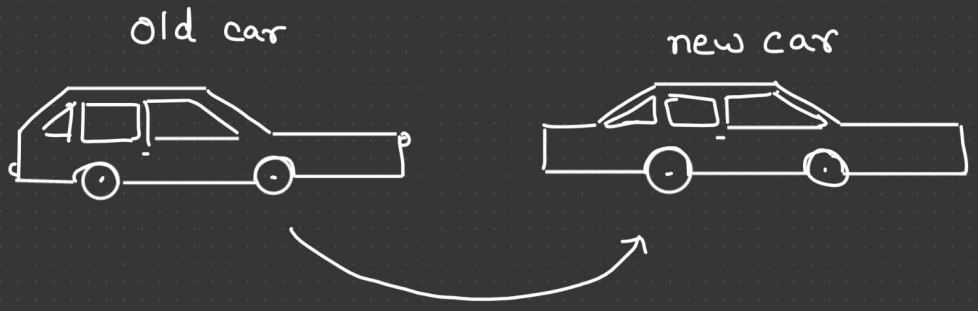
Inheritance

One of the main goal of OOP's is to provide reusable code.

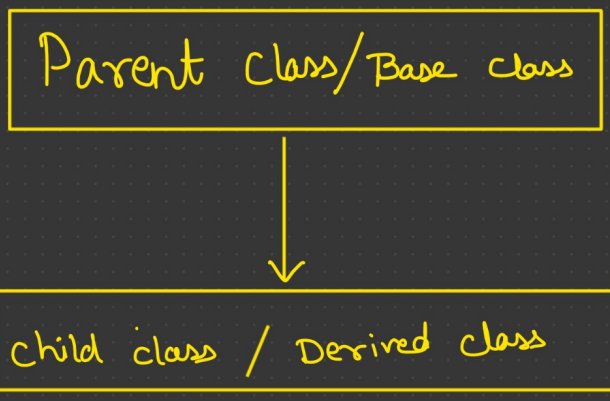


+ engine ↑
+ design ↑
+ new features ↑

+ Old functionality

```
Class Calculator
{

    add()
    {

    }
    sub()
    {

    }

};
```

```
Class NewCalculator
{

    add() ✓
    sub() ✓
    mult() +
    divide() +

};
```



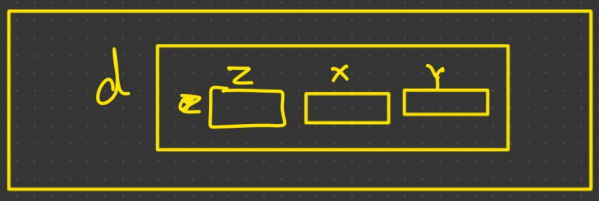

```
Class A
{
  ____
  ____
  ____
  ____
};
```

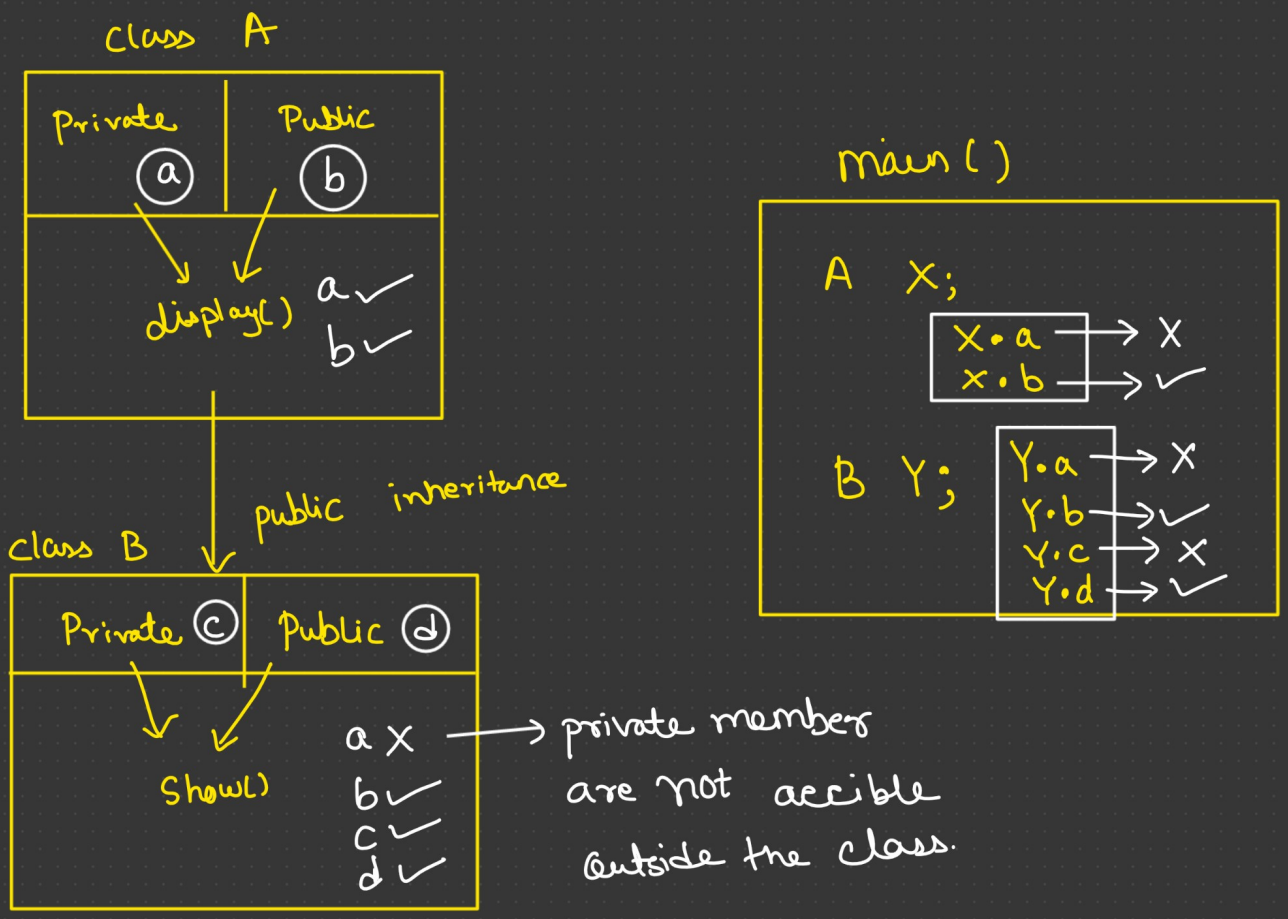
```
Class B : public A
{
  ____
  ____
  ____
  ____
  +
  New
};
```

```
Class ABC
{
  public :
    int x, y;
};
```

```
Class DEF : Public ABC
{
  public :
    int z;
};
```

```
int main()
{
  DEF d;

};
```




Class A
Private
Public
a
b
display()
a ✓
b ✓
public inheritance
Class B
Private c
Public d
Show()
a X
b ✓
c ✓
d ✓
private member are not accible outside the class.
main()
A X;
X.a → X
X.b → ✓
B Y;
Y.a → X
Y.b → ✓
Y.c → X
Y.d → ✓

```
class Parent
{
  public :
    int x, y;

    void display()
    {
      cout << x << y;
    }

};
```

```
class Child : public Parent
{
  pubic :
      int z;

      void display()
      {
        cout << x << y << z;
      }

};
```

```
int main()
{
   Parent a;
   Child  b;

   Parent *p = &a;
   p->display();
```

① ⟶ parent class display() called

```
   Child  *c = &b;
   c -> display();
```

② ⟶ Child class display() called.

```
   parent *p1 = &b;
```

③ → parent pointer ⟶ Child object

```
   Child *c1 = &a;
```

④ → child pointer ⟶ parent object

```
Parent *p1 = &y;  //1. parent class pointer can point to child class object
p1->display();    //2. Function of pointer type will be called

Child *c1 = &x;  // It is an error Child class pointer cannot point to parent class object
 c1->display();  // error
```

Example :-

```
Class Base
{
   int x;
   void fun( Base *p)
   {
      =
    }
};
```

```
int main()        → old code
{
  Base a, b;
  a.fun( &b);
  return 0;
}
```

```
Class Derived1 : public Base
{
   int y;
}
```

```
int main()        → new code
{
   Derived1 c, d;
   c.fun(&d);
   return 0;
}
```

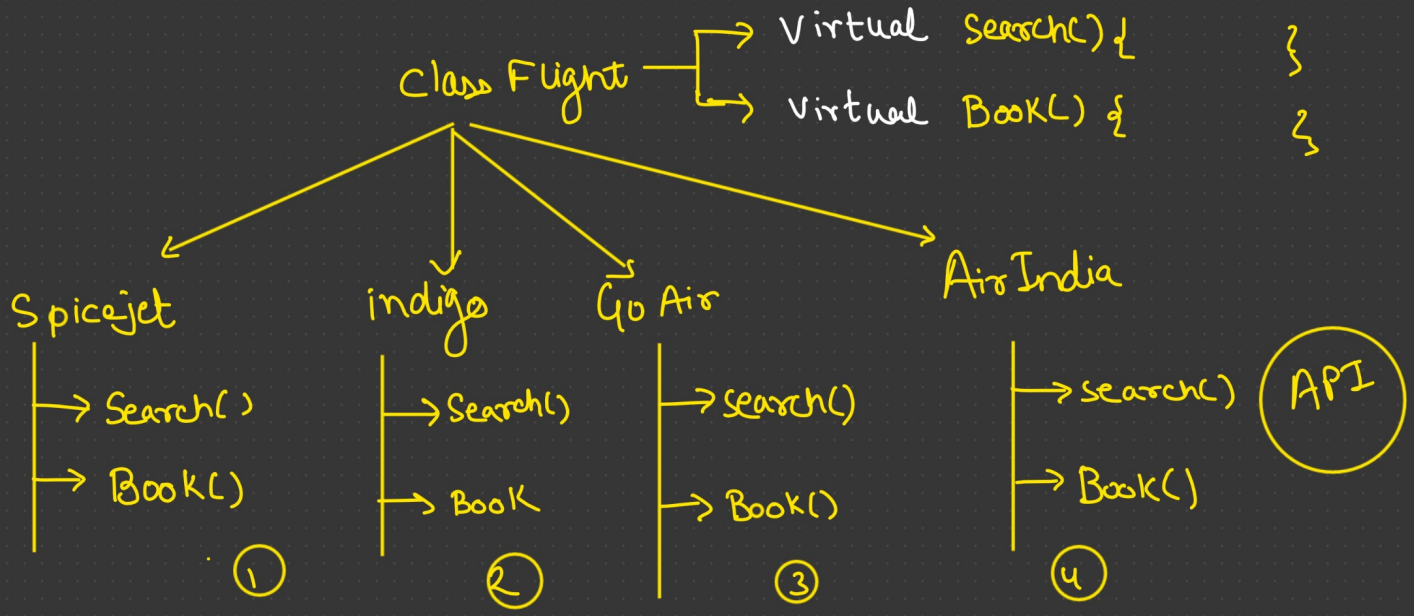
Base *p = &d; ✓

```
class Derived2 : public Base
{
    void fun( Base * p)
    {
        == //modified code
    }
};
```

```
int main()
{
    Derived2 b, c
    Base * a = &b;
    a->fun(&c);

    return 0;
}
```

Base class fn will be called. But I want to call derived2 class function.

Virtual Function



```
int main()
{ int x;
  cout<<"Select flight";
  cin>>x;
  Flight *f = Choice(x);
  f -> Search();
  f -> Book();

  return 0;
}
```

compile

Runtime

```
Flight * Choice(int x)
  {
    if(x==1)
      return new Spicejet();
    else if(x==2)
      return new Indigo();
    else if(x==3)
      return new Goair();
    else if(x==4)
      return new AirIndia();
  }
```

- How the virtual function work?
- What is Static Binding / Compile time Binding / Early Binding?
- What is Dynamic / Runtime / Late Binding?

Static & Dynamic Binding

Compile time
[Before execution of the code]

Runtime
[At the time of execution of code]

Object + function

```
int x;
float y;
Student s;
```

} Compile time → Early Binding → static

```
new Student();
malloc();
calloc();
```

} Runtime → late → Dynamic

Virtual Keyword indicate to the compiler that instead of taking decision at compile time, please take the decision at Runtime.

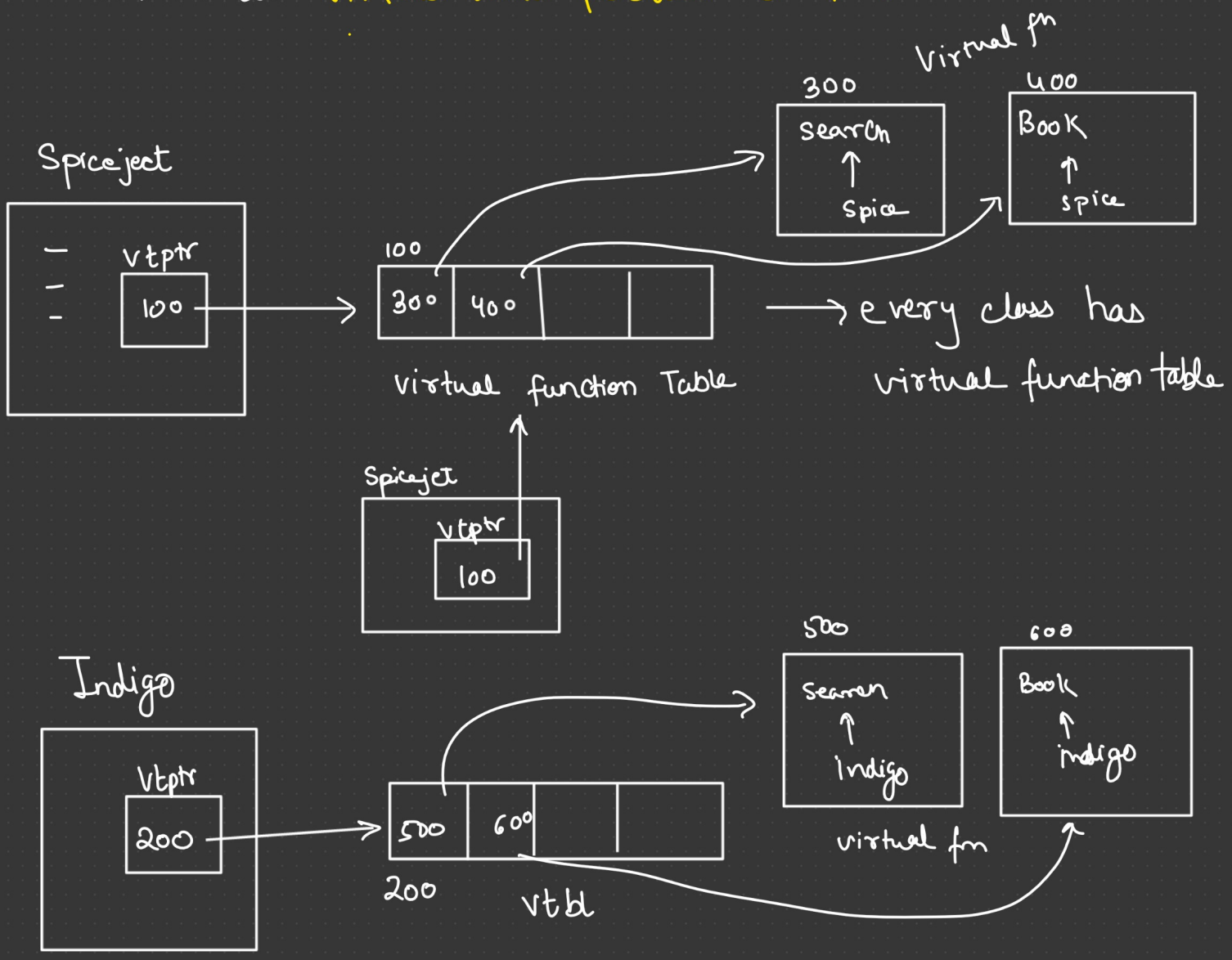
Why two Kinds of Binding ?

- efficiency → By default → Compile time
  Because it is fast.
- Conceptual Model → May be you don't want to redefine the function in derived classes.

How Virtual functions works ?

- Every object has a hidden member that holds the address of an array of functions addresses. Such an array is usually termed as Virtual function Table (Vtbl).

- And the pointer that holds the address of Vtbl is known as virtual table pointer (Vtptr).



Constructor & Destructor

* Constructor can't be virtual — Because constructor does not inherited by derived class. And if we create an object of derived class, it will first call base class constructor. ∴ we don't need to make it virtual.

* Destructor should be virtual —

```
Flight *f = new Spicejet;
delete f;
```

→ ~Flight() or ~Spicejet()

virtual ~Flight();

if flight class destructor is called then child class (spicejet) object will not released.

* But we know that, first child class destructor should be called & there after parent class destructor need to be called.

∴ it should be virtual so that correct destructor is called.

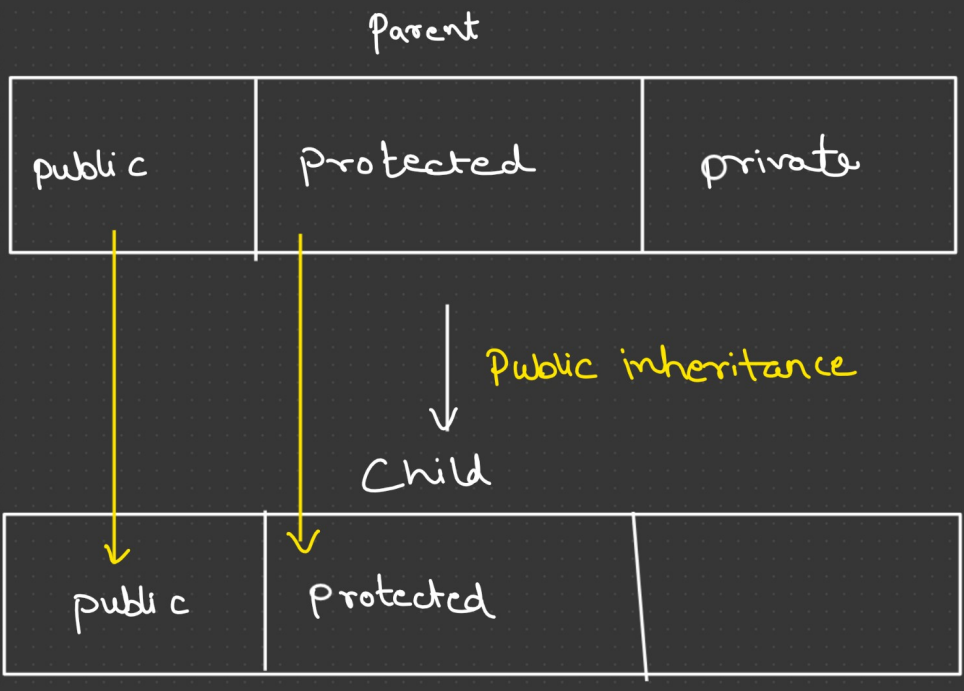
Access Control : Protected

```
class A
{
   private :
            int x;

   protected :
            int y;

   public  :  int z;

            void display()
            {
             cout << x <<y<< z;

              }

};
```

```
int main()
{
   A a;

   a.x = 5; //private not accessible

   a.y = 10; // protected = private for outside the class

   ∴ y is also not accessible.

   a.z = 20; // valid

   a.display(); //valid

   return 0;
}
```

```
class B : public A
{
    // x not accessible, because x is private.
    // But y is accessible, it means protected is accessible
       in child class.
    ∴ For child class protected = public.

    void display()
    {
        cout << y << z;
    }
};
```

```
int main()
{
    B b;
    b.y = 5; // error
             ∵ y is protected
    b.z = 10; //valid.
    return 0;
}
```



Security can only be increased.

public ⟶ protected ⟶ private

protected ⟶ private

private

---

max (public, public) = public

max (public, protected) = protected

max (public, private) = private

↑

for Public inheritance.

max (protected , public) = protected

max (protected , protected) = protected

max (protected , private) = private

For protected inheritance

max (private , public) = private

max (private , protected) = private

max (private , private) = private.

for private inheritance

	public	protected	private ← parent
public	✓	✓	✗
protected	✓	✓	✗
private	✓	✓	✗

child