# Object-oriented programming

Week 5 – Inheritance



6/2014

# What will be discussed?

- Introduction to inheritance
- Types of inheritance
- Derived class
  - Constructor
  - Destructor
  - Copy constructor & assignment operator
- Virtual functions and dynamic binding

# Introduction

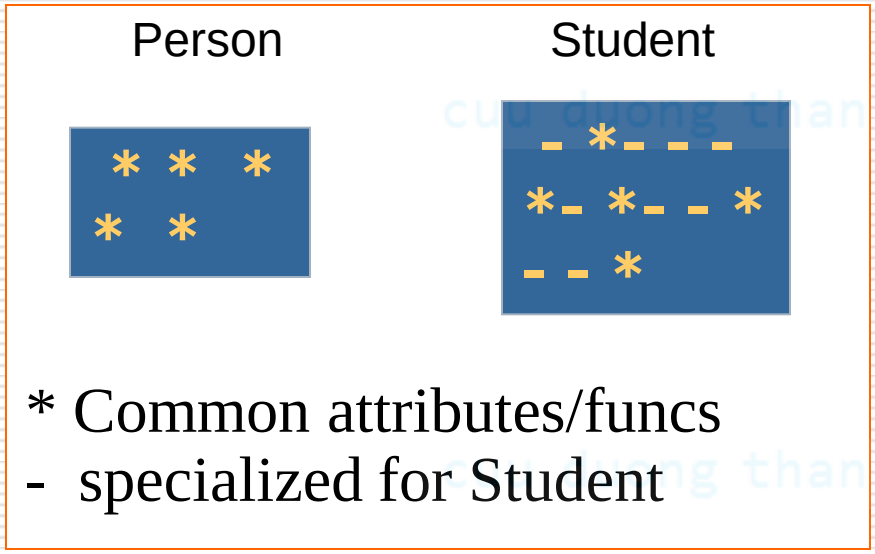
- A new concept does not come alone. When we introduce a class of **`car`** or **`employee`** for example. It may lead us to describe:
  - wheel, engine, driver etc.
  - Or: manager, director…
- To model them, we can use **`class`**. However, how can we model the relationship between them?

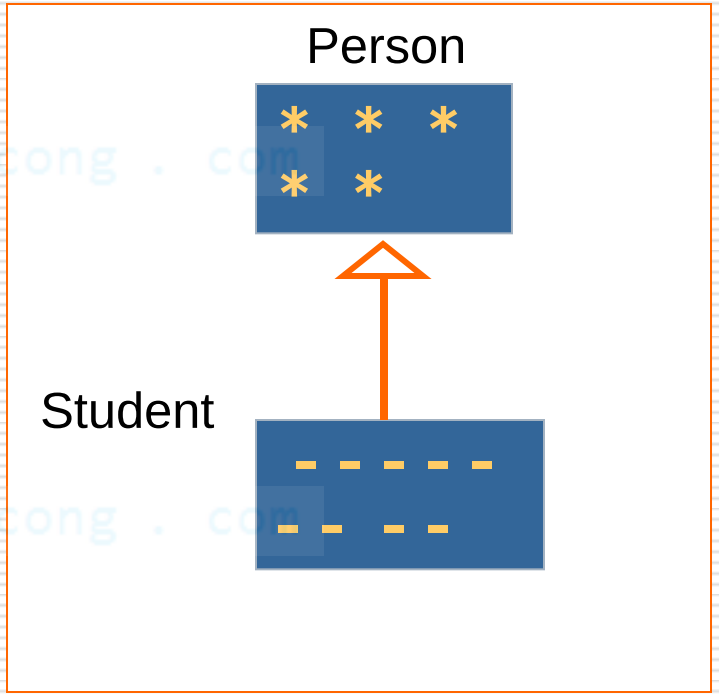
# Introduction (cont.)

- In addition, re-usability of existing classes is one of the features of OOP.
- All of the features including attributes and behaviors of a class are also the features of another class.

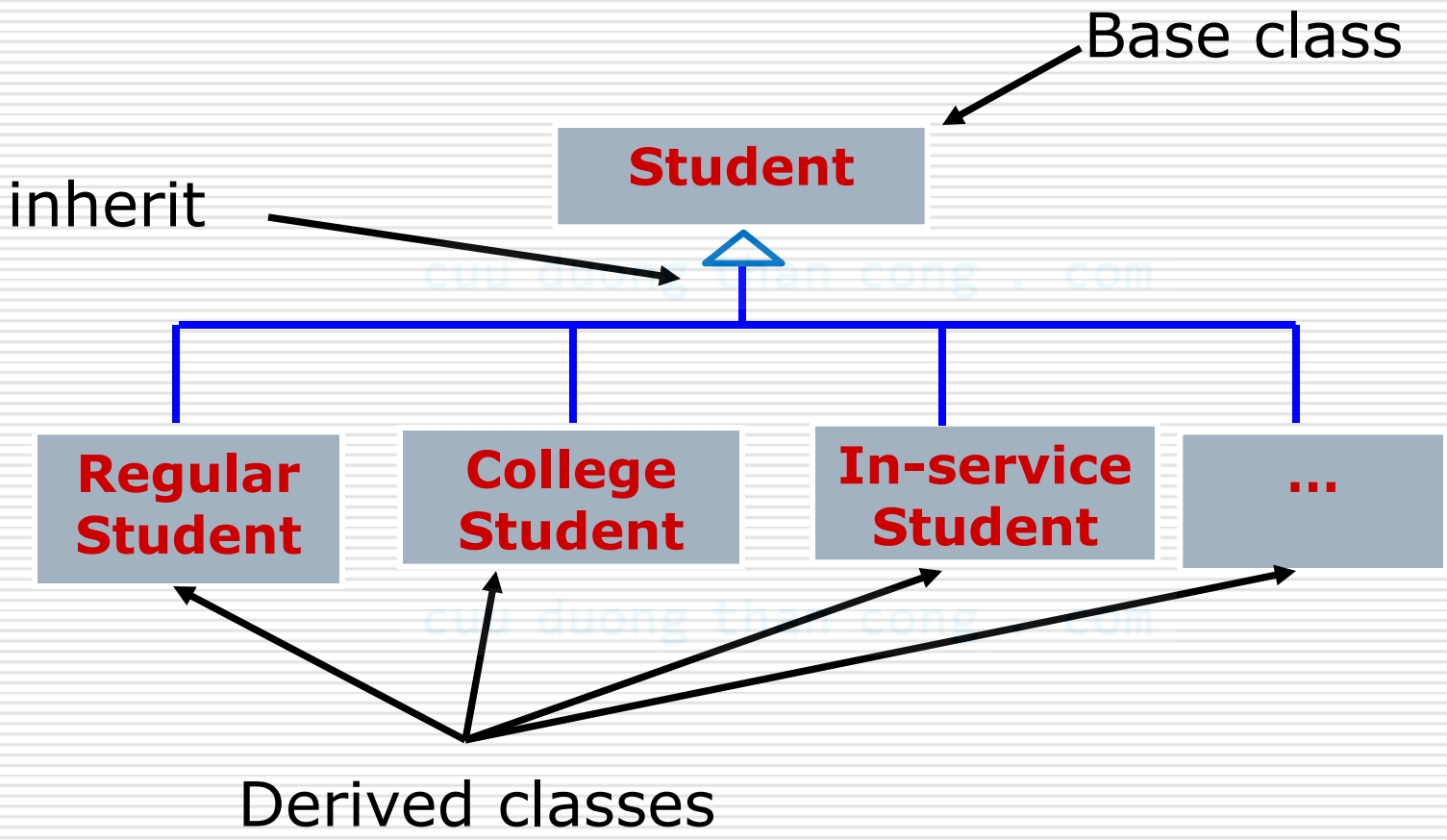
# Inheritance

- Student “is a” person



# An example



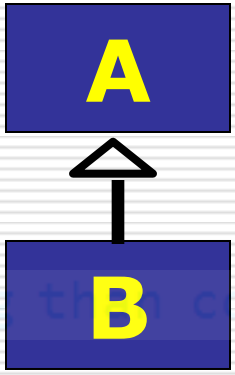
# Syntax

- In C++, the inheritance is described as:

```
class <Derived Class> : <TypeOfInheritance> <Base class>
{
      public:
            <public attributes/functions>

      private:
            <private attribute/functions>
};
```

# Inheritance: notes






- Attributes/functions in **`public`** of A will become attributes/functions in B
- **`Private`** of A will be part of B but it is only accessible via **`public`** or **`protected`** of A

# **protected** keyword

- **protected** of A is accessible from the derived class B but not from outside

```
class A
{
   public:
      ...
   protected:
      int t;
};
```

```
class B: public A
{
   public:
      void test()
      {
         cout << t;
      }
      ...
};
```

# Types of inheritance

There are 3 types:

- **`public`** inheritance
- **`protected`**
- **`private`**

**Notes:** from now on, if there is no mention of what type of inheritance, it means public inheritance

# Types of inheritance

- **`public`**: public and protected of the base class become public and protected of the derived class.
- **`protected`**: public and protected of the base class become protected of the derived class.
- **`private`**: public and protected of the base class become private of the derived class.

# Inheritance: member functions

- Member functions of the base class are inherited in the derived class, except:
  - Constructors
  - Destructors
  - Assignment operators

- Notes: private members or functions of the base class are inherited but ***only accessible via other public/protected functions*** of A

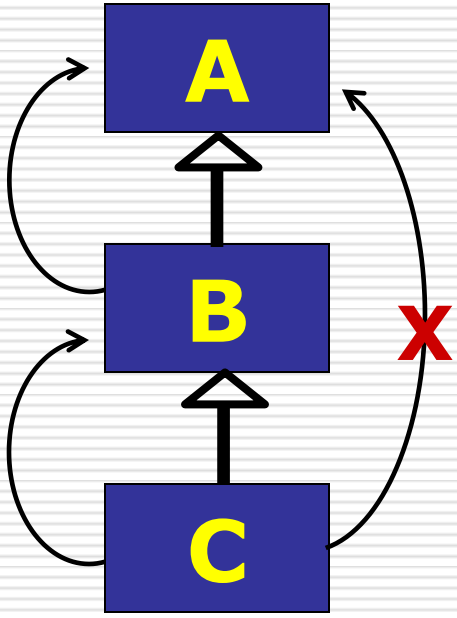
# Constructors in inheritance

- When a new object of a derived class is created
  - The constructor of the base class is invoked first.
  - Then, the constructor of the derived class is invoked.
  - In the constructor of the derived class, we can specify which constructor of the base class is called. Otherwise, the default constructor of the base class will be invoked.

# Constructors in inheritance

Notes:

- The constructor of the derived class is able to specify the constructor of the immediate base class to be called.



# An example

```
class A
{
public:
      A();
      A(int);
};

class B : public A
{
public:
      B(int);
};
```

```
class A {
public:
      A();
      A(int);
};

class B : public A
{
public:
      B(int t) : A(t) {
            ...
      }
};
```

# Destructor in inheritance

- When an object of the derived class finishes its lifespan:
  - The destructor of the derived class is invoked first.
  - Then, the destructor of the base class is called later.

# “Re-define” member functions

- Sometimes, we need to “re-define” the member functions of the base class in the derived class.
  - It can be done by re-defining the functions inside the derived class

**Notes:** this re-definition will hide other overloading member functions of this function from the base class.

# An example

```
class A {
public:
    void test();
    void test(int);
    void test(int, int);
    ...
};

class B : public A
{
public:
    void test(int);
};
```

```
int main()
{
    B b;
    int x, y;
    ...
    b.test(x); // OK
    b.test(x, y); //error
    ...
}
```

# **using** keyword

```
class A {
public:
    void test();
    void test(int);
    void test(int, int);
    ...
};

class B : public A
{
public:
    using A::test;
    void test(int);
};
```

```
int main()
{
    B b;
    int x, y;
    ...
    b.test(x); // OK
    b.test(x, y); //OK
    ...
}
```

# Assignment operator

- It is not inherited from the base class
- To implement the assignment operator for the derived class:
  - Calling the assignment operator of the base class to assign data members of the base class part in the two objects first.
  - Then, implement the assignment for data member of the derived class part.

# An example

```
B& B::operator=(const B& src)
{
   if (this == &src)
      return *this;
   A::operator=(src); //call the BASE
   delete [] ptr;
   iSize = src.iSize;
   ptr = new int [iSize];
   for (int i=0; i<iSize; ++i)
      ptr[i] = src.ptr[i];
   return *this;
}
```