CSCI 334:
Principles of Programming Languages

Lecture 21: OO III & Tech. communication

Instructor: Dan Barowy

Williams

Topics

Virtual dispatch

How to give a good talk

Project Q&A

SWELL user testing

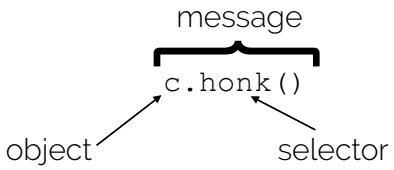
This weekend, 30-40 minutes.

`https://bit.ly/2EgWKgi`

It would be a real help if you have the time!

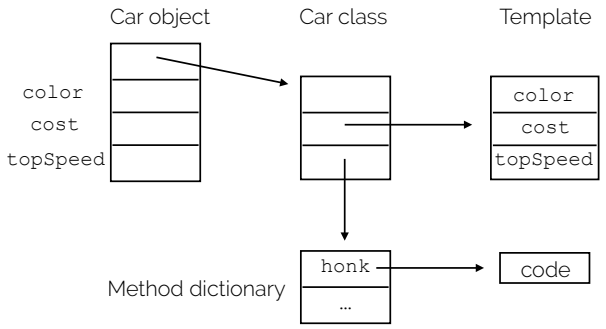
Refresher: Dynamic Dispatch

- Dynamic dispatch is the OO mechanism for polymorphism.
- Functions ("methods") are always bound to an object (or class).
- A method is called ("dispatched") by sending a "message" to the "selector" of an object.

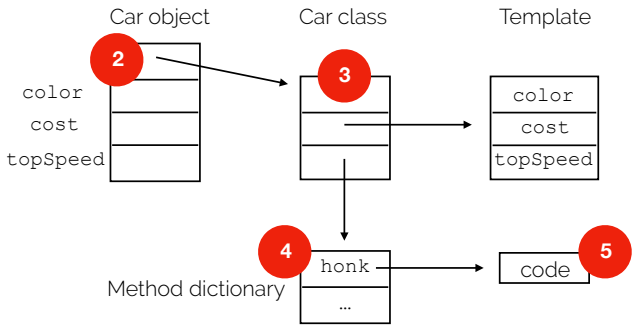


Dynamic Dispatch

- Dynamic dispatch is an algorithm for finding an object's method corresponding to a given selector name.

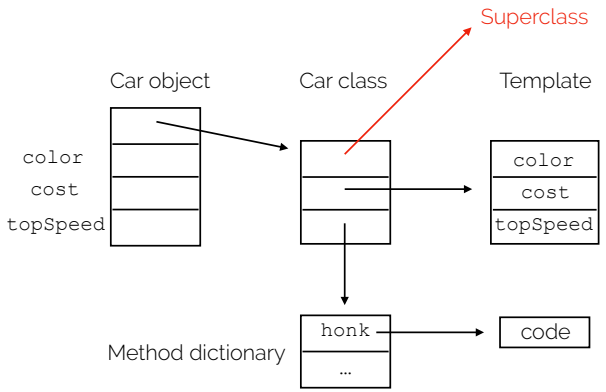


1. Call `c.honk();`
2. `honk` message dispatched to `c`
3. `honk` message forwarded to `Car`
4. `honk` message lookup in method dictionary
5. `honk` executed.

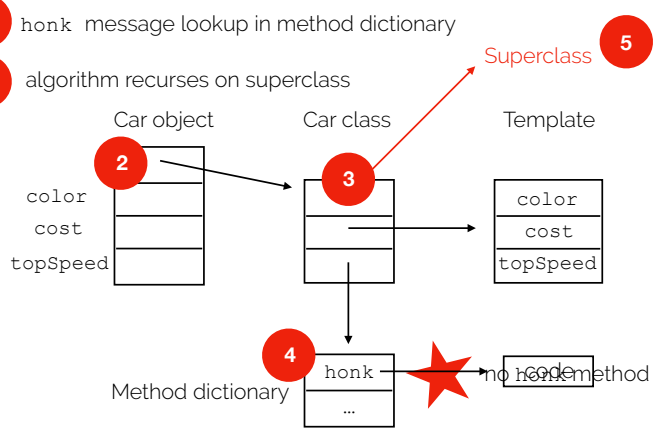


Inheritance

- One small change enables inheritance.



1. Call `c.honk();`
2. `honk` message dispatched to `c`
3. `honk` message forwarded to `Car`
4. `honk` message lookup in method dictionary
5. algorithm recurses on superclass



Question

How expensive is dynamic dispatch?

Cost

1.dereference object
2.defererence class
3.dereference method dictionary
4.dereference method

Cost

1.dereference object
2.defererence class
3.dereference method dictionary
4.dereference method

} for each class or superclass

O(n) method lookup

C++

Efficient object oriented programming.

"Only pay for what you use"

"Only pay for what you use"

What does this mean?

In Java, OO & other features are "always on"

Even when they are not needed

```
class Math {
 public static average(int[] nums) {
   int sum = 0;
   for (int i = 0; i < nums.length; i++) {
     sum += nums[i];
   }
   return (double sum) / nums.length;
 }
}
```

What happens when a Java program starts?

1. boot up the Java Virtual Machine (JVM)
   a. allocate Java heap, stack, and global var areas
   b. start up garbage collector
   c. start up Just-in-Time perfmon & compiler (JIT)
2. load first class definition (the one with `main`)
   a. verify bytecode for runtime safety
3. load all class defs for linked code (e.g., stdlib)
   a. verify, if necessary
4. allocate space for static variables
5. initialize static variables
6. execute main
   a. repeat loading, linking, verifying, allocation, and initialization steps as needed.
   b. periodically run the garbage collector
   c. run the JIT constantly, in a separate thread

"Only pay for what you use"

```
class Math {
 public static average(int[] nums) {
   int sum = 0;
   for (int i = 0; i < nums.length; i++) {
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   }
   return (double sum) / nums.length;
 }
}
```

We're not using any objects!

In C++, the "no class" program is as fast as C

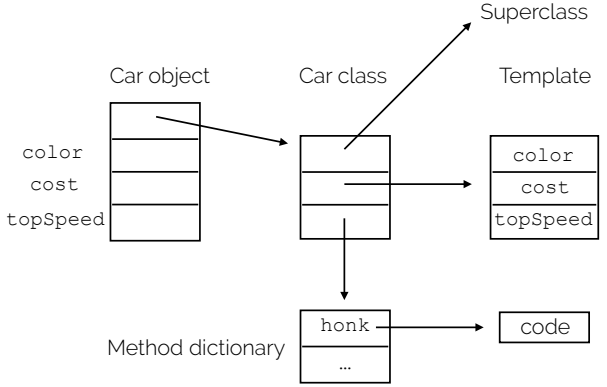
Without classes, C++ is basically C

C++ does OO efficiently

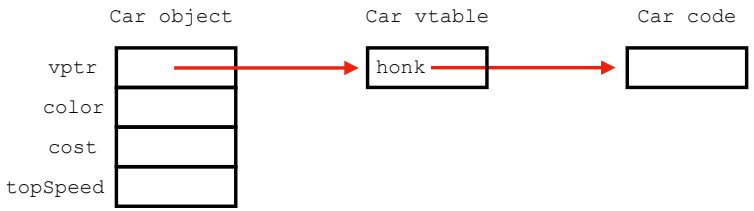
C++ static methods are just C procedures. No classes needed.

C++ eliminates lookups by computing locations at compile-time.

C++ also copies any needed superclass method pointers into class

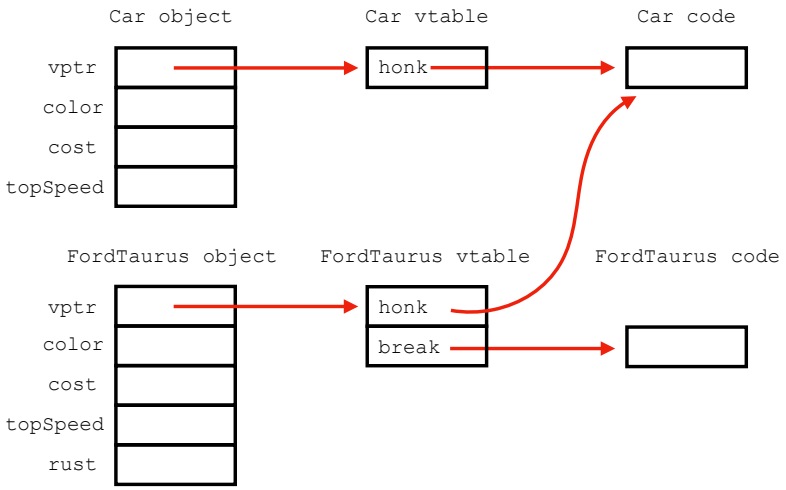


Virtual Dispatch



- Functions without the `virtual` keyword are just regular C functions (that also have access to class instance data).
- C++ virtual dispatch does *never searches* as in SmallTalk; vtable/instance variable offsets known at compile-time.

Virtual Dispatch



Cost

1. dereference object
2. defererence class
3. ~~dereference method dictionary~~
4. dereference method

~~for each class or superclass~~

O(1) method lookup

How to give a good talk

Five tips

1. Have a story

2. Don't "bury the lede"

3. Don't make your audience read

4. Show by example

5. Stay on script

5.1. Finish on time

Project Q&A