

# Quiz #1

[CS 225] Advanced C/C++



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50 / 100  
Points

Name

Student login

Date

Points

Notes: This is a short-answer, closed books quiz. Do not collaborate or copy other people's work. Please write legibly – I can give points only for correct, clear answers I am able to read.

## 1. Analyse the class hierarchy

Given the following code that represents a class hierarchy, for each question below provide a valid answer, or write NC if the statement does not compile (then ignore it for the rest of the program).

```
1 #include <iostream>
2 struct IObject 2
3 {
4     unsigned short int cost() const { return 0; }
5 };
6 struct PowerUp : IObject
7 {
8     PowerUp(unsigned short int v) : cost(v) {}
9     PowerUp() : cost{0} {}
10    virtual ~PowerUp() = default;
11 protected:
12    unsigned short int cost;
13 };
14 struct HealthBonus : virtual PowerUp
15 {
16 public:
17     HealthBonus() : PowerUp(1) {}
18 };
19 class ManaBonus : virtual PowerUp
20 {
21 public:
22     ManaBonus() : PowerUp(2) {}
23     unsigned short int cost() const { return PowerUp::cost; }
24 };
25 struct SpecialItem :
26     public HealthBonus, virtual destructor
27     public ManaBonus virtual destructor
28 {
29     SpecialItem() : _owner{new PowerUp} {}
30     ~SpecialItem() { delete _owner; } // IObject::~~IObject(_owner)
31 private:
32     IObject* _owner;
33 };
34 int main()
35 {
36     IObject* item = new SpecialItem;
37     std::cout << item->cost(); // IObject::cost if not virtual
38     delete item; // item -> ~IObject(item);
39 }
```

- What is the output text printed by the program?
- What is the result of an expression: `sizeof(IObject)` ?
- What is the result of an expression: `sizeof(PowerUp)` ?
- What is the result of an expression: `sizeof(HealthBonus)` ?
- What is the result of an expression: `sizeof(ManaBonus)` ?
- What is the result of an expression: `sizeof(SpecialItem)` ?

0	✓
2 byte	✗ 1
16 byte	✓
16 byte	✗ 24
16 byte	✗ 24
32 24 byte	✗ 40

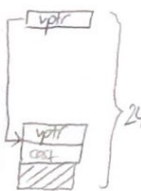
virtual d-ctor



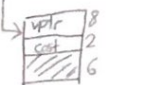
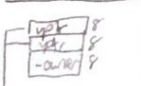
Not an interface class

synthesis destructor

HealthBonus has virtual destructor



Same as above



g) In the above fragment of the code (line 2) is the struct `IObject` an interface class? Explain.

✓ No. line 4 is not a virtual function and an interface class must consist of virtual functions.

h) In the above fragment of the code (line 30) is the destructor `~SpecialItem()` a virtual member function? Explain.

✓ Yes. `SpecialItem` inherits from `HealthBonus` and `ManaBonus` which are ~~inherited by~~ <sup>base</sup> inherits a virtual ~~PowerUp~~ class which consist of a virtual destructor, therefore the ~~derived~~ destructor of a derived class will automatically be a virtual ~~non~~ destructor member function too.

i) In the above fragment of code (line 32) there is a data member `_owner`: a pointer to an empty class; how does it increase the size of the `SpecialItem` class' instances? Explain.

data member `_owner` of type `IObject` <sup>or empty class</sup> is composed by the `SpecialItem` class and when ~~it~~ <sup>it</sup> is being composed, it increases the size of the derive class by 1 byte ~~instead of 4 bytes~~.  
 It is a pointer.

j) Suppose that this program compiles (in case it does not, ignore the errors and assume it does); does it experience memory leaks? Explain.

✓ ~~the~~ Yes. Struct `IObject` ~~do~~ does not have a virtual destructor and when it is being destroyed only the base class will be destroyed and will experience ~~memory~~ memory leak from the derived classes.

2 leaks

End of quiz.