Inheritance

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	C++	Java
Keyword	none	“extends”
Access to base	public, protected or private	public
Poly-morphic	Only if requested	Always
Multiple parents	Yes	No
Interface keyword	none	“interface”

Person

```
class Person
{
private:
    std::string _name;
    int _id;
    static const int NO_ID_VAL= -1;
public:
    Person (const std::string& name, int id);
    void changeName(const string& name);
    void changeId(int id);
    std::string getName() const;
    int getId() const;
} ;
```

Programmer class

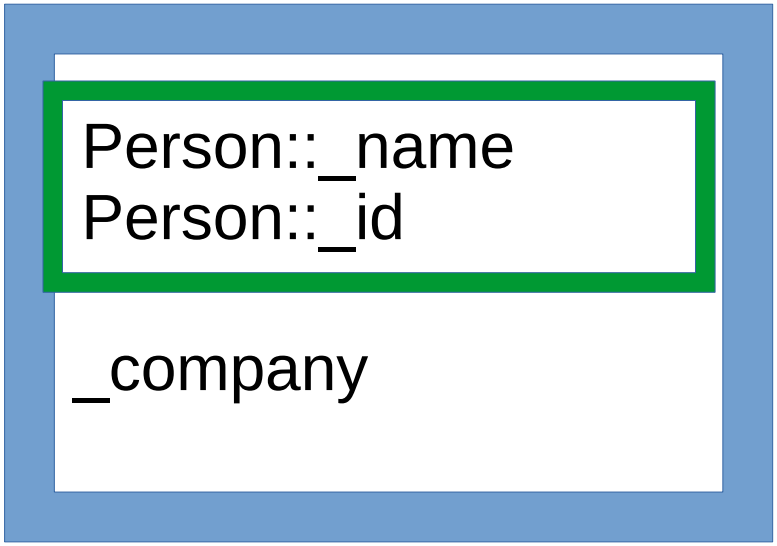
```
#include "Person.hpp"
class Programmer : public Person
{
    std::string _company;
public:
    Programmer(const std::string& name,
               int id,
               const std::string& company);
    …
;
```

Base class

Derived class

Inheritance – under the hood

Every object of class Programmer contains a hidden field of class Person.



Objects of Programmer can use Person's methods

```
int main()
{
  Programmer yoram("Yoram",1226611,"N.G.C ltd.");

  cout << yoram.getCompany() << endl;
  yoram.changeCompany("Microsoft");

  cout << yoram.getName()   << " " <<
          yoram.getId()     << endl;
  yoram.changeName("Yori");
  yoram.changeId(2266110);
  ...
}
```

Programmer class implementation

```
#include "Programmer.hpp"

Programmer::Programmer
          (const std::string& name,
           int id,
           const std::string& company) :
   Person(name, id), _company(company)
{
   // EMPTY  Considered elegant
}
```

Functions you don't inherit:

- Ctors, Dtors (may be called automatically)
- Operator= (technically inherited, but always hidden by an explicitly or implicitly defined assignment operator).

Default Operator=

not inherited but the default one uses the father's automatically.

Algorithm of default `operator= (other)`:

```
For each field in class:
    this->field = other.field;
```

This includes also the hidden field representing the base class!

protected

- Class members that should be accessible by subclasses only are declared as protected.
- To allow class Programmer to access the members of class Person, define:

```
class Person
{
protected:
    std::string _name;
    int _id;
    static const int NO_ID_VAL= -1;
public:
    ...
```

public, protected and private inheritance

public, protected and private inheritance

A base class also has an access modifier:

```
class Programmer : public Person
```

or

```
class Programmer : protected Person
```

or

```
class Programmer : private Person
```

This modifier relates to the **hidden object** of type Person that is contained in Programmer.

public, protected and private inheritance

A base class also has an access modifier:

```
class Programmer : public Person
```

Default for structs

or

```
class Programmer : protected Person
```

or

```
class Programmer : private Person
```

Default for classes

Private inheritance:

- Inside Programmer, you can access the public and protected members of Person.
- Outside Programmer, you cannot access any members of Person (the Person object is private).

Objects of Programmer can use Person's methods

```
int main()
{
  Programmer yoram("Yoram",1226611,"N.G.C ltd.");

  cout << yoram.getCompany() << endl;
  yoram.changeCompany("Microsoft");

  // cout << yoram.getName()  << " " <<
  //         yoram.getId()       << endl;
  // yoram.changeName("Yori");
  // yoram.changeId(2266110);
  // The above do not compile with private inheritance.
}
```

public, protected and private inheritance

```
class Base {…};
class PublicDerived    : public    Base{…};
class ProtectedDerived : protected Base{…};
class PrivateDerived   : private   Base{…};
```

Access to fields of base = minimum of (

access modifier of inheritance,

access modifier of field in Base

).

EXAMPLE: if in Base we have “**protected**:int x”,

then in PublicDerived, ProtectedDerived x is **protected**,

and in PrivateDerived x is **private**.

public inheritance – standard Is-A relation. Derived class can be used whenever base class is needed.

private inheritance – code-reuse without is-A relation. *Example*:

class Stack: private Vector { … }

**** In this case, it is often better to use composition.*

C-tor & D-tor order of execution

C-tor & D-tor order of execution

1. Constructor of the base class is executed
2. Constructor of the class itself is executed

Destruction is done in the opposite order

C-tor & D-tor order of execution

1. Constructor of the base class is executed
    1. First members in initialization list
    2. Then body
2. Constructor of the class itself is executed
    1. First members in initialization list
    2. Then body

Destruction is done in the opposite order

C-tor & D-tor order of execution

```
class A {
  int _a;
 public:
  A(int a) : _a(a) { cout << "A ctor\n"; }
  ~A()             { cout << "A dtor\n"; }
};

class B : public A {
  int _b;
 public:
  B(int a, int b) : A(a), _b(b) { cout << “B ctor\n"; }
  ~B()                          { cout << “B dtor\n“; }
};
```

C-tor & D-tor order of execution

```
int main()
{
    B b(1,2);
}
```

What will be the output?

C-tor & D-tor order of execution

B b(1,2);

```
class A {
  int _a;
 public:
  A(int a) : _a(a) { cout << "A ctor\n"; }
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};

class B : public A {
  int _b;
 public:
  B(int a, int b) : A(a), _b(b) { cout << “B ctor\n"; }
  ~B()                          { cout << “B dtor\n“; }
};
```

C-tor & D-tor order of execution

```
int main()
{
    B b(1,2);
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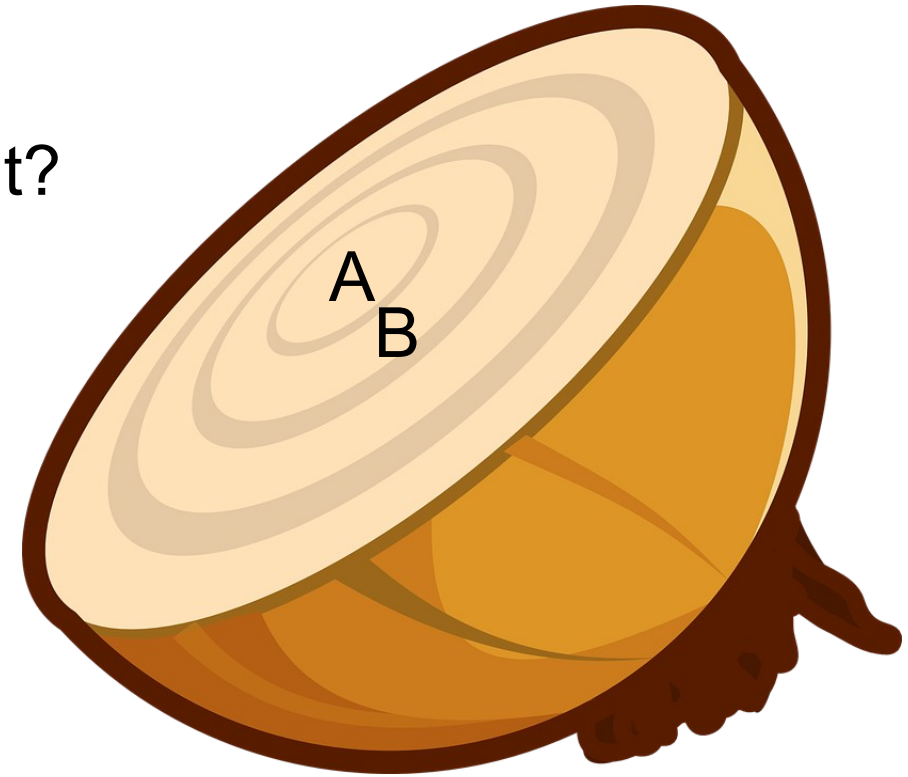
What will be the output?



A ctor
B ctor
B dtor
A dtor

C-tor & D-tor order of execution - demo

Either view folder 1

Or put the following code in https://godbolt.org/

```
struct A {
    int i;
    A() { i = 555; }
    ~A() { i = 666; }
};

struct B: public A {
    int j;
    B() { j = 777; }
    ~B() { j = 888; }
};

int main() {
    B b;
}
```

Overriding

Person

```
class Person
{
    ...
    void outputDetails(std::ostream& os) const;
    ...
} ;
```

Programmer class – Override

```
#include "Person.hpp"
class Programmer : public Person
{
    ...
    void outputDetails(std::ostream& os) const;
    ...
};
```

Overridden member functions (folder 2)

```
void Person::outputDetails(std::ostream& os)
const {
    os << "{";
    if(_name != "") os << " name: " << _name;
    if(_id != NO_ID_VAL) os << " ID: " << _id;
    os << '}';
}
```

```
void Programmer::outputDetails(std::ostream& os)
const {
    Person::outputDetails(os);
    os << '-' << _company;
}
```

Explicit Operator=

```
Person& Person::operator=(const Person& other)
{
      ...
   return *this;
}
Programmer& Programmer::operator=(const
Programmer& other)
{
    Person::operator=(other);
    company = other.company;
….
    return *this;
}
```