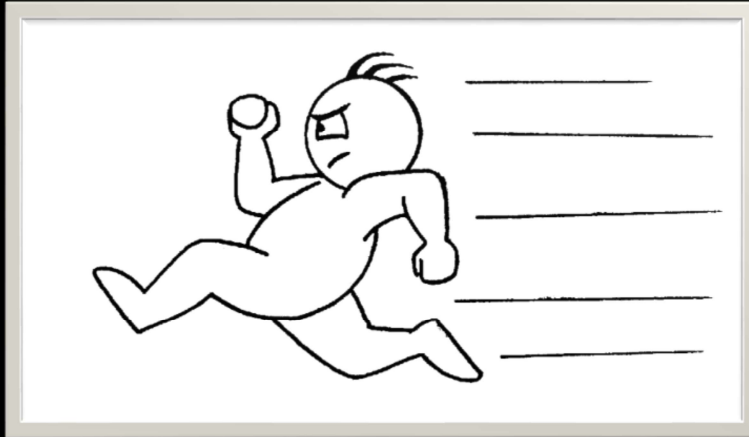


# Polymorphism

- Polymorphism
  - Interfaces and overridden functions



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Q30 – Shape; Q40Smell: Courses weekly, range, list; Q43smell: home address / work address

Q36 – USD, RMB; Q41 – Session (This can be used with Composite Design Pattern)

## Dependency Inversion Principle

- Program to an interface and not to an implementation
  - Any problem?



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“HIGH LEVEL MODULES SHOULD NOT DEPEND UPON LOW LEVEL MODULES, BOTH SHOULD DEPEND UPON ABSTRACTIONS.

ABSTRACTIONS SHOULD NOT DEPEND UPON DETAILS. DETAILS SHOULD DEPEND UPON ABSTRACTIONS.”

No variable should hold a reference to a concrete class.

No class should derive from a concrete class.

No method should override an implemented method of any of its base classes.

It is OK to depend on stable classes like String, Integer, JPanel, etc.

Avoids designs that are rigid, Fragile and Immobile.

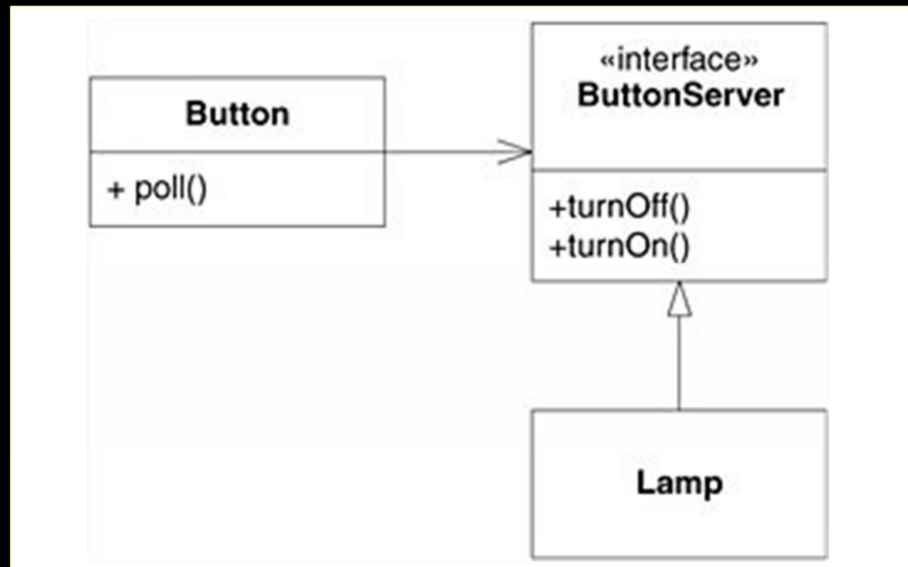
Example: We have a classes: Copy, Keyboard, Printer. The Copy reads from keyboard and prints to the printer. If we use DIP, we have an abstraction for Keyboard and Printer. So we can add input and output devices later on.

Example: Collections in Java.

Example: Customer is a class. Employee is a class. Employees are now allowed to purchase on credit. We need an interface Buyer.

For every variable use the maximum abstract type possible.

## DIP implemented



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### Advantages

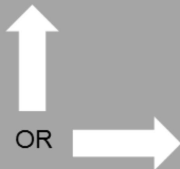
- Clients are unaware of the specific class of the object they are using
- One object can be easily replaced by another
- Object connections need not be hardwired to an object of a specific class, thereby increasing flexibility
- Loosens coupling
- Increases likelihood of reuse
- Improves opportunities for composition since contained objects can be of any class that implements a specific interface

### Disadvantages

- Modest increase in design complexity

## Which is Better?

```
Class Service {  
    //...  
}  
class Client {  
    //...  
    Service s =  
        new Service();  
    //...  
}
```



```
Class Service {  
    private Service(){}  
    static Service  
        getInstance() {  
        return  
            new Service();  
        }  
    //...  
}  
class Client {  
    //...  
    Service s = Service.  
        getInstance();  
    //...  
}
```

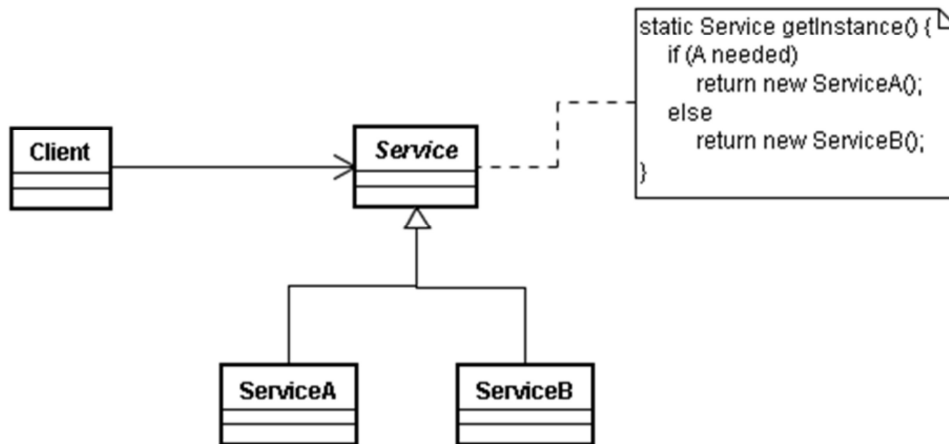
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The right side is better. Service class can be made abstract tomorrow.

## Service can be Abstract now!



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The main advantages of using Static function for construction instead of constructor directly is:

1. Static methods have a name. This serves as documentation e.g. `BigInteger(int, int, Random)` is not clear but `BigInteger.getProbablePrime(int, int, Random)` is more clear.
2. The static method can return the same object for multiple calls e.g. if the object is immutable e.g. `Boolean` class has two objects `TRUE` and `FALSE`. For repeated calls, the same object can be returned.
3. Last, the static function can return a subtype object.
4. Instead of writing `"Map<String,Integer>m=new HashMap<String,Integer>();"` we can write

`"Map<String,Integer>m=HashMap.newInstance();"`