Identification of Refactoring Opportunities in Java Programs

With Main Focus on “Replace Conditional with Polymorphism” Refactoring

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Program transformation that restructures a program by preserving its behaviour.

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Example

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Why to Refactor?

- Improves readability and maintainability of the code
- Helps in finding bugs

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- To address the problems in manual refactoring, several semi-automated tools have been developed
  - Smalltalk Refactoring Browser, IntelliJ Idea, Eclipse and so on.
  - User identifies the parts of the software to be refactored which requires a lot of effort and time for large scale systems.

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  - User identifies the parts of the software to be refactored which requires a lot of effort and time for large scale systems.

- To reduce the efforts involved in manually identifying the refactoring opportunities, techniques for automatic identification have been proposed
  - Identification of Move Method refactorings, the recommendation of Rename refactorings and so on

Refactoring (Contd..)

What is yet to be addressed?

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Goal

Automate the identification process of refactoring opportunities with static analyses efficiently.

Current Goal

Automatic identification of refactoring opportunities for "Replace Conditional with Polymorphism" refactoring.

Motivating Example

- If statement is used to simulate polymorphism in this example.
- The field base of the class Number is compared against values 2/8/16 to check for a state of the object o1 and call the state specific code printBinary()/printOctal()/printHex() (lines 3-9).
- Similarly, many such conditional (If/switch) statements spans across multiple places in the project increasing the complexity of the code.

```
1  class Number{
2    int base;
3    printBinary(){
4      ...
5    }
6    printOctal(){
7      ...
8    }
9    printHex(){
10     ...
11   }    ...  }
```

```
1  class SomeClass{
2   m(Number o1){
3    if(o1.base == 2){
4     o1.printBinary();
5    }else if(o1.base == 8){
6     o1.printOctal();
7    }else if(o1.base == 16){
8     o1.printHex();
9    }
10   ...
11  }  ... }
```

Solution: Replace Conditional with Polymorphism (RCP)

```
class Number{
  print(){
    ...
  }
    ...
}
```

```
class Binary extends Number{
  print(){
    ...
  }
//other methods specific to Binary
}
```

```
class Hex extends Number{
  print(){
    ...
  }
//other methods specific to Hex
}
```

```
class Octal extends Number{
  print(){
    ...
  }
//other methods specific to Octal
}
```

Solution: Replace Conditional with Polymorphism (RCP)

```
class Number{
  print(){
    ...
  }
    ...
}
```

```
class Binary extends Number{
  print(){
    ...
  }
//other methods specific to Binary
}
```

```
class Hex extends Number{
  print(){
    ...
  }
//other methods specific to Hex
}
```

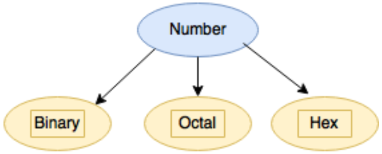
```
class Octal extends Number{
  print(){
    ...
  }
//other methods specific to Octal
}
```

```
class SomeClass{
  m(Number o1){
o1.print();
  }
  ...
}
```

- Creates one subclass per value (2/8/16): Binary, Octal, Hex. i
- Moves the state specific code as a method to the respective sub class.
- Replaces the conditional (If statement) by a polymorphic function call.

Inheritance Hierarchy

- If the field `base` is not redefined after the object `o1` is created. That is `base` is immutable for `o1`. Then the inheritance hierarchy after the refactoring (*Replace Type Code with Subclass*):



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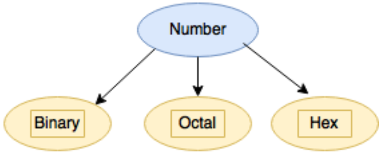
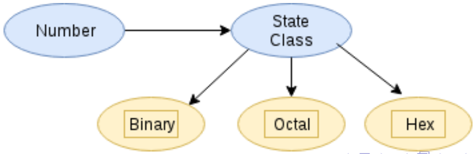


- If the field base is redefined after the object o1 is created. Then the inheritance hierarchy after the refactoring (*Replace Type Code with State*):



More Information at

- Replace Conditional with Polymorphism
  - https://www.youtube.com/watch?v=NCsoEEz_Ta0
  - https://refactoring.com/catalog/replaceConditionalWithPolymorphism.html
- Replace Type Code with State
  - https://refactoring.com/catalog/replaceTypeCodeWithStateStrategy.html
  - https://sourcemaking.com/refactoring/replace-type-code-with-state-strategy
- Replace Type Code with Subclass
  - https://refactoring.com/catalog/replaceTypeCodeWithSubclasses.html
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    - https://refactoring.com/catalog/replaceConditionalWithPolymorphism.html
- Replace Type Code with State
    - https://refactoring.com/catalog/replaceTypeCodeWithStateStrategy.html
    - https://sourcemaking.com/refactoring/replace-type-code-with-state-strategy
- Replace Type Code with Subclass
    - https://refactoring.com/catalog/replaceTypeCodeWithSubclasses.html
    - https://sourcemaking.com/refactoring/replace-type-code-with-subclasses

Thank You!!