



BITS Pilani
Pilani Campus

Object Oriented Programming

CS F213

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Slides Taken from the slides prepared by Dr. Jennifer



Java Object Model

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



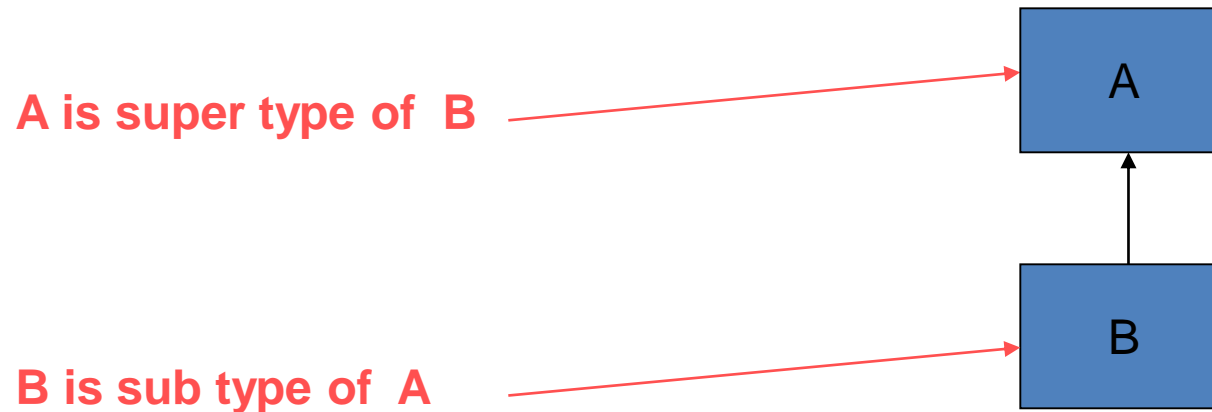
- Primitive types:
 - int short long byte
 - char float double boolean
- Class types
- Interface types
- Array types
- The null type

Note: void is not a type

Sub types



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



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

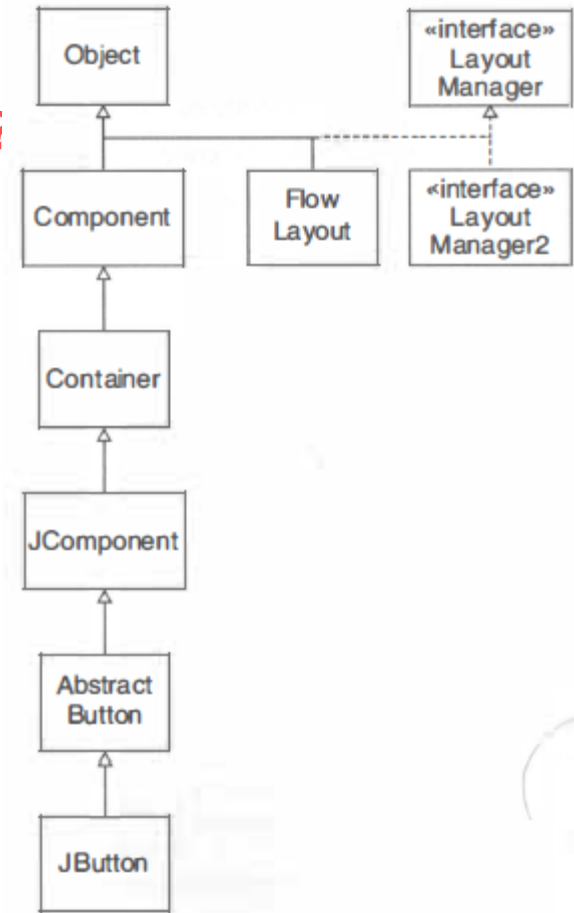


S is a subtype of T if

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 LayoutManager2 is a subtype of LayoutManager ?
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 ?



Object Class

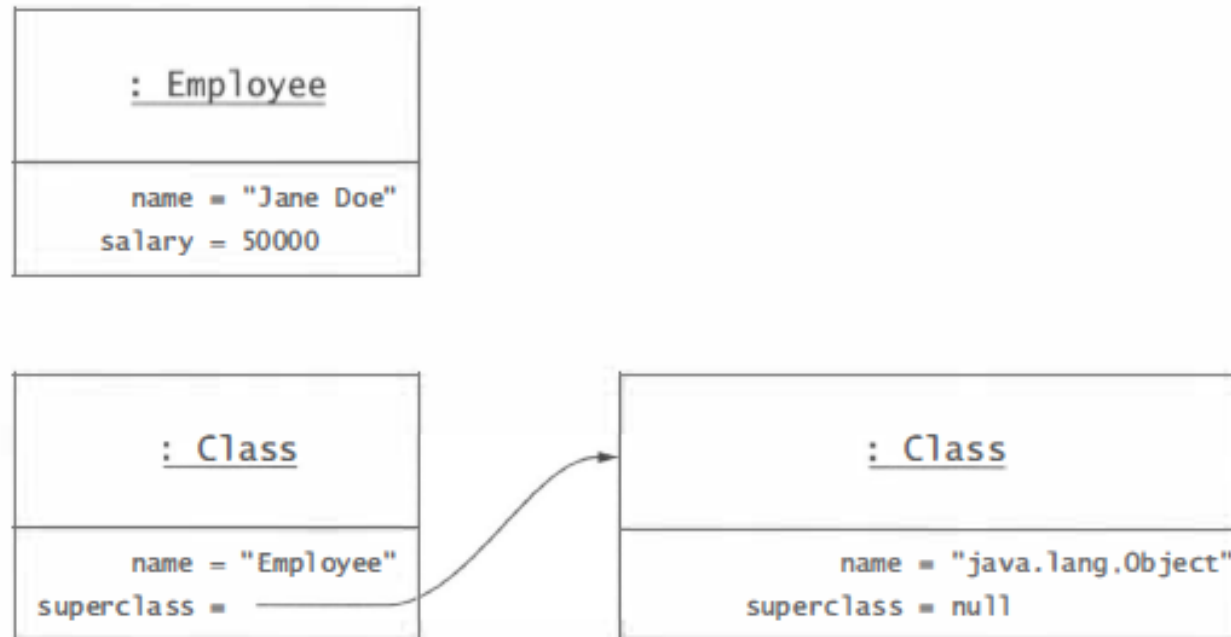


- It is present in java.lang package
- Every class in Java is directly or indirectly derived from Object class
 - If a class extends another class it is indirectly derived
- Methods of the Object class is available to all Java classes
- Object class is the root of inheritance hierarchy.

Methods in Object Class

- `toString()`
- `hashCode()`
 - For every object, JVM generates a unique number which is hashcode.
 - It is not the internal address of the object, but the hash based on the address
 - Advantage of saving objects based on hash code is searching becomes easy
- `equals()`
 - When `hashCode()` method is overridden a general contract is to be maintained which generates equal hash codes for equal objects.
- `getClass()`
 - Returns the actual runtime class of the object.

Class

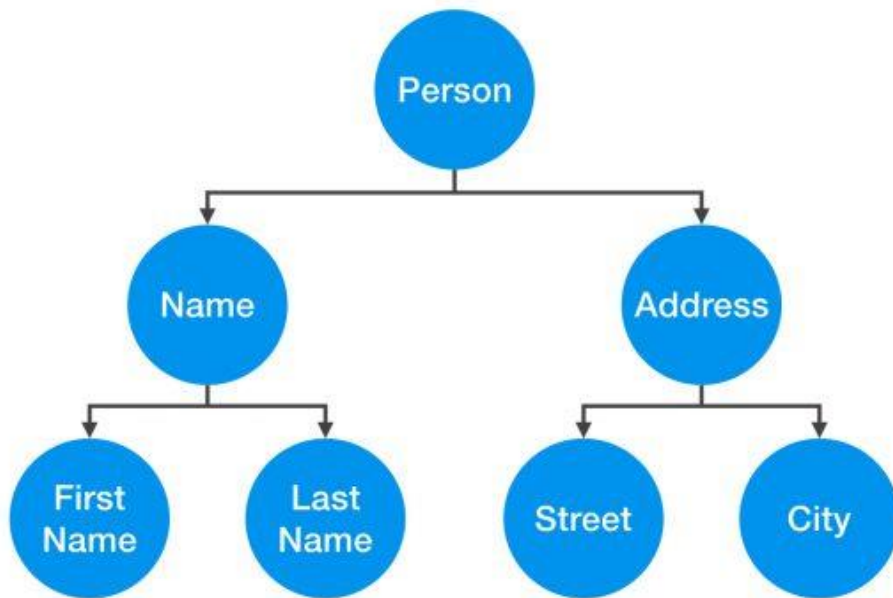


Example



- `toString()`
- `equals()`

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()

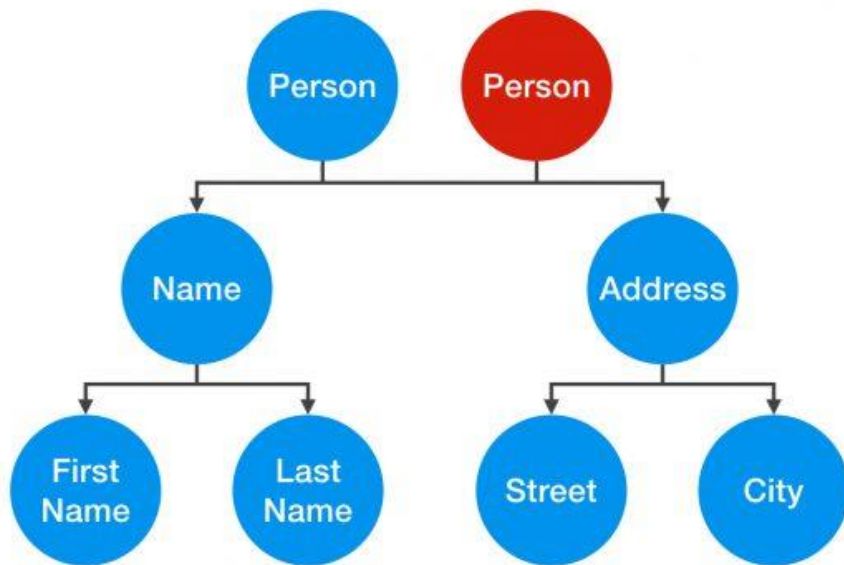
{

try { super.clone() }

catch(CloneNotSupportedException e){ .. }

}

Shallow Copy

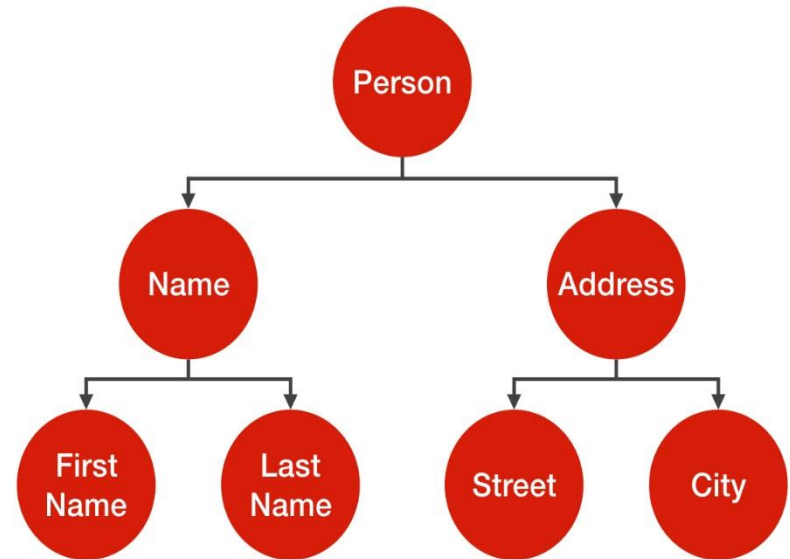
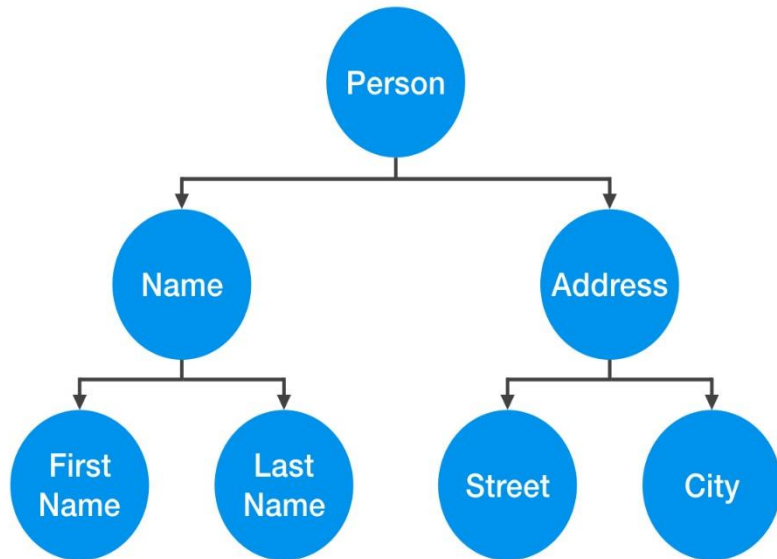


- It copies the main object but doesn't copy the inner objects.
- Inner objects are still shared between the original and its copy

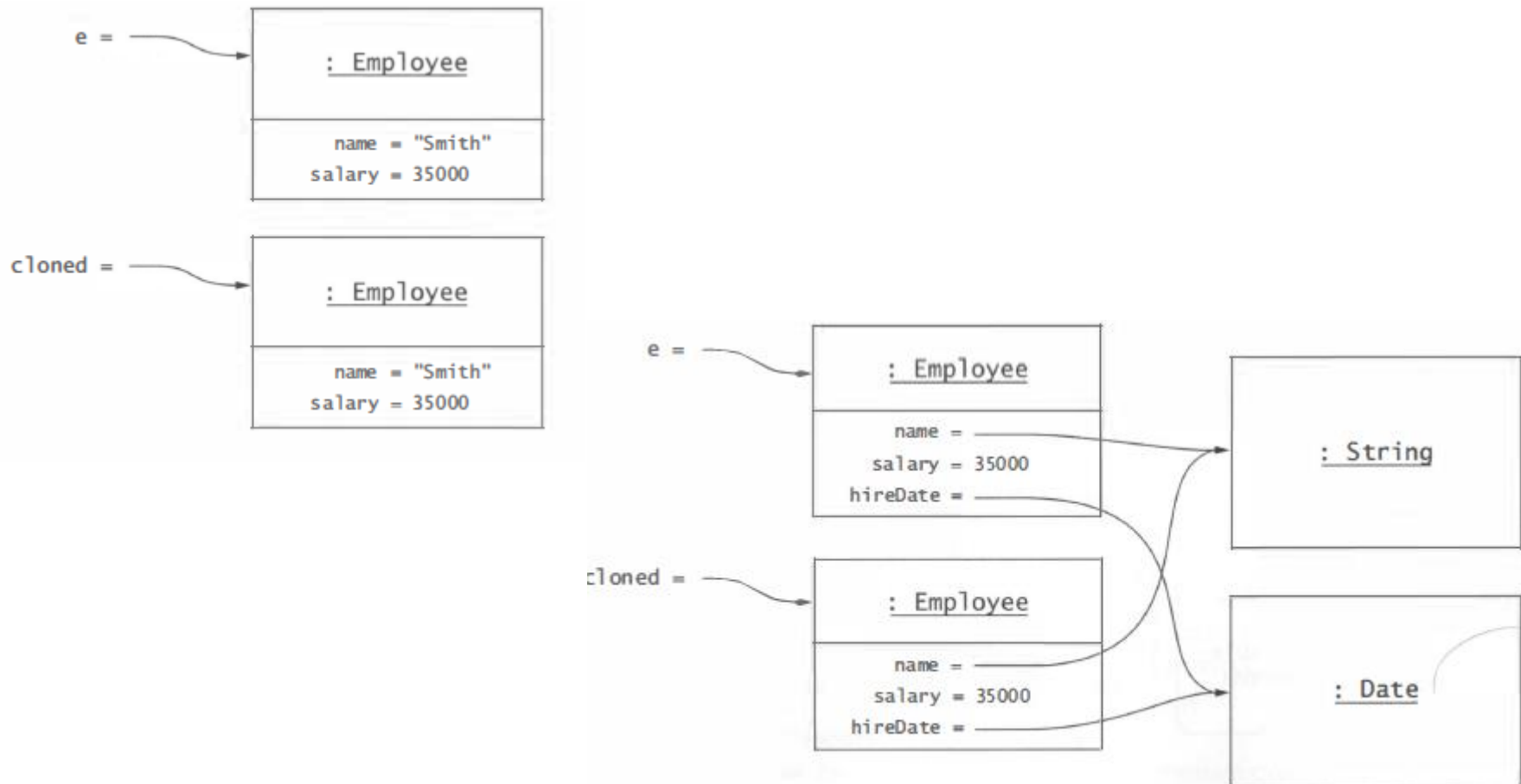
Deep Copy



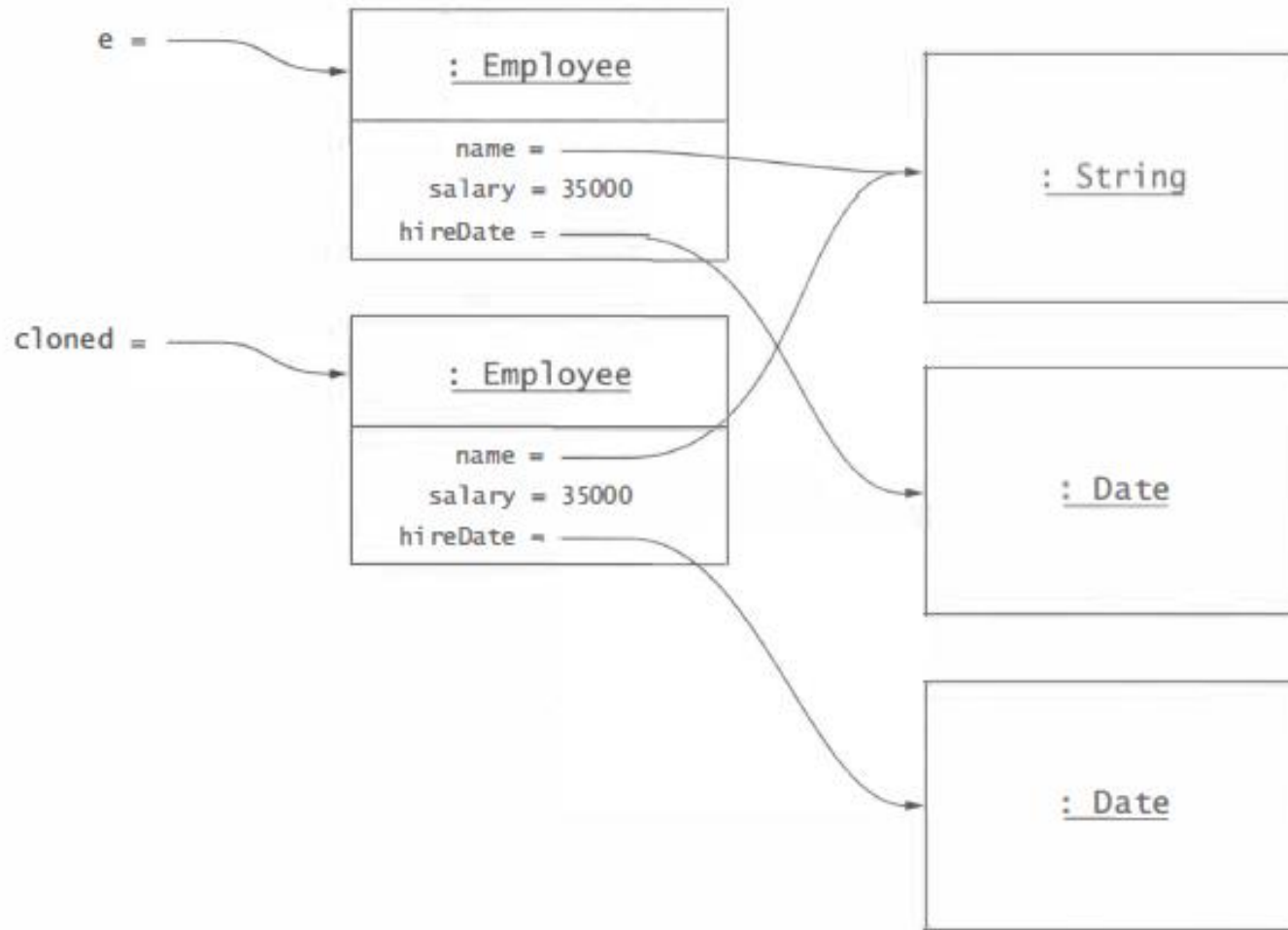
- It is a fully independent copy of an object and it copies the entire object structure



Shallow copy



Deep copy



Example



- Shallow copy
- Deep copy