

601.220 Intermediate Programming

Virtual destructors

Virtual destructors

```
// virt_dtor.h:
class Base {
public:
    Base() : base_memory(new char[1000]) { }

    ~Base() { delete[] base_memory; }

private:
    char *base_memory;
};

class Derived : public Base {
public:
    Derived() : Base(), derived_memory(new char[1000]) { }

    ~Derived() { delete[] derived_memory; }

private:
    char *derived_memory;
};
```

Virtual destructors

```
// virt_dtor.cpp:  
#include "virt_dtor.h"  
  
int main() {  
    // Note use of base-class pointer  
    Base *obj = new Derived();  
    delete obj; // calls what destructor(s)?  
    return 0;  
}
```

`new Derived()` calls `Derived` default constructor, which in turn calls `Base` default constructor; that's good

Which destructor is called?

- Destructor is not virtual
- Does that mean `~Base` is called but not `~Derived`?

Virtual destructors

```
$ g++ -o virt_dtor virt_dtor.cpp
$ valgrind ./virt_dtor
==13202== Memcheck, a memory error detector
==13202== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==13202== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==13202== Command: ./virt_dtor
==13202==
==13202==
==13202== HEAP SUMMARY:
==13202==     in use at exit: 1,000 bytes in 1 blocks
==13202==   total heap usage: 4 allocs, 3 frees, 74,720 bytes allocated
==13202==
==13202== LEAK SUMMARY:
==13202==    definitely lost: 1,000 bytes in 1 blocks
==13202==    indirectly lost: 0 bytes in 0 blocks
==13202==    possibly lost: 0 bytes in 0 blocks
==13202==    still reachable: 0 bytes in 0 blocks
==13202==    suppressed: 0 bytes in 0 blocks
==13202== Rerun with --leak-check=full to see details of leaked memory
==13202==
==13202== For lists of detected and suppressed errors, rerun with: -s
==13202== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

~Derived is *not* called; derived_memory is leaked

Virtual destructors

```
// virt_dtor2.h
class Base {
public:
    Base() : base_memory(new char[1000]) { }

    // Now *** virtual ***
    virtual ~Base() { delete[] base_memory; }

private:
    char *base_memory;
};

class Derived : public Base {
public:
    Derived() : Base(), derived_memory(new char[1000]) { }

    // Now *** virtual ***
    virtual ~Derived() { delete[] derived_memory; }

private:
    char *derived_memory;
};
```

Virtual destructors

```
// virt_dtor2.cpp:
#include "virt_dtor2.h"

int main() {
    // Note use of base-class pointer
    Base *obj = new Derived();
    delete obj; // calls what destructor(s)?
    return 0;
}
```

Virtual destructors

```
$ g++ -o virt_dtor2 virt_dtor2.cpp
$ valgrind ./virt_dtor2
==13212== Memcheck, a memory error detector
==13212== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==13212== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==13212== Command: ./virt_dtor2
==13212==
==13212==
==13212== HEAP SUMMARY:
==13212==     in use at exit: 0 bytes in 0 blocks
==13212==   total heap usage: 4 allocs, 4 frees, 74,728 bytes allocated
==13212==
==13212== All heap blocks were freed -- no leaks are possible
==13212==
==13212== For lists of detected and suppressed errors, rerun with: -s
==13212== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

Fixed; thanks to dynamic binding, delete obj calls ~Derived, which in turn calls ~Base

Derived-class destructor always implicitly calls base-class destructor at the end

Virtual destructors

To avoid this in general: *Any class with virtual member functions* should also have a `virtual` destructor, even if the destructor does nothing

Quiz!

Assume class C is derived from classes A and B and class D is derived from B. At the very least, the destructors of which classes must be `virtual`?

- A. C and D
- B. A and B
- C. A, B and C
- D. A, B, C and D
- E. D only