

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 lanugage?
 - 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?

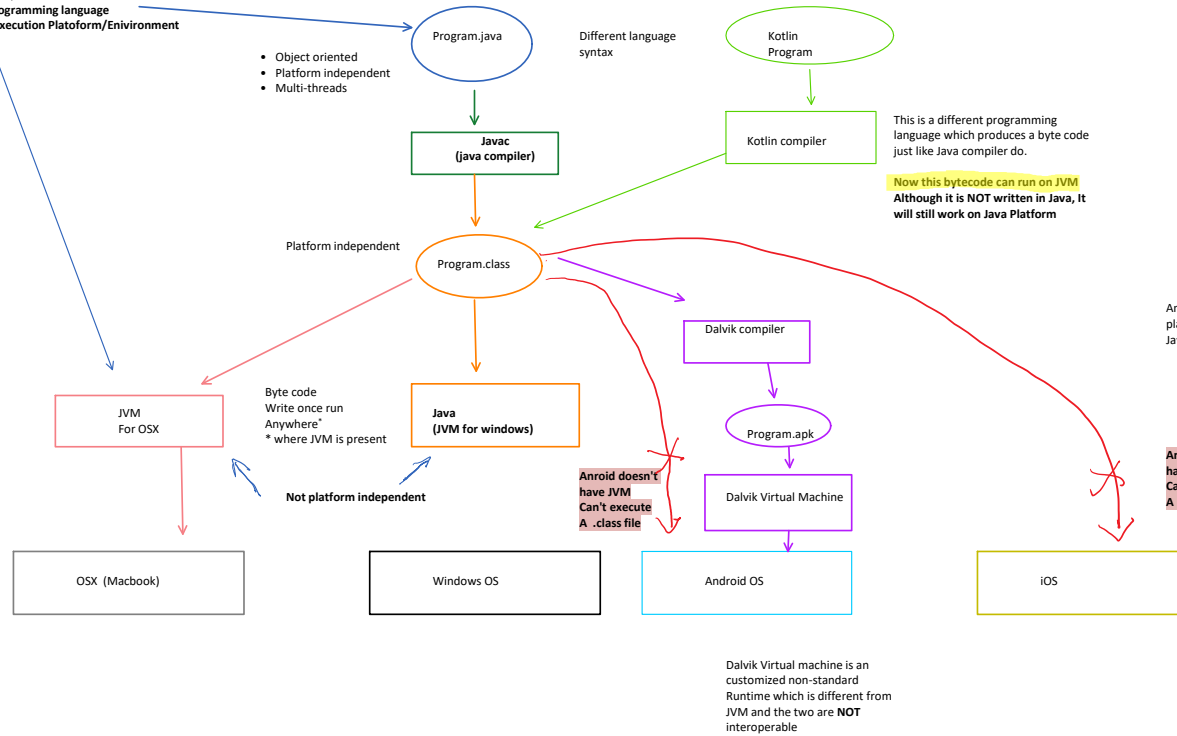


How many Java are there?

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

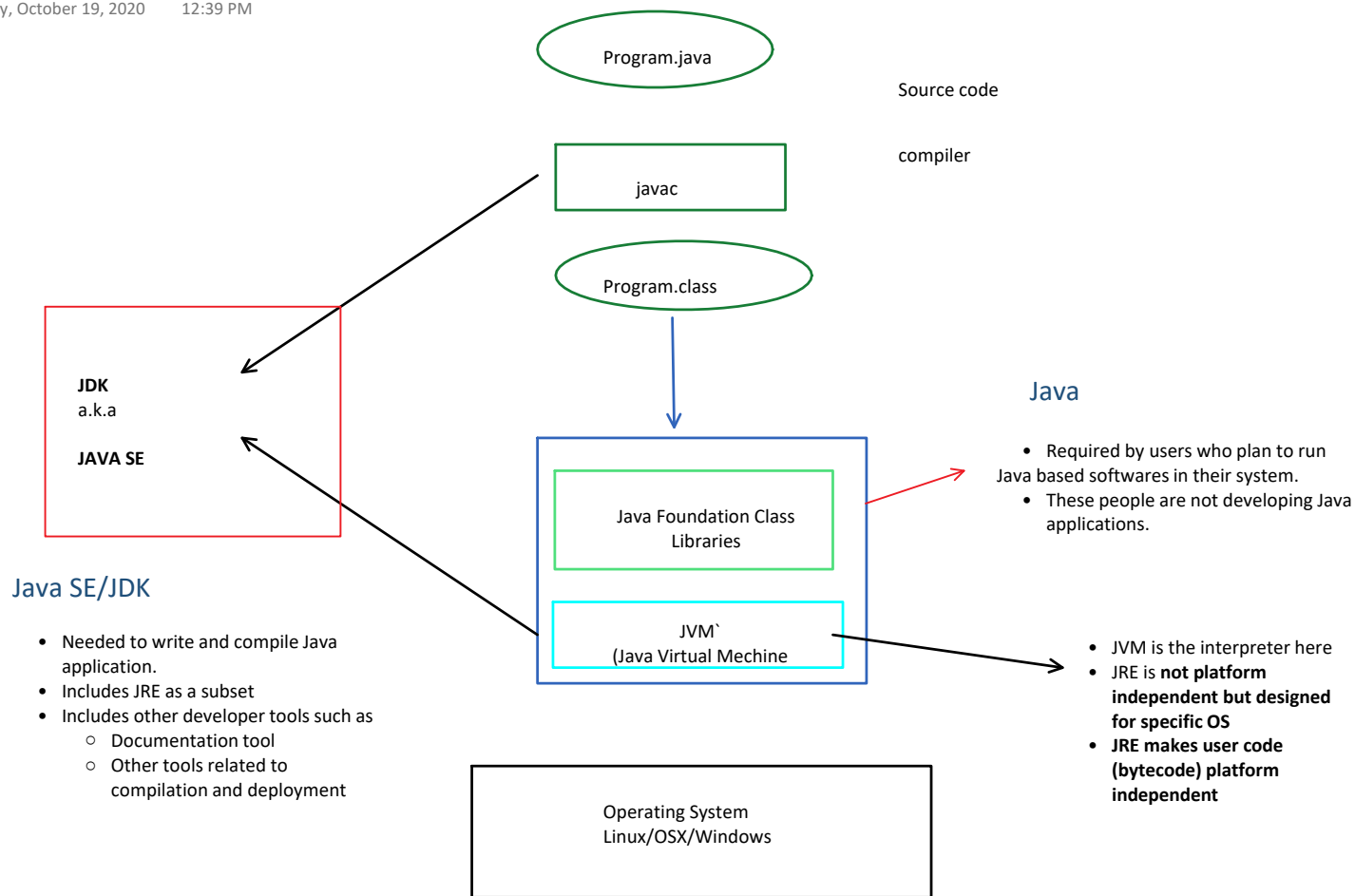
1. **Java is a Programming language**
2. **Java is an execution Platform/Environment**



Since the release of Android Studio 3.0 in October 2017, Kotlin is included as an alternative to the standard Java compiler. The Android Kotlin compiler lets the user choose between targeting Java 6 or Java 8 compatible bytecode. Kotlin has been Google's preferred language for Android app development since 7 May 2019.

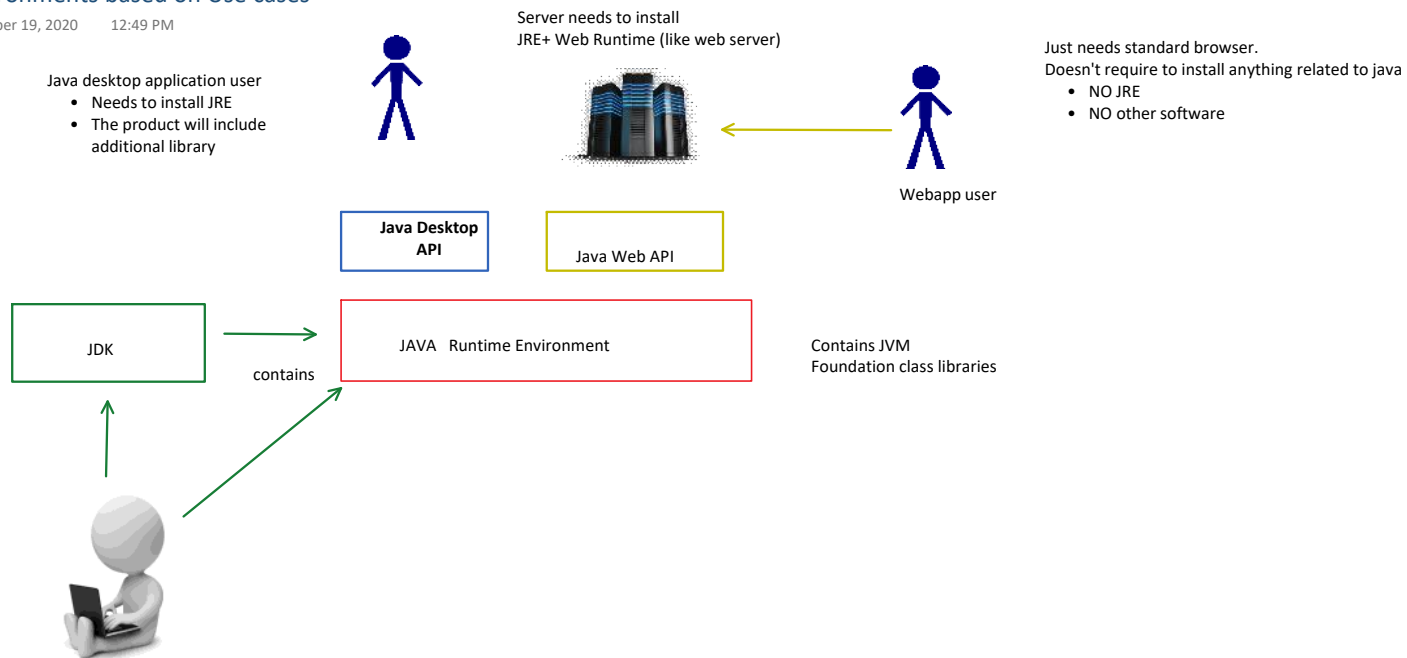
Java Framework

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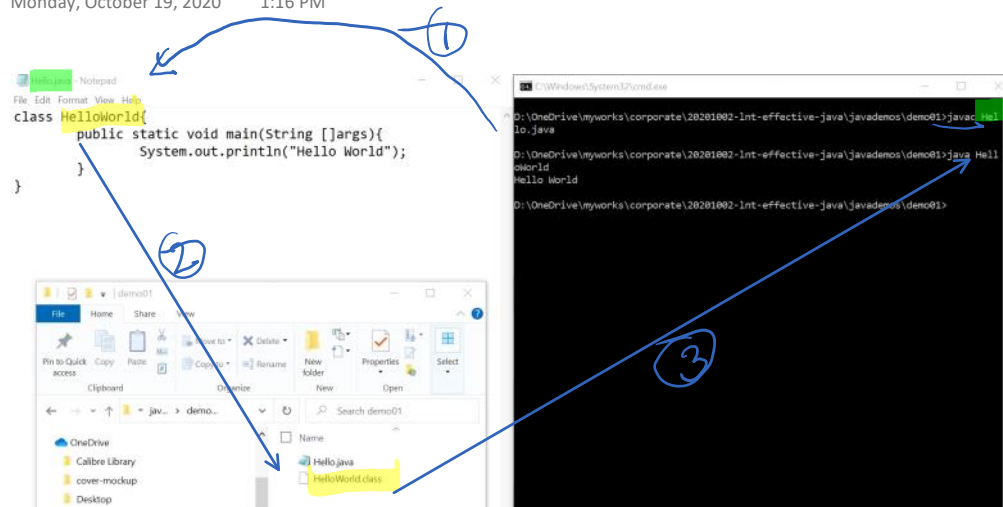
Java Environments based on Use cases

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Compiling and Running Java code

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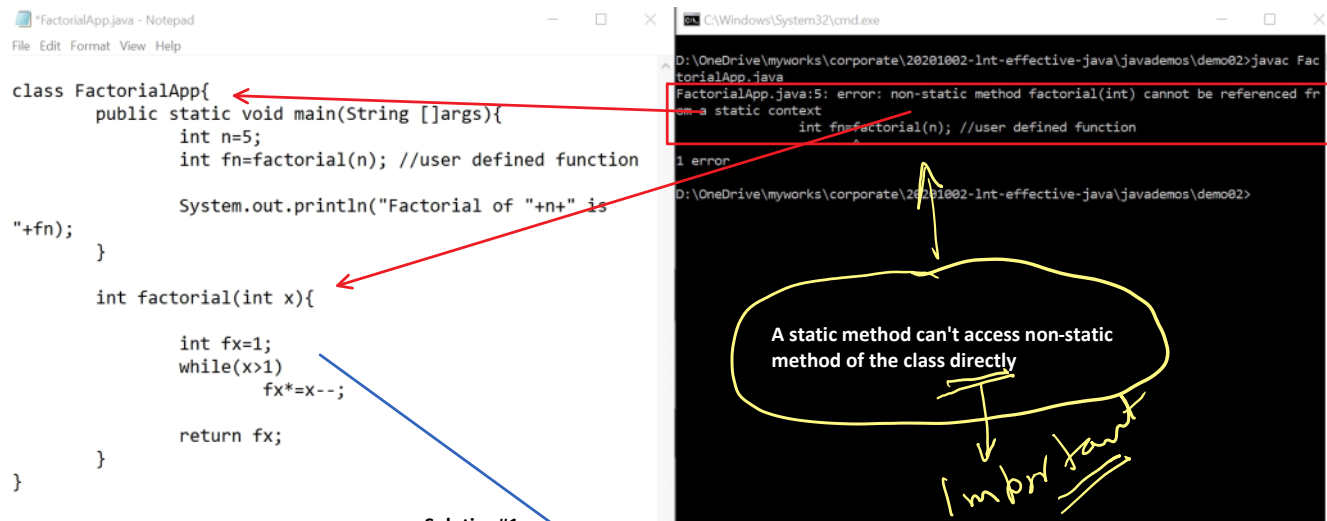


1. You compile a source file
- c:> **javac HelloWorld.java**
1. The byte code name is same as that of Class present in source code and not same as the .java file name
2. You run the byte code using java command

c:> **java HelloWorld**

Static context

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Solution#1

Solution

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

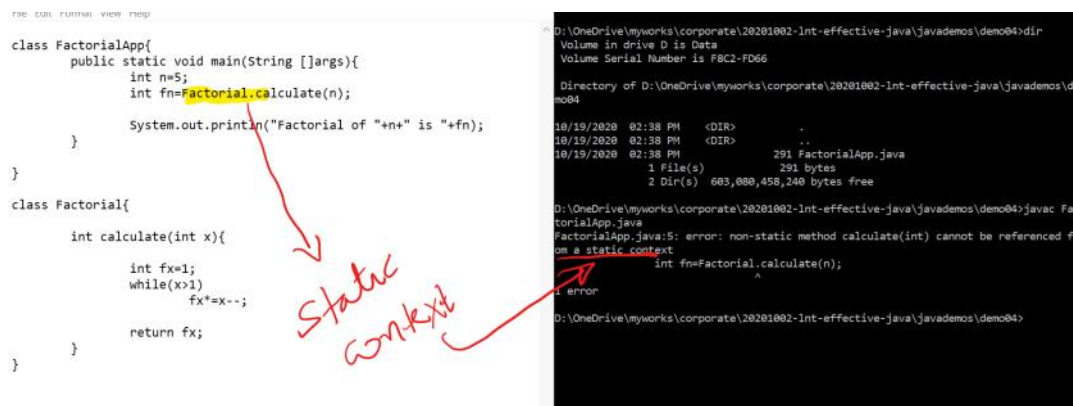
Solution 1

- 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 files: `FactorialApp.java` and `Factorial.java`. The `FactorialApp` class has a `main` method that creates a `Factorial` object and calls its `calculate` method. The `Factorial` class has a `calculate` method that calculates the factorial of a number. Handwritten orange annotations highlight the object creation and method call in `FactorialApp`, and label the `calculate` method in `Factorial` as a "Non Static" method and the object as an "Instance of class". A terminal window on the right shows the execution of the program, displaying the output "Factorial of 5 is 120".

```
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);
    }
}

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

Non Static
Instance of class
Method

```
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 two Java classes: `FactorialApp` and `Factorial`. The `FactorialApp` class has a `main` method that calls `Factorial.calculate`. The `Factorial` class has a static `calculate` method. Blue arrows point from the `calculate` method in `Factorial` to the `calculate` call in `FactorialApp`, and from the `Factorial` class to the `Factorial.class` file in the command prompt output.

```
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

```
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

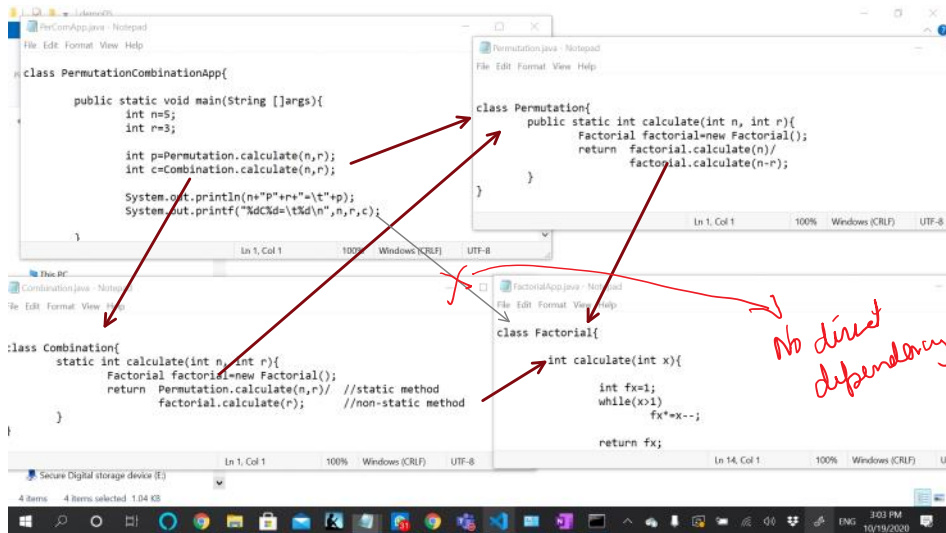
D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo03>dir
Volume in drive D is Data
Volume Serial Number is F8C2-FD66

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

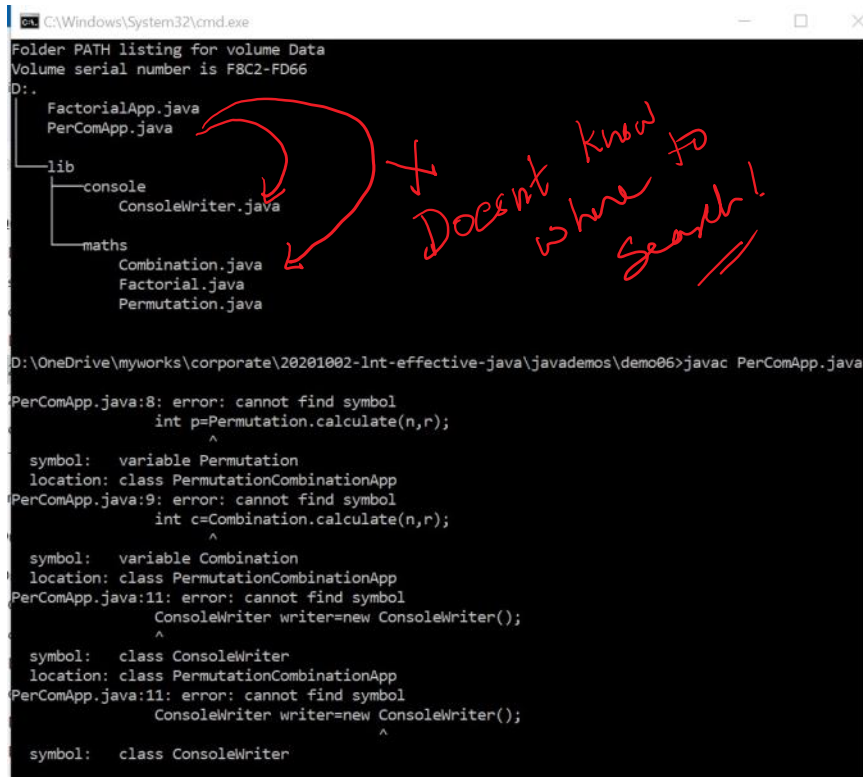
Factorial class has not changed after its
Last modification so it is not recompiled

```
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

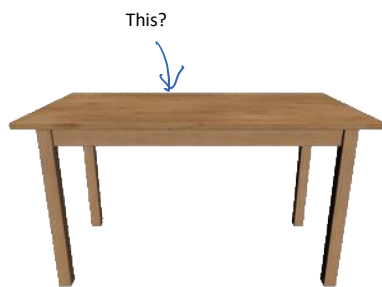
```
<project root>
|
|--> FurnitureApp.java
|
|--> [lib]
|   |
|   |--> [furnitures]
|       |
|       |--> Chair.java
|       |--> Bed.java
|
|--> [data]
|   |
|   |--> List.java
```

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?

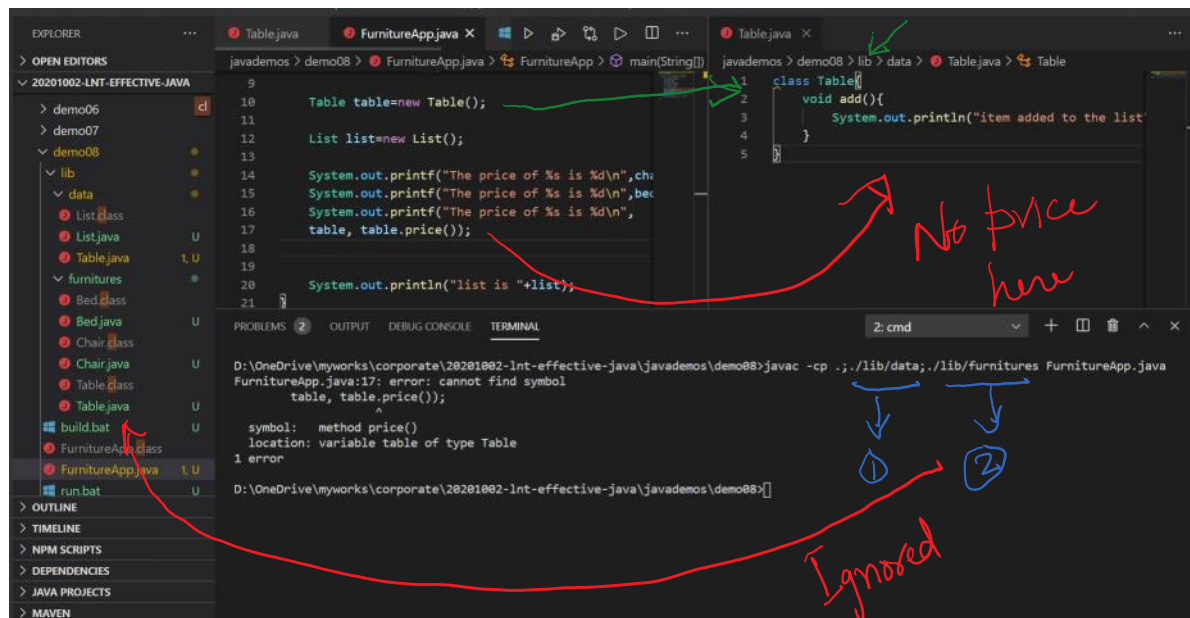
Java/Javac searches for java classes in **sequential order** in every folder mentioned in the **classpath**

- 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

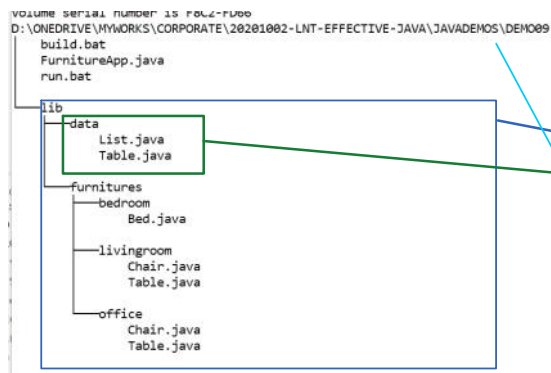
- A java package is a logical grouping for your Java classes and packages
- A Package can contain
 - Java files
 - Class files
 - Other Resource (configurations)
 - Sub Packages
- **A package is physically mapped to a folder on the disk.**
- For every package you will have folder

Note!

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

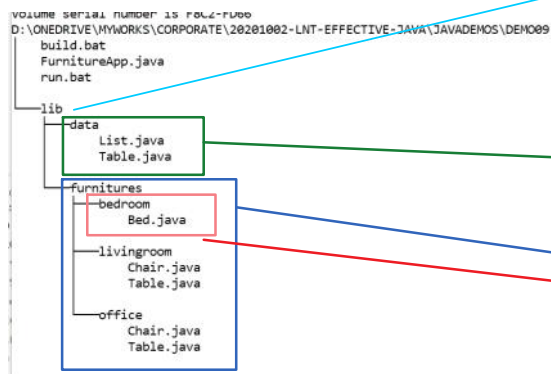
Package is not a folder

- 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**

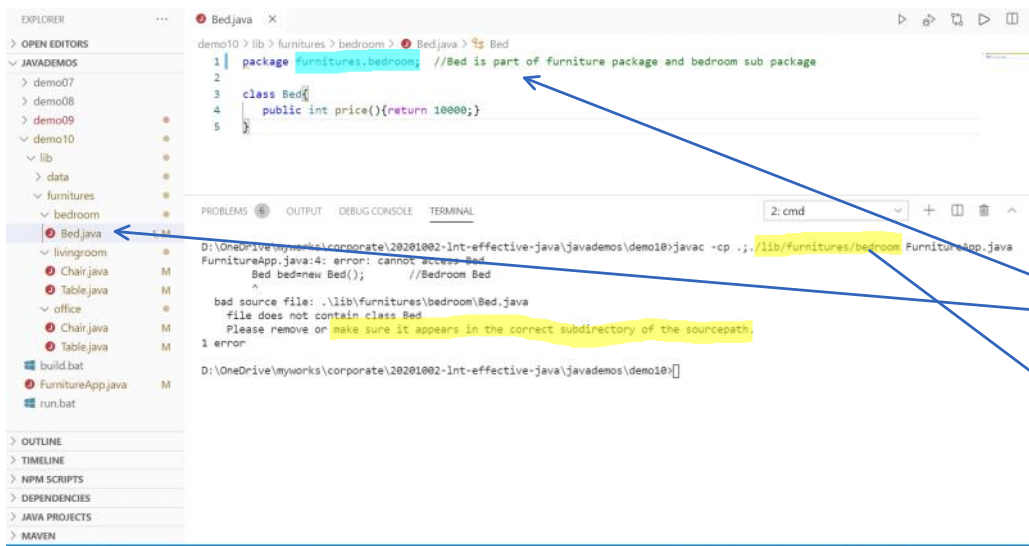
```

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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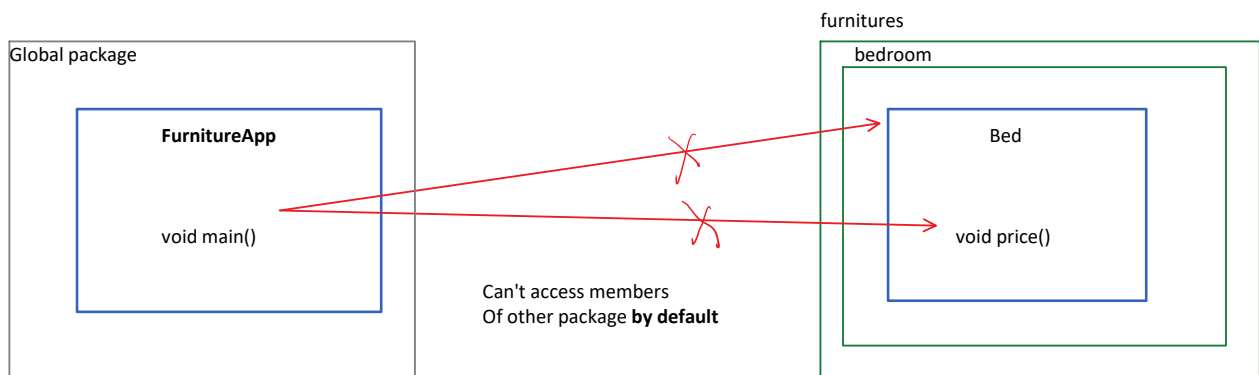
- By default, all elements inside a package (class, class fields, class methods) have a **package scope**.
- They are accessible by members of the same package but not outside the package
- When we write program without package, all classes are part of same global package and can access each other and 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
8     Bed bed=new Bed(); //Bedroom Bed
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.price());
15    System.out.printf("The price of %s is %d\n",bed, bed.price());
16    System.out.printf("The price of %s is %d\n",table, table.price());
17
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

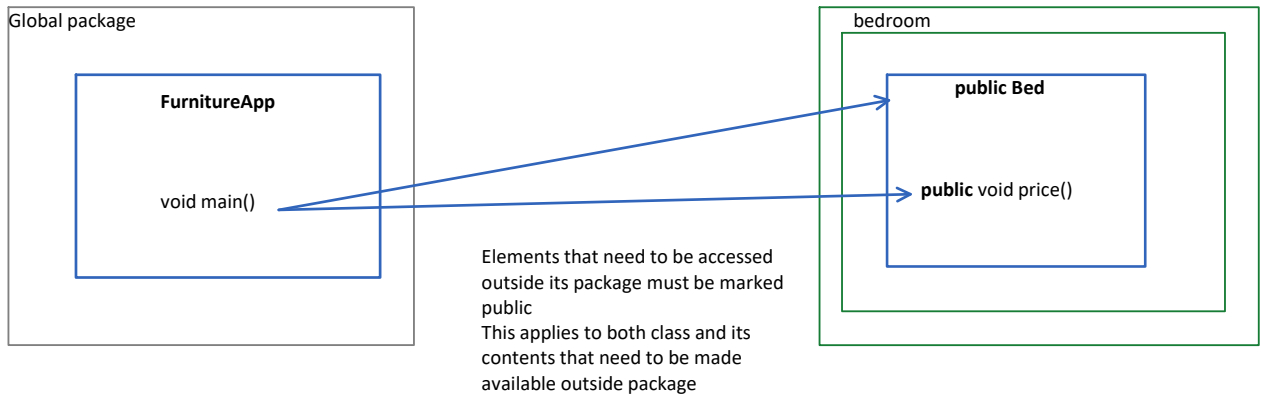
When Using Package



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, Accclerator 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

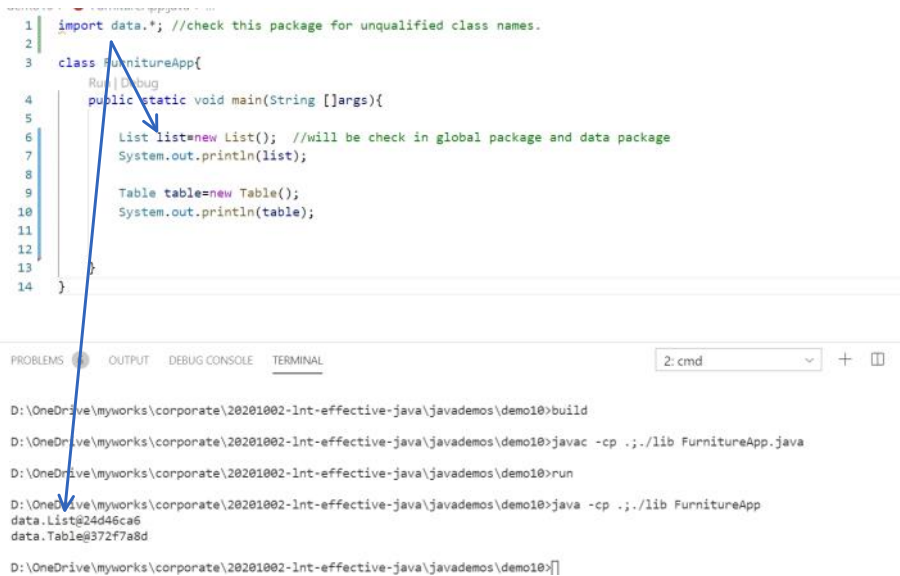
- Adding the right packages
- Use all the classes from all the package in the main function
- Update build and run script
- Build your project
- Run your project
- Take a screen shot of running code
- Update everything **Assignment02 folder**

Package Import

Tuesday, October 20, 2020 12:54 PM

import package.*; or import an entire package

- It imports all the packages from the given package
- When you use an unqualified name it searches for this name in
 - Global package
 - Imported package
- **NOTE**
 - **import package.*** imports only current package and its classes
 - It **doesn't** import subpackages
 - **import furnitures.*** will not import subpackages or their classes like furnitures.bedroom.bed
 - You must import
 - **import furnitures.bedroom.*;**



```
1 import data.*; //check this package for unqualified class names.
2
3 class FurnitureApp{
4     public static void main(String []args){
5
6         List list=new List(); //will be check in global package and data package
7         System.out.println(list);
8
9         Table table=new Table();
10        System.out.println(table);
11
12
13    }
14 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 2: cmd + -

```
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo10>build
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo10>javac -cp ./lib FurnitureApp.java
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo10>run
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo10>java -cp ./lib FurnitureApp
data.List@24d46ca6
data.Table@372f7a8d
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo10>]
```

Problem with the wildcard (*) import

```

1  import data.*; //check this package for unqualified class names.
2  import furnitures.bedroom.*;
3  import furnitures.livingroom.*;
4
5  class FurnitureApp{
6      public static void main(String []args){
7
8          List list=new List(); //will be check in global package and data package
9          System.out.println(list);
10
11         Table table=new Table(); //CONFLICT: which Table?
12         System.out.println(table);
13
14         Bed bed=new Bed(); //no conflict
15         System.out.println(bed);
16
17         Chair chair=new Chair(); //no conflict mode
18         System.out.println(chair);
19     }
20 }

```

Recommendation
Avoid wildcard imports

Handwritten notes:
- Red arrow pointing to line 1: "which Table"
- Blue arrow pointing to line 11: "No Conflict cases"

PROBLEMS
FurnitureApp.java:11: error: reference to Table is ambiguous
Table table=new Table();
^
both class furnitures.livingroom.Table in furnitures.livingroom and class data.Table in data match
FurnitureApp.java:11: error: reference to Table is ambiguous
Table table=new Table();
^
both class furnitures.livingroom.Table in furnitures.livingroom and class data.Table in data match
2 errors

Single class Import (Selective Import)

- Selecting import imports a single class at a time
- They can override wild card import
- If single class import is specified it will be preferred to resolve conflicts coming from wild card import

```

1  import data.*; //check this package for unqualified class names.
2  import furnitures.bedroom.*;
3  import furnitures.livingroom.*;
4  //avoiding wild card conflicts
5  import data.Table; //unqualified Table means Data.Table
6
7  class FurnitureApp{
8      public static void main(String []args){
9
10         List list=new List(); //will be check in global package and data package
11         System.out.println(list);
12
13         Table table=new Table(); //data.Table
14         System.out.println(table);
15
16         Bed bed=new Bed(); //no conflict
17         System.out.println(bed);
18
19         Chair chair=new Chair(); //furnitures.livingroom.Chair
20         System.out.println(chair);
21
22         //How do I resolve furnitures.livingroom.Table
23         //by using fully qualified paths
24         furnitures.livingroom.Table table2=new furnitures.livingroom.Table();
25         System.out.println(table2);
26
27         //same goes for office furnitures
28
29     }
30 }

```

Handwritten notes:
- Blue arrow pointing to line 13: "overrides name conflict"
- Blue arrow pointing to line 24: "Must have fully qualified name for a second conflict class"

A Good Package Name?

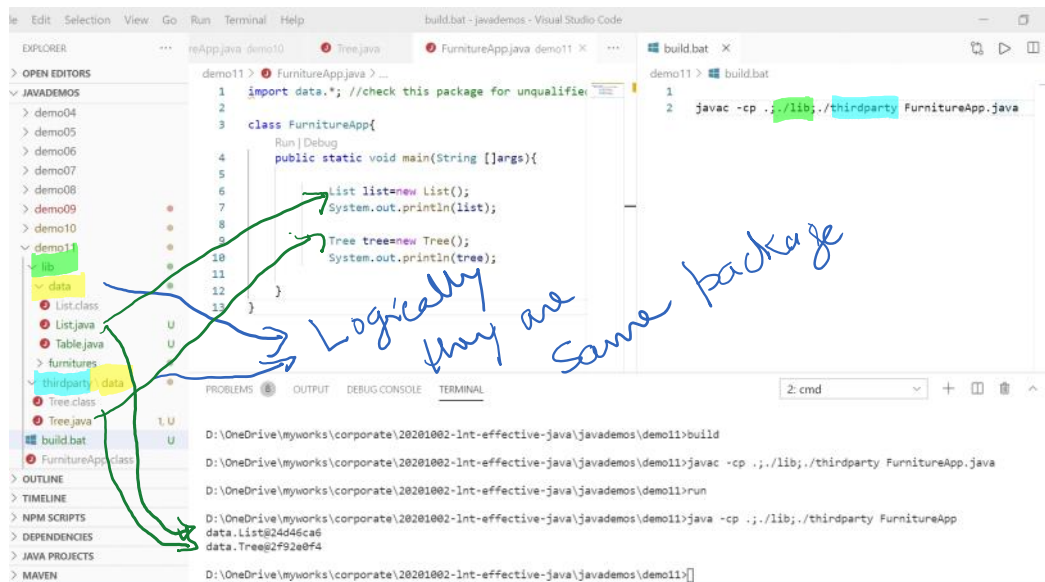
Tuesday, October 20, 2020 1:11 PM

A Package Name Avoid class name conflict. What if Package Name Conflict?

- What if two developer choose to create same package **data**
- Is it likely?
 - YES.

How to resolve package name conflicts?

- Package name doesn't conflict. They merge!



- Package with same in different physical paths are considered to be same package.
- There names don't conflict.
- The content of two packages are treated as part of same package

What is the probability that two different developers would end up creating a package called **data** and have a class inside this package called **List**?

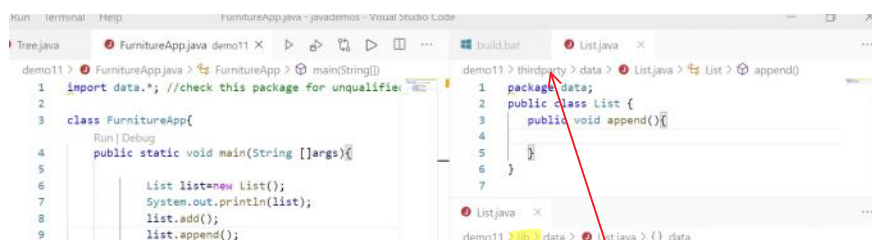
- It is very likely.
- List is a popular element in programming (and real world)
- A List is most likely be present in a package which would be called
 - data
 - collection
 - Datastructure
- Because these names are few, it is highly likely that many developers would use the same packages to house same classes

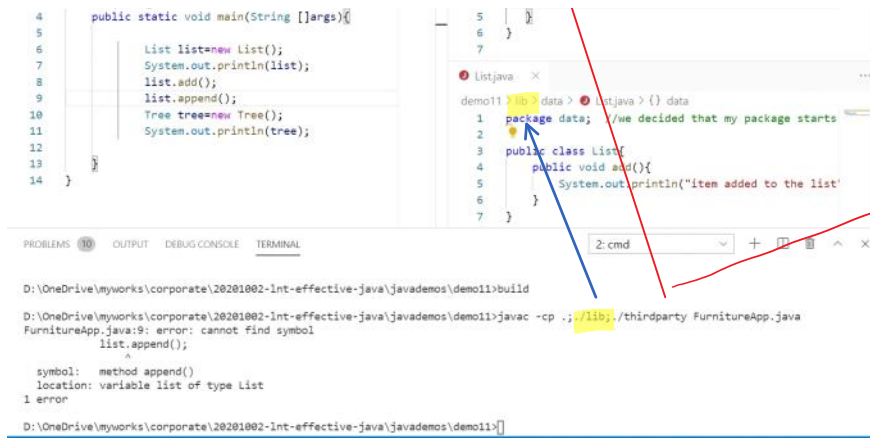
What happens if two different package with same name exists in the class path

- They merge as one package

What happens if these two different package has class with same name?

- The class name conflicts
- **There is no resolution to this problem**
 - Java has no solution to this problem





- Due to classpath order, javac/java never sees the second class with conflicting name
- Since Java does see it and doesn't complain for it, there is no way to resolve it

Conventional Solution

- Make sure your package name is unique
- Generally we never create a one level package (eg. Data)
- We create nested package
- The root package should be an identity/branding package
 - E.g.
 - vivek.data ← data belongs to vivek
 - santosh.data ← data belongs to santosh

Recommendations

- Make sure your identity package (root package) is unique
- One way to ensure is to use copyrighted names as identity
 - Your name is not copyrighted
- Company Name is copyrighted
- We generally use our domain name as package name (in reverse order)
 - Example
 - in.conceptarchitect.data
 - com.ltts.project19.data
 - com.ltts.commons.data
 - in.conceptarchitect.furnitures.office
- A package may include project name or department name as sub package in case or large organization

Problem!

- What is the probability that two vivek will create a package called data and have a class inside called List?
 - High Probability
 - Human names are quite common
 - Not a great choice for avoiding name conflict

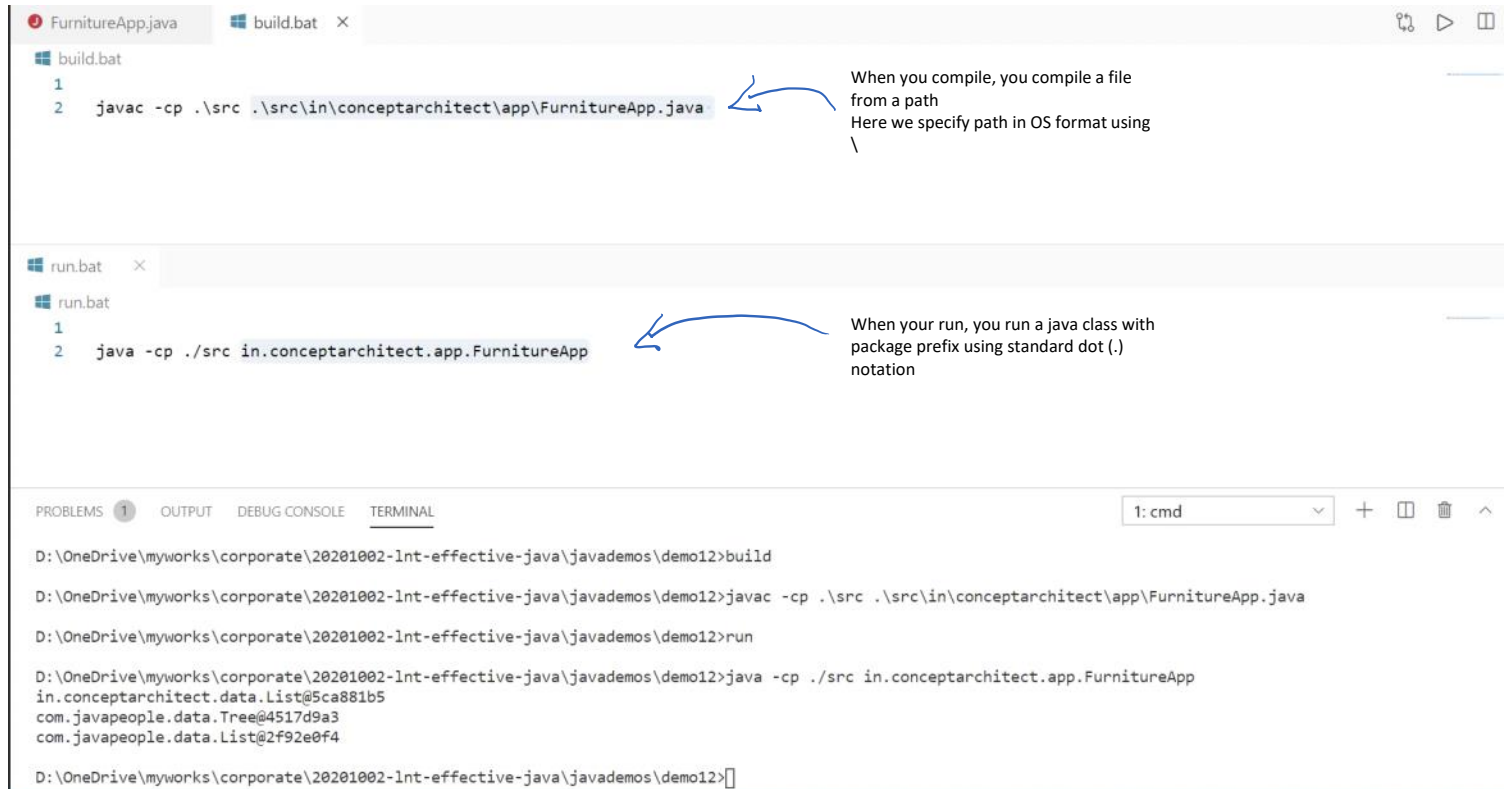
Assignment03

Tuesday, October 20, 2020 1:40 PM

- Start with demo11
- Create your brand:
 - You may use
 - in.surname.name as your package
- Add identity spaces for **lib packages** as **your brand package**
- Add identity package **com.javapeople** as identity to the thirdparty library
- Use all the classes created so far
- Create build path and screenshots.

Building Project with nested classes

Tuesday, October 20, 2020 3:19 PM



The screenshot shows an IDE with two tabs: `FurnitureApp.java` and `build.bat`. The `build.bat` file contains the following code:

```
1
2 javac -cp ./src ./src/in/conceptarchitect/app/FurnitureApp.java
```

A blue arrow points from the text "When you compile, you compile a file from a path. Here we specify path in OS format using \\" to the file path in the `javac` command.

Below the `build.bat` tab is the `run.bat` tab, which contains the following code:

```
1
2 java -cp ./src in.conceptarchitect.app.FurnitureApp
```

A blue arrow points from the text "When your run, you run a java class with package prefix using standard dot (.) notation" to the package name `in.conceptarchitect.app` in the `java` command.

At the bottom is the `TERMINAL` tab, which shows the execution of the build and run commands:

```
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo12>build
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo12>javac -cp ./src ./src/in/conceptarchitect/app/FurnitureApp.java
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo12>run
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo12>java -cp ./src in.conceptarchitect.app.FurnitureApp
in.conceptarchitect.data.List@5ca881b5
com.javapeople.data.Tree@4517d9a3
com.javapeople.data.List@2f92e0f4
D:\OneDrive\myworks\corporate\20201002-Int-effective-java\javademos\demo12>
```

Organizing your code for Deployment

Tuesday, October 20, 2020 3:21 PM

```
D:\OneDrive\myworks\corporate\20201002-lnt-effective-java\javademos\demo12>tree/f
Folder PATH listing for volume Data
Volume serial number is F8C2-FD66
D:.
  build.bat
  run.bat
  src
    com
      javapeople
        data
          List.class
          List.java
          Tree.class
          Tree.java
    in
      conceptarchitect
        app
          FurnitureApp.class
          FurnitureApp.java
        data
          List.class
          List.java
          Table.java
        furnitures
          bedroom
            Bed.java
          livingroom
            Chair.java
            Table.java
          office
            Chair.java
            Table.java
```

- Source file and .class files are present in same folder
- Source file is generally not required to run the code
- You may not distribute or share your source code with client. You will give only .class file
- As a developer we keep deleting older version of class files.
- Keeping them separate would be great for application design.

Solution

1. Keep all source files in **src** folder
2. Keep all class files in **classes** folder

Javac -d switch

- You can specify -d switch on javac to specify the folder in which you will store the class files
- In case of packages it will automatically create the package sub folders

```
classes
  com
    javapeople
      data
        List.class
        Tree.class
  in
    conceptarchitect
      app
        FurnitureApp.class
      data
        List.class
      furnitures
        bedroom
          Bed.class
src
  com
    javapeople
      data
        List.java
        Tree.java
  in
    conceptarchitect
      app
        FurnitureApp.java
      data
        List.java
        Table.java
      furnitures
        bedroom
          Bed.java
        livingroom
          Chair.java
          Table.java
```

1. Classes are organized and stored separately
2. Only those classes required by the client is compiled
3. You can distribute the classes folder and not source folder
4. You can delete all classes at once by deleting the classes folder

```
Chair.java
Table.java
office
Chair.java
Table.java
```

Deployment

Tuesday, October 20, 2020 3:56 PM

A java program can with

- Class files in the disk
- Sub folders representing a package
- A batch file to run the command and class path

Problem

- In a typical java program, there would dozens of package (folders) and hundreds of class (files)
- To distribute the code to clients we need to copy all these files and folders
- Sharing so many files may require us to
 - Zip file files and send to client
 - Ask client to unzip in the right folder
 - Tell which java class contains main
 - Tell them the command arguments

Solution

- Create a jar file
- A jar file is like a zip file
- A java program can run from a jar file without needing to unpack it.
- You need to share a single jar file

1. Create a Jar File

Method 1 — Creating a simple jar

- This is the common method for creating a simple jar

```
c:> jar c v f app.jar .
```

```
c--> create a jar
v --> verbose – print whatever your are doing
f -> we will specify the name of output jar file (if not give the data is
simply shown on console and no jar created)
. -> Jar files and subdirectories of current folder
```

- Running code from a simple jar

```
c:> java -cp app.jar in.conceptarchitect.app.FurnitureApp
```

- We will specify the name of our jar as the CLASSPATH
- We will specify the full qualified name of the MainClass which contains the main function

A jar manifest

- A java jar file contains a manifest file ./META-INF/manifest.mf which contains meta informations about jar file
- This file is automatically added to every jar and contains following sample information

```
//META-INF/manifest
Manifest-Version: 1.0
Created-By: 15 (Oracle Corporation)
```

- To add more information to manifest we can
 - Create a text file with additional information
 - Specify the text file while creating the jar file using "m" option
 - The content of your text file will be merged in standard manifest

```
c:> jar cvfm app.jar meta.txt .
```

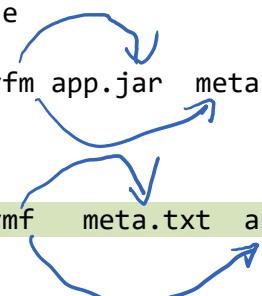
- Note app.jar is final jar file
- meta.txt contains additional data to be added to jar manifest
- The order in which you specify the two files depends on the order in which the options "m" and "f" is applied

- You can use

```
c:> jar cvfm app.jar meta.txt .
```

Or

```
c:> jar cvmf meta.txt app.jar .
```



Important Meta data

Main-Class:

- Specifies your main class within the jar

Class-Path:

- Specify additional class paths that you may need.

Running an application from a jar file that has Main-Class manifest entry

If your jar file has manifest entry you can use it to execute application simply by running

```
c:> java -jar app.jar
```

- This command automatically runs class mentioned in Main-Class of manifest.

Method 3 -- inject Main Class Manifest only

- In case you just want to specify MainClass to manifest and not other details such as version, author etc you have an alternative jar creation syntax

```
c:> jar cvef in.conceptarchitect.app.FurnitureApp app.jar .
```

- "e" stands for entry point or Main-Class
- You must specify the main class
- This is automatically added in Manifest.mf as Main-Class:
 - You don't need to create a meta.txt file just to specify Main-Class
 - If you have to specify other information, you need to specify manifest

Assignment04

Tuesday, October 20, 2020 5:22 PM

- Create a class to represent a Bank Account
- A Bank Account will have
 - Account number
 - Name
 - Password
 - Balance
 - Interest rate
- A bank account will support following operations
 - Create an account
 - Deposit money
 - Should fail if amount ≤ 0
 - Withdraw money
 - Should fail if
 - Amount ≤ 0
 - Amount > balance
 - Password supplied doesn't match
 - Credit interest (one month interest)
 - Formula: **balance=balance*rate/1200**
 - Provide getters/setters e.g.
 - Account number can't change in future
 -
- Write a main program to test bank account details (menu driven)

Coding Conventions

Wednesday, October 21, 2020 10:00 AM

- Conventions are not syntactical compulsions.
- Violating convention doesn't cause compile time or runtime error.
- They simply make your code harder to
 - Read
 - Maintain
 - Debug
- Conventions are followed throughout developer community
- When we violate conventions other developers find it difficult to follow my codes

1. Package naming

- Your package name should be all lower case letter
- Package Name should start with two top level brand identity in reverse order or your domain
 - Eg.
 - com.javapeople
 - in.conceptarchitect
 - org.apache
 - In your design you can assume a domain such as
 - in.you-name or org.your-company
- Your business name should be a package at the depth 3.
- Don't use unbranded package names
- Don't use single layer brands
 - Instead of ~~com.app~~ use **com.javadev.finance.app**
- A package name groups a set of classes
 - Package name should represent the purpose of that grouping
 - com.javadev.finance.data.Table
 - com.javadev.finance.ui.Table
- You may use a super package **com.javatraining**

2. Class Naming

- Your class name should follow Pascal Naming Convention
 - Class Name should begin with an upper case letter
 - Triangle
 - Factorial
 - If using More than one word in class name
 - Each word should begin with upper case letter
 - Example
 - ◆ RaceCar
 - ◆ LinkedList
 - ◆ SortedArray
 - Names should be
 - Meaningful

- Avoid an abstract name for a concrete class
 - Your name should tell what is the purpose of the class
- Avoid
 - Names with all upper case letters unless you have very good reason like your class represents and Acronym
 - ◆ CID
 - ◆ GUID
 - DON'T USE snake case naming
 - ◆ Name where multiple words are separated by underscore (_)

3. Method Names

- Your method name should follow **Camel Naming Convention**
 - **Should begin with an lower case letter**
 - calculate()
 - show()
 - If using More than one word in class name
 - Each word starting second should begin with upper case letter
 - Example
 - ◆ getBalance()
 - ◆ toString()
 - ◆ createSavingsAccount()
 - Names should be
 - Meaningful
 - Avoid an abstract name for a concrete class
 - Your name should tell what is the purpose of the class
 - Avoid
 - Names with all upper case letters unless you have very good reason like your class represents and Acronym
 - ◆ generateGUID()
 - DON'T USE snake case naming
 - ◆ Name where multiple words are separated by underscore (_)
 - **Sometimes to highlight an private operation the name may begin with an underscore**
 - ◆ **Acceptable. But avoid if you can**

4. Field Names

- Your field name should follow **Camel Naming Convention**
 - **Should begin with an lower case letter**
 - balance
 - amount
 - If using More than one word in class name
 - Each word starting second should begin with upper case letter
 - Example
 - ◆ intrestRate
 - Names should be
 - Meaningful
 - Avoid an abstract name for a concrete class
 - Your name should tell what is the purpose of the class
 - Avoid
 - Names with all upper case letters unless you **are defining a constant**
 - ◆ PI
 - ◆ MAX
 - DON'T USE snake case naming

- ◆ Name where multiple words are separated by underscore (`_`)
- **Sometimes to highlight an private operation the name may begin with an underscore**

What is Object Oriented Programming? (Popular Perception)

Wednesday, October 21, 2020 10:27 AM

Participants Feedbacks

- Creating Objects that contains data and logic
- Programming with class and objects
- Real world objects like car etc.

- Why do I create an object for data and logic?
- Why not create logic as functions and data as simple structure like in C language?

- Why should I really program class and objects?
- Why do we call it **object oriented programming** and not **class oriented programming** or **class and object oriented programming**.

- Why do we need real world entities?
 - Because we program to solve a real world problem

What is a Program?

A set of instructions
Given to computer
For solving a problem.

- Where is object in (the definition) of Program?
- Why is there no reference to either object or class in definition of a Program?

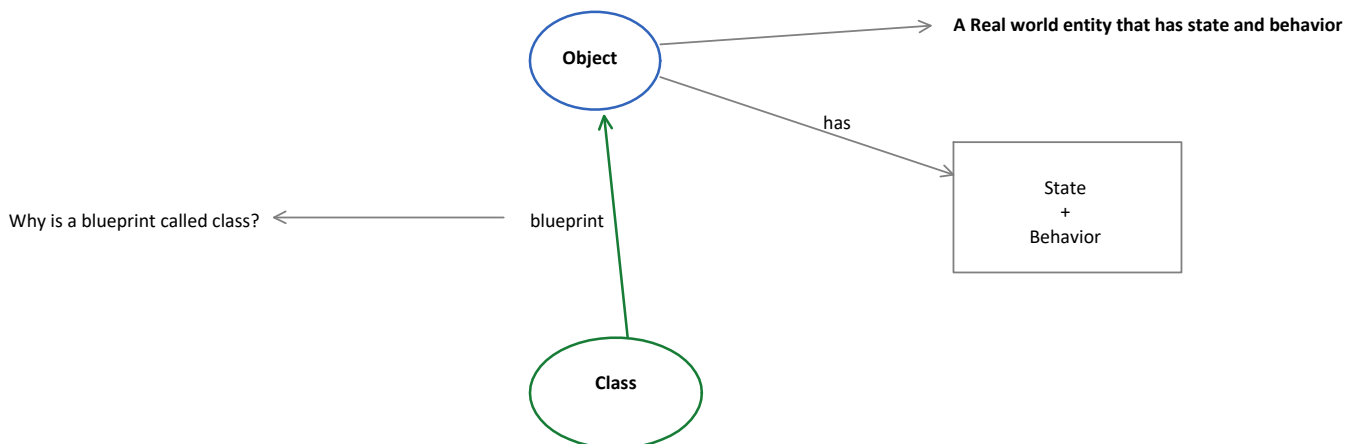
What is an Object Oriented Program?

A **set of instructions** constructed by using **classes** and creating ~~blueprint of that class called~~ an **objects** to use the functionalities available in that class.

Three important words in the definition in decreasing order of priority

1. set of instruction
2. class
3. object

What is an Object?



Let's talk about a real world Object

Yamaha Alien —> A New Bike

- Colors
- Mileage
- CC
- Cost
- BHP
- AT/MT

What is the source of your knowledge about Bike?

- Because you use it

Dinasourous?

- Animal that existed years ago
- Lived in Jurassic park

What is the source of your knowledge about Dinasourous?

- Have you seen it?
 - Movies
 - Wikipedia

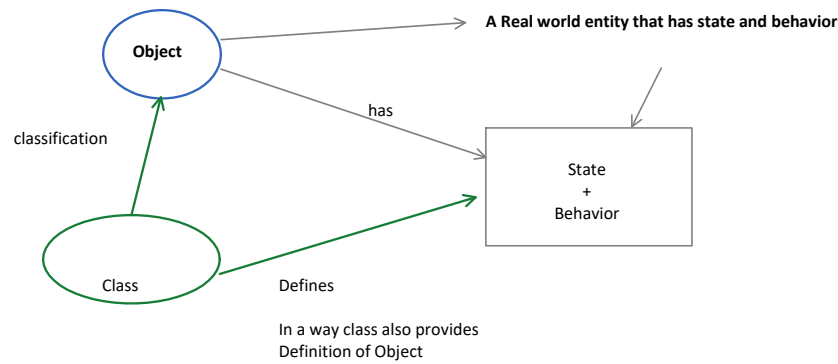
Object Oriented Design

Wednesday, October 21, 2020 10:57 AM

Domain
The problem space

Object

- Represents a Real World Physical Entity
- Object represents a Domain Entity
- An Object can be
 - Real World Physical --> Employee
 - Real World Non Physical --> Department
 - Non Real Physical --> Magic Wand
 - None Real World Non Physical --> Magic Wand
- Has its State and Behavior
- Object is anything/everything that you can conceptualize



Class

- Class stands for Classification
- Class is the basis of object classification
- It defines parameters for such classification
 - State
 - behaviors

What comes First — Object or Class?

LET'S DESCRIBE AN OBJECT

- Imagine A new to be launched Bike, whose brochures are yet to be released.
- What question would you ask about the technical specification of this bike?
 - Mileage
 - CC
 - BHP
 - Break?
- How do you know What questions to ask?
 - Experience with Other Bikes

Handwritten notes: A blue circle around 'Experience with Other Bikes' has an arrow pointing to the question 'How do you know What questions to ask?'. A green bracket groups the technical specifications with the question 'What question would you ask about the technical specification of this bike?'. The word 'basis' is written in green below the bracket.

- Do we realize this is where we create a **class**?
- How do you decide what property you will have in the class?

You use your knowledge/experience With existing objects to create the class definition

- Is this Bike a class or an object?
 - It's an object that you have used.

Why class comes first?

- Class is a language of feature of popular object oriented language like
 - C++
 - Java
 - C#
- It is a semntical compulsion but **not a real requirement** for Object Oriented Programming
 - Remember we call is Object Oriented and not class Oriented
- There are Object Oriented langauges where Class doesn't even exist
 - Javascript
 - New version has class, but that's optional

Creating An Object

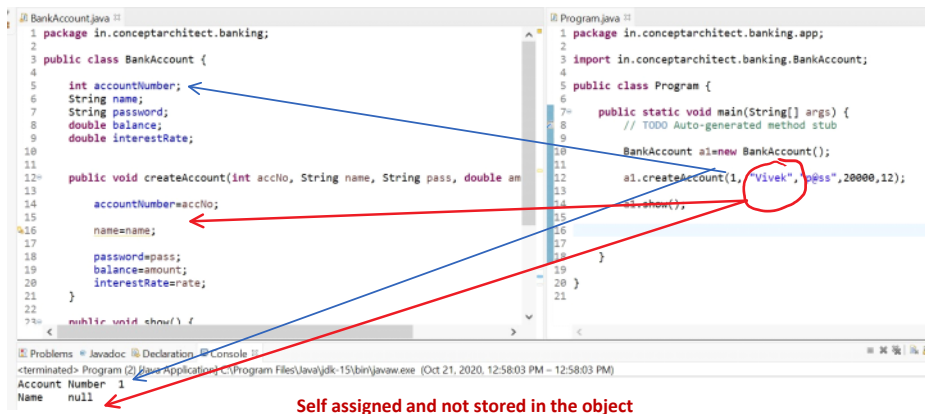
Wednesday, October 21, 2020 12:48 PM

```
public class BankAccount {  
    int accountNumber;  
    String name;  
    String password;  
    double balance;  
    double interestRate;  
  
    void createAccount(int accNo, String name, String pass, double amount, double rate) {  
        accountNumber=accNo;  
        name=name;  
        password=pass;  
        balance=amount;  
        interestRate=rate;  
    }  
}
```

What will this code do?

name=name;

- Whenever you have two different names in a given context a local (near) one is preferred over far one.
- In this case name refers to parameter that is passed which is closer to function than the class members.
- Here it would end up as a self assignment of function parameter.
 - The code has No effect.



Self assigned and not stored in the object

Solution

Option 1

- Don't use same name for parameter and the class fields (states)

Option 2 (PREFERRED)

- Use **this** keyword
 - "this" is a special keyword in an object method that represents the current object
 - So a "this.name" would always represent an object's property and not a method argument
 - You can always use "this" with any class field or method
 - We generally use it only to distinguish between method argument and properties.

```
public class BankAccount {  
    int accountNumber;  
    String name;  
    String password;  
    double balance;  
    double interestRate;  
  
    public void createAccount(int accountNumber, String name, String password, double amount, double rate) {  
        this.accountNumber=accountNumber;  
        this.name=name; //this.name is class field, name is argument  
        this.password=password;  
  
        this.balance=amount; //this is not required as balance has no conflict  
        interestRate=rate; //this is not required  
    }  
  
    public void show() {  
        System.out.println("Account Number:" + this.accountNumber); //this is not required  
    }  
}
```

If there is a name conflict explicit use of **this** is required.

When there is no name conflict

- **this** is optional and implicit.
- Even when you don't write this, you mean this as


```

    }
    interestRate=rate; //this is not required
}

public void show() {
    System.out.println("Account Number\t"+this.accountNumber); //this is not required
    System.out.println("Name\t"+name); //this is not required
    System.out.println("Password\t"+password); //this is not required
    System.out.println("Balance\t"+balance); //this is not required
    System.out.println("Interest Rate\t"+interestRate); //this is not required
}

public void deposit() {
    //TODO: write the deposit logic
}
}

```

When there is no name conflict

- **this** is optional and implicit.
- Even when you don't write this, you mean this as implicit.
- You can write explicit this
- You can write without this

Value Type Vs Reference

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In Java Script a variable can be of two types

Value Types

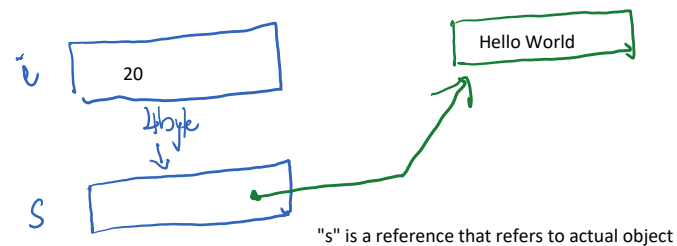
- A primitive data type is called value types.
- They are stored directly in the variable memory
- These include built-in data types such as
 - int
 - float
 - double
 - char
 - byte
 - Boolean

Reference Type

- It represents all complex data type which are created as class
- This also includes all user defined data types
- Variable stores the reference (address) of the actual object that would store value

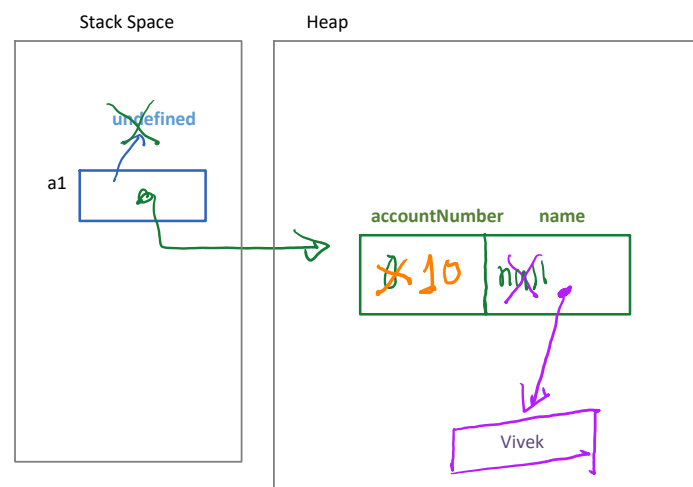
Example 1 -- int is value type, String is reference type

```
public static void main(String [] args){  
    int i=20;  
    String s="Hello World";  
}
```



Example 2 — User defined Object

```
class BankAccount{  
    int accountNumber;  
    String name;  
}  
  
void main(){  
    BankAccount a1; //draw memory model here  
    a1= new BankAccount(); //draw memory model here  
    a1.accountNumber=10; //draw memory model here  
    a1.name="Vivek"; //draw memory model here  
}
```



Assignment 5 -- Draw the Memory Snapshot for Following code

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```
class BankAccount{  
    int accountNumber;  
    String name;  
}  
  
void main(){  
    BankAccount a1; //draw memory snapshot 1  
    a1= new BankAccount(); //draw memory model snapshot2  
    a1.accountNumber=10; //draw memory snapshot 3  
    a1.name="Vivek"; //draw memory snapshot 4  
}
```

- You can create a single diagram and use 4 different color to define the 4 stage of memory allocation
- You may create 5 different diagrams

When is Object Created?

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```
BankAccount.java
1 package in.conceptarchitect.banking;
2
3 public class BankAccount {
4
5     int accountNumber;
6     String name;
7     String password;
8     double balance;
9     double interestRate;
10
11     public void createAccount(int accNo, String name, String pass, double am
12
13         accountNumber=accNo;
14
15         name=name;
16
17         password=pass;
18         balance=amount;
19         interestRate=rate;
20
21     }
22
23     public void show() {
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```

Default Constructor is removed if we provide our own constructor

```
BankAccount.java
1 public class BankAccount {
2
3     int accountNumber;
4     String name;
5     String password;
6     double balance;
7     double interestRate;
8
9     public BankAccount(int accountNumber, String name, String password, double amount, double rate) {
10         createAccount(accountNumber, name, password, amount, rate);
11     }
12
13     public void createAccount(int accountNumber, String name, String password, double amount, double rate) {
14
15         this.accountNumber=accountNumber;
16         this.name=name; //this.name is class field, name is argument
17         this.balance=amount;
18         this.interestRate=rate;
19     }
20 }

```

Once we define our own constructor

```
Program.java
1 import in.conceptarchitect.banking.BankAccount;
2
3 public class Program {
4
5     public static void main(String[] args) {
6         // TODO Auto-generated method stub
7
8         BankAccount a1=new BankAccount();
9
10        a1.createAccount(1, "Vivek","p@ss",20000,12);
11    }
12 }

```

The Default constructor is removed

Right way to call the constructor

```
BankAccount.java
1 public class BankAccount {
2
3     int accountNumber;
4     String name;
5     String password;
6     double balance;
7     double interestRate;
8
9     public BankAccount(int accountNumber, String name, String password, double amount, double rate) {
10         createAccount(accountNumber, name, password, amount, rate);
11     }
12
13     public void createAccount(int accountNumber, String name, String password, double amount, double rate) {
14
15         this.accountNumber=accountNumber;
16         this.name=name; //this.name is class field, name is argument
17         this.balance=amount;
18         this.interestRate=rate;
19     }
20 }

```

```
Program.java
1 import in.conceptarchitect.banking.BankAccount;
2
3 public class Program {
4
5     public static void main(String[] args) {
6         // TODO Auto-generated method stub
7
8         BankAccount a1=new BankAccount(1, "Vivek","p@ss",20000,12);
9
10        //a1.createAccount(1, "Vivek","p@ss",20000,12); //no need to call this line
11        a1.show();
12    }
13 }

```

Constructor vs createAccount

- What to use?
- If we see our code, my constructor is calling createAccount.
- Why should I create constructor if I already have a createAccount()

Constructor Advantages

1. Constructor merges Programming creation with domain creation
2. Both constructor and create logic are executed at the same time.
3. Constructor is called only once for an object at the beginning.
4. Problem with creator
 - a. You may forget to call the method
 - i. Object will be invalid till you call it
 - b. You may call create method more than once for the same object
 - i. This is not desirable.

```
BankAccount.java
1 public class BankAccount {
2
3     int accountNumber;
4     String name;
5     String password;
6     double balance;
7     double interestRate;
8
9     public BankAccount(int accountNumber, String name, String password, double amount, double rate) {
10         createAccount(accountNumber, name, password, amount, rate);
11     }
12
13     public void createAccount(int accountNumber, String name, String password, double amount, double rate) {
14
15         this.accountNumber=accountNumber;
16         this.name=name; //this.name is class field, name is argument
17         this.balance=amount;
18         this.interestRate=rate;
19     }
20 }

```

```
Program.java
1 import in.conceptarchitect.banking.BankAccount;
2
3 public class Program {
4
5     public static void main(String[] args) {
6         // TODO Auto-generated method stub
7
8         BankAccount a1=new BankAccount(1, "Vivek","p@ss",20000,12);
9
10        //a1.createAccount(1, "Vivek","p@ss",20000,12); //no need to call this line
11        a1.show();
12    }
13 }

```

Object Modelling

Wednesday, October 21, 2020 3:40 PM

```
BankAccount.java
80 System.out.println("Invalid Amount. Deposit Failed");
81 }
82 }
83 }
84 }
85 public void withdraw() {
86 // 1000 Auto-generated method stub
87 Input input=new Input();
88
89 int amount=input.readInt("Amount to withdraw");
90 String password=input.readString("password");
91
92 if(!this.password.equals(password)) {
93 System.out.println("Invalid credentials");
94 return ;
95 }else if(amount<=0) {
96 System.out.println("Invalid denomination. please enter positive");
97 }
98 }else if(amount> balance) {
99 System.out.println("Insufficient Funds");
100 }
101 }else {
102 balance-=amount;
103 System.out.println("please collect your cash");
104 }
105 }
106 }
107 }
108 }
109 }
110 }
```

```
Program.java
12 //a1.createAccount(1, "Vivek", "p@ss",20000,12); //no need to call th
13
14
15 int choice=0;
16 Input input=new Input();
17 do {
18
19 choices=input.readInt("1. Deposit\n2. Withdraw\n3.Credit Interest\n");
20
21 switch(choice) {
22 case 1:
23 a1.deposit();
24 break;
25 case 2:
26 a1.withdraw();
27 break;
28 case 3:
29 a1.creditInterest();
30 break;
31 case 4:
32 a1.show();
33 break;
34 case 0:
35 break;
36 default:
37 System.out.println("Invalid Input.Retry");
38 }
39 }
40 }
41 }
42 }
```

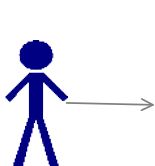
- There is Zero Interaction between Client (Program.java) and Service (BankAccount.java)

Problems

- Client has no way to know if withdraw was successful or it failed?
- Who is responsible for interacting with User?

Real world Banking Scenario

1. How will a user withdraw the money from his account?
 - o ATM
 - o Mobile App
 - o Web App (paying a bill is also withdrawing from account)
2. Where is BankAccount object stored?
 - a. Is **BankAccount** object stored in ATM memory?
 - i. No.
 - b. It is stored on the central Bank server on a remote location (Cloud)



ATM



BankAccount a1

BankServer

3. Where will Input and Print Statement Execute — on ATM or on Server?
 - a. On Server

Problem

- User has no access to the server
- User can reach server to type the input
- User can't see anything typed on the server console

Solution

- Don't include I/O logic (Input or print) in Business layer object
- Don't have any print statement in any not designed to display out
- BankAccount object should have BankAccount Business Logic But not User Interaction Logic
- User Interaction Logic should be present in Presentation layer object such as an ATM machine
- ATM machine should interact with Business objects behind the scene.

Assignment 06

Wednesday, October 21, 2020 3:59 PM

1. Add mechanism to get/set password from the BankAccount Object
2. Remove all the Input/Print from BankAccount object
3. Move all User Interaction to ATM Object main Function

How do I allow BankAccount Password accessed or Modified

```
package in.conceptarchitect.banking;

import in.conceptarchitect.utils.Input;

public class BankAccount {

    int accountNumber;
    String name;
    String password;
    double balance;
    static double interestRate;

    public String getPassword() {
        return password;
    }

    public void setPassword(String password) {
        this.password = password;
    }
}
```

- Anyone can call getPassword() and display it using System.out.println
- Not safe
- What is password is **salted**
 - Generally passwords are stored in an encrypted format in the database so that no one can know the true phrase of your password, including the admins
- Anyone can change your password without knowing your existing password.
- This makes password useless.

How should you model the password access/change mechanism

```
5 public class BankAccount {
6
7     int accountNumber;
8     String name;
9     String password;
10    double balance;
11    static double interestRate;
12
13
14
15
16    //Its a dummy and non-secured logic for password hashing just to demonstrated
17    //the idea. Search for password hashing algorithm for better logic
18*   private String salt(String password) {}
19
20*   public boolean authenticate(String password) {
21*       return salt(password).equals(this.password);
22*   }
23
24*   public boolean changePassword(String oldPassword, String newPassword) {
25*       if(authenticate(oldPassword)) {
26*           password=salt(newPassword);
27*           return true;
28*       }else
29*           return false;
30*   }
31
32
33
34
35
36
37
38
39
40
41 }
42
```

Don't give them password. You ask them a password and confirm if it is the correct password.

Before you change the password, authenticate user with current password and then change

Assignment 07

Wednesday, October 21, 2020 4:00 PM

- Introduce ATM object to include User interaction logic
- ATM should take user Input and interact with BankAccount Object

Static Vs NonStatic in Java

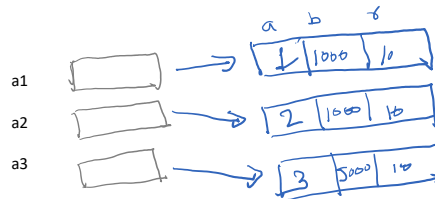
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Consider a BankAccount class

```
class BankAccount{
    int accountNumber;
    double balance;
    double rate;
}
```

What happens if I create 3 BankAccount Objects?

```
BankAccount a1=new BankAccount(1,1000,10);
BankAccount a2=new BankAccount(2,1000,10);
BankAccount a3=new BankAccount(3,5000,10);
```



If you have 10000 different BankAccount objects, is it probable that

- Some of them will have same balance?
 - YES
 - May be but a coincidence
 - Each object will have their own balance
- All of them will have same balance?
 - No
- One or more of them has same name?
 - YES
 - Same name may just be a coincidence
- Same account number
 - NEVER
- Same rate of interest?
 - ALWAYS
 - For same type of account you would get same interest

Problem!

- Why should I create 10000 copies of same value?

Static Field

- A field that is marked static is a shared field in the class.
- There will be a single copy of that field irrespective of number of objects have
- We call them class level member
- Non static fields are called instance members or object level members
- They are not initialized by constructor, rather by static block

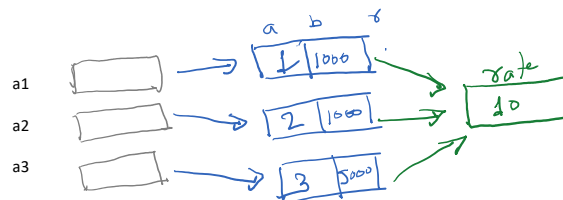
Note!

- Use static to create those states which are common and shared for all object of a class

```
class BankAccount{
    int accountNumber;
    double balance;
    static double rate;
}
```

```
void main(){
    BankAccount a1=new BankAccount(1,1000,10);
    BankAccount a2=new BankAccount(2,1000,10);
    BankAccount a3=new BankAccount(3,5000,10);
}
```

A special copy each non-static or instance member is created per object call



Each instance will access a common copy of the static field or class level field

Non-static interest Rate

```

// BankAccount.java
package in.conceptarchitect.banking;
import in.conceptarchitect.util.Input;

public class BankAccount {
    int accountNumber;
    String name;
    String password;
    double balance;
    double interestRate;

    public int getAccountNumber() {
        return accountNumber;
    }
}

// Program.java
package in.conceptarchitect.banking.app;
import in.conceptarchitect.banking.BankAccount;
import in.conceptarchitect.util.Input;

public class Program {
    public static void main(String[] args) {
        // TODO Auto-generated method stub
        //menuDrivenProgram();

        BankAccount a1=new BankAccount(1,"Vivek","p@ss", 10000,10);
        BankAccount a2= new BankAccount(1,"Vivek","p@ss", 10000,10);
        System.out.println("Interest rate for a1\t"+a1.getInterestRate());
        System.out.println("Interest rate for a2\t"+a2.getInterestRate());

        a1.setInterestRate(12);

        System.out.println("Interest rate for a1\t"+a1.getInterestRate());
        System.out.println("Interest rate for a2\t"+a2.getInterestRate());

        //menuDrivenProgram();

        private static void menuDrivenProgram() {
            BankAccount a1=new BankAccount(1, "Vivek", "p@ss",20000,12);
        }
    }
}

```

- Each Object maintains its own copy of the object state.
- Change in one doesn't change value for others.

```

// BankAccount.java
package in.conceptarchitect.banking;
import in.conceptarchitect.util.Input;

public class BankAccount {
    int accountNumber;
    String name;
    String password;
    double balance;
    static double interestRate;

    public int getAccountNumber() {
        return accountNumber;
    }
}

// Program.java
package in.conceptarchitect.banking.app;
import in.conceptarchitect.banking.BankAccount;
import in.conceptarchitect.util.Input;

public class Program {
    public static void main(String[] args) {
        // TODO Auto-generated method stub
        //menuDrivenProgram();

        BankAccount a1=new BankAccount(1,"Vivek","p@ss", 10000,10);
        BankAccount a2= new BankAccount(1,"Vivek","p@ss", 10000,10);
        System.out.println("Interest rate for a1\t"+a1.getInterestRate());
        System.out.println("Interest rate for a2\t"+a2.getInterestRate());

        a1.setInterestRate(12);

        System.out.println("Interest rate for a1\t"+a1.getInterestRate());
        System.out.println("Interest rate for a2\t"+a2.getInterestRate());

        //menuDrivenProgram();

        private static void menuDrivenProgram() {
            BankAccount a1=new BankAccount(1, "Vivek", "p@ss",20000,12);
        }
    }
}

```

Changing Value for one changes for everyone

- What is this code doing?
 - Changing the interest rate for a1 or for everyone?

Problem

- It appears to be changing the rate for only a1.
- Actually its changing for everyone

Remember

- If you cant understand what a code is doing, you can manage code

Static Methods

- Just like a fields, a method can also be static.
- A static method belongs to class.
- A static method doesn't contain "this" reference
- A static method can't access any non-static field or methods
- Both static and non-static method have only one copy present in memory.
 - Static method doesn't help us save memory

| S.No | Feature | Static Method | Non Static Method |
|------|---|---------------|-------------------|
| 1 | No of copies in memory | 1 | 1 |
| 2 | this reference | NO | YES |
| 3 | Accessing Static properties and methods | YES | YES |
| 4 | Accessing non-static properties and methods | NO | YES |
| 5 | Calling using object reference | YES | YES |
| 6 | Calling using class reference | YES | NO |
| 7 | Object required | NO | YES |

Why do I need static methods?

- You can call the method using Class Reference
- When a method is changing a value for entire class, it is logical that you call the method using class name rather than individual object name.

```

// BankAccount.java
package in.conceptarchitect.banking;
import in.conceptarchitect.util.Input;

public class BankAccount {
    int accountNumber;
    String name;
    String password;
    double balance;
    static double interestRate;

    public int getAccountNumber() {
        return accountNumber;
    }

    //no set balance, to set balance use deposit or withdraw
    //get set interest rate
    public static double getInterestRate() {
        return interestRate;
    }

    public static void setInterestRate(double interestRate) {
        BankAccount.interestRate = interestRate;
    }
}

// Program.java
package in.conceptarchitect.banking.app;
import in.conceptarchitect.banking.BankAccount;
import in.conceptarchitect.util.Input;

public class Program {
    public static void main(String[] args) {
        // TODO Auto-generated method stub
        //menuDrivenProgram();

        BankAccount a1=new BankAccount(1,"Vivek","p@ss", 10000,10);
        BankAccount a2= new BankAccount(1,"Vivek","p@ss", 10000,10);
        System.out.println("Interest rate for a1\t"+a1.getInterestRate());
        System.out.println("Interest rate for a2\t"+a2.getInterestRate());

        //It appears to change rate only for object "a1"
        //it is actually changing rate for everyone
        //Bad code! Unreadable
        //unclear code
        a1.setInterestRate(12);

        //logically clear code
        BankAccount.setInterestRate(12);

        System.out.println("Interest rate for a1\t"+a1.getInterestRate());
        System.out.println("Interest rate for a2\t"+a2.getInterestRate());

        //menuDrivenProgram();

        private static void menuDrivenProgram() {
            BankAccount a1=new BankAccount(1, "Vivek", "p@ss",20000,12);
        }
    }
}

```

This code is allowed in Java And it defeats the purpose of static as a class level method can still be called using Object reference.

Recommendation!

- Avoid using object reference for static methods

Initializing Static Data

- Don't initialize static data in constructor
 - Constructor is called for every object
 - Static data is a single shared copy

Option 1

- Initialize by assigning a constant value wherever you declared static
- This should be used if the initial value is const

```
class BankAccount{  
  
    static double interestRate=10;  
  
}
```

Option 2

- We may need to get initial value from database or calculate them before use
- In such cases we should use static initialization block

```
1 package in.conceptarchitect banking;  
2  
3 import in.conceptarchitect.utils.Input;  
4  
5 public class BankAccount {  
6  
7     int accountNumber;  
8     String name;  
9     String password;  
10    double balance;  
11    //static double interestRate=10; //Initializing static member (if it is a constant value  
12  
13    //write one-time initialization logic to initialize your static data  
14    //It is called before any constructor is called and as soon as class is loaded in the memory  
15    static {  
16        System.out.println("BankAccount initialized...");  
17        interestRate=10;  
18        //can't initialize non-static fields  
19    }  
20  
21    //It's a dummy and non-secured logic for password hashing just to demonstrated  
22    //the idea, search for password hashing algorithm for better logic  
23    private String hashing(String password) {  
24        String res="";  
25        for(int i=0;i<password.length();i++) {  
26            char ch=password.charAt(i);  
27            int i=Character.getNumericValue(ch);  
28            res+=Integer.toString(i);  
29        }  
30    }  
31}
```

- Static block is invoked exactly once when the class is loaded
- It is done before any constructor or other methods of the class is called
- It can have logic for static initialization
- **It can't access any non-static member of the class**

Static Field Use Cases

- Share Common Data Between Objects
- Let object connect with each other based on that shared information

```
1 BankAccount.java 20 Program.java  
2 import in.conceptarchitect.utils.Input;  
3  
4 public class BankAccount {  
5  
6  
7  
8     int accountNumber;  
9     String name;  
10    String password;  
11    double balance;  
12  
13    static int accountCount=0; //initialized with a constant  
14  
15    static double interestRate; //what is this value is pulled from a database and not a constant  
16  
17    static {  
18        //write one-time initialization logic to initialize your static data  
19        //It is called before any constructor is called and as soon as class is loaded in the memory  
20  
21        System.out.println("BankAccount initialized...");  
22        interestRate=10;  
23        //accountNumber=5; //can't initialize non-static fields  
24    }  
25  
26  
27  
28  
29    public BankAccount( String name, String password, double amount) {  
30  
31        this.accountNumber=++accountCount; //uses shared field to auto increment account number  
32        this.name=name;  
33        this.password=salt(password); //we are saving a hashed/salted password and not the original one  
34  
35        this.balance=amount;  
36        //interestRate=rate; //static members are not initialized in constructor  
37    }  
38  
39  
40}
```

- Any change in Interest rate is done at one place
- Every object gets to use this value.
- They all share the interestRate like a constant for them
- Remember static is not constant. Its common or shared.

- Can be used coordinating between object
- We can have things like auto increment values which can help assign unique ids
- We can also have a common block where one object can put some information and other object can pull the information from that common block.
- Here object constructor increments the common value (not-constant)
- The next constructor uses the incremented value to further increment it

Static Method Usage

There are three popular usage of Static Methods

1. Define a generic function that is not connected any object
 - a. These are independent functions similar to a procedural programming
 - b. Examples:
 - i. public static void main(String []args)
 - ii. All Math formula present in Math class like **Math.pow()**
2. To access or modify static fields
 - a. Since you have static fields, they need to be modified or accessed event without object
 - b. To access or modify them it is better to create static methods
 - c. Example:

Why is main() static?

- main() is the first function that is called in your application.
- It is called by the JVM
- At this stage there is no one to create an object of the class
- JVM simply calls **Program.main()**
 - It doesn't need to create an object of the Program class

Important!

- Static fields can be accessed even using non-static method
- The problem is
 - You need at least one object to call them
 - The operation may look like applied on one object rather than on all object

2. To access or modify static fields

- Since you have static fields, they need to be modified or accessed even without object
- To access or modify them it is better to create static methods
- Example:
 - BankAccount.setInterestRate()
 - BankAccount.getTotalAccounts()

3. To coordinate the interaction between multiple objects

- What if I want to write a **transferFunds** method that transfers money from one account to another?
- We can do it using BankAccount.transfer(a1,a2,amount,password);

```
public static boolean transfer(BankAccount source, double amount, String password, BankAccount target) {  
    if (source.withdraw(amount, password)) {  
        target.balance += amount;  
        return true;  
    } else {  
        return false;  
    }  
}
```

Concerns

- Here we are accessing non-static members in static block
 - Non-static method
 - Non-static field
- But static methods can't access non-static members. Right? How is it working?

Remember!

- You can't access non-static member **directly**
- Here we are **not** accessing those fields or methods
- We are calling the object and its methods
 - source.withdraw()
 - target.balance += amount
- I can't access withdraw() or balance directly
- Here since object is involved, it's not a static context

Use Static or Not?

- Do we agree
 - interestRate is not owned by **bank account object**?
 - You own your name, password and balance
 - But you don't own or control interest rate
 - You certainly get the benefit of the interest rate
 - Bank account object can't know the **account count**?

Concerns

- If an object doesn't own a property (that is why it is static), why is it present in the class?
 - A static element is not owned by object, it is owned by the class
- Remember! A class is just the definition of an object
 - If it is not present in the object, why is it present in the class?

BankAccount doesn't know or own account count. Who owns it? Who controls interest rate?

- Bank
 - A bank opens the accounts
 - A bank maintains a list of opened accounts
 - A bank provides interest on the accounts
 - Interest rate and account count should be the property of a Bank object
 - Different bank can provide different rate of interests they choose

```
class BankAccount{  
    static int accountCount;  
    static double interestRate;  
  
    int accountNumber;  
    double balance;  
    String name;  
    String password;  
  
    static double getInterestRate(){return interestRate;}  
    static int getAccountCount(){ return accountCount;}  
  
    public boolean deposit(double amount){  
        ...  
    }  
  
    public BankAccount(...){  
    }  
}  
  
class Bank{  
    static int accountCount;  
    static double interestRate;  
  
    static double getInterestRate(){return interestRate;}  
    static int getAccountCount(){ return accountCount;}  
}
```

Remember — Every static member of class X is actually part of some other object y of class Y

- In real world there is no real use case of static
- Static means no object or class level

- But classes are not real. They are just notions (abstract ideas)

Should I create 'Bank' class only because I want to keep my interest rate and account count there.

- No.
- You need Bank
 - You can't create an bank account object yourself
 - You need to go to some bank to open your account
 - You can't withdraw money from your account directly
 - You need to go to bank to deposit/withdraw the money
 - Bank mains a list of all the accounts that it has opened.

Object Model 02

Thursday, October 22, 2020 10:09 AM



Connect to



Create and stores

Access the right account
and performs transactions
like deposit/withdraw
etc

| DATE | DESCRIPTION | AMOUNT | BALANCE |
|------------|-------------|--------|---------|
| 2020-10-20 | DEPOSIT | 100.00 | 100.00 |
| 2020-10-21 | WITHDRAW | 50.00 | 50.00 |
| 2020-10-22 | DEPOSIT | 20.00 | 70.00 |
| 2020-10-23 | WITHDRAW | 30.00 | 40.00 |
| 2020-10-24 | DEPOSIT | 10.00 | 50.00 |

ATM

Bank

BankAccount

User

1. Allows you to interact with your BankAccount
2. Takes User Input
3. Sends request to Bank
4. Gets Response from Bank
5. Dispense cash if required.
6. Operations
 - a. Insert Your Card (Provide Account Number)
 - b. Main Menu
 - i. Deposit
 - 1) Enter Deposit Details
 - ii. Withdraw
 - 1) Enter Amount
 - 2) Enter Pin
 - iii. Balance Info

1. Creates (opens) an account
2. Stores the account for future
3. Allows you to transact with your account
 - a. Deposit
 - b. withdraw

1. Stores information about individual BankAccounts
2. Can be accessed only by the BankObject
3. Customer or ATM interacts with this object using BankObject

What is the role of main function here?

- It is to setup the ATM and BankAccount and Bank Object

```
class Bank{  
  
    int accountCount;  
    double interestRate;  
  
    BankAccount [] accounts;  
    double getInterestRate(){return interestRate;}  
    int getAccountCount(){ return accountCount;}  
  
    int openAccount(String name, String pass, int amount){  
        int id=++accountCount;  
        BankAccount newAccount=new BankAccount(id,name,pass,amount);  
        //store a list of bank account in bank object  
    }  
  
    boolean withdraw( int accountNumber, double amount, String password){  
        BankAccount acc= getAccountById(accountNumber);  
        return acc.withdraw(amount,password);  
    }  
  
}
```

```
class BankAccount{  
  
    int accountNumber;  
    double balance;  
    String name;  
    String password;  
  
    public BankAccount(...){  
    }  
  
    public boolean withdraw(double amount, String password){  
        ...  
    }  
  
}
```

Assignment 08

Thursday, October 22, 2020 10:47 AM

- In our current BankAccount user is specifying the account Number
- This may conflict between to different account as they may choose same account number
- Create a design to auto assign and auto incremented account number to every bank account that is created
- Constructor shouldn't take account number from the user.

Array

Thursday, October 22, 2020 12:53 PM

- An array is a continuous non-expanding list of values that can be accessed using zero based index

Creating an array

```
int [] numbers; //creates reference. No memory allocated
```

Allocating the memory

```
numbers= new int[5]; //allocates the memory
```

Accessing the array

```
numbers[2]=21;  
numbers[4]=33;
```

```
System.out.println(numbers[2]); //21  
System.out.println(numbers[1]); //0
```

Trying to Access invalid Index throws exception

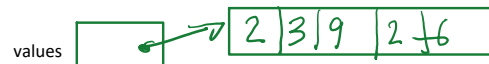
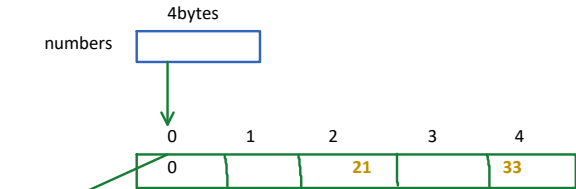
```
numbers[5]=29; //throws IndexOutOfBoundsException
```

```
numbers[-2]=29; //throws IndexOutOfBoundsException
```

```
System.out.println(numbers[21]); //throws IndexOutOfBoundsException
```

Initializing Array with Fixed Values

```
int[] values={2,3,9,2,6}
```



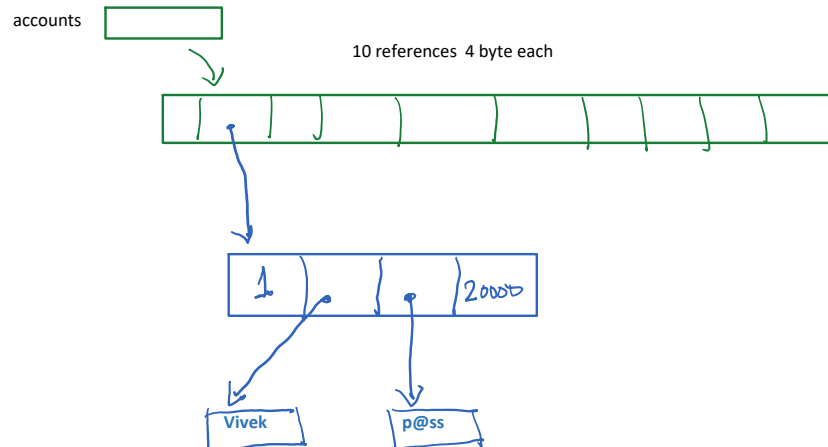
Array of Objects

- It uses the same style
- Creates an array of references
- Each reference refers to a different Object
- Objects will be stored in different memory

```
BankAccount accounts[] = new BankAccount[10];
```

Creating Actual Objects

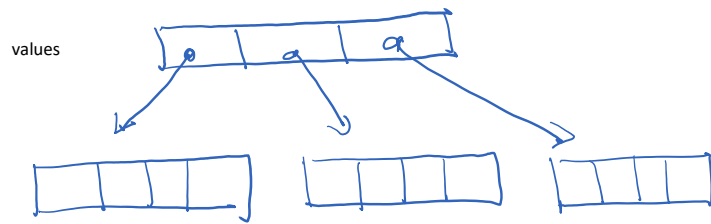
```
accounts[1]=new BankAccount(1,"Vivek","p@ss",20000);
```



Array of Array

- An Array can have another array as member
- This makes multi dimensional Array

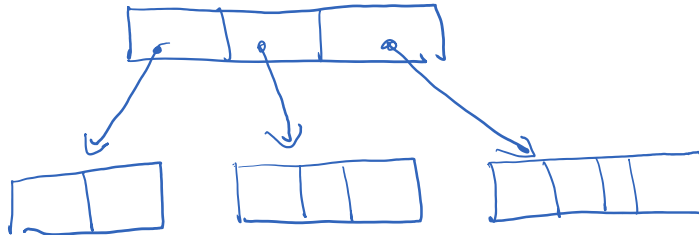
```
int [][] values= new int [3][4];
```



Non Rectangular array

```
int [] [] values= new int [3] [] ; //second is not given
```

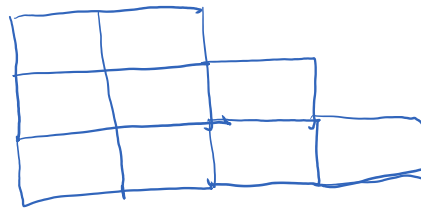
```
for (int i=0;i<values.length;i++)  
    value[i]= new int[i+2];
```



Conceptual View

Multi-dimensional array is rarely used
in Object Oriented Programming

- We generally use array of objects rather than array or arrays



String

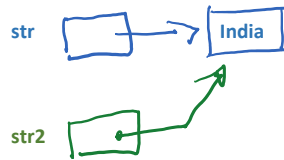
Thursday, October 22, 2020 1:14 PM

- Java Strings are immutable Objects
 - Once an object is created, it can't be modified in place
- Immutable design allows us to reuse the memory for a String object

Creating a string

```
String str="India";
```

```
String str2="India";
```



Since str2 is also the same immutable string, we will reuse it and not allocate a second memory

Important String methods

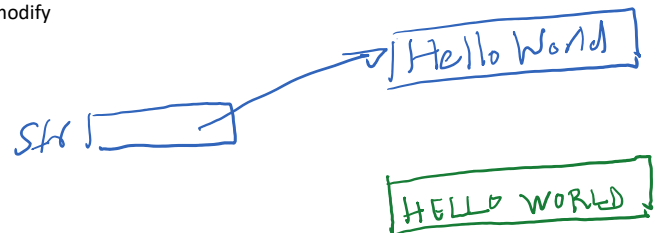
| | | |
|---|---------------|--|
| 1 | length() | Returns string length |
| | equals() | Compares if strings are equal (same) |
| | charAt() | Returns character at a 0 based index |
| | toUpperCase() | Converts String to upper case |
| | indexOf() | Index of another string into this string |
| | substr() | Returns a substring |
| | format() | Creates formatted strings with printf style syntax %s , %d etc |

String is immutable

- Any method that tries to change the string actually creates a new string and doesn't modify existing one

```
String str="Hello World";
```

```
str.toUpperCase();
```

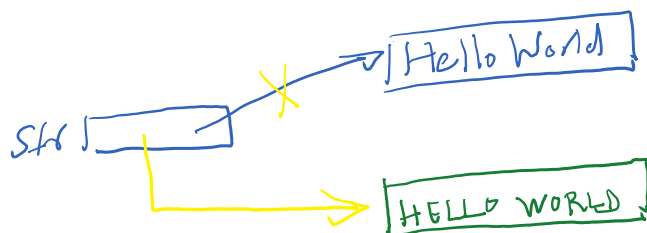


Note the changes are in a new memory. But no one refers this memory. So this change will not reflect anywhere and will be lost.

How to accept changes

```
String str="Hello World";
```

```
str=str.toUpperCase();
```



- Now str points to modified String

- The original string "Hello World" is no more referenced
 - It will be eventually garbage collected.

Assignment 09

Thursday, October 22, 2020 1:25 PM

Create the necessary classes to Implment Banking Project as Per the Object Model 2