Refactoring

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Refactoring: Definition

- A change made to the internal structure of software to make it
  - easier to understand, and
  - cheaper to modify.
- The observable behavior of the software should not be changed.

Refactoring: Why?

- Refactoring Improves the Design of Software
- Refactoring Makes Software Easier to Understand
- Refactoring Helps You Find Bugs
- Refactoring Helps You Program Faster

Refactoring: When?

- Refactor the third time you do something similar (The Rule of Three)
- Refactor When You Add Function
- Refactor When You Need to Fix a Bug
- Refactor As You Do a Code Review

Symptoms of Bad Code

- **1. Duplicated Code**
- **2. Long Method**
- **3. Large Class**
- **4. Long Parameter List**
- **5. Divergent Change:** When one class is commonly changed in different ways for different reasons.
- **6. Shotgun Surgery:** When every time you make a kind of change, you have to make a lot of little changes to a lot of different classes.
- **7. Feature Envy:** A method that seems more interested in a class other than the one it actually is in.
- **8. Data Clumps:** Bunches of data that regularly appear together.

Symptoms of Bad Code (2)

- **9. Primitive Obsession:** Excessive use of primitives, due to reluctance to use small objects for small tasks.
- **10. Switch Statements**
- **11. Parallel Inheritance Hierarchies:** Where every time you make a subclass of one class, you also have to make a subclass of another.
- **12. Lazy Class:** A class that isn't doing enough to justify its maintenance.
- **13. Speculative Generality:** Classes and features have been added just because a need for them may arise someday.
- **14. Temporary Field:** An instance variable that is set only in certain circumstances.
- **15. Message Chains:** Transitive visibility chains.

Symptoms of Bad Code (3)

- **16. Middle Man:** Excessive delegation.
- **17. Inappropriate Intimacy:** Excessive interaction and coupling.
- **18. Alternative Classes with Different Interfaces:** Classes that do the same thing but have different interfaces for what they do.
- **19. Incomplete Library Class**
- **20. Data Class:** Classes that have fields, getting and setting methods for the fields, and nothing else.
- **21. Refused Bequest:** When subclasses do not fulfill the commitments of their superclasses.
- **22. Comments:** When comments are used to compensate for bad code.

Refactoring Patterns: Categories

- **Composing Methods:** Packaging code properly
- **Moving Features Between Objects:** Reassigning responsibilities
- **Organizing Data:** Making data easier to work with
- **Simplifying Conditional Expressions:** Making conditional logic less error-prone
- **Making Method Calls Simpler:** Making interfaces easy to understand and use
- **Dealing with Generalization:** Moving features around a hierarchy of inheritance
- **Big Refactorings:** Large-scale changes to code

Composing Methods: Extract Method

- You have a code fragment that can be grouped together.
- Turn the fragment into a method whose name explains the purpose of the method.

```
void printOwing() {
        printBanner();

        //print details
        System.out.println ("name:       " + _name);
        System.out.println ("amount     " + getOutstanding());
}
```

```
void printOwing() {
        printBanner();
        printDetails(getOutstanding());
}

void printDetails (double outstanding) {
        System.out.println ("name:       " + _name);
        System.out.println ("amount     " + outstanding);
}
```

Composing Methods: Inline Method

- A method's body is just as clear as its name.
- Put the method's body into the body of its callers and remove the method.

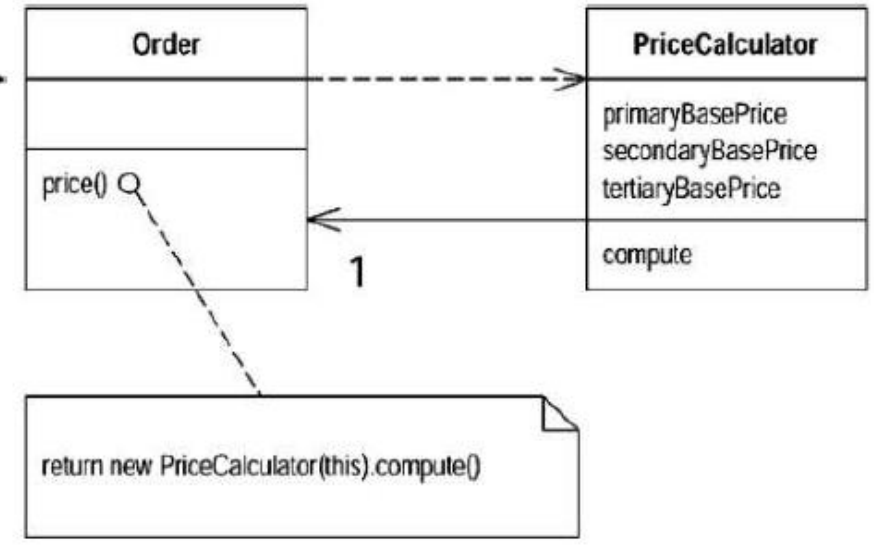
```
int getRating() {
        return (moreThanFiveLateDeliveries()) ? 2 : 1;
}
boolean moreThanFiveLateDeliveries() {
        return _numberOfLateDeliveries > 5;
}
```

```
int getRating() {
        return (_numberOfLateDeliveries > 5) ? 2 : 1;
}
```

Composing Methods: Replace Method with Method Object

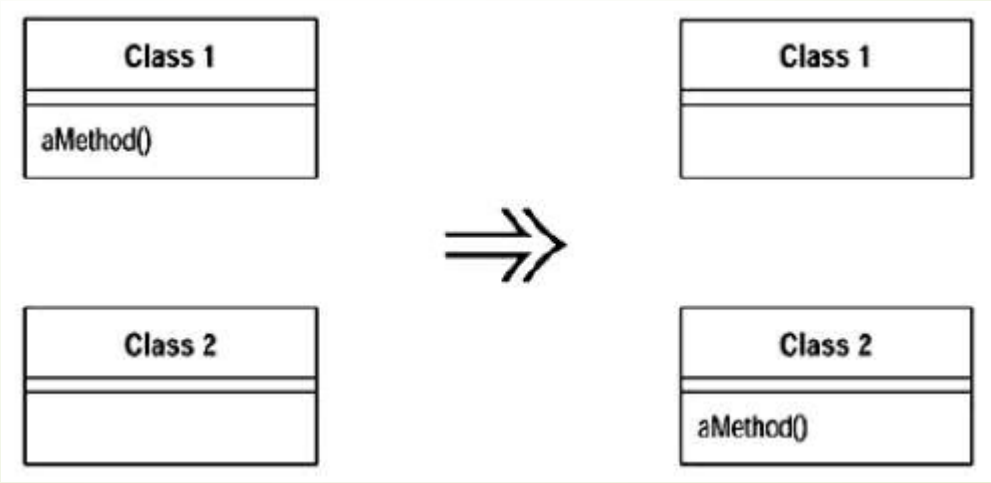
- You have a long method that uses local variables in such a way that you cannot apply Extract Method.
- Turn the method into an object so that all the local variables become fields on that object. It can then be decomposed into other methods on the same object.

```
class Order...
        double price() {
                double primaryBasePrice;
                double secondaryBasePrice;
                double tertiaryBasePrice;
                // long computation;
                ...
        }
```



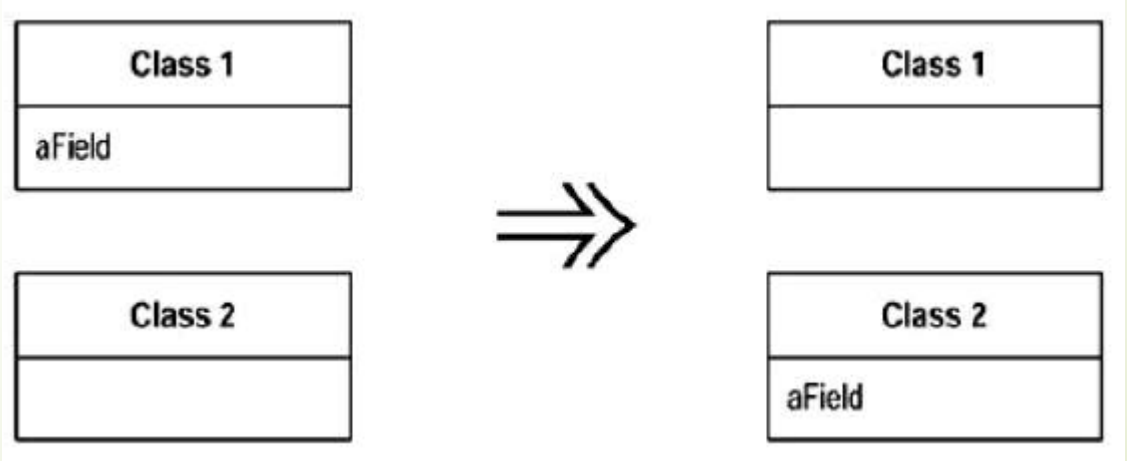
Moving Features Between Objects: Move Method

- A method is, or will be, using or used by more features of another class than the class on which it is defined.
- Create a new method with a similar body in the class it uses most. Either turn the old method into a simple delegation, or remove it altogether.



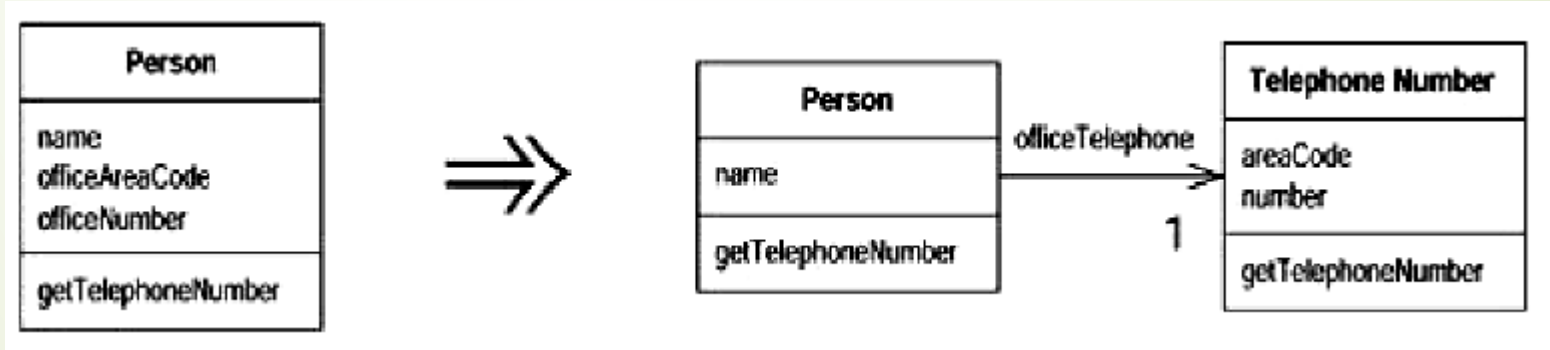
Moving Features Between Objects: Move Field

- A field is, or will be, used by another class more than the class on which it is
- defined.
- Create a new field in the target class, and change all its users.



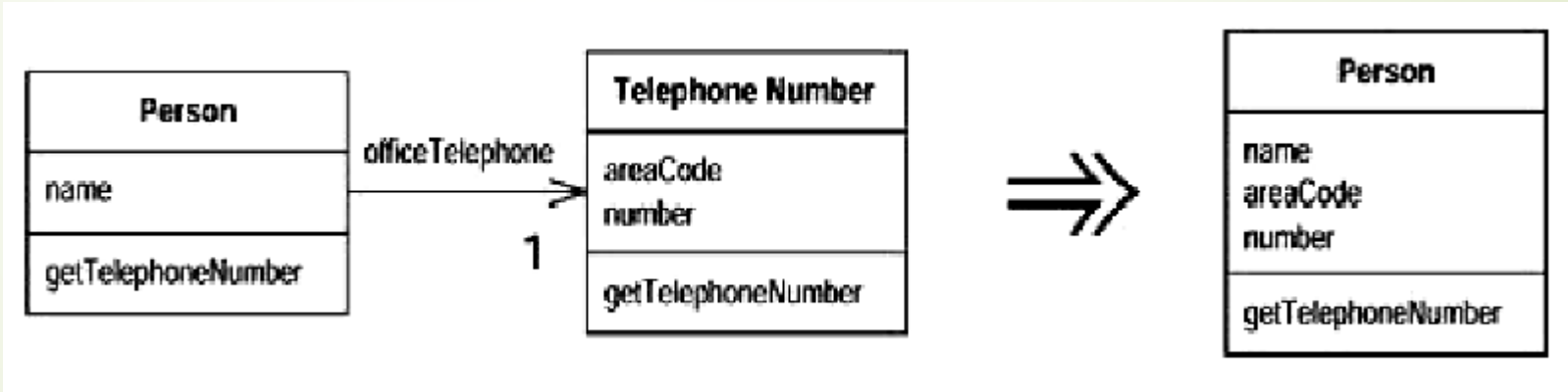
Moving Features Between Objects: Extract Class

- You have one class doing work that should be done by two.
- Create a new class and move the relevant fields and methods from the old class into the new class.



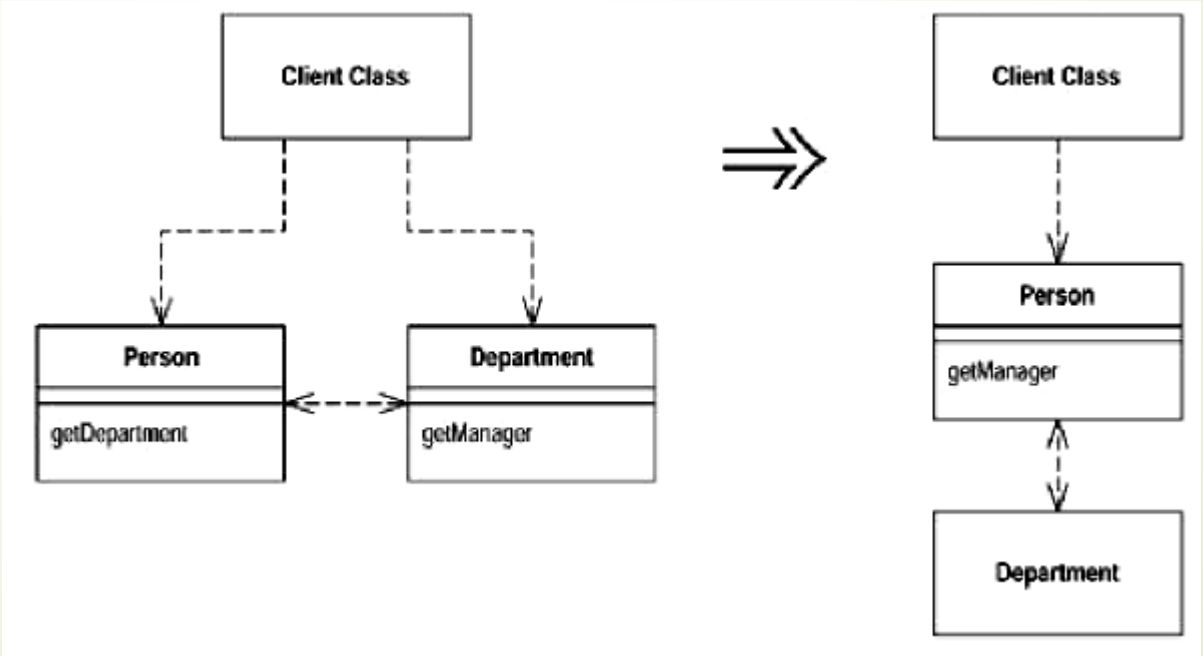
Moving Features Between Objects: Inline Class

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



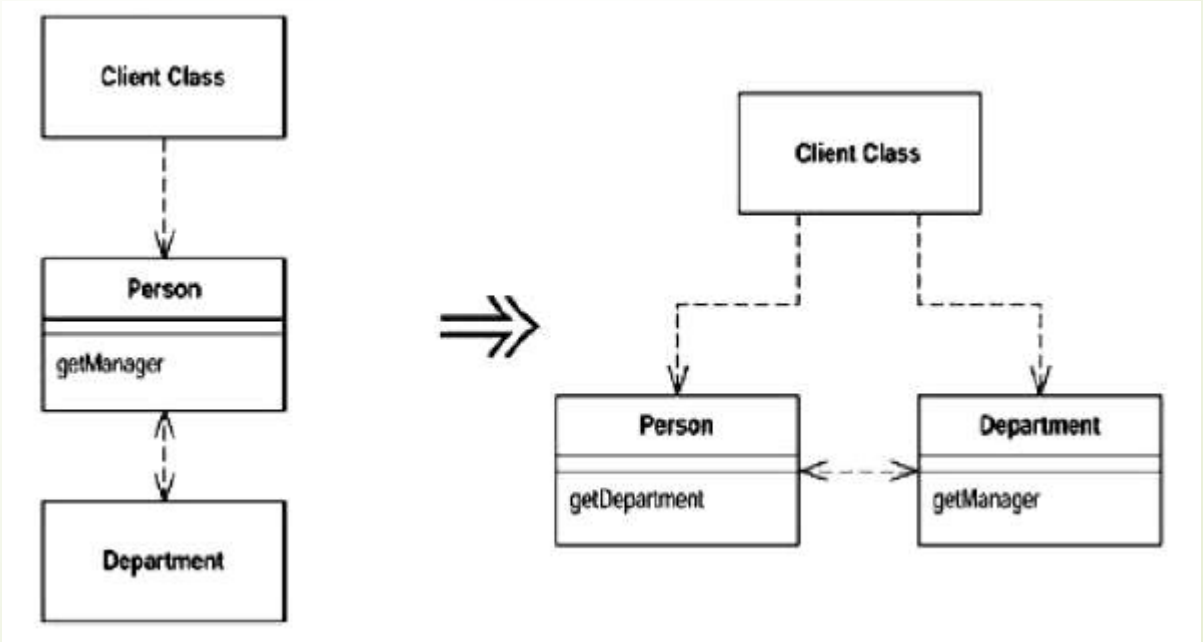
Moving Features Between Objects: Hide Delegate

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



Moving Features Between Objects: Remove Middle Man

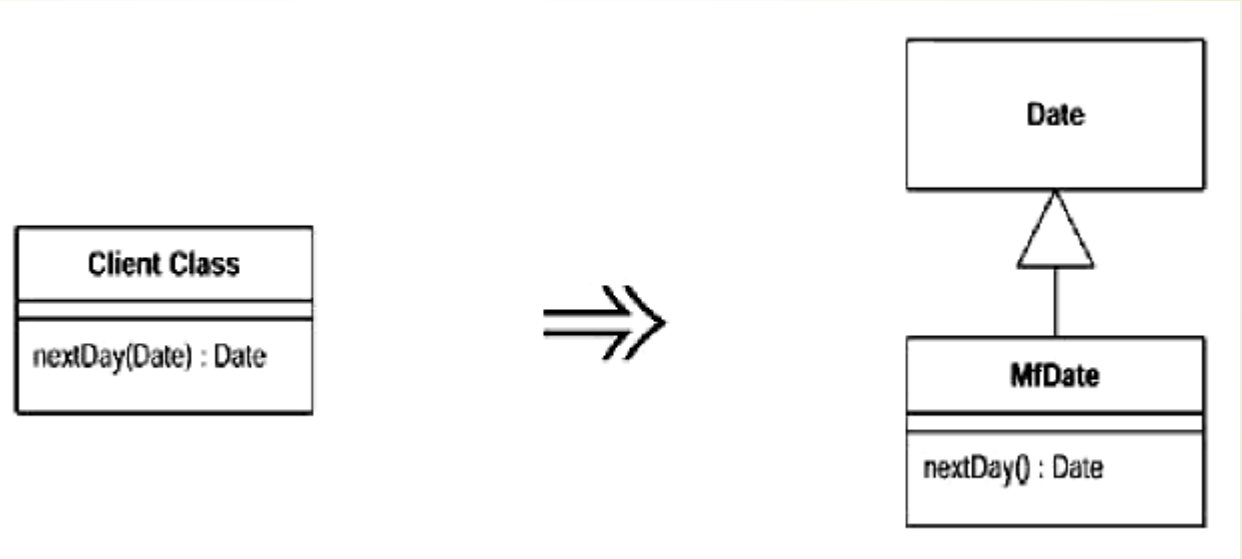
- A class is doing too much simple delegation.
- Get the client to call the delegate directly.



Moving Features Between Objects: Introduce Method/Class

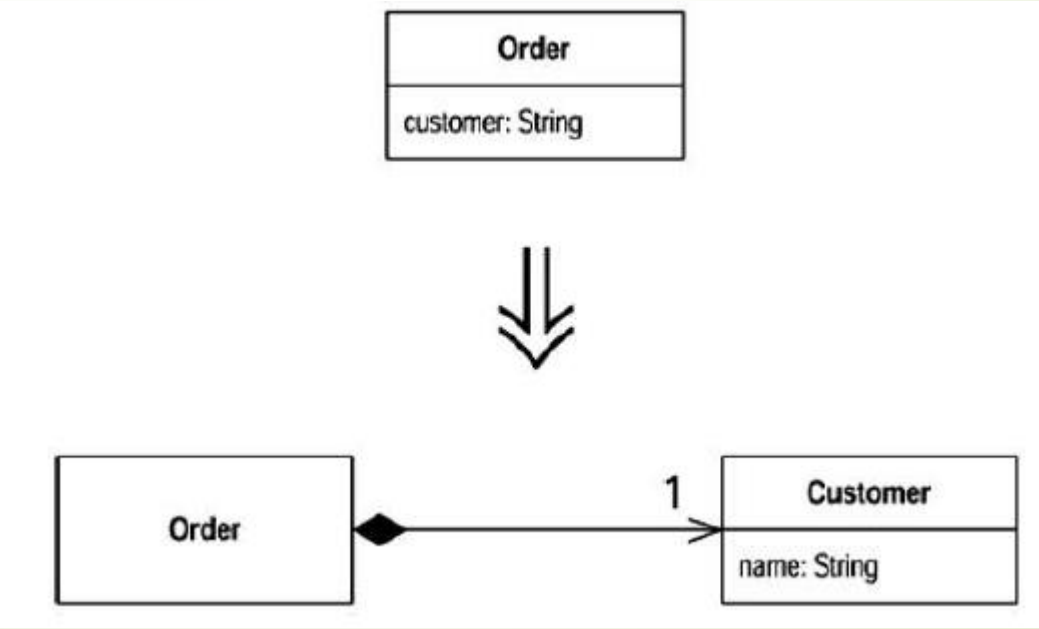
- **Introduce Foreign Method**
  - A server class you are using needs an additional method, but you can't modify the class.
  - Create a method in the client class with an instance of the server class as its first argument.
- **Introduce Local Extension**
  - A server class you are using needs several additional methods, but you can't modify the class.
  - Create a new class that contains these extra methods. Make this extension class a subclass or a wrapper of the original.

Moving Features Between Objects: Introduce Local Extension



Organizing Data: Replace Data Value with Object

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



Organizing Data: Replace Array with Object

- You have an array in which certain elements mean different things.
- Replace the array with an object that has a field for each element.

```
String[] row = new String[3];
row [0] = "Liverpool";
row [1] = "15";
```

```
Performance row = new Performance();
row.setName("Liverpool");
row.setWins("15");
```

References

- Fowler, M., Refactoring: Improving the Design of Existing Code, Addison-Wesley, 1999.
- Fowler, M., Catalog of Refactorings, Published online at: http://refactoring.com/catalog/, December 2013 (last visited on: 1 December 2014).
- Ramsin, Raman. "Home." Department of Computer Science and Engineering, Sharif University of Technology. Accessed February 15, 2025. https://sharif.edu/~ramsin/index.htm.