LEVELIZATION TECHNIQUES:

- **Escalation** Moving mutually dependent functionality higher in the physical hierarchy. (p. 215)
- **Demotion** Moving common functionality lower in the physical hierarchy. (p. 229)
- **Opaque Pointers** Having an object use another in name only. (p. 247)
- **Dumb Data** Using data that indicates a dependency on a peer object, but only in the context of a separate, higher-level object. (p. 257)
- **Redundancy** Deliberately avoiding reuse by repeating small amounts of code or data to avoid coupling. (p. 269)
- **Callbacks** Using client-supplied functions that enable lower-level subsystems to perform specific tasks in a more global context. (p. 275)
- **Manager Class** Establishing a class that owns and coordinates lower-level objects. (p. 288)
- **Factoring** Moving independently testable subbehavior out of the implementation of complex components involved in excessive physical coupling. (p. 294)
- **Escalating Encapsulation** Moving the point at which implementation details are hidden from clients to a higher level in the physical hierarchy. (p. 312)

INCREMENTAL INSULATION TECHNIQUES:

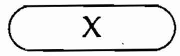
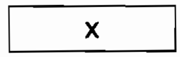
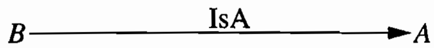
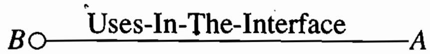
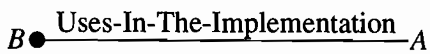
- Removing ***private inheritance*** by converting WasA to HoldsA. (p. 349)
- Removing ***embedded data members*** by converting HasA to HoldsA. (p. 352)
- Removing ***private member functions*** by making them static at file scope and moving them to the `.c` file. (p. 353)
- Removing ***protected member functions*** by creating a separate utility component and/or extracting a protocol. (p. 363)
- Removing ***private member data*** by extracting a protocol and/or moving static data to the `.c` file at file scope. (p. 375)
- Removing ***compiler-generated functions*** by explicitly defining these functions. (p. 378)
- Removing ***include directives*** by removing unnecessary include directives or replacing them with (forward) class declarations. (p. 379)
- Removing ***default arguments*** by replacing valid default values with invalid default values or employing multiple function declarations. (p. 381)
- Removing ***enumerations*** by relocating them to the `.c` file, replacing them with `const` static class member data, or redistributing them among the classes that use them. (p. 382)

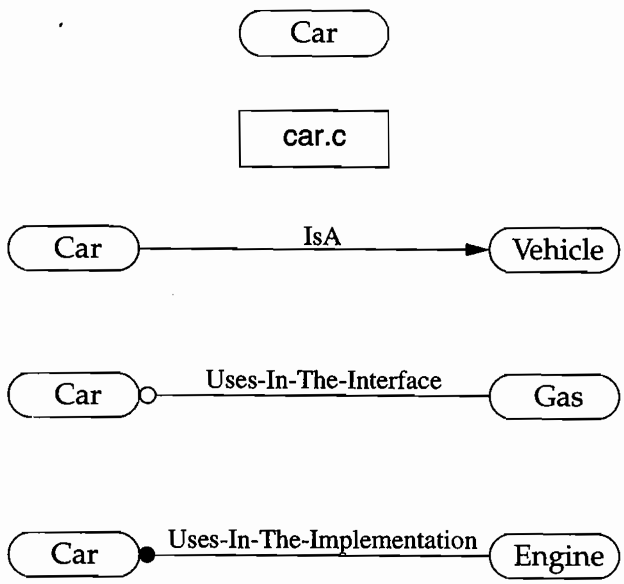
TOTAL INSULATION TECHNIQUES:

- ***Protocol Class:*** Creating an abstract "protocol" class is a general insulation technique for factoring the interface and implementation of an abstract base class. Not only are clients insulated from changes to the implementation at compile time, but even link-time dependency on a specific implementation is eliminated. (p. 386)
- ***Fully Insulating Concrete Class:*** A "fully insulating" concrete class holds a single opaque pointer to a private structure defined entirely in the `.c` file. This `struct` contains all of the implementation details that were formerly in the private section of the original class. (p. 398)
- ***Insulating Wrapper Component:*** The concept of an encapsulating wrapper component (from Chapter 5) can be extended to a fully insulating wrapper component. Wrappers are typically used to insulate several other components or even an entire subsystem. Unlike a procedural interface, a wrapper layer requires considerable up-front planning and top-down design. In particular, care must be taken in the design of a multi-component wrapper to avoid the need for long-distance friendships. (p. 405)

DEFINITION:

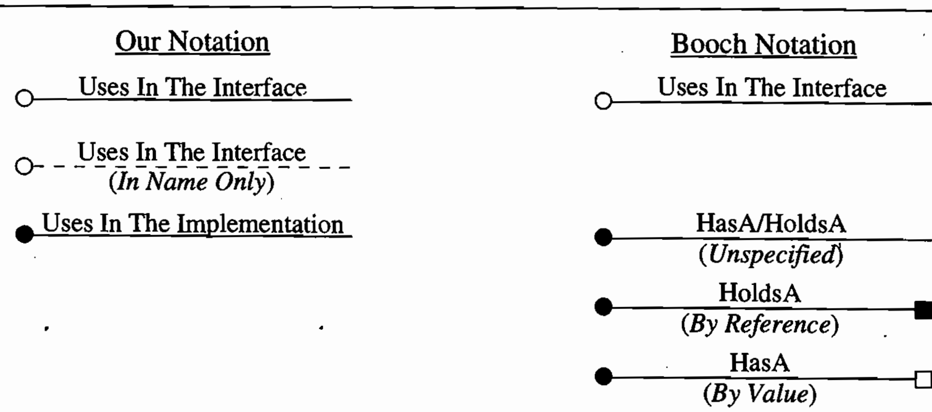
p. 47

NOTATION	MEANING
	X is a logical entity (e.g., class).
	x is a physical entity (e.g., file).
	*B* is a kind of *A*.
	*B* uses *A* in *B*'s interface.
	*B* uses *A* in *B*'s implementation.




```
class Car {
    // ...
};

// car.c
#include "car.h"
// ...

class Car : public Vehicle {
    // ...
};

class Car {
    // ...
  public:
    void addFuel(Gas *);
    // ...
};

class Car {
    Engine d_motor;
    // ...
};
```

p. 250



QUICK REFERENCE:

DEFINITIONS:

A type is ***used in the interface*** of a function if the type is referred to when declaring that function. (p. 50)

A type is ***used in the (public) interface*** of a class if the type is used in the interface of any (public) ***member*** function of that class. (p. 51)

A type is ***used in the implementation*** of a function if the type is referred to in the definition of that function. (p. 53)

A type is ***used in the implementation*** of a class if that type (1) is used in a member function of the class, (2) is referred to in the declaration of a data member of the class, or (3) is a private base class of the class. (p. 55)

Specific kinds of the Uses-In-The-Implementation Relationship: (p. 55)

Name	Meaning
Uses	The class has a member function that names the type.
HasA	The class embeds an instance of the type.
HoldsA	The class embeds a pointer (or reference) to the type.
WasA	The class privately inherits from the type.

A class is ***layered*** on a type if the class uses that type substantively in its implementation. (p. 58)

A component `y` ***DependsOn*** a component `x` if `x` is needed in order to compile or link `y`. (p. 121)

A component `c` uses a type `T` ***in size*** if compiling `c` requires having first seen the definition of `T`. (p. 248)

A component `c` uses a type `T` ***in name only*** if compiling `c` and any of the components on which `c` may depend does not require having first seen the definition of `T`. (p. 249)