Lecture. Refactoring

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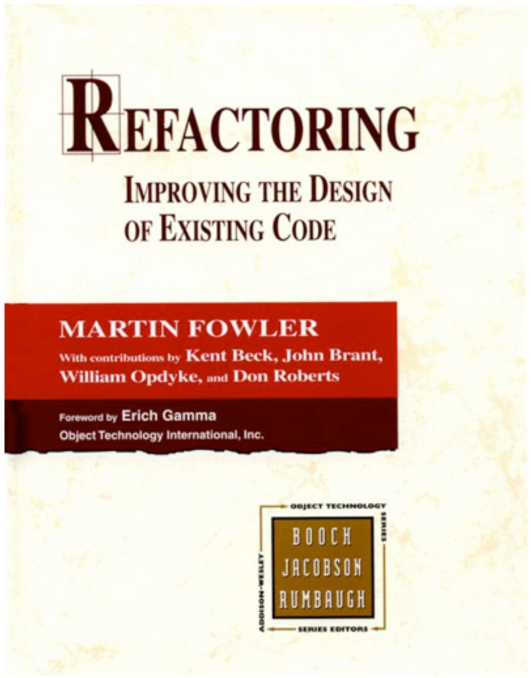
Topics

- Topics for today's lecture
  - What is refactoring?
  - Bad code smells/ When should I refactor code?
  - Refactoring types & transformations
  - Refactoring research projects at SEAL

Announcement

- Refactoring research projects at SEAL
  - A field study of refactoring benefits & challenges at Microsoft
  - SYDIT: example-driven automated refactoring

Refactoring


REFACTORING
IMPROVING THE DESIGN OF EXISTING CODE
MARTIN FOWLER
With contributions by Kent Beck, John Brant, William Opdyke, and Don Roberts
Foreword by Erich Gamma
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- semantic-preserving program transformations
- a change made to the internal structure to ~~the structure to~~ make it easier to understand and cheaper to modify without changing its observable behavior

Why do we need Design Patterns?

skip

1. Abstract design experience => a reusable base of experience
2. Provide common vocabulary for discussing design
3. Reduce system complexity by naming abstractions => reduce the learning time for a class library / program comprehension

Why do we need Design Patterns?

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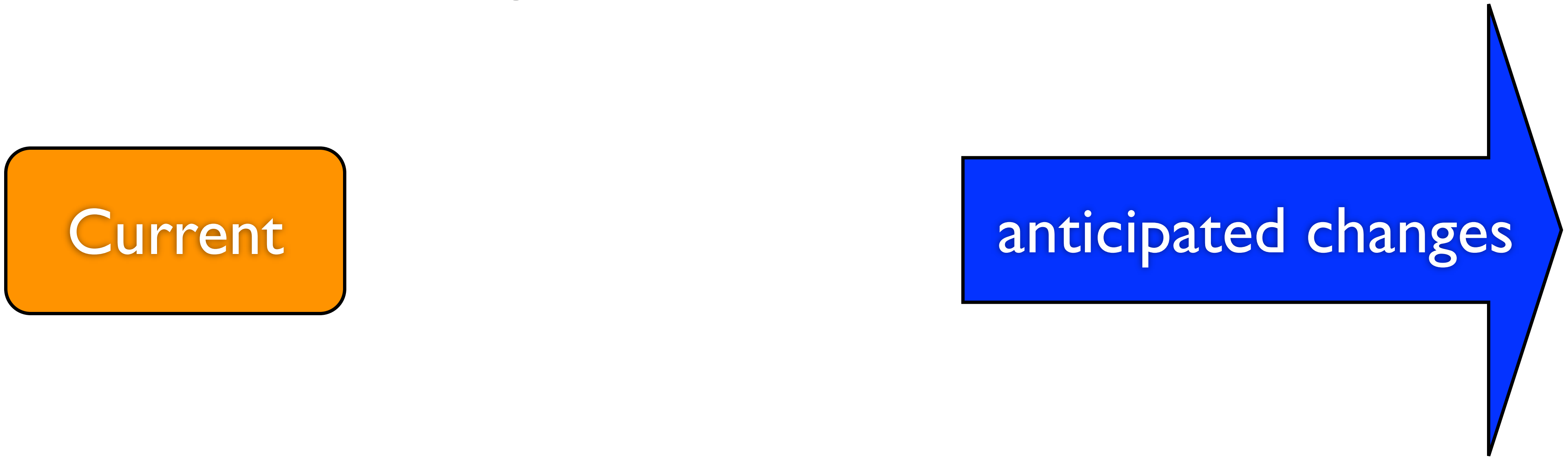
4. Provide a target for the reorganization or refactoring of class hierarchies



Why do we need Design Patterns?

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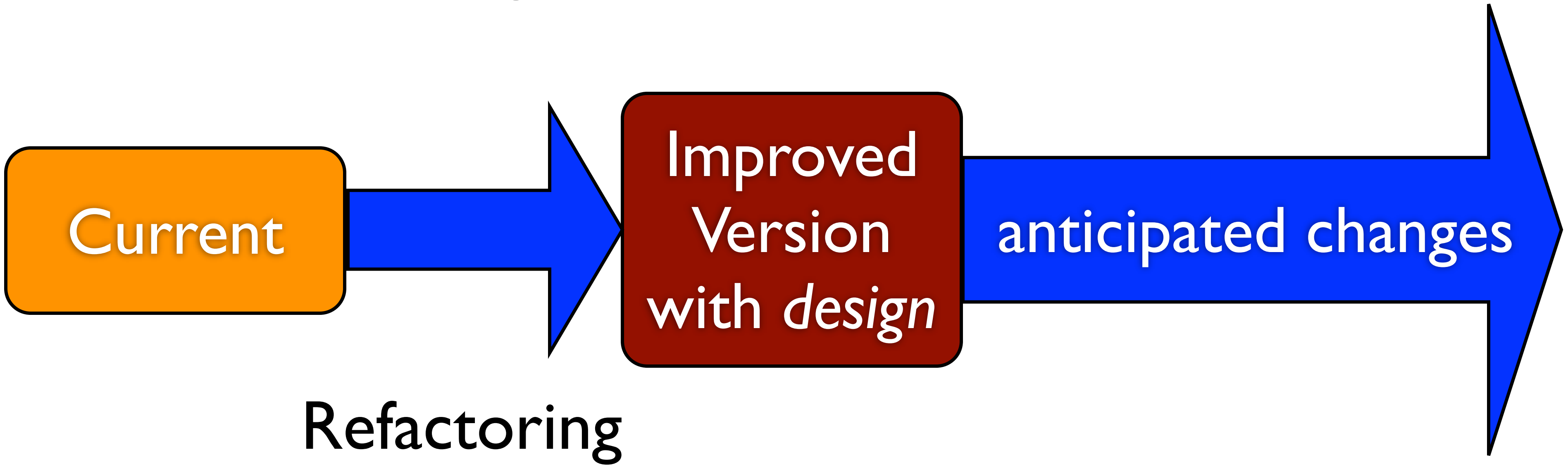
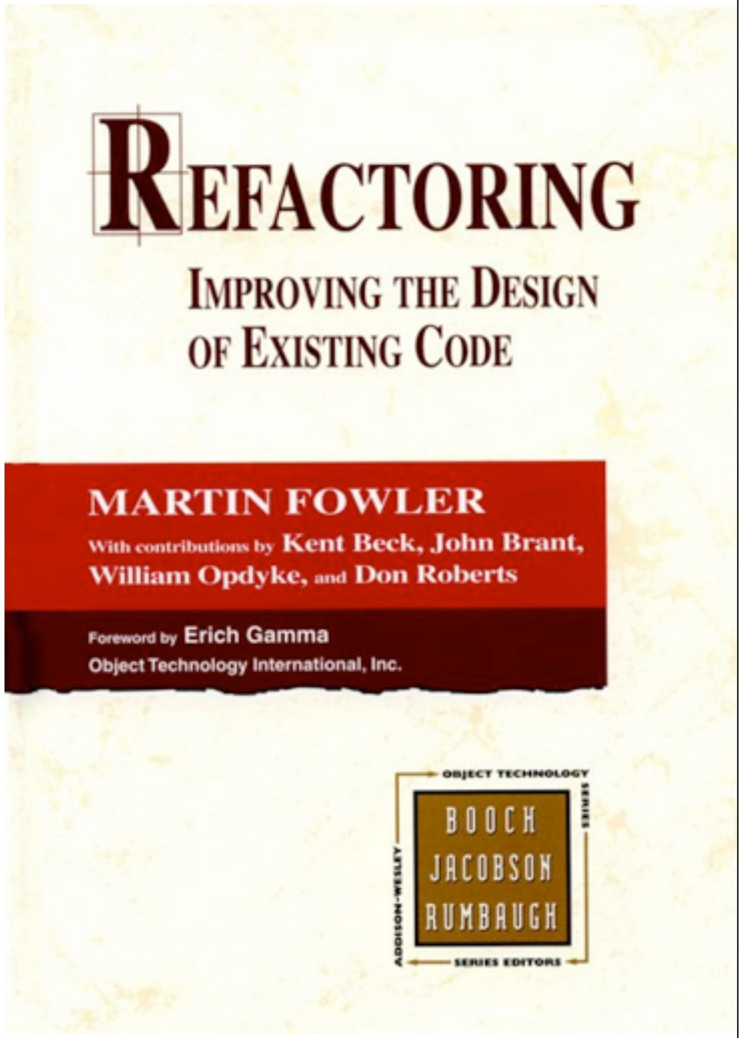


Reasons to Refactor

- Sometimes code degenerates under maintenance, and sometimes the code just wasn't very good in the first place.

Bad Code Smells

- What are reasons to refactor code?
- Fowler termed "code smells" to indicate the symptoms of bad software design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What are examples of bad *code smells*?

Bad Code Smells

- Duplicated code
- Long method
- Large class
- Long parameter list
- Divergent change
- *Shotgun surgery*

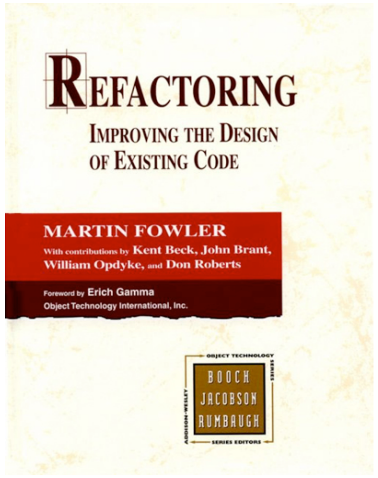
Bad Code Smells

- *Feature envy*
- *Data clumps*
- *primitive obsession*
- *switch statements*
- *parallel inheritance hierarchies*
- *lazy class*

Bad Code Smells

- speculative generality
- temporary field
- message chains
- middle man
- inappropriate intimacy
- alternative classes with different interfaces

Refactoring (Fowler 2000)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- It is a catalogue of common refactorings in object-oriented programs.
- It is not formally defined (there's no way to check semantics preservation.)
- However, just like a design pattern, it provides a common vocabulary to refer to common refactoring types.

Problem: Divergent Change
Solution: *Extract Class*

- when one class is commonly changed in different ways for different reasons.
  - I have to change mA(), mB(), and mC() every time I get a new database, and mD(), mE(), mF(), and mG() every time there's a new financial instrument.
  - *Extract Class refactoring to separate different concerns*

Shotgun Surgery

- Shotgun surgery is similar to divergent change but the opposite.
  - Divergent change is one class that suffers many kinds of changes, and shotgun survey is one change that alters many classes.
- You have to make a lot of little changes to a lot of different classes.
- Solution: Move Method, Move Field, Inline Class

Feature Envy

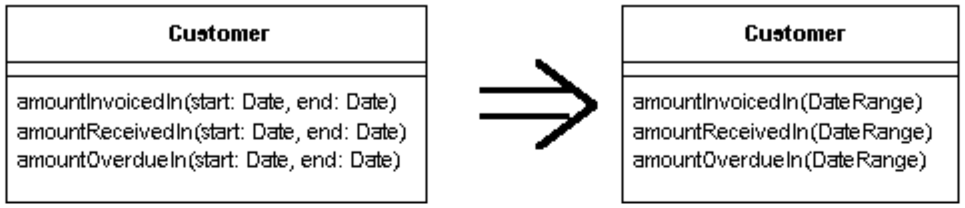
- A method that seems more interested in a class other than the one it actually is in.
- The most common focus of the envy is the data
  - e.g. a method that invokes half-a-dozen getter methods to another object to calculate some value.

Data Clumps

- Bunches of data that hang around together really ought to be made into their own object
- Solutions:
    - Extract class
    - Introduce parameter objects
    - Preserve whole objects

Introduce Parameter Object

You have a group of parameters that naturally go together.
=>Replace them with an object


Customer
amountInvoicedIn(start: Date, end: Date)
amountReceivedIn(start: Date, end: Date)
amountOverdueIn(start: Date, end: Date)
Customer
amountInvoicedIn(DateRange)
amountReceivedIn(DateRange)
amountOverdueIn(DateRange)

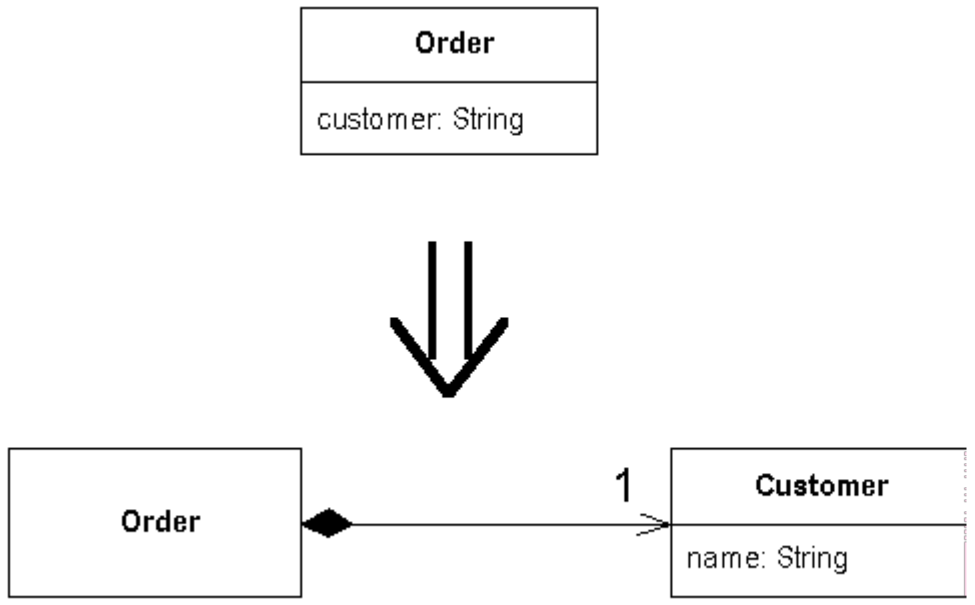
See Handout

Primitive Obsession

- Record types allow you to structure data into meaningful groups
- Primitive types are your building blocks
- Solutions
    - replace data value with object
    - replace type code with class

Replace Data Value with Object

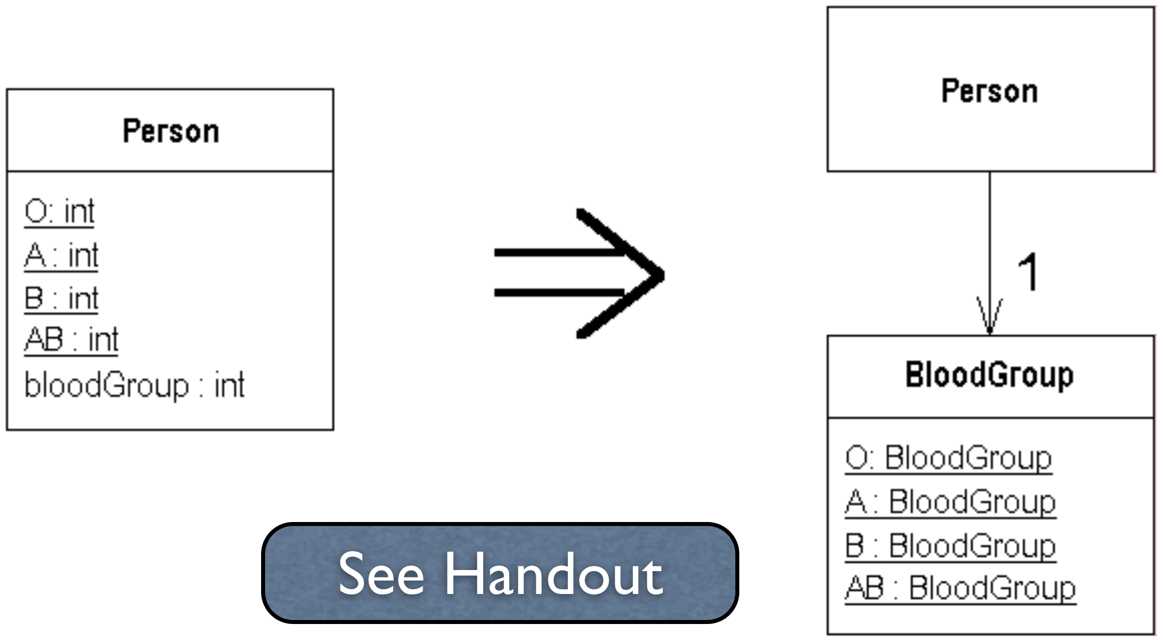
You have a data item that needs additional data or behavior.
Turn the data item into an object.



Replace Type Code with Class

A class has a numeric type code that does not affect its behavior.

=> replace the number with a new class



See Handout

Parallel Inheritance Hierarchies

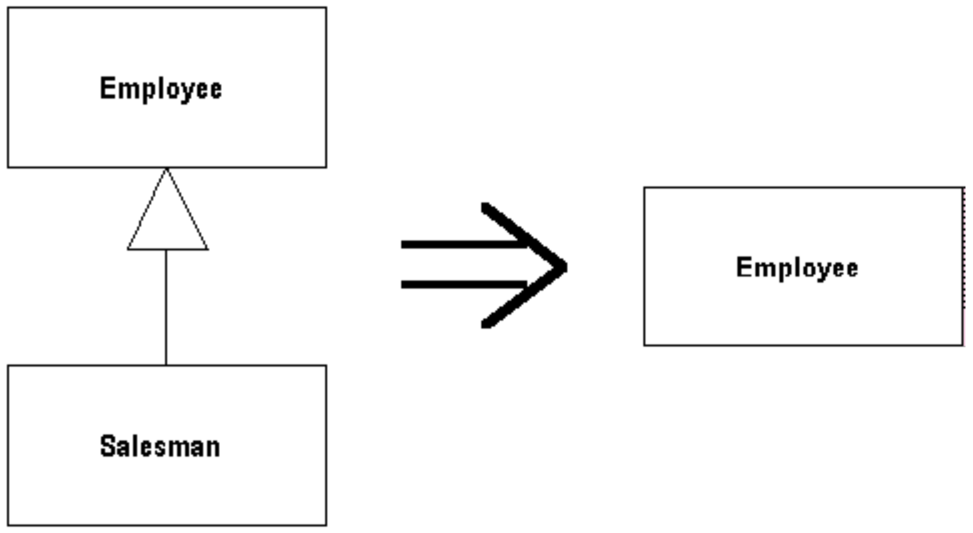
- Parallel inheritance hierarchies is a special case of shotgun surgery.
- Every time you make a subclass of one class, you also have to make a subclass of another.
- Solution: move method or move field

Lazy Class

- Each class you create costs money to maintain and understand.
- A class that isn't doing enough to pay for itself should be eliminated.
- If you have subclasses that aren't doing enough, try to use *Collapse Hierarchy.*
- Nearly useless components should be subjected to *Inline Class*

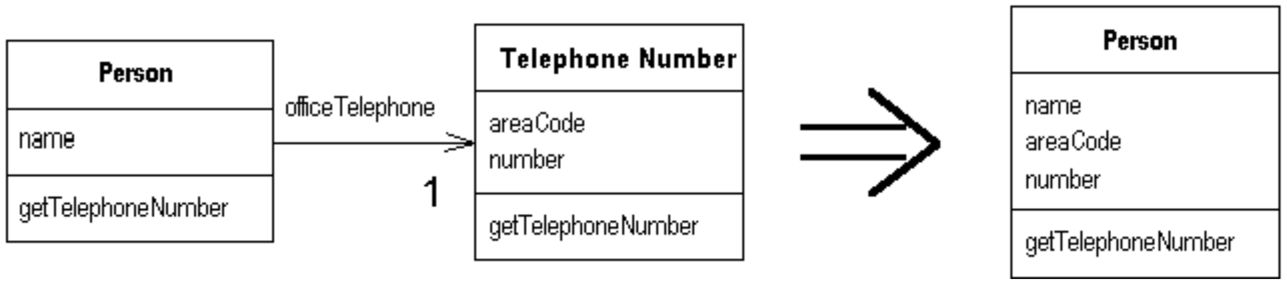
Collapse Hierarchy

A superclass and subclass are not very different. Merge them together



Inline Class

A class isn't doing very much
=> Move all its features into another class and delete it



Speculative Generality

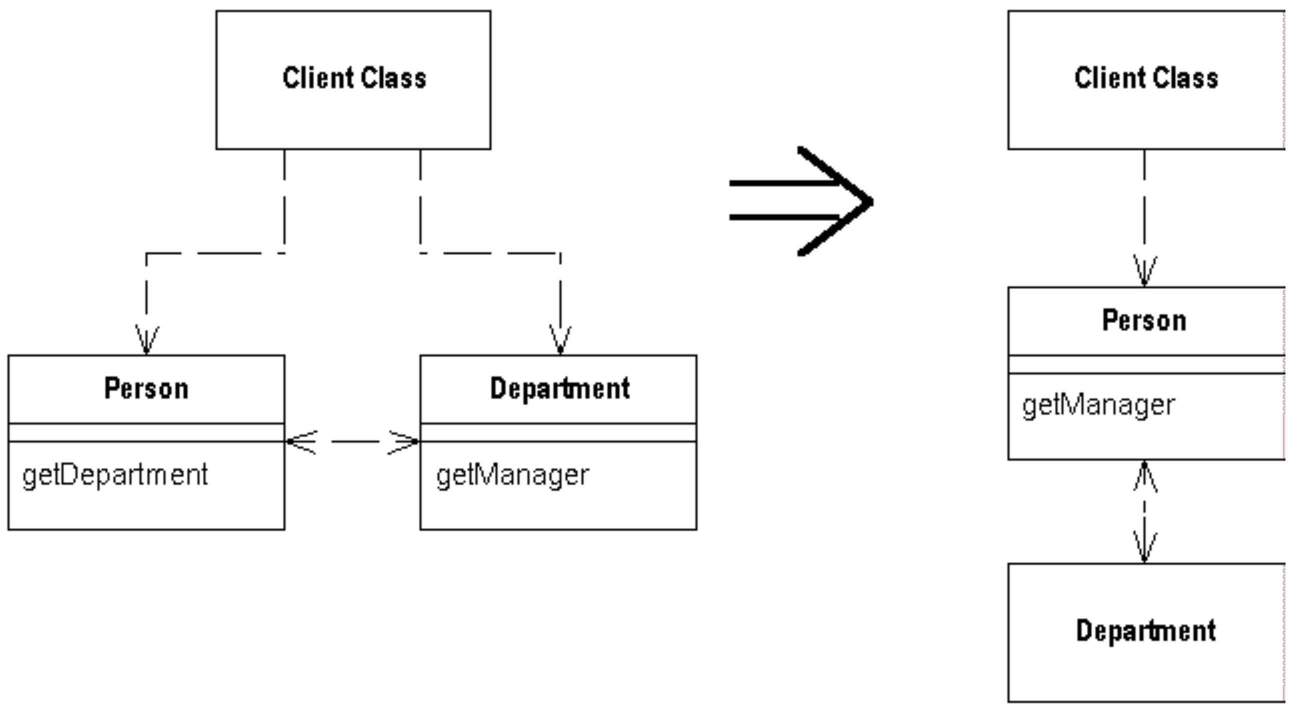
- "Oh, I think we need the ability to this kind of thing someday."
- If you have abstract classes that aren't doing much, use *Collapse Hierarchy.*
- Unnecessary delegation can be removed with *Inline class*. Methods named with odd abstract names should be brought down to earth with *Rename Method.*

Inappropriate Intimacy

- Sometimes classes become far too intimate and spend too much time delving in each other's private data
- *Change Bidirectional Association to Uni-direction.*
- If the classes do have common interests, use *Extract Class* to put the commonality in a safe place.
- *Hide Delegate* to let another class act as go-between.

Hide Delegate

A client is calling a delegate class of an object.
=> Create methods on the server to hide the delegate



Replace Conditional with Polymorphism

- You have a conditional that chooses different behavior depending on the type of an object.
- *Move each leg of the conditional into an overriding method in a subclass. Make the original method abstract.*

See Handout

Refactoring Categories

- Data-Level Refactorings
- Statement-Level Refactorings
- Routine-Level Refactorings
- Class Implementation Refactorings
- Class Interface Refactorings
- System Level Refactorings

Eclipse Demo

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Refactoring Safely

- Save the code you start with
- Keep refactorings small
- Do refactorings one at a time
- Make a list of steps you intend to take
- Make a parking lot--- for changes that aren't needed immediately, make a "parking lot."

Refactoring Safely

- Make frequent checkpoints
- Use your compiler warnings
- Retest
- Add test cases
- Review the changes
- Adjust your approach depending on the risk level of the refactoring

Recap

- Bad code smells indicate the symptoms of poor design.
- Fowler's catalog lists code transformations to address individual bad code smells.
- It is important to apply refactoring safely and to validate the correctness of refactoring.

Research Projects at SEAL

- A field study of refactoring benefits & challenges at Microsoft
- Sydit: Learning program transformations from an example