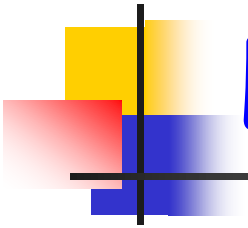


Lecture-4

- Inheritance.
- Polymorphism
  - Virtual functions
- Abstract classes

Inheritance – base class & derived class

- Base class

```
class account
{
    int user_SSN;
    int accountNumber;
public:
    void deposit (int amount);
    void withdraw (int amount);
    double computeInterest ( );
};
```

- Derived class or child class

```
class checkingAccount : public account // checkingAccount is
{                                       // derived from account
    int lastCheckCleared;              // not present in account
    void showAllChecksCleared( );      // not present in account
    double computeInterest( );         // defined in both classes
};
```

Inheritance – base class and derived classes

- Base Class

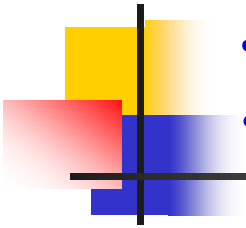
```
class account
{
private:
    int user_SSN;
    int accountNumber;
    int balance;
public:
    account ( ) { }
    account (int ssn, acctNum);
    ~account( ) { }
    void deposit (int amount)
    void withdraw (int amount);
    double computeInterest( );
};
```

- Derived (or child) class-1

```
class checkingAccount : public account
{
public:
    int lastCheckCleared;
    void showChecksCleared ( );
    double computeInterest ( )
};
```

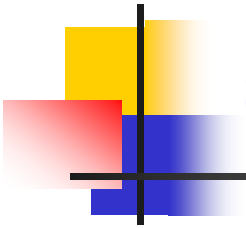
- Derived (or child) class-2

```
class IRA_account : public account
{
public:
    void buyFund (int fund_ID);
    void sellFund (int fund_ID);
    double computeInterest ( );
};
```



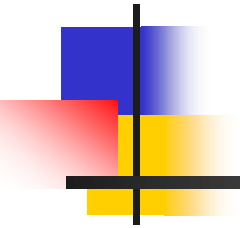
Inheritance – continued.

- 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. lastCheckCleared, showAllChecksCleared( ), buyFund( ), sellFund( ), etc.
    - Members of one derived class are not accessible to another

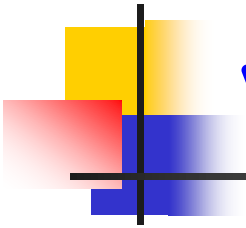


Examples

- Valid usage in an external function
  - account acct(123456, 5672);
  - checkingAccount ca;
  - acct.deposit (700);
  - acct.withdraw (300);
  - ca.deposit (1000);
  - ca.showAllChecksCleared( )
- Invalid usage in derived class
  - ca.user_SSN = 1234; // Can't access user_SSN
  - ca.accountNumber = 567;



Polymorphism & virtual functions



virtual functions

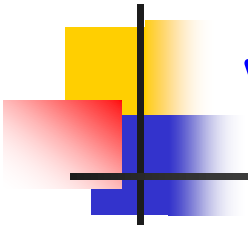
- Function "double computeInterest( )" is defined in both base and child classes.
  - Supposed to return different values
    - virtual double Account::computeInterest ( )
      { return 0; }
    - double CheckingAccount::computeInterest ( )
      { return 10.0; }
    - double IRA_Account::computeInterest ( )
      { return 100.0; }

virtual functions … contd.

```
main( )
{
   Account *x = new CheckingAccount();
   x→computeInterest( );
   // Will this return 0 or 10.0?
}
```

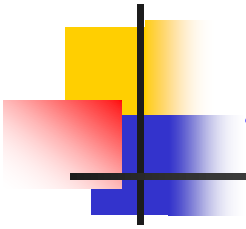
- This will return
  - 0, if the function is NOT virtual
  - 10.0, if the function is defined virtual

Why are virtual functions needed?



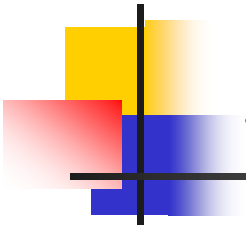
- Mainly to enforce class specific functional implementation.
- Should not call base class function from a child object.
- An account object may take different "forms" at different times
  - Checking account, IRA account, etc.
  - computeInterest( ) should compute derived class specific function.

⇒ Polymorphism



Abstract classes

- Consider an object of Account.
- It makes sense to have
  - A specific type (e.g., checking) of account
  - Not just a generic account object.
- A user should be able to create
  - Specific object types.
  - NOT generic objects.
- An abstract class is the generic class.



Abstract classes … contd.

- Properties of abstract classes.
  - Defines a generic base class
  - Class definition has attributes and methods
  - Other classes are derived from it.
  - Derived classes implement the methods defined in abstract class.
  - Can NOT instantiate objects of base class.
  - Can instantiate only objects of derived classes.

How do we create abstract classes?

- Set ANY virtual function to 0.
  - Pure virtual function – value of function = 0
  - NO BODY for function

```
class Account
{
    virtual double computeInterest ( ) = 0;
}
class CheckingAccount : public Account
{
    double computeInterest ( ) { … }
}

Account x; // Will NOT work.
CheckingAccount y; // Will work.
```