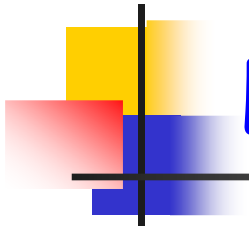
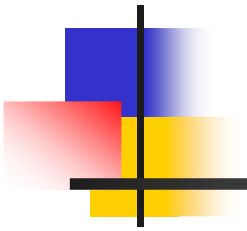
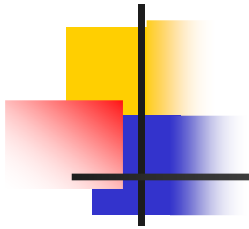


Lecture4 – OOP concepts in Java

- Object Oriented Programming
  - Concept of class/object – review
  - Data encapsulation
    - Access restrictions
      - public and private members
  - Inheritance
  - Polymorphism
- We will cover all these OOP concepts in Java



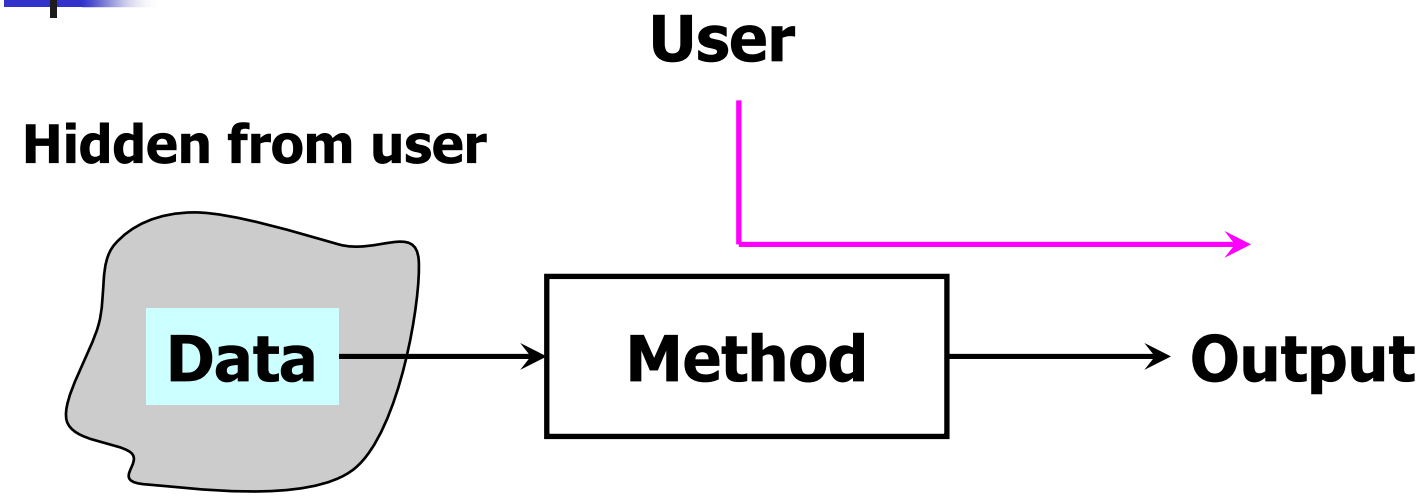
Data encapsulation



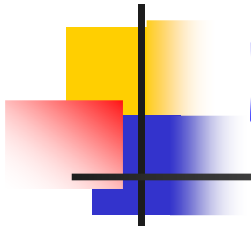
Data encapsulation

- Hide the data from end user
- Need to know what methods are implemented
- Not how they are implemented
- Provide interfaces (APIs) to access data
- E.g. To compute interest in a bank an user
  - Needs to know what function to call
  - NOT how the function is implemented

Data encapsulation … contd.



- Methods act on data to provide output.
- User needs to see only method, not data.
- User should not be affected by
  - Implementation details of methods.
  - Changes in implementation of methods.

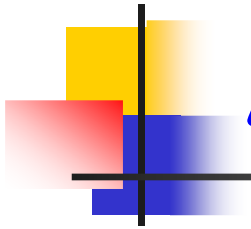


Data encapsulation … contd.

- Not all data needs to be hidden
  - It is fine to give direct access to some data.
- Not all methods need to be given access
  - Some methods may be hidden – for internal use by classes

⇒ Data and methods both need access restrictions.

- How can data/methods be hidden?
  - By using access modifiers.
- Different access modifiers:
  - public – accessible to every class, function
  - private – accessible only to class and package
  - protected – accessible to class package and subclass
  - No modifier – accessible only to class and package



Access modifiers

Modifier	class	package	subclass	others
public	Yes	Yes	Yes	Yes
protected	Yes	Yes	Yes	No
No modifier	Yes	Yes	No	No
private	Yes	No	No	No

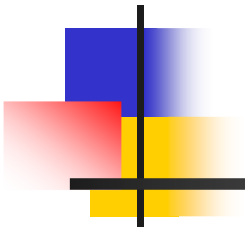
Source: Oracle.com

Data encapsulation in account example

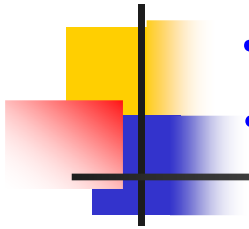
In an object of account

- user_ssn and accountNumber are declared private
  - Accessible only to account and nothing else.
  - Methods are public
    - Anyone can access them.

```
public class Account
{
  private  int user_SSN;                          // Accessible only to Account
  private  int accountNumber;                     // Accessible only to Account
  public   Account ( ) { .. }                          // Accessible to all
  public   void withdrawMoney (int amount) { .. } ; // Accessible to all
  public   void depositMoney (int amount)   { .. };  // Accessible to all
  public   void computeInterest( )          { .. };  // Accessible to all
 ...
};
```



Inheritance



Inheritance

- Let's take the account example again
- There can be many types of accounts
  - Checking, saving, money market, IRA, etc.
- All accounts may have
  - Some common members.
    - Account number, user SSN, etc.
  - Some class specific members.
    - Checks cleared, investment options, etc.
- Method implementation may be
  - Same in different classes
  - Different in different classes.

Inheritance – base class & derived class

- Base class

```
class account
{
    private int user_SSN;
    private int accountNumber;
    public Account ( ) { .. }
    public void deposit (int amount)    { …  }
    public void withdraw (int amount) { …  }
};
```

- Derived class or child class

```
class checkingAccount  extends account     // checkingAccount is
{                                          // derived from account
    private int lastCheckCleared;          // not present in account
    public  void showAllChecksCleared( ) { } // not present in account
};
```

Inheritance – base class and derived classes

- Base Class

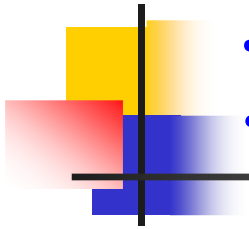
```
class account
{
   private int user_SSN;
   private int accountNumber;
   public  Account ( ) { … } // code
   public  void deposit (int amt)
    {
      // code
    }
   public  void withdraw (int amt)
    {
      // code
    }
};
```

- Derived (or child) class-1

```
class checkingAccount extends account
{
     private int lastCheckCleared;
     public checkingAccount ( ) { … };
     public void showChecksCleared ( ) { //code
      }
};
```

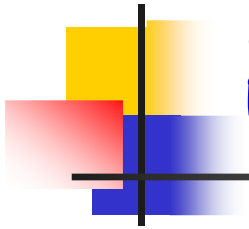
- Derived (or child) class-2

```
class IRA_account extends account
{
     public IRA_Account ( ) { … };
     public void buyFund (int fund_ID)  {
     //code
      }
     public void sellFund (int fund_ID)  {
     //code
      }
};
```



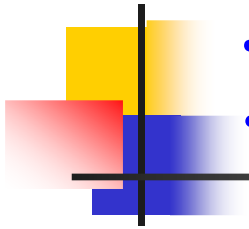
Inheritance – continued.

- Important points to note:
  - Derived classes have access to members of base classes in this example.
  - Derived classes can have their own members.
    - E.g. showLastCheckCleared( ), buyFund( ), sellFund( ), etc.
    - Members of one derived class are not accessible to another.



Examples

- Valid usage in an external function
  - Account acct = new Account ( );
  - checkingAccount ca = new checkingAccount ( );
  - acct.deposit (700);
  - acct.withdraw (300);
  - checkingAccount.deposit (1000);
  - checkingAccount.withdraw (600);
- Invalid usage in an external function
  - acct.user_SSN = 1234; // Can't access user_SSN
  - acct.accountNumber = 567;



Inheritance … Object class

- In Java Object is the base class for every Java class.
- Object is a built-in class.
- Defines useful functions.
  - hashCode
  - toString
  - equals
  - notify, etc.