CS314 Software Engineering Refactoring

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Dave Matthews

## CMMI for Development Model

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Process</th>
<th>Project</th>
<th>Engineering</th>
<th>Support</th>
</tr>
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<tbody>
<tr>
<td>5</td>
<td>• Organizational Performance</td>
<td>• Causal Analysis and Resolution</td>
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<td>Management</td>
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<td>• Organizational Process</td>
<td>• Quantitative Project Management</td>
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<td>Performance</td>
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<td>3</td>
<td>• Organizational Process</td>
<td>• Integrated Project Management</td>
<td>• Requirements Development</td>
<td>• Decision Analysis and Resolution</td>
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<td>Definition</td>
<td>• Risk Management</td>
<td>• Technical Solution</td>
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<td>• Organizational Process</td>
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<td>• Product Integration</td>
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<td>Focus</td>
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<td>• Verification</td>
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<td>• Organizational Training</td>
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<td>• Validation</td>
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<td>2</td>
<td>• Requirements Management</td>
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<td>• Project Planning</td>
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<td>• Project Monitoring and Control</td>
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<td>• Supplier Agreement Management</td>
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</table>
Scrum

Refactoring

- Process of changing a software system in such a way that it does not alter the external behavior of the code, yet improves its internal structure.
- Disciplined way to clean up code that minimizes the chances of introducing bugs.
Refactoring – Why?

- Improves the design of software
- Makes software easier to understand
- Helps you find bugs
- Helps you program faster.

Refactoring – When?

- When you add a function
- When you need to fix a bug
- When you do a code review
Bad Smells in Code

- Duplicated Code
- Long method
- Large Class
- Long Parameter List
- Divergent Change
- Shotgun Surgery
- Feature Envy
- Data Clumps
- Primitive Obsession
- Switch Statements
- Parallel inheritance hierarchies
- Lazy class

- Speculative Generality
- Temporary Field
- Message Chains
- Middle Man
- Inappropriate Intimacy
- Alternative Classes with Different Interfaces
- Incomplete Library Class
- Data Class
- Refused Bequest
- Comments

Refactoring, Martin Fowler, 1999
## Common Refactorings

<table>
<thead>
<tr>
<th>Smell</th>
<th>Common Refactorings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Classes with Different Interfaces</td>
<td>Rename Method, Move Method</td>
</tr>
<tr>
<td>Comments</td>
<td>Extract Method, Introduce Assertion</td>
</tr>
<tr>
<td>Data Class</td>
<td>Move Method, Encapsulate Field, Encapsulate Collection</td>
</tr>
<tr>
<td>Data Clumps</td>
<td>Extract Class, Introduce Parameter Object, Preserve Whole Object</td>
</tr>
<tr>
<td>Divergent Change</td>
<td>Extract Class</td>
</tr>
<tr>
<td>Duplicated Code</td>
<td>Extract Method, Extract Class, Pull Up Method, Form Template Method</td>
</tr>
<tr>
<td>Feature Envy</td>
<td>Move Method, Move Field, Extract Method</td>
</tr>
<tr>
<td>Inappropriate Intimacy</td>
<td>Move Method, Move Field, Change Bidirectional Association to Unidirectional, Replace Inheritance with Delegation, Hide Delegate</td>
</tr>
<tr>
<td>Incomplete Library Class</td>
<td>Introduce Foreign Method, Introduce Local Extension</td>
</tr>
<tr>
<td>Large Class</td>
<td>Extract Class, Extract Subclass, Extract Interface, Replace Data Value with Object</td>
</tr>
<tr>
<td>Lazy Class</td>
<td>Incline Class, Collapse Hierarchy</td>
</tr>
<tr>
<td>Long Method</td>
<td>Extract Method, Replace Temp with Query, Replace Method with Method Object, Decompose Conditional</td>
</tr>
<tr>
<td>Long Parameter List</td>
<td>Replace Parameter with Method, Introduce Parameter Object, Preserve Whole Object</td>
</tr>
<tr>
<td>Message Chains</td>
<td>Hide Delegate</td>
</tr>
<tr>
<td>Middle Man</td>
<td>Remove Middle Man, Inline Method, Replace Delegation with Inheritance</td>
</tr>
<tr>
<td>Parallel Inheritance Hierarchies</td>
<td>Move Method, Move Field</td>
</tr>
<tr>
<td>Primitive Obsession</td>
<td>Replace Data Value with Object, Extract Parameter Object, Replace Array with Object, Replace Type Code with Class, Replace Type Code with Subclasses, Replace Type Code with State/Strategy</td>
</tr>
<tr>
<td>Refused Bequest</td>
<td>Replace Inheritance with Delegation</td>
</tr>
<tr>
<td>Shotgun Surgery</td>
<td>Move Method, Move Field, inline Class</td>
</tr>
<tr>
<td>Speculative Generality</td>
<td>Collapse Hierarchy, Inline Class, Remove Parameter, Rename Method</td>
</tr>
<tr>
<td>Switch Statements</td>
<td>Replace Conditional with Polymorphism, Replace Type Code with Subclasses, Replace Type Code with State/Strategy, Replace Parameter with Explicit Methods, Introduce Null Object</td>
</tr>
<tr>
<td>Temporary Field</td>
<td>Extract Class, Introduce Null Object</td>
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</table>
Refactoring – Duplicated Code

• Same code structure in more than one place – unify them
• Example:
  – same expression in two methods of the same class
  – Use Extract Method refactoring and call the new method from both places
• Example:
  – same expression in two sibling classes
  – Use Extract Method refactoring in both classes, and Pull Up Method

Refactoring – Long Method

• Shortest methods live the best and longest
• Most of the time all you need to do is Extract Method refactoring to long methods.
• Long lists of parameters can be slimmed down with Introduce Parameter Object and Preserve Whole Object Refactoring.
Extract Method

• Create a new method, name it after intention
• Copy extracted code from source into new method
• Scan code for references to variables that are local in scope to source method - local
  variables and parameters for new method.
• See whether any temporary variables are only used within the extracted code and
  declare in new method.
• Look to see whether any of these local variables are modified by the extracted code.
  May need to use a different approach.
• Pass into the target method as parameters the local-scope variables that are read from
  the extracted code.
• Compile when you have dealt with locally scoped variables.
• Replace the extracted code in the source methods with a call to the new methods.
• Remove temporary variables defined and used in the new method from the source
  methods.
• Compile and test.

Sprint 3 - Priorities

• Sprint 2 (2/3-opt, background, GUI map/options/subset
• Non-functional requirements
  – Code Coverage, Code Climate, BCH
• Sprint 3
  – Units (–m vs –k)
  – Itinerary (new SVG example, formatted on GUI)
  – Trips (best 0/2/3 opt of all nearest neighbors)
  – Map (background, wrapping)
  – GUI subset Selection
Itinerary on GUI

<table>
<thead>
<tr>
<th>Leg</th>
<th>From</th>
<th>To</th>
<th>Distance</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>KDEN Denver International Airport 39.86N, 104.67W, 5431 ft Denver, Colorado, United States, North America</td>
<td>KDEN Denver International Airport 39.86N, 104.67W, 5431 ft Denver, Colorado, United States, North America</td>
<td>0 miles</td>
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GUI / Database selection

Type filter
Continent filter
Country filter
Region filter
Municipality search
Airport name search

SEARCH

first # of # matching airports
Scrolling list of airports matching criteria above that can be added to the selection list to the right.

SEARCH

miles/cm
0/2/3 optimization level
show ids on map
show distance on map
?
?

SEARCH

# selected airports
Scrolling list of selected airports for trip planning. Should be able to remove individual or collectively

SELECT

SEARCH

SEARCH

Plan

SELECT

SEARCH

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