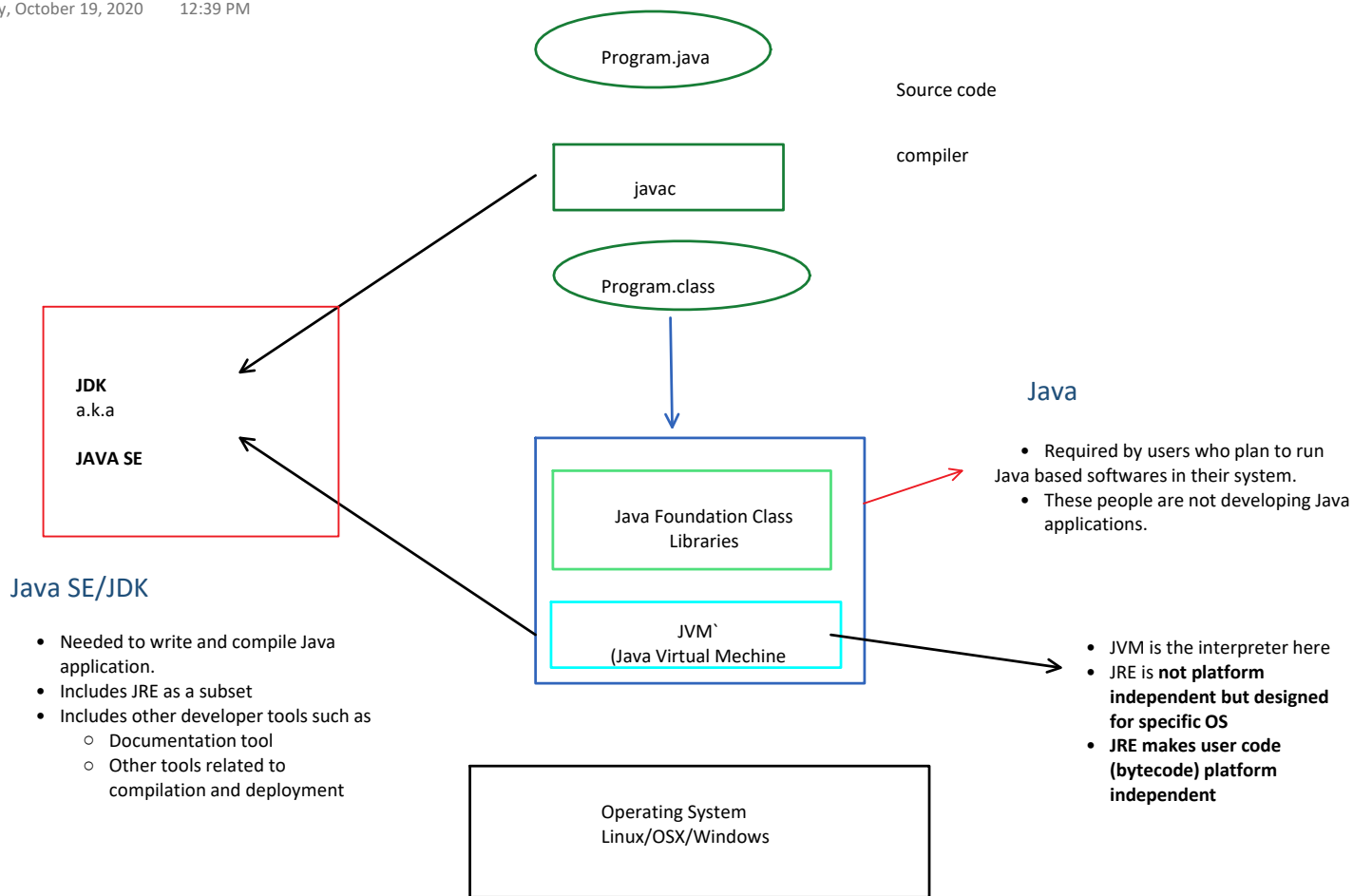
In the world of computation Java refers to two related but **distinct terms**

1. **Java is a Programming language**
2. **Java is an execution Platform/Environment**



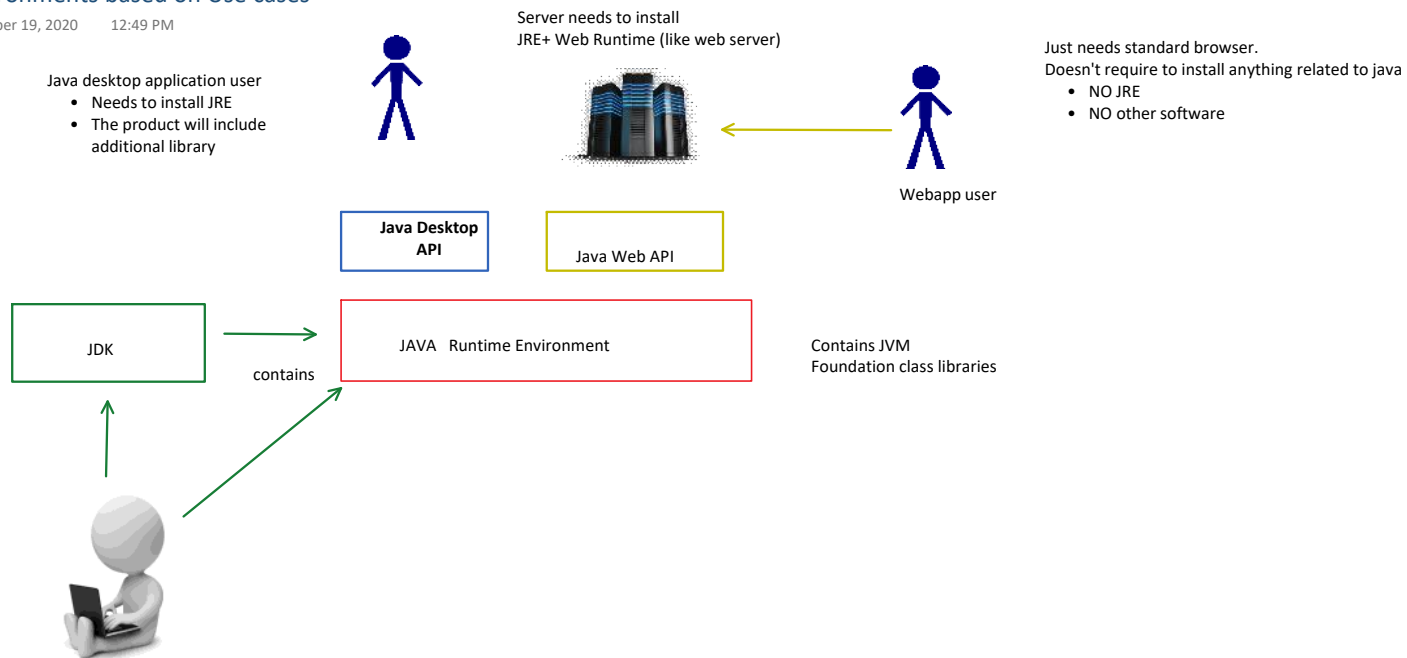
Java Framework

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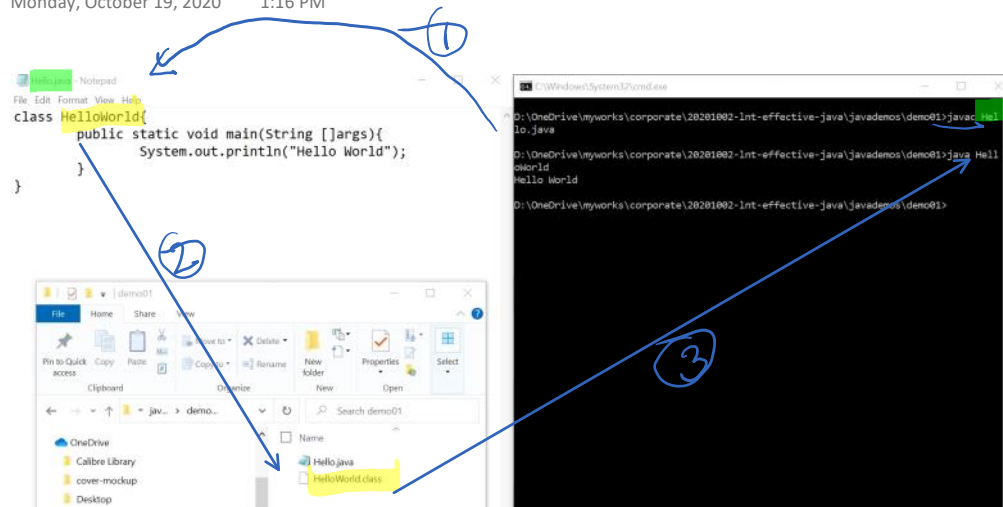
Java Environments based on Use cases

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Compiling and Running Java code

Monday, October 19, 2020 1:16 PM

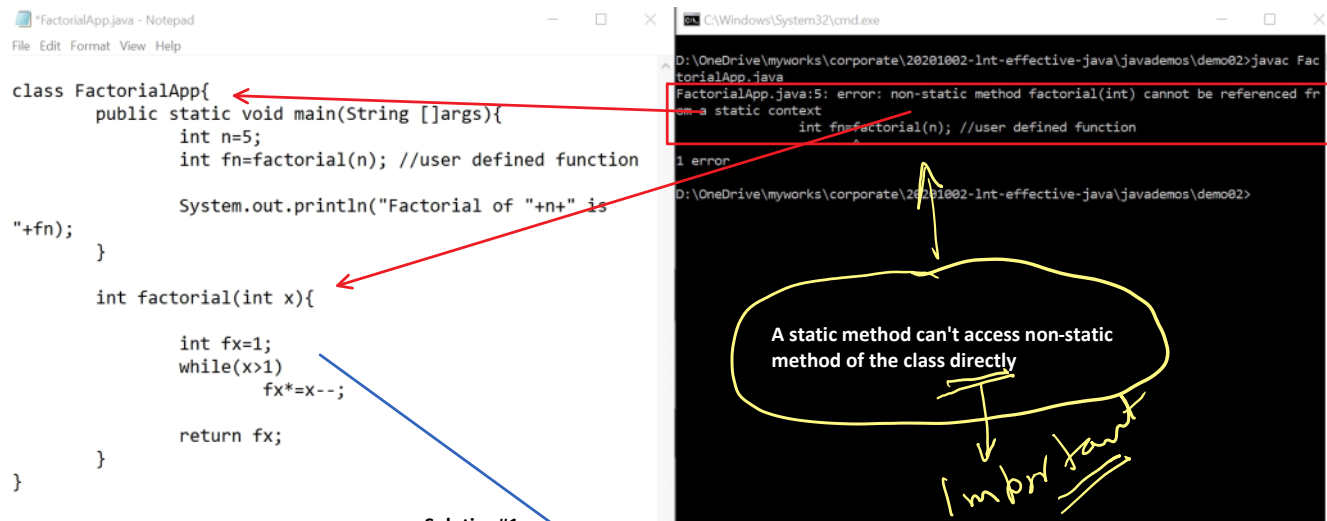


1. You compile a source file
1. The byte code name is same as that of Class present in source code and not same as the .java file name
2. You run the byte code using java command

c:> java HelloWorld

Static context

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Solution

- There are multiple way to solve this problem
- We will choose different solutions depending on the context

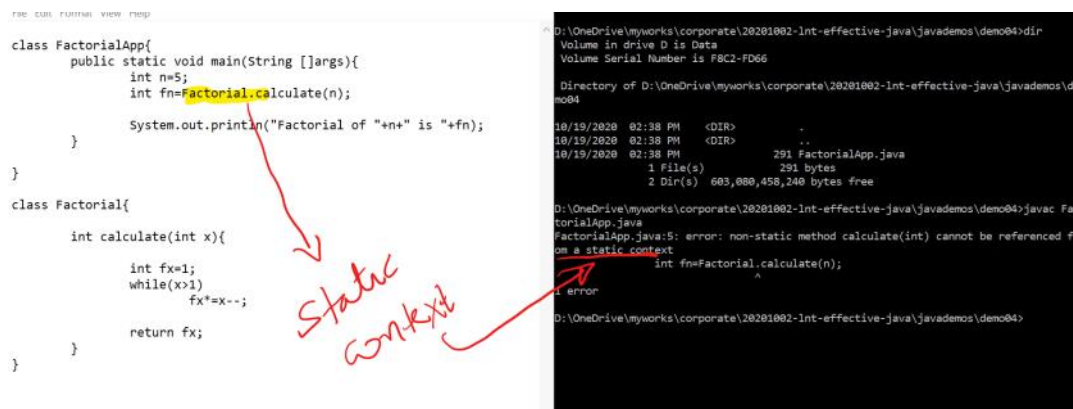
Solution 1

- Make factorial function static

```
static int factorial(int x){
    int fx=1;
    while(x>1)
        fx*=x--;

    return fx;
}
```

More on static context



A Class name is a static context.
You can call only static methods using Class reference and not non-static methods

Working with a non-static context

To work with a non-static method, we need an object of the class to

Working with a non-static context

To work with a non-static method, we need an object of the class to refer and use the method.

The image shows a Java IDE with two windows. The left window displays the source code for `FactorialApp.java` and `Factorial.java`. The right window shows the command prompt output of running the program.

FactorialApp.java:

```
class FactorialApp{
    public static void main(String []args){
        int n=5;

        //step#1: get object of the class
        Factorial fact=new Factorial();

        //step#2: call method using the object
        int fn=fact.calculate(n);

        System.out.println("Factorial of "+n+" is "+fn);
    }
}
```

Factorial.java:

```
class Factorial{
    int calculate(int x){
        int fx=1;
        while(x>1)
            fx*=x--;
        return fx;
    }
}
```

Handwritten Annotations:

- An orange box highlights the object creation and method call steps in `FactorialApp.java`.
- An orange arrow points from the `Factorial` class to the `fact` object creation.
- Handwritten text "Non Static" with an arrow pointing to the `calculate` method in `Factorial.java`.
- Handwritten text "Instance of class Method" with an arrow pointing to the `calculate` method in `Factorial.java`.

Terminal Output:

```
D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04>dir
Volume in drive D is Data
Volume Serial Number is F8C2-FD66

Directory of D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04

10/19/2020  02:38 PM  <DIR>          .
10/19/2020  02:38 PM  <DIR>          ..
10/19/2020  02:44 PM                370 FactorialApp.java
               1 File(s)                370 bytes
               2 Dir(s)  603,080,458,240 bytes free

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04>javac FactorialApp.java

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04>java FactorialApp
Factorial of 5 is 120

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04>dir
Volume in drive D is Data
Volume Serial Number is F8C2-FD66

Directory of D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04

10/19/2020  02:45 PM  <DIR>          .
10/19/2020  02:45 PM  <DIR>          ..
10/19/2020  02:45 PM                312 Factorial.class
10/19/2020  02:45 PM                943 FactorialApp.class
10/19/2020  02:45 PM                399 FactorialApp.java
               3 File(s)                1,654 bytes
               2 Dir(s)  603,080,450,048 bytes free

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo04>
```

Multi Class Java Program

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The image shows a Notepad window with a Java program and a Windows Command Prompt window showing its execution. Blue arrows point from the code in the Notepad to the corresponding output in the Command Prompt.

FactorialApp.java - Notepad

```
class FactorialApp{
    public static void main(String []args){
        int n=5;
        int fn=Factorial.calculate(n);

        System.out.println("Factorial of "+n+" is "+fn);
    }
}

class Factorial{
    static int calculate(int x){
        int fx=1;
        while(x>1)
            fx*=x--;

        return fx;
    }
}
```

When compiled a separate .class is generated for every class that exists in our system

Command Prompt Output:

```
D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03>dir
Volume in drive D is Data
Volume Serial Number is F8C2-FD66

Directory of D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03

10/19/2020  02:34 PM  <DIR>          .
10/19/2020  02:34 PM  <DIR>          ..
10/19/2020  02:34 PM                291 FactorialApp.java
               1 File(s)                291 bytes
               2 Dir(s)  603,080,462,336 bytes free

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03>javac FactorialApp.java

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03>java FactorialApp
Factorial of 5 is 120

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03>dir
Volume in drive D is Data
Volume Serial Number is F8C2-FD66

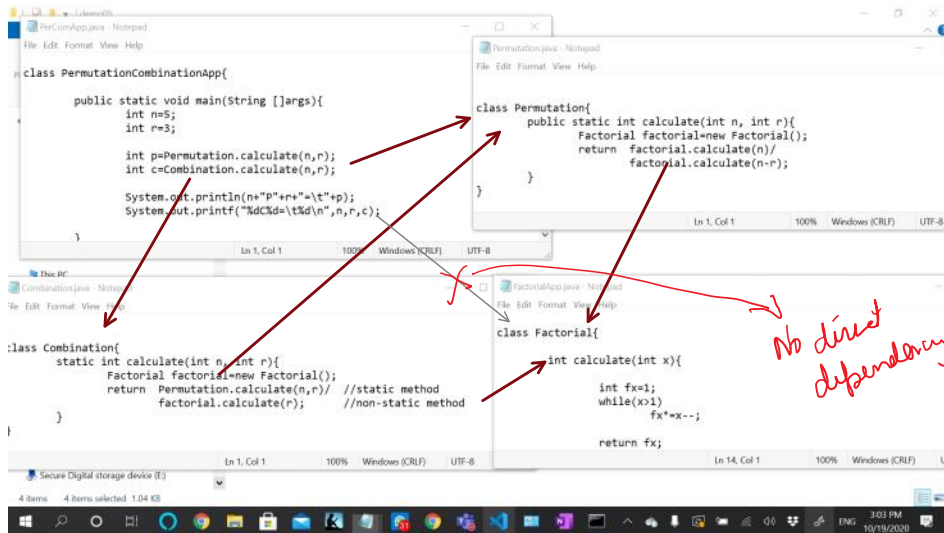
Directory of D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03

10/19/2020  02:35 PM  <DIR>          .
10/19/2020  02:35 PM  <DIR>          ..
10/19/2020  02:35 PM                312 Factorial.class
10/19/2020  02:35 PM                925 FactorialApp.class
10/19/2020  02:34 PM                291 FactorialApp.java
               3 File(s)                1,528 bytes
               2 Dir(s)  603,080,458,240 bytes free

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03>
```


Class Dependencies

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- Unlike c/c++ (or even javascript or python) You don't need any kind of include of classes before you can use.
- An .class present in the current folder can be accessed directly.

How to compile a project with multiple files

Method #1 compile all files using * wildcard

```
c:> javac *.java
```

Method #2 compile the startup file — the one that contains main()

The steps would be as follows

1. It will try to compile PerComApp.java to create class PermutationCombinationApp.class.
 - While compiling it needs to use Permutation class
2. Javac searches for a file Permutation.class
 - It is not currently present
3. Javac searches for file Permutation.java.
 - It compiles Permutation.java to create Permutation.class
4. While compiling Permutation.class, it realizes it Needs Factorial.class
 - There is no Factorial.class present
5. Since there is not Factorial.class Present, it searches for Factorial.java
 - Factorial.java is also not present
 - Factorial class is a part of FactorialApp.java file. **It is not housed in a file name of its own**
 - **At this stage it returns an error message**

if I have both Combination.class and Combination.java present, which of them will be used by javac?

- If both files are present, then javac would compare their last modification data.
- If .class file is more recent than .java file, that means there has been no change in source code since last compilation, it would simply use the class file.
- If the class file is modified after last compilation, that means we must rebuild class file
 - It would recompile the java file

Recommendation!

- We should create one class per java file
- A class should be housed in a java file of same name
- This will help Java compiler automatically compile your java file if required.

Compilation based on Modification

| Name | Status | Date modified | Type | Size |
|--|--------|--------------------|------------|------|
| <input type="checkbox"/> Combination.class | ✓ | 10/19/2020 3:27 PM | CLASS File | 1 KB |
| <input type="checkbox"/> PermutationCombinationApp.class | ✓ | 10/19/2020 3:27 PM | CLASS File | 2 KB |
| <input checked="" type="checkbox"/> Combination.java | ✓ | 10/19/2020 3:26 PM | JAVA File | 1 KB |
| <input type="checkbox"/> Factorial.class | ✓ | 10/19/2020 3:20 PM | CLASS File | 1 KB |
| <input type="checkbox"/> Permutation.class | ✓ | 10/19/2020 3:20 PM | CLASS File | 1 KB |
| <input checked="" type="checkbox"/> Permutation.java | ✓ | 10/19/2020 3:19 PM | JAVA File | 1 KB |
| <input checked="" type="checkbox"/> FactorialApp.java | ✓ | 10/19/2020 3:18 PM | JAVA File | 1 KB |
| <input checked="" type="checkbox"/> Factorial.java | ✓ | 10/19/2020 3:17 PM | JAVA File | 1 KB |
| <input checked="" type="checkbox"/> PerComApp.java | ✓ | 10/19/2020 2:56 PM | JAVA File | 1 KB |

Combination has changed after its last compile
So it is recompiled along with PerComApp.java

Factorial class has not changed after its
Last modification so it is not recompiled

```
C:\Windows\System32\cmd.exe
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo05>javac PerComApp.java
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo05>
```

①
This file will always be compiled irrespective of its date
as we are explicitly compiling

Organization Project files in multiple folders

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```
CAWindows\System32\cmd.exe
Folder PATH listing for volume Data
Volume serial number is F8C2-FD66
D:..
  FactorialApp.java
  PerComApp.java
  lib
    console
      ConsoleWriter.java
    maths
      Combination.java
      Factorial.java
      Permutation.java

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo06>javac PerComApp.java

PerComApp.java:8: error: cannot find symbol
    int p=Permutation.calculate(n,r);
           ^
symbol:   variable Permutation
location: class PermutationCombinationApp
PerComApp.java:9: error: cannot find symbol
    int c=Combination.calculate(n,r);
           ^
symbol:   variable Combination
location: class PermutationCombinationApp
PerComApp.java:11: error: cannot find symbol
    ConsoleWriter writer=new ConsoleWriter();
                        ^
symbol:   class ConsoleWriter
location: class PermutationCombinationApp
PerComApp.java:11: error: cannot find symbol
    ConsoleWriter writer=new ConsoleWriter();
                        ^
symbol:   class ConsoleWriter
```

Java compiler by default doesn't know where to search for the java/class files if it is not present in current folder.

It doesn't search entire file system for those files

How do I locate .java/.class files

1. CLASSPATH

- We can specify an environment variable called **CLASSPATH** listing all the folders where javac/java should search for .java/.class files
- Folders should be separated using path separator character that varies from one os to another
 - Windows using semicolon
 - Linux/osx uses colon

Our class path should look like

```
c:>set classpath=.\lib\console;.\lib\maths;.
```

Current directory

Note

- We have mentioned 3 path here
 - .\lib\console
 - .\lib\maths
 - . (current directory)
- We can't specify just lib
 - We must include right sub directory
- If you are having a classpath, then java/javac doesn't search current directory by default.
 - You must include current directory if you have files in current directory

```
C:\Windows\System32\cmd.exe
Volume serial number is F8C2-FD66
D:\..
  FactorialApp.class
  FactorialApp.java
  PerComApp.java
  PermutationCombinationApp.class
  lib
    console
      ConsoleWriter.class
      ConsoleWriter.java
    maths
      Combination.class
      Combination.java
      Factorial.class
      Factorial.java
      Permutation.class
      Permutation.java

D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo06>java PermutationCombinationApp
Error: Could not find or load main class PermutationCombinationApp
Caused by: java.lang.ClassNotFoundException: PermutationCombinationApp

D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo06>
```

Java is not searching for .class file in the current folder because current folder is not present in class path

Works correctly with the Right Path Set

```
C:\Windows\System32\cmd.exe
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo06>set classpath=.\lib\console;.\lib\maths;.
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo06>tree /f
Folder PATH listing for volume Data
Volume serial number is F8C2-FD66
D:\..
  FactorialApp.class
  FactorialApp.java
  PerComApp.java
  PermutationCombinationApp.class
  lib
    console
      ConsoleWriter.class
      ConsoleWriter.java
    maths
      Combination.class
      Combination.java
      Factorial.class
      Factorial.java
      Permutation.class
      Permutation.java

D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo06>java PermutationCombinationApp
SP3= 60
SC3= 10

D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo06>
```

Works fine with the right classpath

Note About class path

- Any classpath set at the terminal or the command window is good for current session only and is lost once you close the window.
- Classpath or any environment variable set on a terminal/command window is not available to other terminal or the command window.
- If you need a classpath everyday then you must store it in **system environment variables**
 - A good place to store classpath for common libraries.

```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19041.508]
(c) 2020 Microsoft Corporation. All rights reserved.

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo06>java PermutationCombinationApp
5P3=    60
5C3=    10

D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo06>cd \

D:\>java PermutationCombinationApp
5P3=    60
5C3=    10

D:\>
```

Once a classpath is properly set, you
can run your application from
anywhere in your file system.

Assignment01

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Create A Project called Furniture App with following file structure

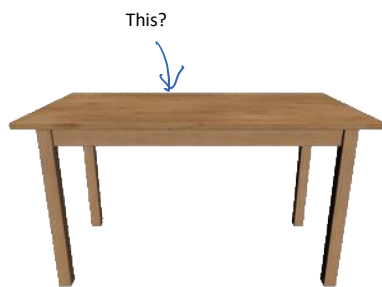
```
<project root>
|
|--> FurnitureApp.java
|
|--> [lib]
|   |
|   |--> [furnitures]
|       |
|       |--> Chair.java
|       |--> Bed.java
|
|--> [data]
|   |
|   |--> List.java
```

FurnitureApp should

1. Craete a list of Furnitures
2. Add Chair and Bed to this list

Write necessary code to compile and run the program

What is a Table?



That?

| Product | Rate | Stock |
|---------|-------|-------|
| Chair | 1000 | 12 |
| Table | 5000 | 7 |
| Bed | 20000 | 4 |

- In real world a word can have different meanings. Same word (like Table) can represent multiple different and unrelated elements.
- Often in a single project we may need to use one or more such objects
 - Example:
 - A Furniture Shop sells **Table (Furnitures)**
 - The maintain their stock details in a **Table (Data)**

How do I represent Multiple Objects with same name in same application

Why Multiple Folder Design Doesn't work?

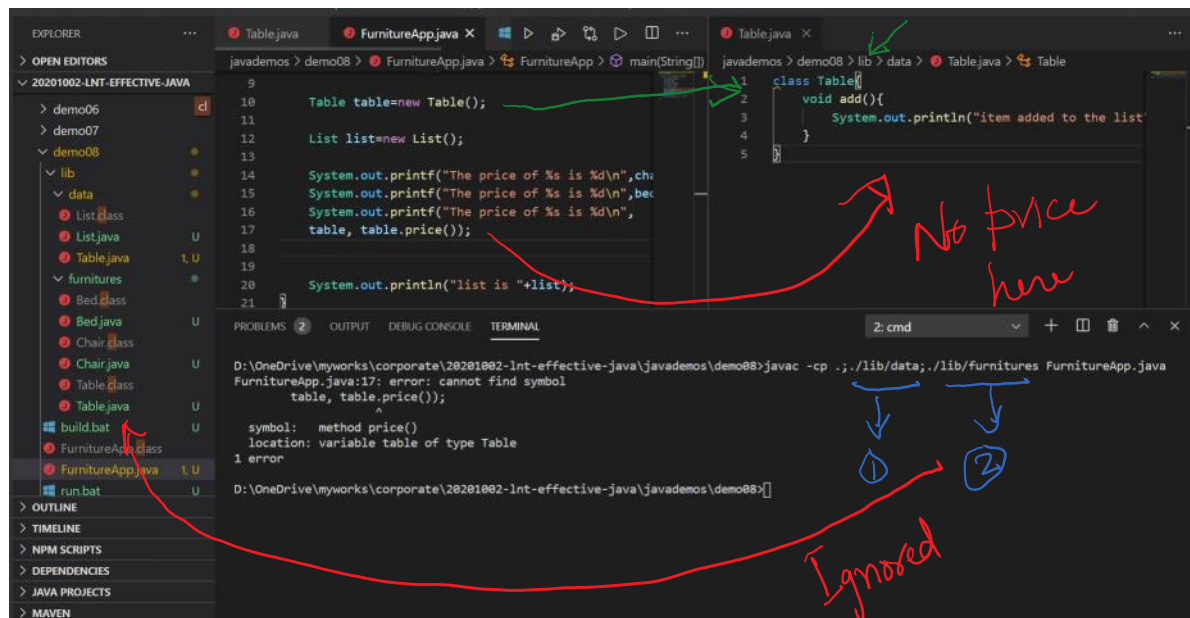
Java/Javac searches for java classes in **sequential order** in every folder mentioned in the **classpath**

- They stop searching when they find their **first match**
- If a class with same name is present in the two folders, it will always match the first folder mentioned in the list and will never use other option.

unreachable

Search order

If we change the order in classpath, it will get a different Table. But we can't get Both Tables to work in single Application



How to make it work?

- Create classes with different Names —
 - FurntiureTable
 - DataTable
- This can avoid name conflicts
- **Why this is not a great idea**
 - We may not always be in a position to find a good prefix
 - Sometimes conflict may be between
 - Your Data Table
 - My Data Table
 - Two different developers may be developing a class for same Purpose
 - Prefixing won't be useful here!

Java Package

Tuesday, October 20, 2020 10:21 AM

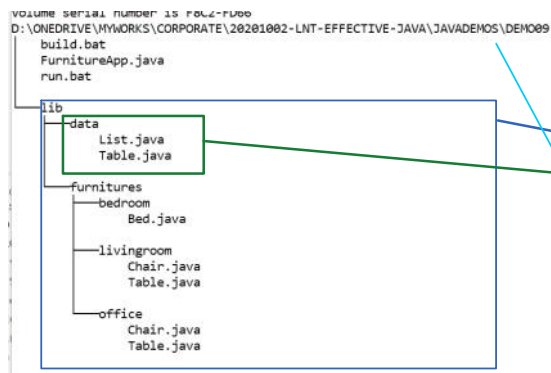
- A java package is a logical grouping for your Java classes and packages
- A Package can contain
 - Java files
 - Class files
 - Other Resource (configurations)
 - Sub Packages
- **A package is physically mapped to a folder on the disk.**
- For every package you will have folder

Note!

- A class which is not part of any specific package is still a part of a global package

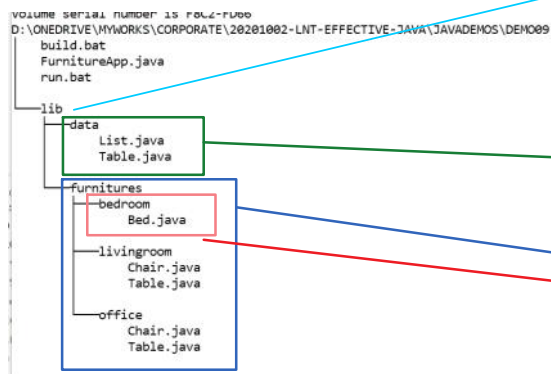
Package is not a folder

- Package resides in a folder.
 - If we have a package **xyz** it would be mapped to a folder **xyz**
- **The key difference between a package and a folder**
 - Folder is an OS concept and Java doesn't know about the folder
 - i. You reach the folders using OS level environment variable like **classpath**
 - ii. Java program internally knows nothing about a folder
- Package is a java concept mapped to folders.
 - **It is a java programming element and using in Java Program**
- **We can designate our selected folder as package**
 - **That would be our choice**



| Package | Sub Package | Sub Package | Sub Package | Class | Java Name | |
|---------|-------------|-------------|-------------|-------|----------------------------|--|
| lib | | | | | lib | |
| | data | | | | lib.data | |
| | | | | List | lib.data.List | |
| | | | | Table | lib.data.Table | |
| | furniture | | | | lib.furntiures | |
| | | bedroom | | | lib.furnitures.bedroom | |
| | | | | Bed | lib.furnitures.bedroom.Bed | |

Alternative View



| Package | Sub Package | Sub Package | Class | Java Name | |
|-----------|-------------|-------------|-------|------------------------|--|
| data | | | | data | |
| | | | List | data.List | |
| | | | Table | data.Table | |
| furniture | | | | furntiures | |
| | bedroom | | | furnitures.bedroom | |
| | | | Bed | furnitures.bedroom.Bed | |

- This is just a folder and not a package.
- **This is where the you package lives.**
- **This folder should be present in the classpath**
- Your package folders will not be present in classpath

How do you mark your package?

- We mark our package and sub package by giving **package** statement on the top of class

- **package** statement if present **must be the first statement in a file.**
- **There can be only one package statement per file**
- Package must include entire package sub package hierarchy
- If not package is specified it is assumed to be part of a global un-named package
- .class file must be present in folder mentioned as per package hierarchy
- **Root of the package** should be present in **CLASSPATH**

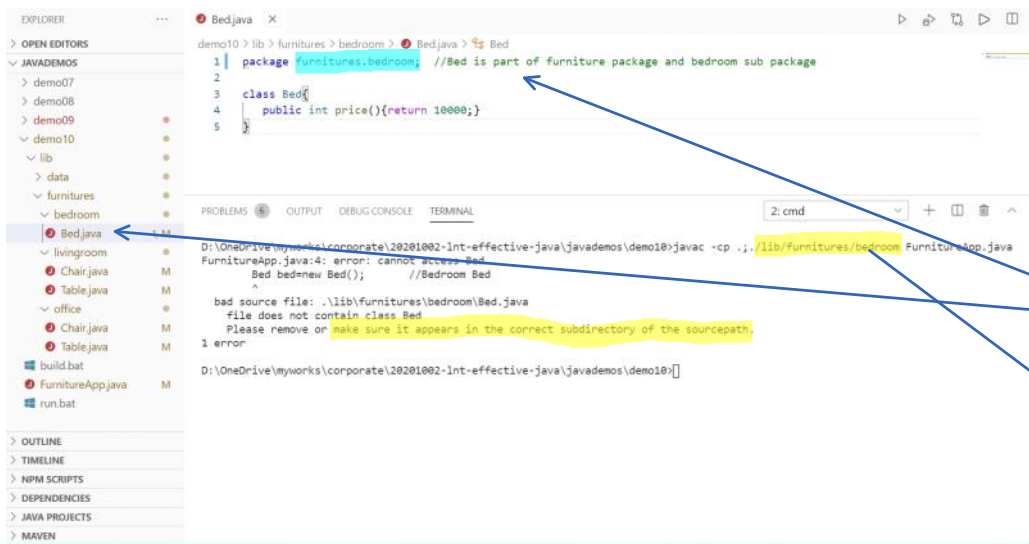
```

demo10 > lib > data > List.java > {} data
1 package data; //we decided that my package starts
2
3 class List{
4     void add(){
5         System.out.println("item added to the list"
6     }
7 }

demo10 > lib > furnitures > bedroom > Bed.java > {} Bed
1 package furnitures.bedroom; //Bed is part of fur
2
3 class Bed{
4     public int price(){return 10000;}
5 }
  
```

Using Package

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- Compiler is expecting **Bed** to be present in a folder
 - **furnitures/bedroom**
- Is it not already present in the right folder?
 - No.
 - Because we are searching for this folder by going inside this folder.
 - Remember this path is part of **classpath**
 - Javac goes into the folder and searches those folder inside

IMPORTANT!

- The error is because package name is mentioned in **CLASSPATH**
- You should never mention package itself in classpath
- You should mention the Parent folder for package in class path

Referring a class defined inside the package

- Once you have created a class **Bed** inside a package **furnitures.bedroom**,
 - you can't access the class simply as **Bed**
 - There is not Bed present in global package
 - You have to access the class Bed using its package qualified name that is **furnitures.bedroom.Bed**



- Can't access Bed without package qualification
- Here is the right way to use it

C

Package and Scopes

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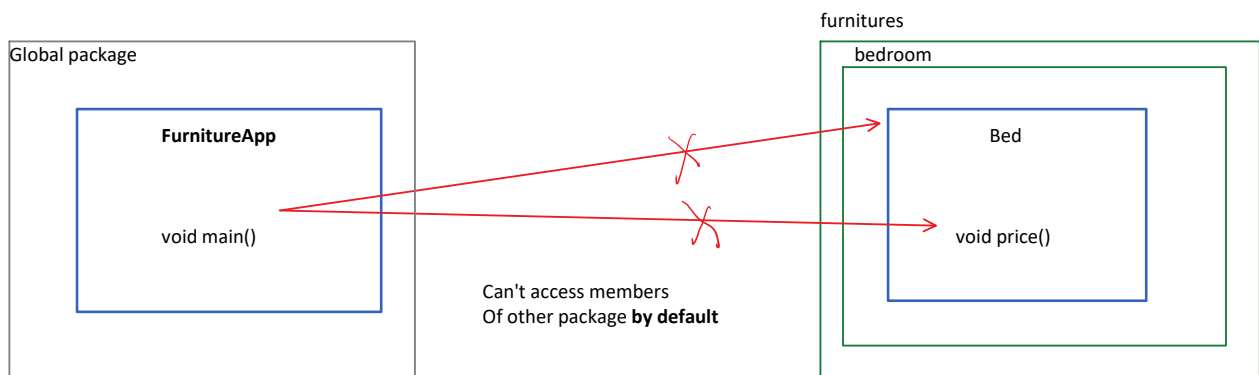
- By default, all elements inside a package (class, class fields, class methods) have a **package scope**.
- They are accessible by members of the same package but not outside the package
- When we write program without package, all classes are part of same global package and can access each other and their method without any problem

```
demo09 > FurnitureApp.java > FurnitureApp > main(String[])
4 public static void main(String []args){
5
6     Chair chair=new Chair(); //Living room chair
7     Bed bed=new Bed(); //Bedroom Bed
8
9
10    Table table=new Table(); //living room table
11
12    List list=new List();
13
14    System.out.printf("The price of %s is %d\n",chair, chair
15    System.out.printf("The price of %s is %d\n",bed, bed.pr
16    System.out.printf("The price of %s is %d\n",
17    table, table.price());
18
19
20    System.out.println("list is "+list);
21
22 }
```

```
demo09 > lib > furnitures > bedroom > Bed.java > ...
1
2
3 class Bed{
4     public int price(){return 10000;}
5 }
```

Can Access members of same package & in this can global package

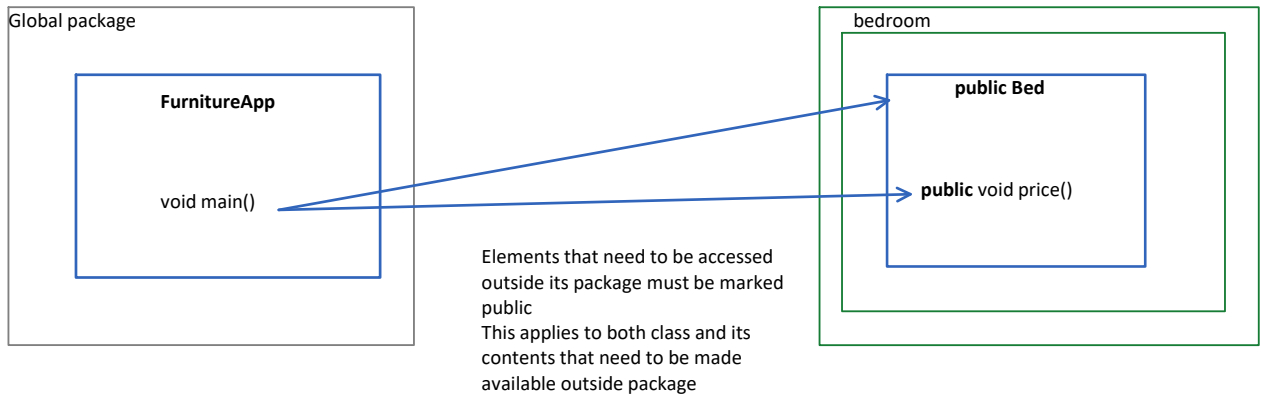
When Using Package



Scope: public

When Using Package

furnitures



Important!

- We don't need all classes and class contents to be directly accessible from outside
- Example
 - You car needs an engine
 - Engine need to be directly accessed by the driver
 - You access car using few public elements like
 - Steering
 - Gear
 - Clutch, Break, Acclerator Paddles
 - This public components internally use other components which are not directly used by drivers
- We can make
 - public class Steering{}
 - class Engine {} ← no scope is package scope

Assignment02

Tuesday, October 20, 2020 12:11 PM

Complete the furniture shop app by

- Adding the right packages
- Use all the classes from all the package in the main function
- Update build and run script
- Build your project
- Run your project
- Take a screen shot of running code
- Update everything **Assignment02 folder**