**Polymorphism**

Recall that if we call an object by its parents, the overrode functions (within children's class) will not be called (since the compiler is considering the object as the parent class)

**AND,** we can't even use the new functions that we defined for the children class!

Text

Description automatically generated🡪 Compile error !!!!

In general, we want to use a pointer to the base class object to invoke a function that is implemented in a derived class

**SOLUTION: virtual functions**

**If a function is declared as virtual in base class A, and redefined in derived class B, then**

**B derived\_obj;**

**A\* ptr = &derived\_obj;**

**A -> redefined\_func()** // will call redefined\_func() in derived class B

\*\* A class that declares or inherits a virtual function is called a polymorphic class

* The decision to which redefined function to call is made at runtime 🡪 late binding
* Virtual function in base class is like a "dummy", or "placeholder" function declaration
  + Since only the children will define the behavior of this function, we can use a syntax to **declare that base class does not know what function do**

**virtual int area() = 0;** 🡪 The base class will be abstract class

🡪 This is called purely virtual function.

**🡪 We cannot instantiate an object of abstract class (but can still create a pointer to abstract class, pointing to derived class objects)**

**🡪 We must override the function in Derived class. Else, the Derived class is also abstract 🡪 cannot instantiate an object of Derived class also!**

* You **cannot** declare a member variable as virtual. Only functions!

**Vtable**

**? So how does the compiler "know" which function from which derived class to call?**

* The moment you declare a function member of a class as "virtual", the compiler will create a vtable (virtual method table) as a hidden member variable of that class, and any object that inherits from it
* There is a separate vtable for each class both based and derived (not for each object)
* The vtable only contains virtual functions, which maps to the function target

Say we have these classes:

A screenshot of a computer

Description automatically generated with medium confidence

Diagram

Description automatically generated

As we can see, there are additional space and process that has to be done 🡪 slows down 6-13%

Remember that these calls only happen if we are doing polymorphism on derived objects.