BITS Pilani
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CS F213 - Object Oriented Programming

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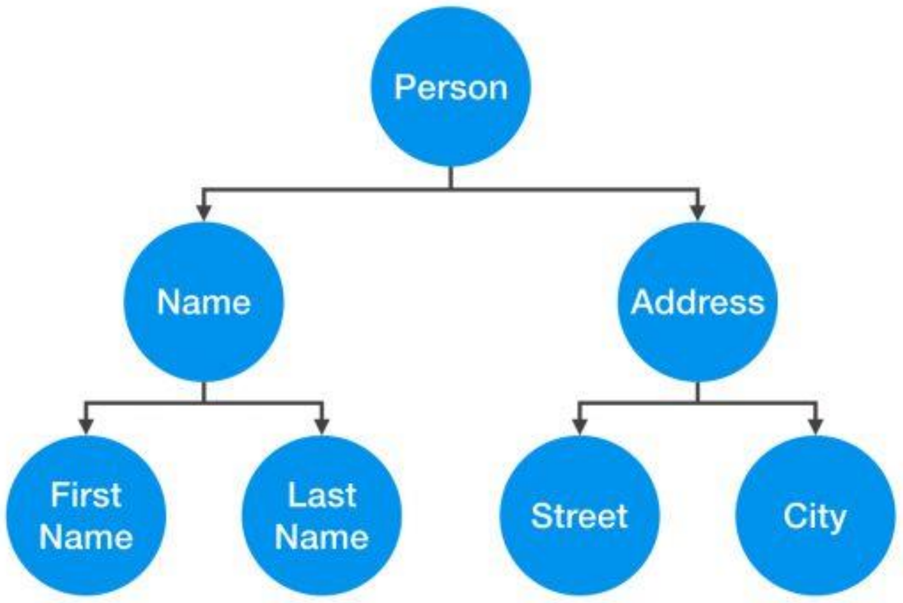
https://github.com/JenniferRanjani/Object-Oriented-Programming-with-Java

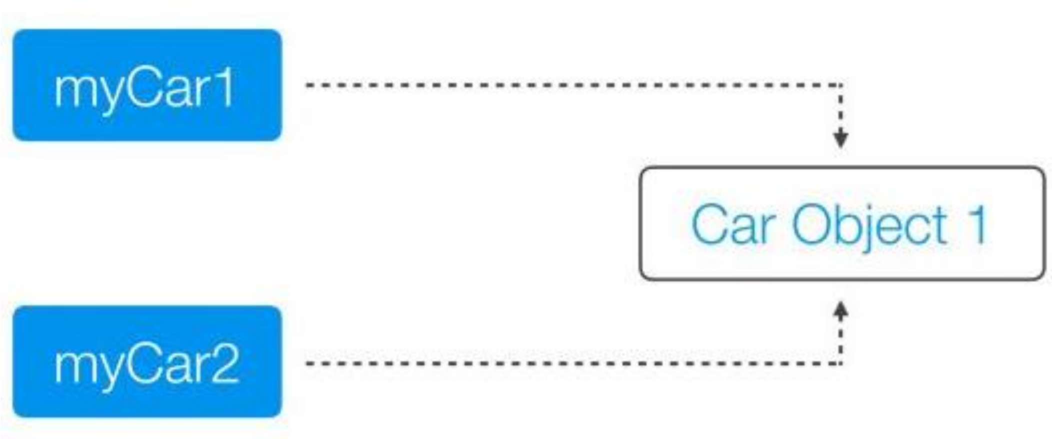
Objects – an Example



Person is made up of Name and Address objects which in turn is made up of objects like FirstName, LastName, Street and City respectively

Copying Objects

- When we use assignment operator it will create a copy of reference variable and not the object.



- Cloning refers to creation of exact copy of an object

- It creates a new instance of the class of current object and initializes all its fields with exactly same contents.

Cloning Condition

x.clone() != x

x.clone().equals(x) return true

x.clone().getClass() == x.getClass()

“ clone should be a new object but it should be equals to its original”

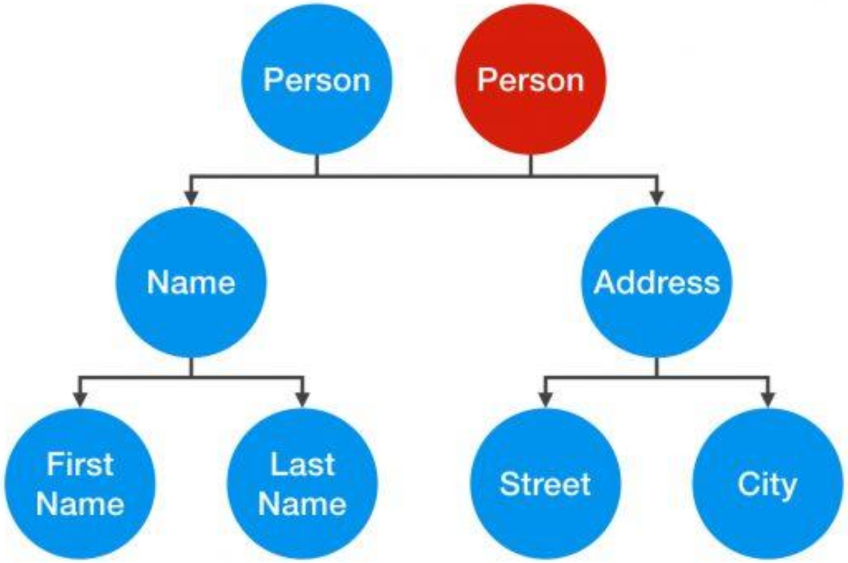
Clone requirements

Any class willing to be cloned must

1. **Declare the clone() method to be public**
2. **Implement Cloneable interface**

```
class Account implements Cloneable
{
public Object clone()
{
 try { super.clone() }
catch(CloneNotSupportedException e){ .. }
}
```

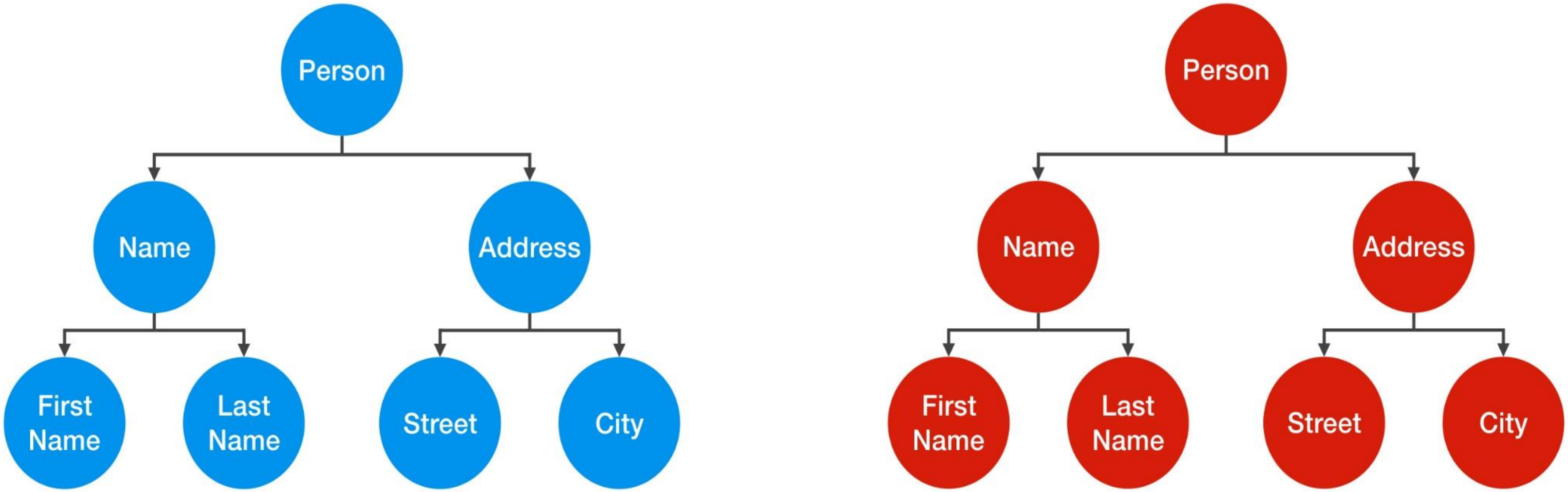
Shallow Copy



- It copies the main object but doesn’t copy the inner objects.
- Inner objects are still shared between the original and its copy

Deep Copy

- It is a fully independent copy of an object and it copies the entire object structure



Java Type System

- Type: Set of values with a set of operations that can be applied to the values

- Example:
  - int type
  - Account type

- Java is a strongly typed language
  - Compile-time check
    Employee e = new Employee();
    e.clear(); // ERROR

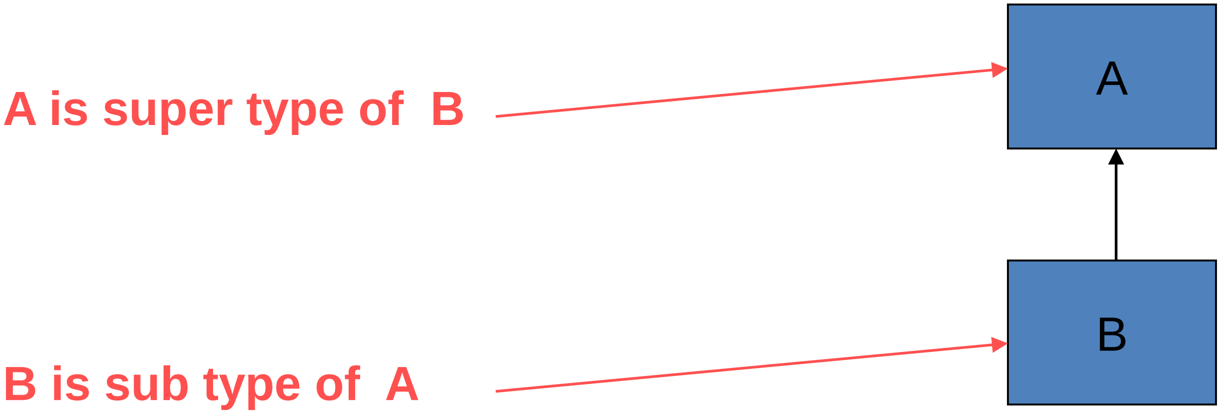
  - Run-time check:
    e = null;
    e.setSalary(20000); // ERROR

Types in Java

- Primitive types:
  - int short long byte
  - char float double boolean
- Class types
- Interface types
- Array types
- The null type
- Note: void is not a type

Sub types

- Sub type specifies the inheritance relationship either by extending a class or implementing an interface



A is super type of B

B is sub type of A

Example

What’s Expected

X x1 = ?

- If X is an interface
  - RHS can be an instance of any class implementing X.
- If X is abstract class
  - RHS can be an instance of any concrete subclass of X
- If X is a concrete class
  - RHS can be either an instance of X or any of its subclasses

Rules for Subtype Relationship

S is a subtype of T if

1. S and T are the same type
2. S and T are both class types, and T is a direct or indirect superclass of S
3. S is a class type, T is an interface type, and S or one of its superclasses implements T
4. S and T are both interface type, and T is a direct or indirect superinterface of S
5. S and T are both array type, and the component type of S is a subtype of the component type of T
6. S is not a primitive type and T is the type Object
7. S is an array type and T is Cloneable or Serializable
8. S is the null type and T is not a primitive type

Review Questions

1. Is Container is a subtype of Component ?.
2. Is JButton is a subtype of Component ?
3. Is FlowLayout is a subtype of LayoutManager?
4. Is ListIterator is a subtype of Iterator ?
5. Is Rectangle[ ] is a subtype of Shape[ ] ?
6. Is int[ ] is a subtype of Object ?
7. Is int is subtype of long ?
8. Is long is a subtype of int ?
9. Is int is a subtype of Object ?

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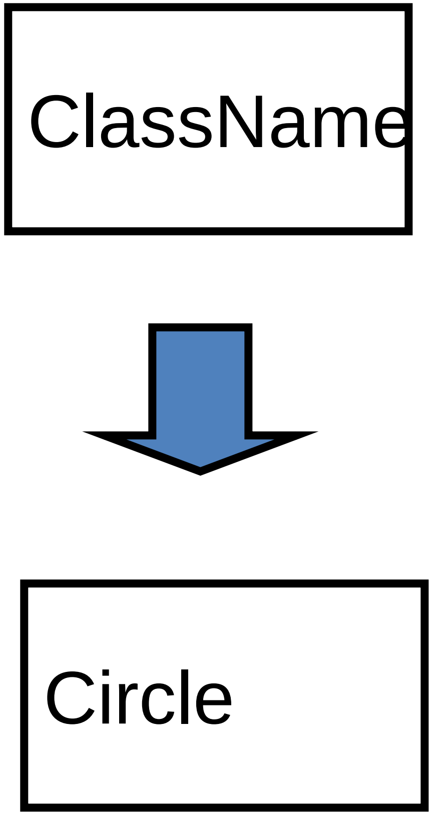
Class Diagram

Modelling a class in UML

- Class can be modeled in four different ways:
  - With no attributes or operations shown
  - With only the attributes shown
  - With only the operations shown
  - With both the attributes and operations shown

Class with no members

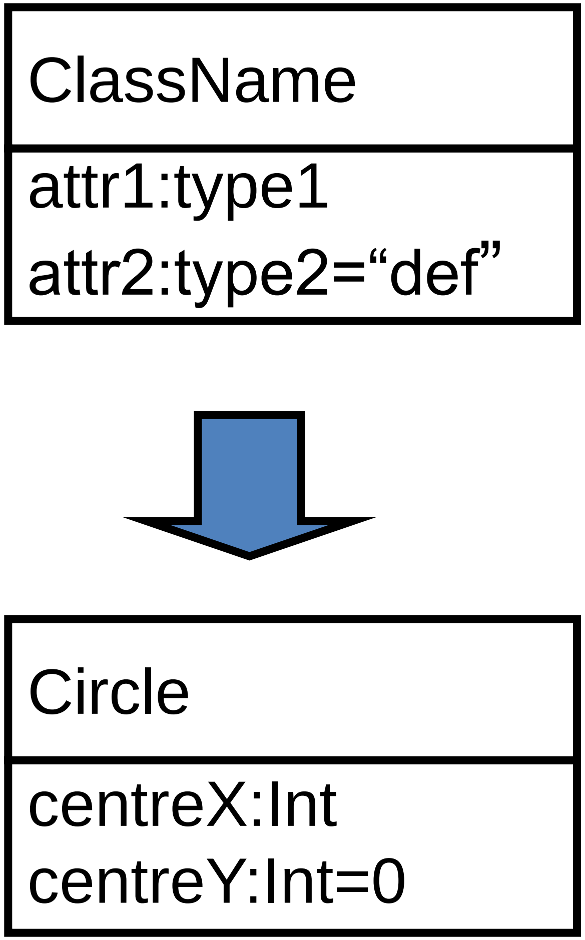
Class - The rectangle is the icon for the class. The name of the class is, by convention, a word with an initial uppercase letter. It appears near the top of the rectangle. If your class name has more than one word name, then join the words together and capitalize the first letter of the every word.



ClassName

Circle

Classes with Attributes and Operations

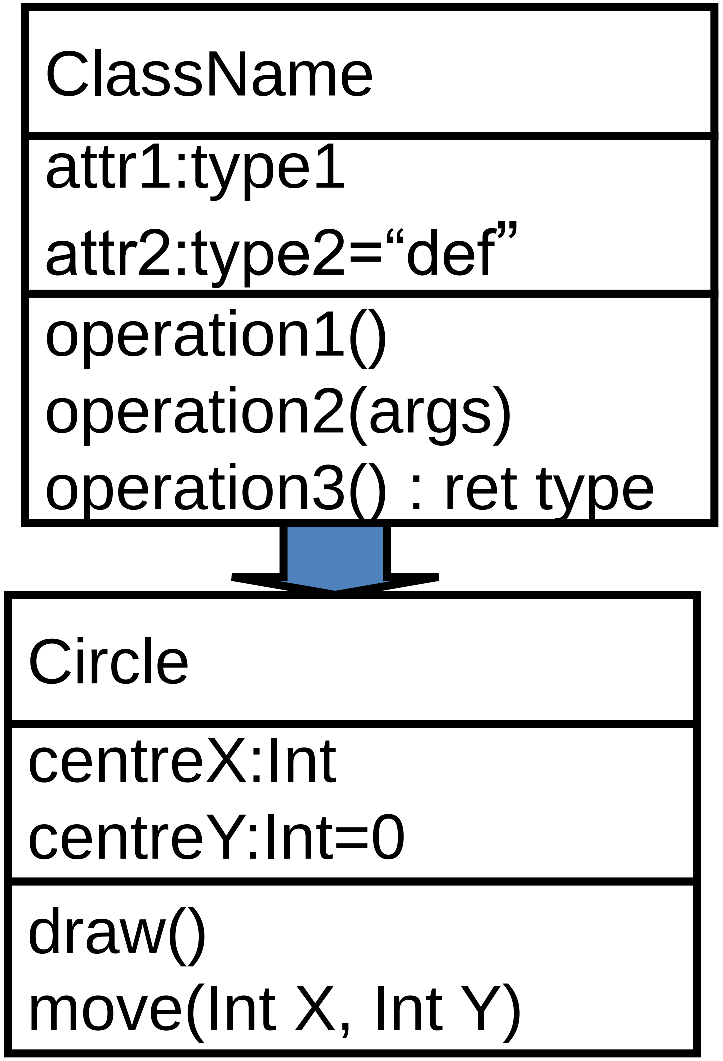


ClassName

attr1:type1
attr2:type2="def"

Circle

centreX:Int
centreY:Int=0



ClassName

attr1:type1
attr2:type2="def"

operation1()
operation2(args)
operation3() : ret type

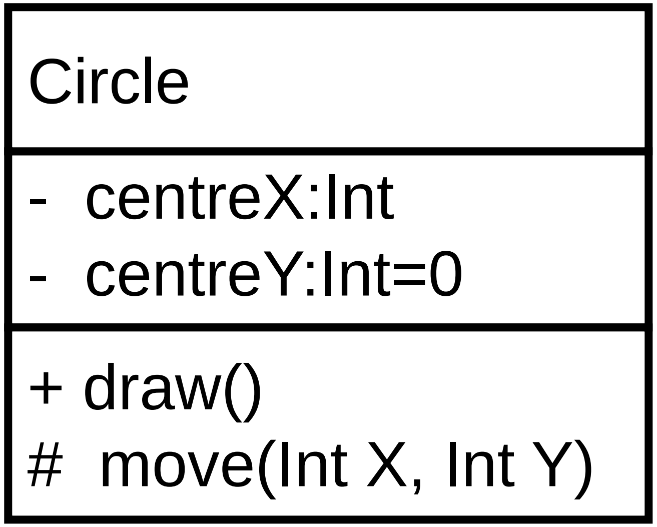
Circle

centreX:Int
centreY:Int=0

draw()
move(Int X, Int Y)

Class Visibility

public level	+
protected level	#
private level	-

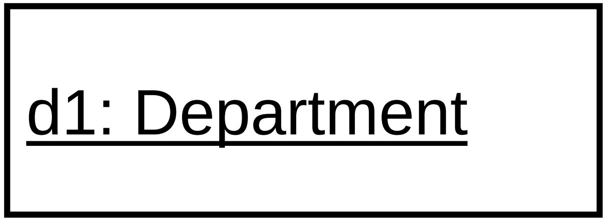


Circle

- centreX:Int
- centreY:Int=0

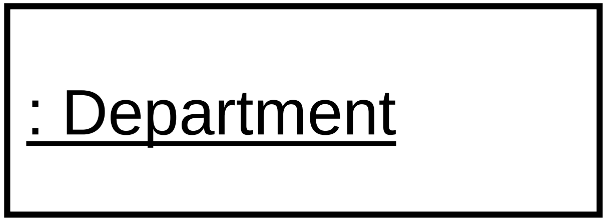
+ draw()
# move(Int X, Int Y)

Objects



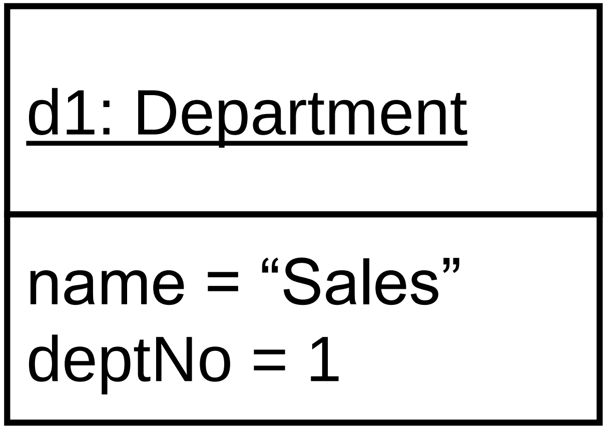
d1: Department

(a)



: Department

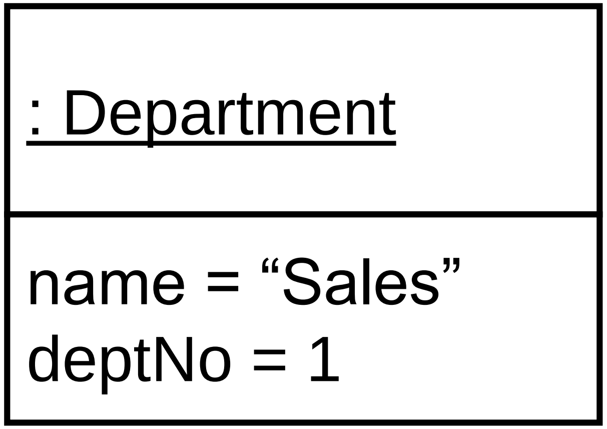
(b)



d1: Department

name = “Sales”
deptNo = 1

(c)



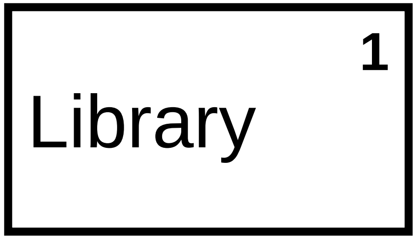
: Department

name = “Sales”
deptNo = 1

(d)

Multiplicity

- A multiplicity in a class specifies the number of instances (objects) of that class that can exist simultaneously.



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Library

- Only one Library object is allowed in the system (referred to as a *singleton* object).

Classes, Objects, and Packages

- A package is expressed by appending the name of package and a double colon before the class name in either a class or an object.

```
PackageName::ClassName
```

```
ObjectName:Packagename::ClassName
```