CS6308- Java Programming

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Syllabus

MODULE III JAVA OBJECTS – 2	L	T	P	EL
	3	0	4	3
Inheritance and Polymorphism – Super classes and sub classes, overriding, object class and its methods, casting, instance of, Array list, Abstract Classes, Interfaces, Packages, Exception Handling				
SUGGESTED ACTIVITIES : • flipped classroom • Practical - implementation of Java programs – use Inheritance, polymorphism, abstract classes and interfaces, creating user defined exceptions • EL – dynamic binding, need for inheritance, polymorphism, abstract classes and interfaces				
SUGGESTED EVALUATION METHODS: • Assignment problems • Quizzes				

Object class methods and its purpose

Object clone()

Creates a new object that is the same as the object being cloned.

boolean equals(Object)

Compares two Objects for equality.

Void finalize()

Called by the garbage collector on an object to reclaim the memory of the unused object.

Class<?>getClass()

Returns the class of an object at run time.

int hashCode()

Returns a hash code value associated with the invoking object.

notify()

Resumes the execution of a single thread that is waiting on the invoking object.

notifyAll()

Resumes the execution of all threads that is waiting on the invoking object.

toString()

Returns a string that describes the object.

wait()

wait(long)

wait(long, int)

Waits to be notified by another thread of execution.

Clone() method of Object class

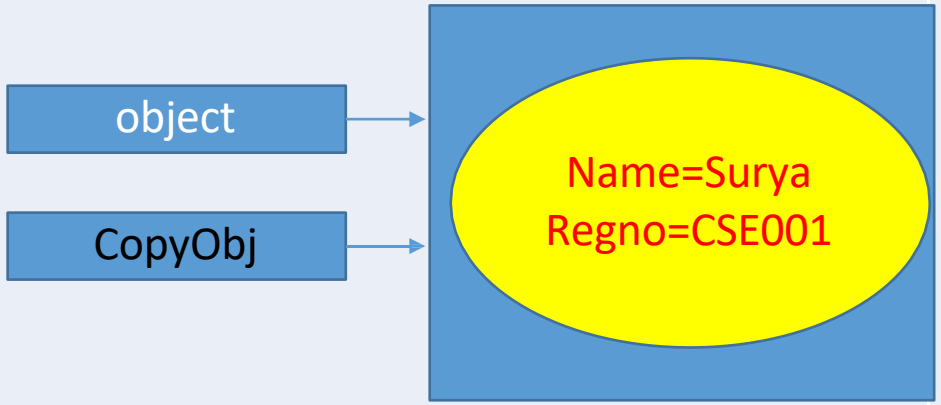
- protected Object clone() throws CloneNotSupportedException
- Object class is the super class of all the classes.
- Clone method of Object class creates an new copy of the object exactly same as the referred object by declaring that the class implements Cloneable interface otherwise throws CloneNotSupportedException
- Clone method can create shallow copy and Deep copy.
  - Returns: a clone of the object.
  - Throws: CloneNotSupportedException
    - In case if the object's class does not implement the Cloneable interface then the subclasses that override the clone method can throw this exception to indicate that an instance cannot be cloned.
  - Throws: OutOfMemoryError
    - if there is not enough memory.

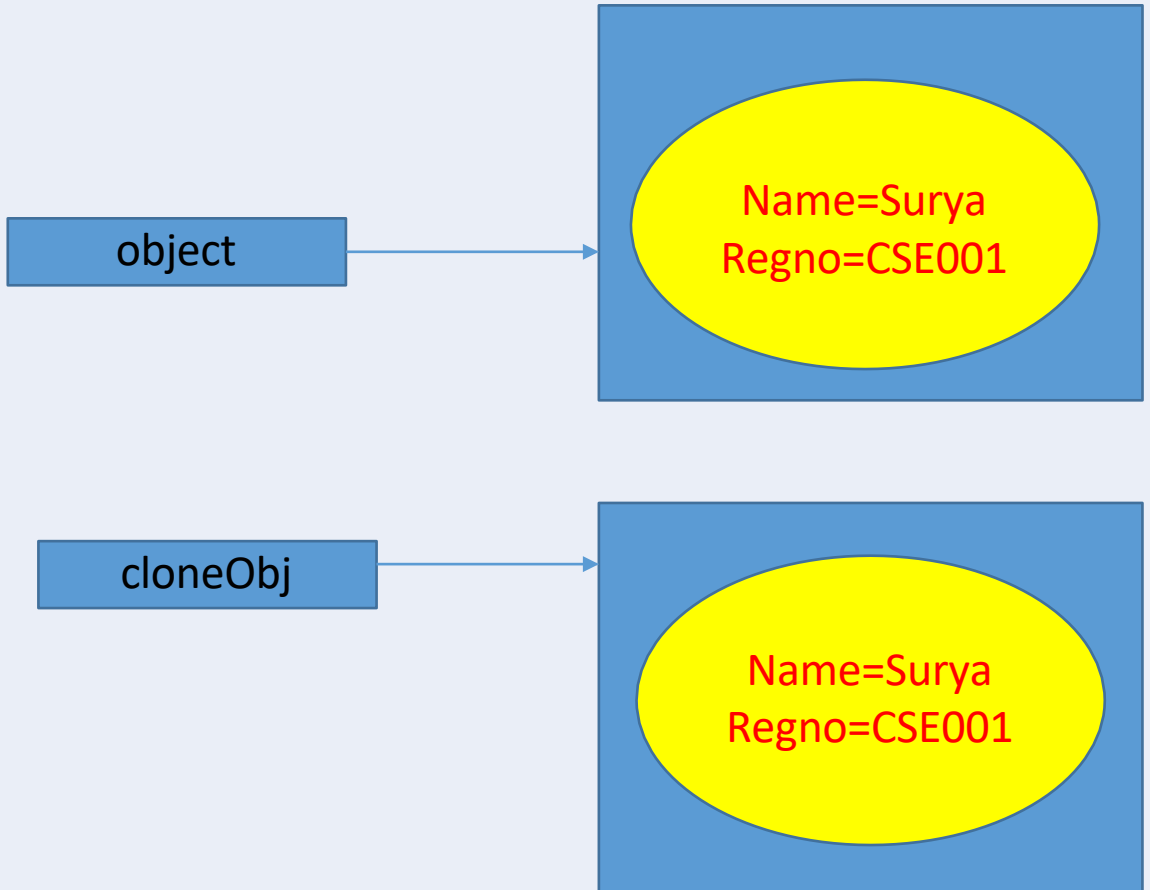
Object class and its method

- public interface Cloneable
  - A class implements the Cloneable interface to indicate to the clone method can make a field-for-field copy of instances of that class.
  - Attempts to clone instances that do not implement the Cloneable interface will throw an exception CloneNotSupportedException.

Assignment copy vs clone method copy

Assignment copy	Clone() copy
Student object = **new** Student(); object.Name=Surya object.Regno=CSE001 Student CopyObj = object; //**object** and CopyObj point to the same location	Student object = **new** Student(); object.Name=Surya object.Regno=CSE001 Student cloneObj = (Student) object.clone(); //object and clone object remain independent

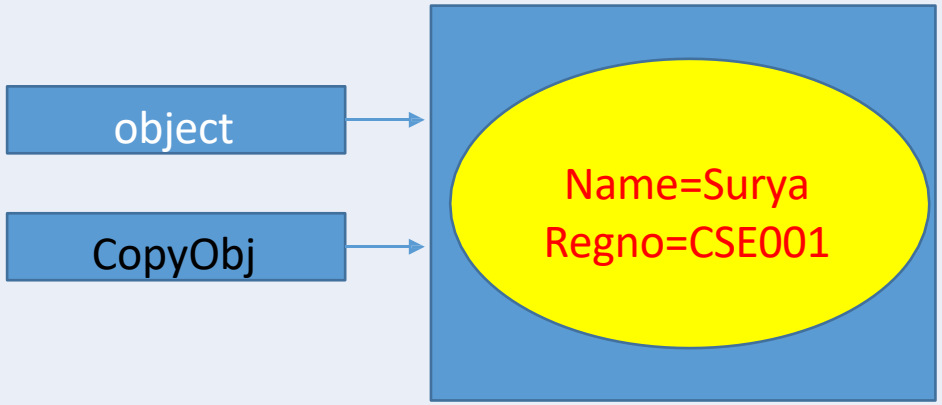
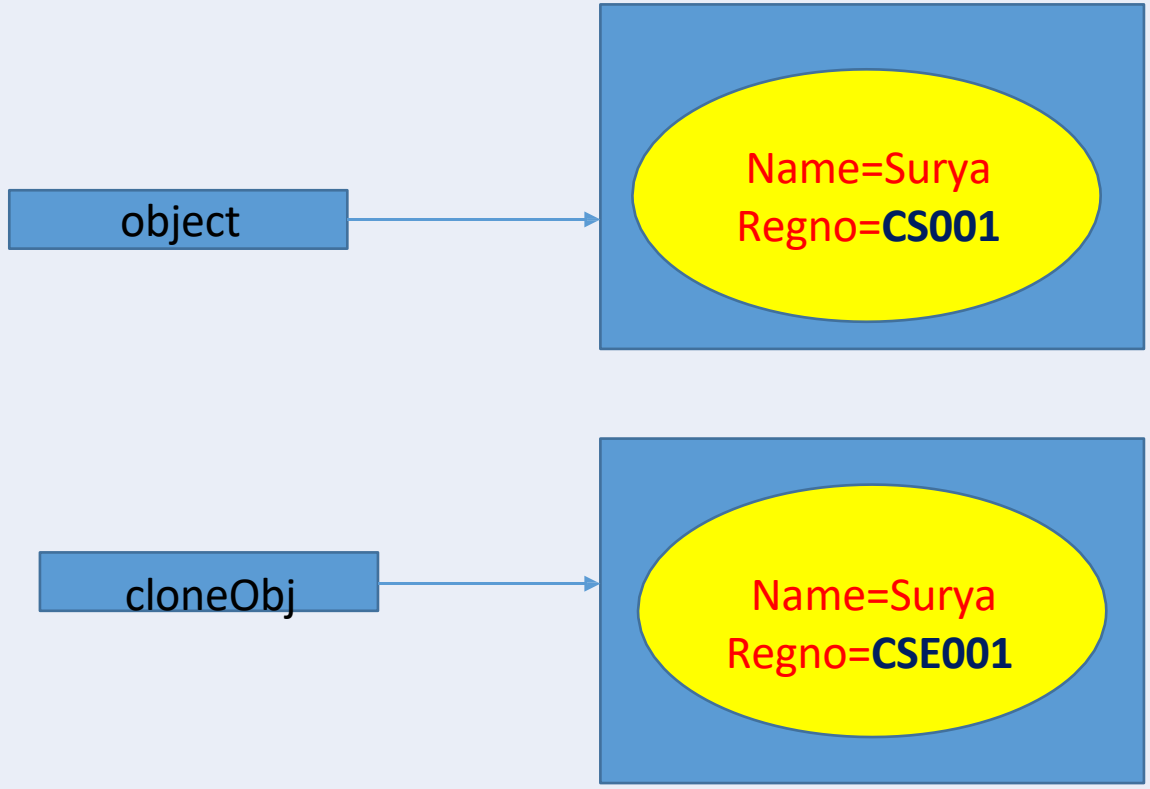




Assignment copy vs clone method copy

Assignment copy	

Student object = **new** Student();
object.Name=Surya;
object.Regno=CSE001;
Student CopyObj = object;
object.Regno=CS001;
//any changes in **object** will be reflected in **CopyObj**
	Student object = **new** Student();
	object.Name=Surya;
	object.Regno=CSE001;
	Student cloneObj = (Student) object.clone();
	object.Regno=CS001;
	//any changes in **object** will not be reflected in **cloneObj**.

```java
//Shallow copy
public class StudentClass {
    String Name;
    String Regno;
    public static void main(String[] args) {
        Student object = new Student();
        object.Name = "James";
        object.Regno = "CSE001";

        // Shallow copy: copyObj references the same object as object
        Student copyObj = object;

        // Both references point to the same object
        System.out.println("Original object Name: " + object.Name);
        System.out.println("CopyObj Name: " + copyObj.Name);

        // Changing copyObj will affect object as well
        copyObj.Name = "Gosling";

        System.out.println("Original object Name after change: " + object.Name);
        System.out.println("CopyObj Name after change: " +copyObj.Name);
        System.out.println("Equality of Object and clone object:" + (object == copyObj));

    }
}
```

```
Original object Name: James
CopyObj Name: James
Original object Name after change: Gosling
CopyObj Name after change: Gosling
Equality of Object and clone object:true
```

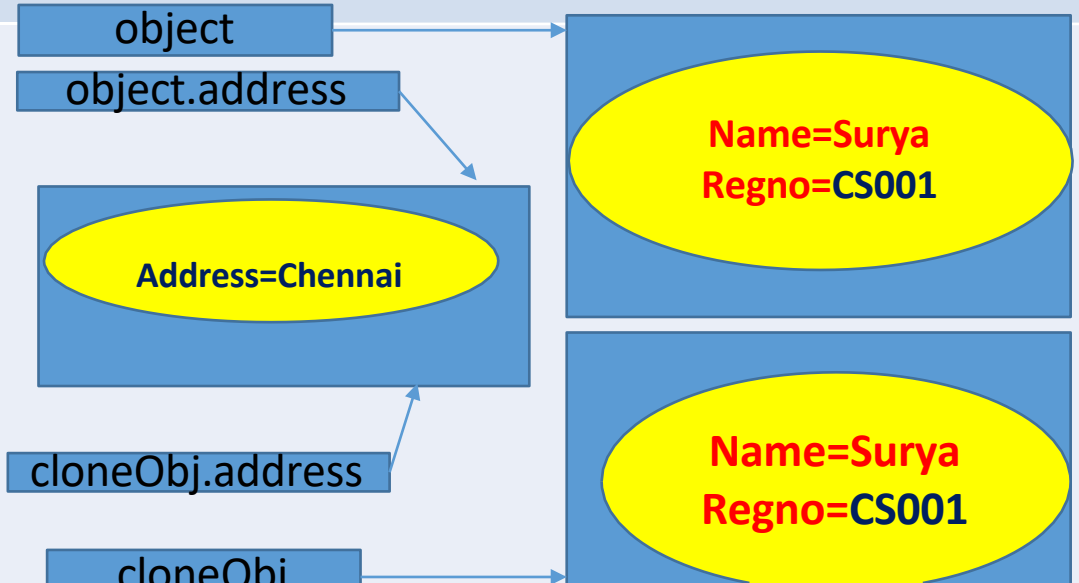
```java
//Shallow vs Deep copy
public class Student implements Cloneable {
    String Name;
    String Regno;

    @Override
    protected Object clone() throws CloneNotSupportedException {
        return super.clone(); // Perform a deep copy
    }

    public static void main(String[] args) throws Exception {
        Student object = new Student();
        object.Name = "James";
        object.Regno = "CSE001";

        // Deep copy: cloneObj is a new object with the same state as object
        Student cloneObj = (Student) object.clone();

        // Both references are independent
        System.out.println("Original object Name: " + object.Name);
        System.out.println("CloneObj Name: " + cloneObj.Name);
        // Changing cloneObj will not affect object
        cloneObj.Name = "Gosling";

        System.out.println("Original object Name after change: " + object.Name);
        System.out.println("CloneObj Name after change: " + cloneObj.Name);
        System.out.println("Equality of Object and clone object:" + (object == cloneObj));
    }
}
```

```
Original object Name: James
CloneObj Name: James
Original object Name after change: James
CloneObj Name after change: Gosling
Equality of Object and clone object:false
```

Shallow copy vs Deep copy

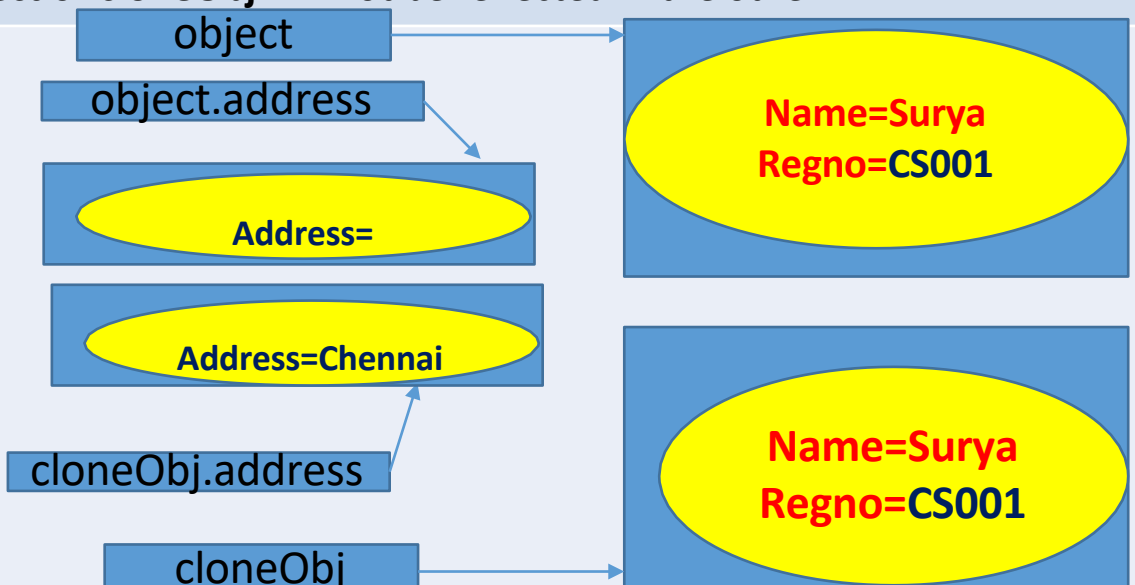
```
Student object = new Student();
object.Name=Surya;
object.Regno=CSE001;
Student cloneObj = (Student) object.clone();
object.Regno=CS001;
Address address=new Address();
object.address="Chennai";
```

//copying from **one object** to another object(only Primitive type data members). Any changes made in the referenced object member **object** or **cloneObj** will be reflected in the other.




```
Student object = new Student();
object.Name=Surya;
object.Regno=CSE001;
object.Regno=CS001;
Address address=new Address();
object.address="Chennai";
Student cloneObj = (Student) object.clone();
cloneObj.address = (Address) object.address.clone();
object.address="Delhi";
```

//copying everything from **one object** to another object(Primitive and class type data members). Any changes made in the referenced object member in **object** or **cloneObj** will not be reflected in the other.



Shallow cloning

```
//Shallow vs Deep copy
class Address implements Cloneable{
    int pincode;
    String city;
    Address(){ }
    Address(int pincode, String city){
        this.pincode = pincode; this.city = city;
    }
    public Object clone() throws CloneNotSupportedException {
        return super.clone();
    }
}
```

```
public class Student implements Cloneable {
    String Name;
    String Regno;
    Address address;

    @Override
    protected Object clone() throws CloneNotSupportedException {
        return super.clone(); // Perform a deep copy
    }

    public static void main(String[] args) throws CloneNotSupportedException { Student object = new Student();
        object.Name = "Surya";
        object.Regno = "CSE001";
        object.address = new Address( pincode: 600042, city: "Chennai");
        Student cloneObj = (Student) object.clone();
        System.out.println("object member details:");
        System.out.println("Name:"+object.Name + " Regno:"+ object.Regno);
        System.out.println("Address:"+ object.address.pincode + object.address.city);
        System.out.println(" Clone object member details :");
        System.out.println("Name:"+ cloneObj.Name + " RollNo:"+ cloneObj.Regno);
        System.out.println("Address:"+ cloneObj.address.pincode + " and " + cloneObj.address.city);
        System.out.println("Equality of Object and clone object:" + (object == cloneObj));
        System.out.println(" Equality of address Object and cloned address object:" + (object.address == cloneObj.address));
    }
}
```

```
object member details:
Name:Surya Regno:CSE001
Address:600042Chennai
 Clone object member details :
Name:Surya RollNo:CSE001
Address:600042 and Chennai
Equality of Object and clone object:false
 Equality of address Object and cloned address object:true
```

Deep cloning

```
//Shallow vs Deep copy
class Address implements Cloneable{
    int pincode;
    String city;
    Address(){ }
    Address(int pincode, String city){
        this.pincode = pincode; this.city = city;
    }
    public Object clone() throws CloneNotSupportedException {
        return super.clone();
    }
}
```

```
object member details:
Name:Surya Regno:CSE001
Address:600042Chennai
Clone object member details :
Name:Surya RollNo:CSE001
Address:600042 and Chennai
Equality of Object and clone object:false
Equality of address Object and cloned address object:false
```

```
public class Student implements Cloneable {
    String Name;
    String Regno;
    Address address;

    @Override
    protected Object clone() throws CloneNotSupportedException {
        return super.clone(); // Perform a deep copy
    }

    public static void main(String[] args) throws CloneNotSupportedException { Student object = new Student();
        object.Name = "Surya";
        object.Regno = "CSE001";
        object.address = new Address( pincode: 600042,  city: "Chennai");
        Student cloneObj = (Student) object.clone();
        cloneObj.address = (Address) object.address.clone();
        System.out.println("object member details:");
        System.out.println("Name:"+object.Name + " Regno:"+ object.Regno);
        System.out.println("Address:"+ object.address.pincode + object.address.city);
        System.out.println("Clone object member details :");
        System.out.println("Name:"+ cloneObj.Name + " RollNo:"+ cloneObj.Regno);
        System.out.println("Address:"+ cloneObj.address.pincode + " and " + cloneObj.address.city);
        System.out.println("Equality of Object and clone object:" + (object == cloneObj));
        System.out.println("Equality of address Object and cloned address object:" + (object.address == cloneObj.address));
    }
}
```

hashCode

- hashCode invoked on the same object more than once during an execution of a Java application, the hashCode method must consistently return the same integer.
- This integer need not remain consistent from one execution of an application to another execution of the same application.
- If two objects are equal according to the equals method, then calling the hashCode method on each of the two objects must produce the same integer result.
- This method is supported for the benefit of hashtables.

equals()

- public boolean equals(Object obj)
- This method returns true if and only if x and y refer to the same object.
- For any reference value x, x.equals(x) returns true
- For any reference value x and y, x.equals(y) returns true, if y.equals(x) returns true.
- Parameters:
  - obj - the reference object with which to compare.
- Returns:
  - true if this object is the same as the obj argument; false otherwise

toString()

- public String toString()
- Returns a string representation of the object
- Subclasses override this method.
- The toString method for class Object returns a string consisting of the name of the class of which the object is an instance, the at-sign character `@', and the unsigned hexadecimal representation of the hash code of the object.

- Returns:
  - a string representation of the object.

finalize()

- protected void finalize() throws Throwable
- Called by the garbage collector on an object when garbage collection determines that there are no more references to the object.
- A subclass overrides the finalize method to dispose of system resources or to perform other cleanup.
- Throws: Throwable

```
public class FinalizeGC {

    @Override
    protected void finalize() throws Throwable {
        try {
            System.out.println("finalize executed");
            super.finalize(); // Ensure superclass finalize is called
        } finally {
            super.finalize(); // Ensure superclass finalize is called
        }
    }

    public static void main(String[] args) {
        FinalizeGC obj = new FinalizeGC(); // Create an instance of Example
        obj = null; // Make the object eligible for garbage collection
        System.gc(); // Suggest the JVM to perform garbage collection
        System.out.println("Garbage collector");
    }
}
```

```
Garbage collector
finalize executed
```

```java
public class FinalizeGC {

    @Override
    protected void finalize() throws Throwable {
        try {
            System.out.println("finalize executed");
            super.finalize(); // Ensure superclass finalize is called
        } finally {
            super.finalize(); // Ensure superclass finalize is called
        }
    }

    public static void main(String[] args) {
        FinalizeGC obj1 = new FinalizeGC();
        try {
            obj1.finalize(); // Explicitly call finalize method
        } catch (Throwable t) {
            System.err.println("Caught Throwable during finalize: " + t.getMessage());

        }
        System.out.println("Garbage collector");
    }
}
```

```
finalize executed
Garbage collector
```

```
public class FinalizeGC {

    @Override
    protected void finalize() throws Throwable {
        try {
            System.out.println("finalize executed");
        } finally {
            super.finalize(); // Ensure superclass finalize is called
        }
    }
    public static void main(String[] args) {
        String str = "Hai";
        str = null; // Make the object eligible for garbage collection
        System.gc(); // Suggest to JVM to perform garbage collection
        System.out.println("Garbage collector");
    }
}
```

```
Garbage collector
```

JAVA Collections:ArrayList

- The ArrayList class implements the List interface.
- ArrayList is a generic class that has this declaration:
  - class ArrayList<E>
  - Here, E specifies the type of objects that the list will hold.
- ArrayList supports dynamic arrays that can grow as needed.
- In Java, standard arrays are of a fixed length. After arrays are created, they cannot grow or shrink, which means that how many elements an array will hold must be known in advance.
- But, sometimes, until run time precisely how large an array is needed is not known.
- To handle this situation, the Collections Framework defines ArrayList.

- **Create an ArrayList**

```
ArrayList<String> list=new ArrayList<String>();
ArrayList<Integer> list=new ArrayList<Integer>();
```

- **add elements to an ArrayList**
  - **Use add() method**
  - **list.add(“Steve Jobs"); //This will add "Steve Jobs" at the end of List**
  - **list.add(2, "Steve Jobs"); //This will add "Steve Jobs" at the third position**

```
import java.util.*;
class JavaExample{
  public static void main(String args[]){
    ArrayList<String> list=new ArrayList<String>();
    list.add("Steve Jobs");
    list.add("Tim Cook");

    list.add(1, " Ali baba "); //Adding “Ali baba" at the 1st position

    System.out.println(list); //displaying elements

     list.set(0, “Charless Babage"); // Change an element in ArrayList
     String s=list.get(0);
     System.out.println(list); //displaying elements

     list.remove("Steve Jobs"); //to remove elements from ArrayList

     list.remove(0) ; //to remove elements from ArrayList
     //iterating ArrayList
              for(String str:list)
                  System.out.println(str);
      System.out.println(list.size()); // ArrayList Size
   }    }
```

add(Object o): adds an object o to the arraylist.

add(int index, Object o): adds the object o to the array list at the given index.
remove(Object o): Removes the object o from the ArrayList.
remove(int index): Removes element from a given index.
set(int index, Object o): Used for updating an element. It replaces the element present at the specified index with the object o.
int indexOf(Object o): Gives the index of the object o. If the element is not found in the list then this method returns the value -1.
Object get(int index): It returns the object of list which is present at the specified index.
int size(): It gives the size of the ArrayList – Number of elements of the list.
boolean contains(Object o): It checks whether the given object o is present in the array list if its there then it returns true else it returns false.
clear(): It is used for removing all the elements of the array list in one go.
obj.clear();

```
import java.util.ArrayList; import java.util.Collections; class
JavaExample{
  public static void main(String args[]){ ArrayList<String> list=new ArrayList<String>();
    list.add("Steve Jobs");
    list.add("Tim Cook");
     Collections.sort(list);
   //iterating ArrayList
            for(String str:list) System.out.println(str);
     System.out.println(list.size()); // ArrayList Size int pos = list.indexOf("Tim Cook ");
}   }
```