Patterns in Software Engineering

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Lecture 10

Refactoring Patterns

Part 1

Refactoring: Definition

- ***Refactoring:***
  - 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?

- **Why Should You Refactor?**
  - Refactoring Improves the Design of Software
  - Refactoring Makes Software Easier to Understand
  - Refactoring Helps You Find Bugs
  - Refactoring Helps You Program Faster

Refactoring: When?

- **When Should You Refactor?**
  - 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)

1. **Mysterious Name**
2. **Duplicated Code**
3. **Long Function**
4. **Long Parameter List**
5. **Global Data**
6. **Mutable Data**
7. **Divergent Change:** When one class is commonly changed in different ways for different reasons.
8. **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.

Symptoms of Bad Code (2)

9. **Feature Envy:** A method that seems more interested in a class other than the one it actually is in.
10. **Data Clumps:** Bunches of data that regularly appear together.
11. **Primitive Obsession:** Excessive use of primitives, due to reluctance to use small objects for small tasks.
12. **Repeated Switches**
13. **Loops**
14. **Lazy Element:** An Element that isn't doing enough to justify its maintenance.
15. **Speculative Generality:** Classes and features have been added just because a need for them may arise someday.

Symptoms of Bad Code (3)

16. **Temporary Field:** An attribute that is set only in certain circumstances.
17. **Message Chains:** Transitive visibility chains.
18. **Middle Man:** Excessive delegation.
19. **Insider Trading:** Excessive interaction and coupling.
20. **Large Class**
21. **Alternative Classes with Different Interfaces**
22. **Data Class**
23. **Refused Bequest:** When children don't fulfill their parents' commitments.
24. **Comments:** When comments are used to compensate for bad code.

Refactoring Patterns: Categories

- **First Set:** The most commonly used refactorings
- **Encapsulation:** Enhancing information hiding
- **Moving Features:** Moving elements between contexts
- **Organizing Data:** Making data easier to work with
- **Simplifying Conditional Logic:** Making conditional logic less error-prone
- **Refactoring APIs:** Making interfaces easy to understand and use
- **Dealing with Inheritance:** Moving features around a hierarchy of inheritance

First Set: *Extract Function*

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

```
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);
}
```

First Set: *Inline Function*

- **Inline Function**
  - A function's body is just as clear as its name.
  - *Put the function's body into the body of its callers and remove the function.*

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

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

First Set: *Encapsulate Variable*

- **Encapsulate Variable**
  - You are accessing a variable directly, but the coupling to the variable is becoming awkward.
  - *Create getting and setting functions for the variable and use only those to access the variable.*

```
private int _low, _high;
boolean includes (int arg) {
    return arg >= _low && arg <= _high;
}
```

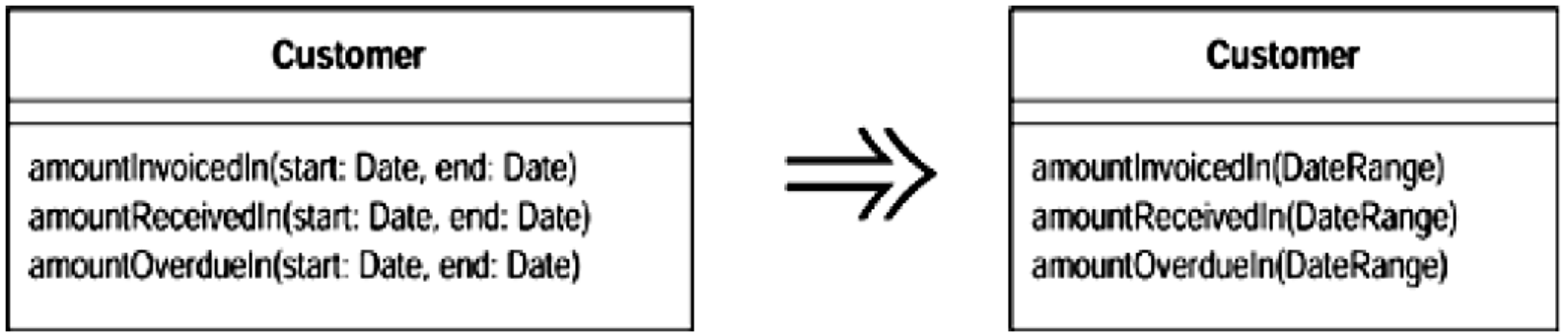
```
private int _low, _high;
boolean includes (int arg) {
    return arg >= getLow() && arg <= getHigh();
}
int getLow() {return _low;}
int getHigh() {return _high;}
```

First Set: *Introduce Parameter Object*

- **Introduce Parameter Object**
  - You have a group of parameters that naturally go together.
  - *Replace them with an object.*

```
function amountInvoiced(startDate, endDate) {...}
function amountReceived(startDate, endDate) {...}
function amountOverdue(startDate, endDate) {...}
```

```
function amountInvoiced(aDateRange) {...}
function amountReceived(aDateRange) {...}
function amountOverdue(aDateRange) {...}
```



First Set: *Combine Functions into Class*

- **Combine Functions into Class**
  - A group of functions operate closely together on a common body of data
  - *Form a class to contain the functions;*

```
function base(aReading) {...}
function taxableCharge(aReading) {...}
function calculateBaseCharge(aReading) {...}
```

```
class Reading {
  base() {...}
  taxableCharge() {...}
  calculateBaseCharge() {...}
}
```

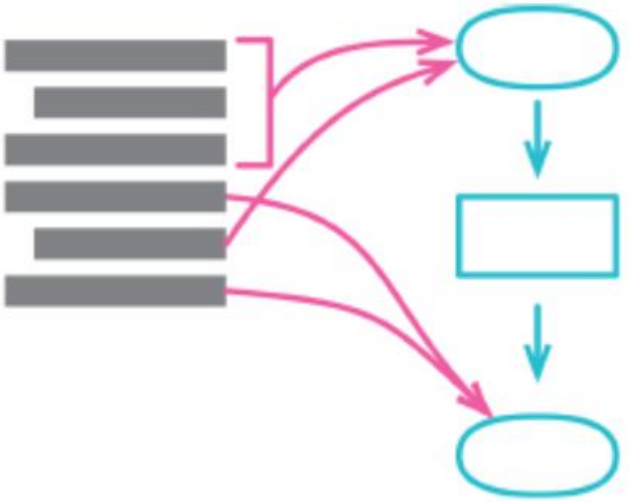
First Set: *Split Phase*

- **Split Phase**
  - The code is dealing with two or more different things.
  - *Split it into separate modules.*

```
const orderData = orderString.split(/\s+/);
const productPrice = priceList[orderData[0].split("-")[1]];
const orderPrice = parseInt(orderData[1]) * productPrice;
```

```
const orderRecord = parseOrder(order);
const orderPrice = price(orderRecord, priceList);

function parseOrder(aString) {
  const values =  aString.split(/\s+/);
  return ({
    productID: values[0].split("-")[1],
    quantity: parseInt(values[1]),
  });
}
function price(order, priceList) {
  return order.quantity * priceList[order.productID];
}
```

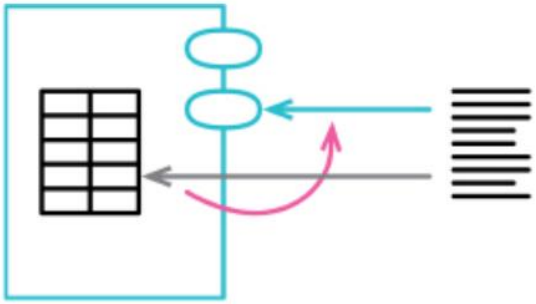


Encapsulation: *Encapsulate Record*

- **Encapsulate Record**
  - You have a mutable data record.
  - *Turn it into a class and create getting and setting methods to access the variables.*

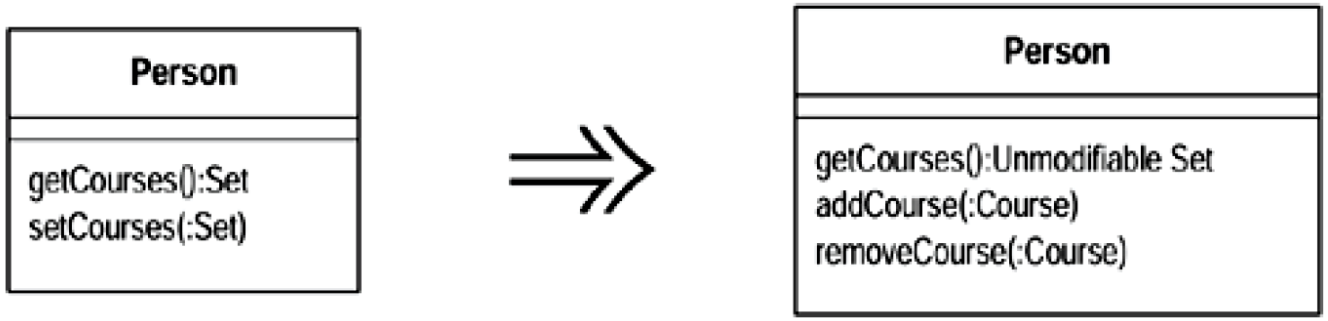
```
organization = {name: "Acme Gooseberries", country: "GB"};
```

```
class Organization {
  constructor(data) {
    this._name = data.name;
    this._country = data.country;
  }
  get name()    {return this._name;}
  set name(arg) {this._name = arg;}
  get country()    {return this._country;}
  set country(arg) {this._country = arg;}
}
```



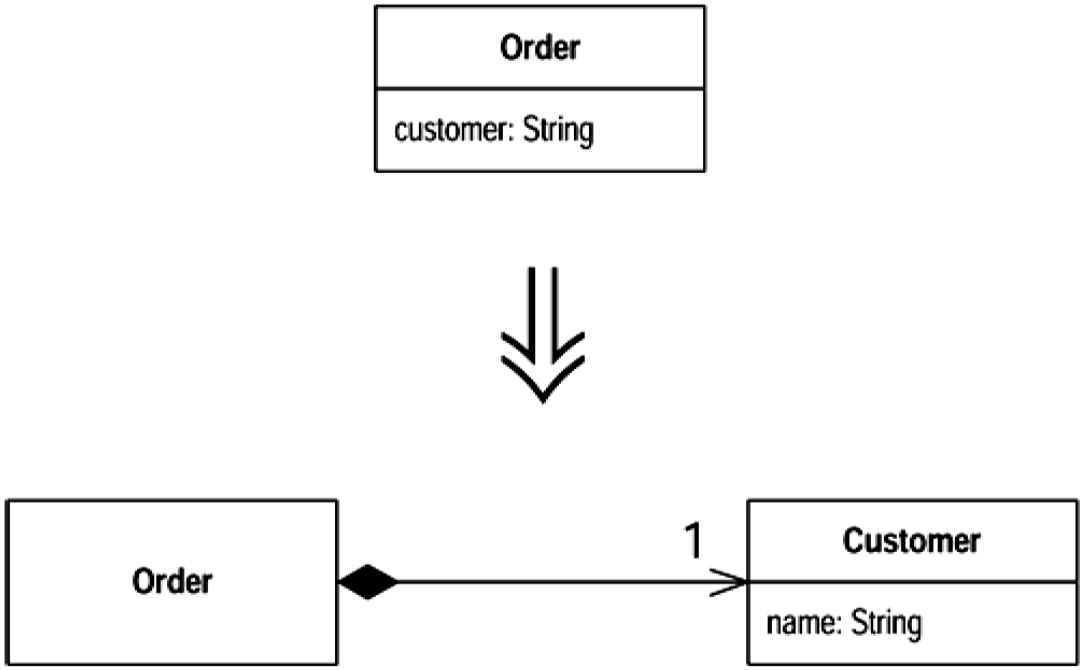
Encapsulation: *Encapsulate Collection*

- **Encapsulate Collection**
  - A method returns a collection.
  - *Make it return a read-only view and provide add/remove methods.*



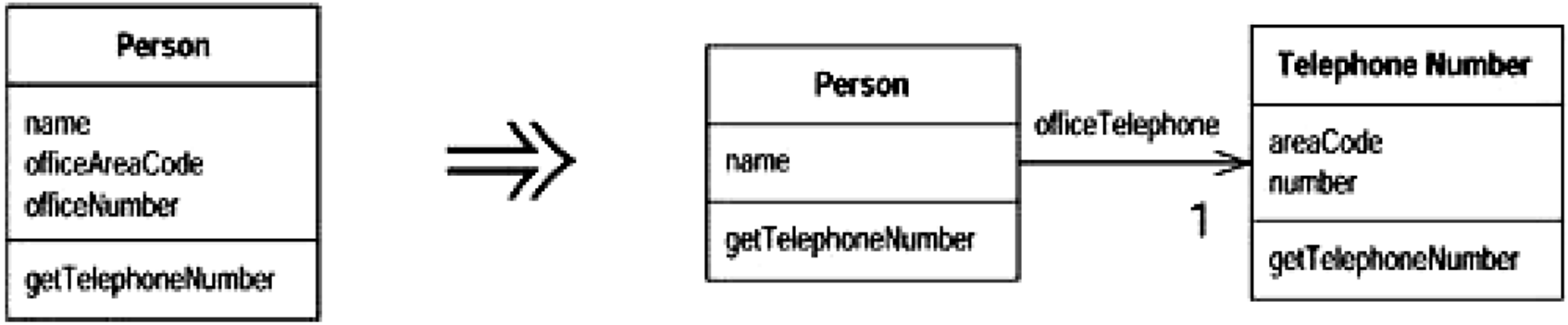
Encapsulation: *Replace Primitive with Object*

- **Replace Primitive with Object**
  - You have a data item that needs additional data or behavior.
  - *Turn the data item into an object.*



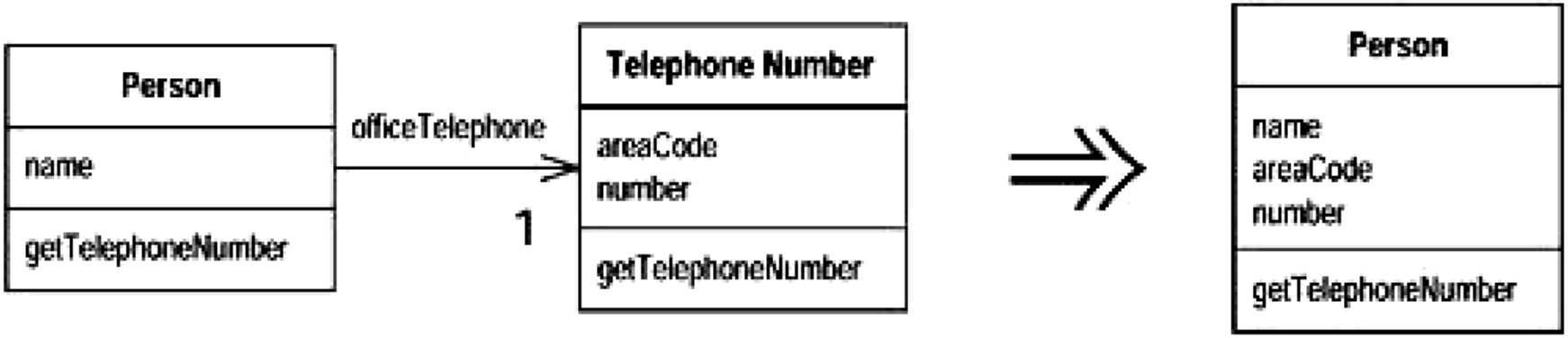
Encapsulation: *Extract Class*

- **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.*



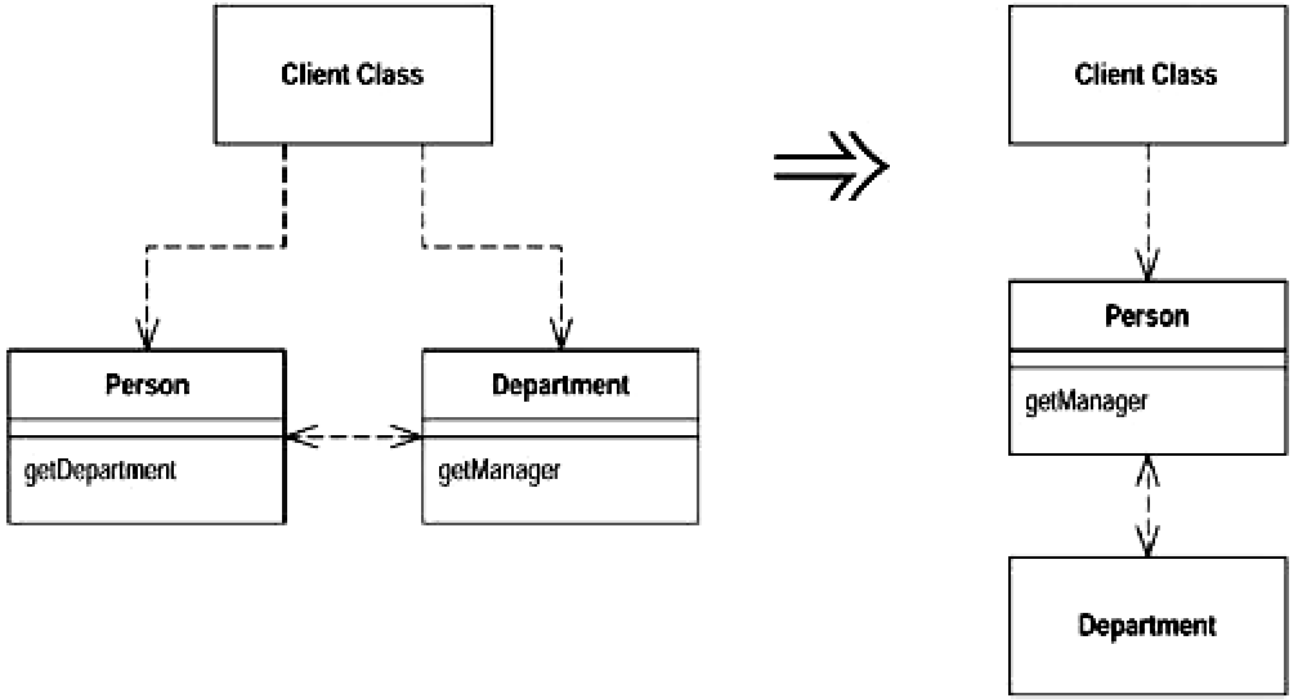
Encapsulation: *Inline Class*

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



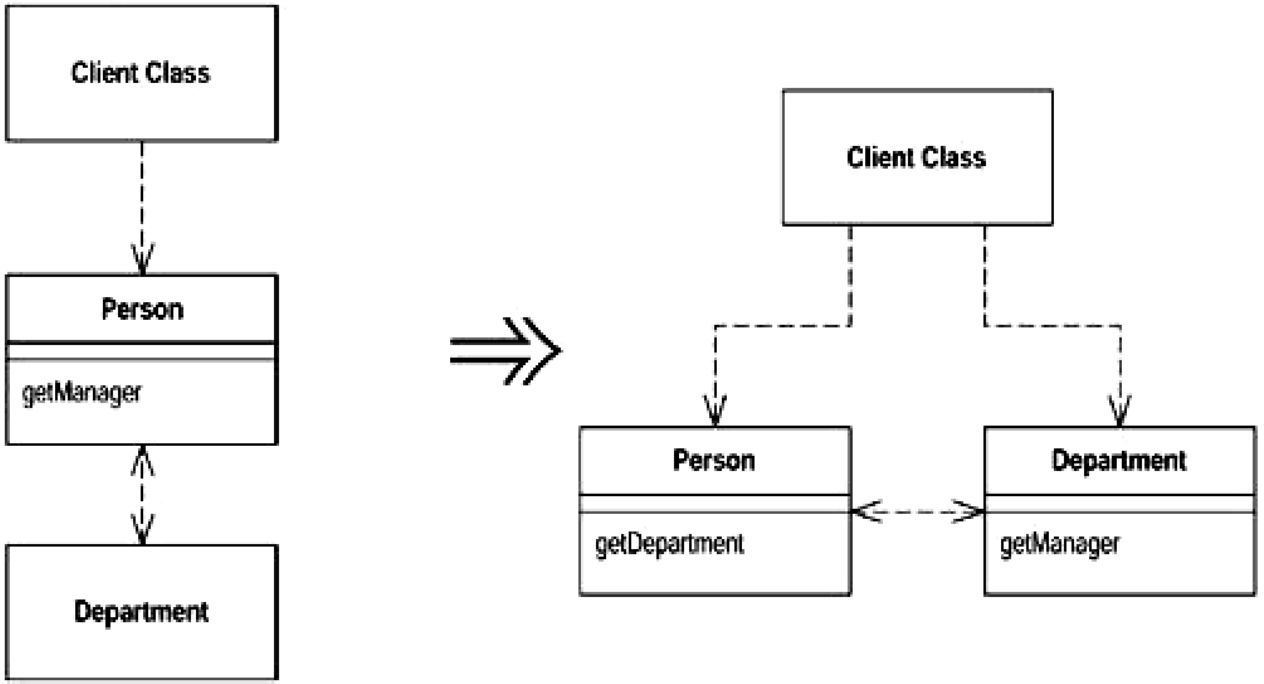
Encapsulation: *Hide Delegate*

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



Encapsulation: *Remove Middle Man*

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



Reference

- Fowler, M., *Refactoring: Improving the Design of Existing Code,* 2nd Edition, Addison-Wesley, 2019.