KERNKONZEPT

ADVANCED C++ TOPICS

Alexander Warg, 2022

Overview

WHAT IS BEHIND C++

- Language Magics
- Object Life Cycle
- Object Memory Layout

INTRODUCTION TO TEMPLATES

- Template Function
- Template Class

WHAT I DO NOT EXPLAIN

- Standard C++ Library

C++ vs C

Some more keywords

- new, delete, class, virtual, mutable, explicit...

Stricter type system

- e.g. no automatic conversion from void *
- custom class types
- strictly typed enums (since C++11)

Function overloading / Operator overloading

- multiple functions with the same name but different arguments

Extensible hierarchical type system

- classes and inheritance

Generic programming via templates

OBJECT STORAGE CLASSES

- Heap
  - manual Memory Management
- Global Data Segments / Thread Local Storage
  - exist for the whole program runtime
- Stack (local variables)
  - exist as long as their scope exists

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OBJECT LIFE CYCLE

Constructors: Special Member Functions for object initialization

- Same name as the class
- No return type

Destructors: Special Member Functions for object destruction

- Name: ~Classname()
- No return type
- No arguments

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CONSTRUCTORS (CLASS FOO)

Foo() -> Default Constructor

No arguments

Generated by Compiler if no other Constructors

Foo(Type x) -> Conversion Constructor

Is used to cast type Type to Foo (implicitly)

(see keyword **explicit**)

Foo(Foo const &o) -> Copy Constructor

Always generated by Compiler if not provided

(related to **operator = (Foo const &o)**, see later)

Foo(Foo &&o) -> Move Constructor

(related to **operator = (Foo &&o)**, see later)

Foo(Type a, Type b, Type c) -> Normal Constructor

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Rule Of Six

The 'default' operations:

- default constructor: X()
- copy constructor: X(const X&)
- copy assignment: operator=(const X&)
- move constructor: X(X&&)
- move assignment: operator=(X&&)
- destructor: ~X()

The default operations rules:

- If you can avoid defining any default operations, do
- If you define or =delete any default operation, define or =delete them all
- Make default operations consistent

TYPE CONVERSION / CAST

Implicit type conversion

- among integer types (incl. enum)
- conversion ctor ?
- conversion operator ?
- from pointers/references of derived classes to pointers/references to base classes

Explicit typex conversion (casts)

C++ has three (actually four) types of casts

- static_cast<type>(...)
- reinterpret_cast<type>(...)
- dynamic_cast<type>(...)
- const_cast<type>(...)

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POLYMORPHISM (ADVANCED)

Virtual Functions

Support for Overriding functions in C++

Pure Virtual Functions (Abstract Function)

class A { void func() = 0; };

<A> cannot be instantiated (is abstract)

Multiple Inheritance

class A : public B, public C {...};

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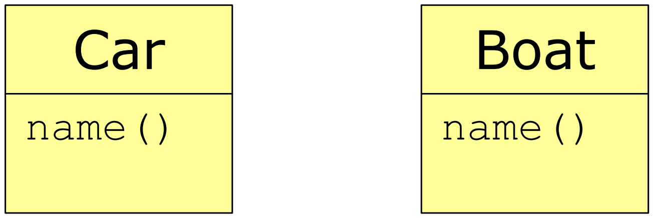
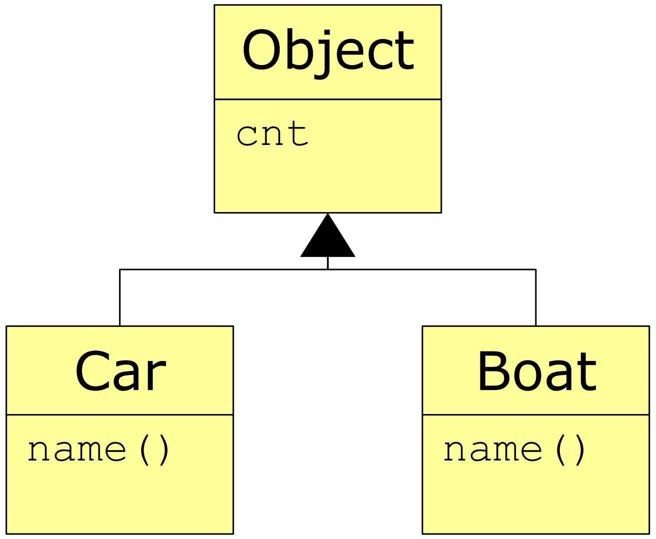
POLYMORPHISM – VIRTUAL DTOR

Virtual deletion ...

MULTIPLE INHERITANCE



MULTIPLE INHERITANCE



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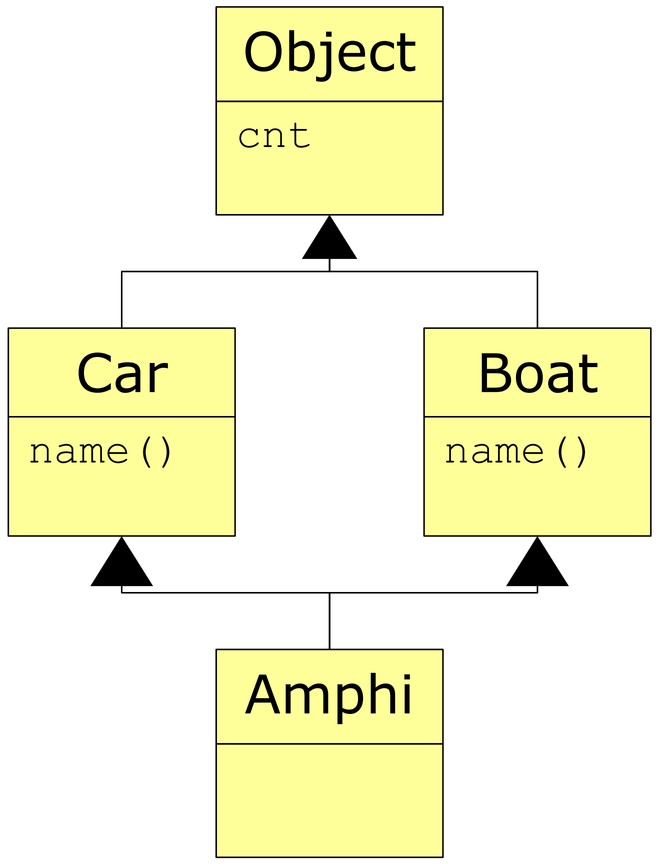

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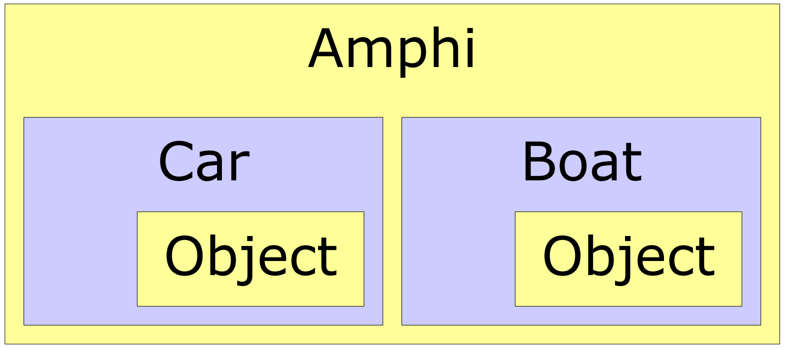

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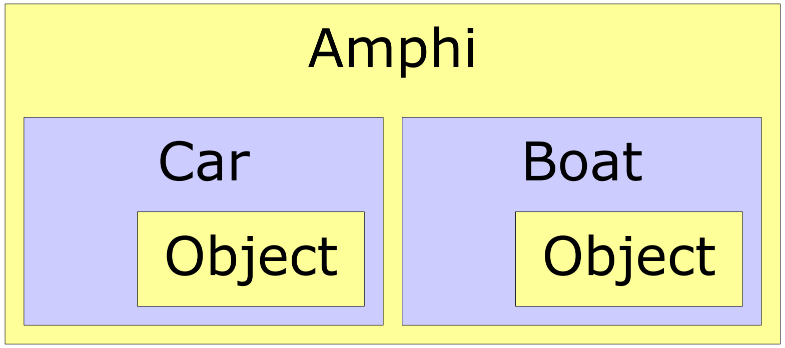

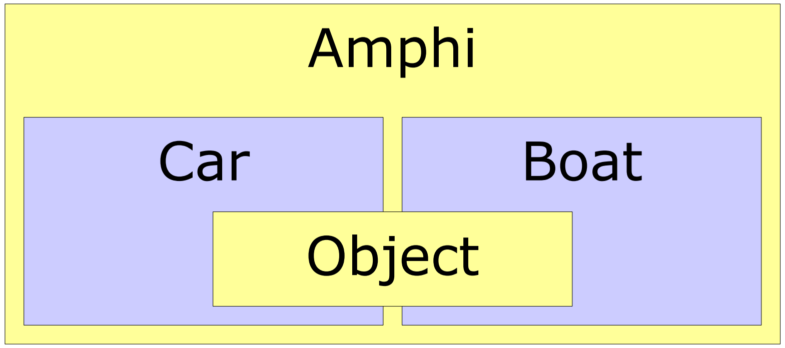

TEMPLATES – FUNCTION TEMPLATES

Functions that operate on a *Generic Type* (e.g. *T*)

```
                   template< typename T >
int max(int a, T max(T a, T b)
{ return a>b?a { return a>b?a:b; }

int a, b;
int x = max<int>(a, b);

double a, b;
double x = max<double>(a, b);
```

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TEMPLATES – CLASS TEMPLATES

Classes with members of *Generic Types* (e.g. *T*)

```
template< typename T >
class List_item
{
      List_item *_next, *_prev;
      T *_data;
};
```

DON'T DO THIS...

Too Much operator overloading

- Keep usual semantics
- Avoid implicit conversion operators

using namespace <X> in Header Files

#define ...

- Use enum's for constant values
- Use templates for functions