Comparative Analysis Of Strategies For Applying AOP On Legacy Code

Forth Turkish Aspect-Oriented Software Development Workshop(Bilkent Ankara 12/2009)

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Outline

- Introduction
- Case Study
- Strategies
  - Direct Application Of Aspects To Legacy Code Without Refactoring
  - Dealing crosscutting concerns by Object-Oriented re-factoring without AOP
  - Applying AOP After Object-Oriented Re-factoring
- Conclusion

Problem Definition

- Object Oriented Programming
- Design Patterns
- Aspect Oriented Programming

Problem Definition

- Problems with Existing Code

The Goal

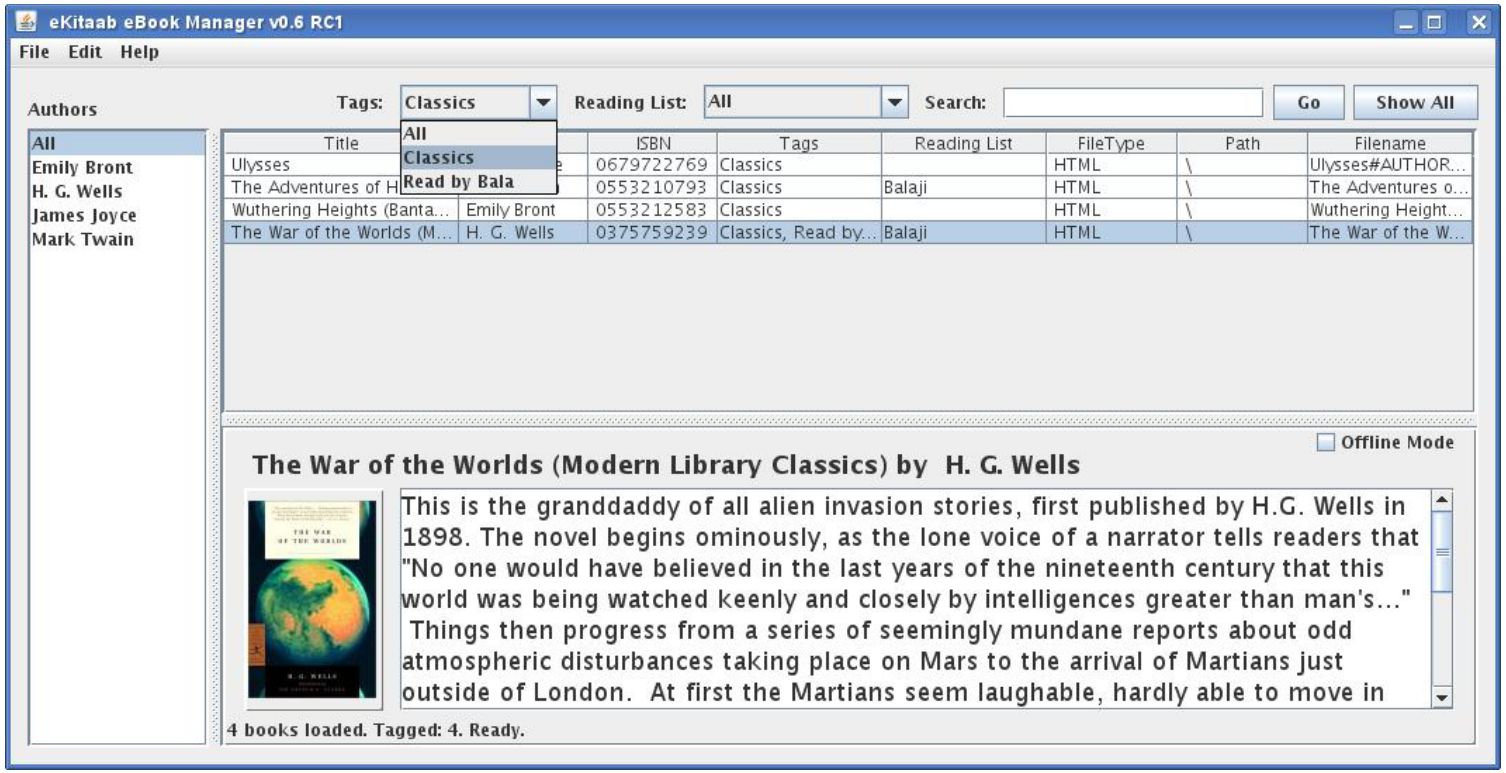
- Investigate the Usage of AOP in existing code.

Our Approach

- Use Aspect Oriented Approach
  - Not only as complementary to the shortages of OOP programming
  - But also solely to create solutions in a fast manner
    - Which saves
      - Time
      - Effort
      - Cost

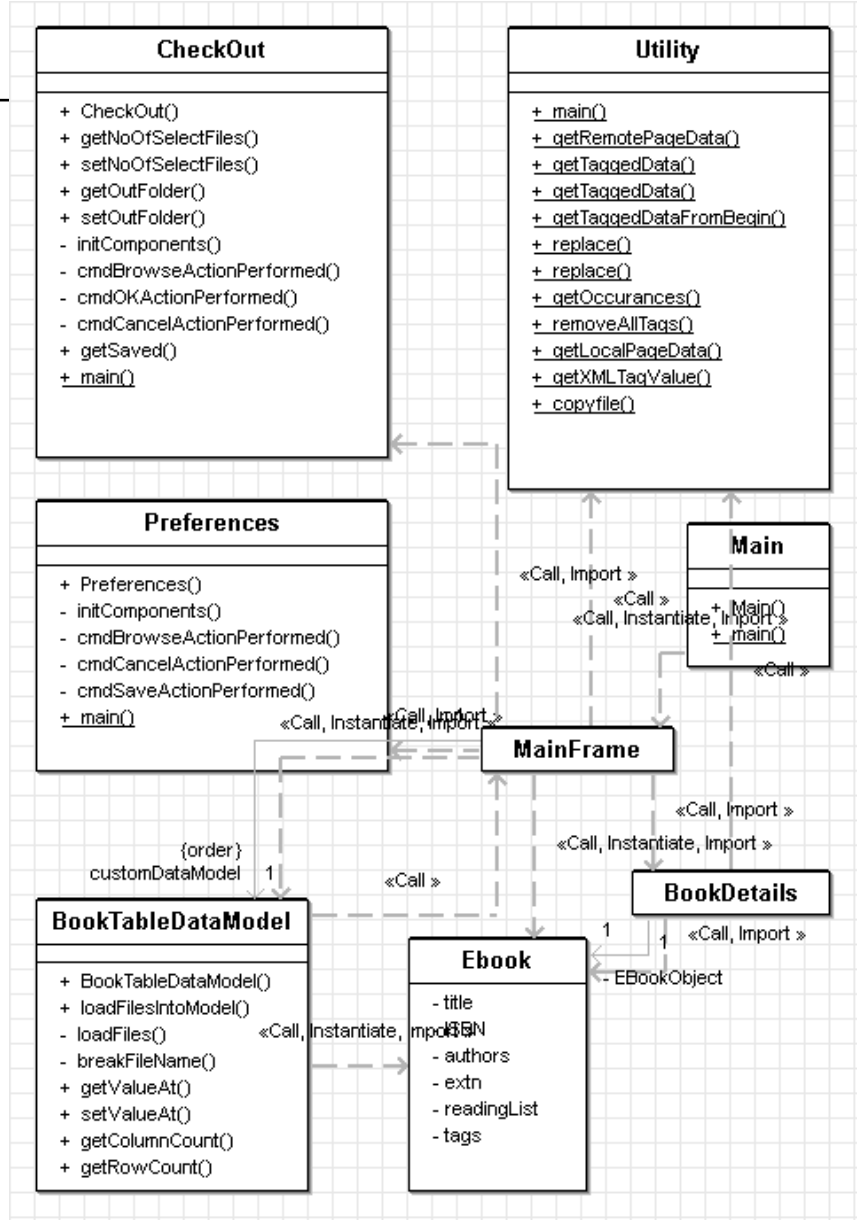
Case Study

- E-Book Manager Application



Case Study: E-Book Manager Application

- Class Diagram



Our Strategy

- Direct Application Of Aspects To Legacy Code Without Refactoring
  - Existing Concerns
  - New Concerns
- Dealing crosscutting concerns by Object-Oriented re-factoring without AOP
  - Existing Concerns
  - New Concerns
- Applying AOP After Object-Oriented Re-factoring
  - Existing Concerns
  - New Concerns

Our Strategies: Direct Application Of Aspects To Legacy Code Without Refactoring

- Existing Concerns
  - Detail Storage
  - Checkout
  - Web Service
- New Concerns
  - Internationalization
  - Look&Feel

Existing Concerns :Detail Storage

- By Using Aspect Oriented Approach
  - 3 point cuts – 3 advices
    - Save Details
      - Saving Ebook objects with file streams
    - Load Details
      - Loading files and casting them to Ebook objects
    - Copy File
      - Copying detail storage files along with Ebook files

Existing Concerns :Detail Storage

```
public aspect DetailStorage {

pointcut saveBook(Ebook book, int i, MainFrame mf) :call(* MainFrame.SaveBook(Ebook , int)) &&
      args(book,i) && target(mf);

pointcut loadBook(String fileName, BookTableDataModel btdm) : call(*
      BookTableDataModel.breakFileName(String)) && args(fileName) && target(btdm);

pointcut copyFile(String src, String dst):call(* Utility.copyfile(..)) && args(src, dst) &&
      this(FileCopyCheckOut);

declare parents: Ebook implements Serializable;//use serializable interface to store book information

//Advice for overriding method calls to breakFileName method to get boot information from file name and
      create book object

Ebook around(String s, BookTableDataModel btdm) : loadBook(s, btdm){

        ...

      }

...
```

Existing Concerns :Checkout

- By Using Aspect Oriented Approach
  - Menu integration
  - Implementation

Existing Concerns :Checkout

```
public aspect CheckOutManager {


pointcut checkOut(MainFrame mf) : call(* MainFrame.CheckoutFiles()) && target(mf);
pointcut checkOutFileMenuFunction(MainFrame mf): call(* MainFrame.mnuCheckoutActionPerformed(*)) &&
      target(mf);
pointcut menuCreation(MainFrame mf): call(* MainFrame.initComponents()) && this(mf);


//override checkOut function so that it will work according to selected check out manager
void around(MainFrame mf) : checkOut(mf) {
        ...
      }


//Create send-by-email menu
after(final MainFrame mf): menuCreation(mf){
        ...
      }
//Set manager to fileCopyManager before menu action performed
before(MainFrame mf):checkOutFileMenuFunction(mf){
        ...
      }
}
```

Existing Concerns :Web Service

:Aspect code of Web Service

Our Strategies:New Concerns

- Dealing with crosscutting concerns that come with adding related functionalities
  - Internatinalization
  - Look and Feel
  - Agent Based Communication

New Concerns:Internatinalization

- Swing and AWT elements
  - SetText() method
  - Language files

New Concerns:Internatinalization

```
public aspect internationalization
{
pointcut setText(String s,JComponent comp):call(* *.setText(String)) && args(s) && target(comp) &&
!this(internationalization);
void around(String s, JComponent
comp): setText(s, comp) {
//some variable declarions
...
locale = new Locale("tr","TR");
rb =ResourceBundle.getBundle("Messages"
, locale);
//getting locale value according to keys
...
if(comp instanceof JMenuItem){
JMenuItem jm=(JMenuItem)comp;
jm.setText(s);
}
// check for other types
...
}
```

New Concerns:Look and Feel

- Swing look & feels
- OS dependent visual style
- Component type specific style

New Concerns:Look and Feel

```
public aspect lookandfeel {
pointcut catchButton(Jbutton j): set(JButton *.*) && args(j);
after(Jbutton j):catchButton(j){
int osType =DetailStorage.osType();
switch (osType){
case 0://Unknown OS
break;
case 1://Windows
j.setUI(new
javax.swing.plaf.basic.BasicButtonUI());
break;
case 2://Mac
…
break;
case 3://Unix, Linux
j.setUI(new javax.swing.plaf.metal.MetalButtonUI());
break;
```

New Concerns: Agent Based Communication

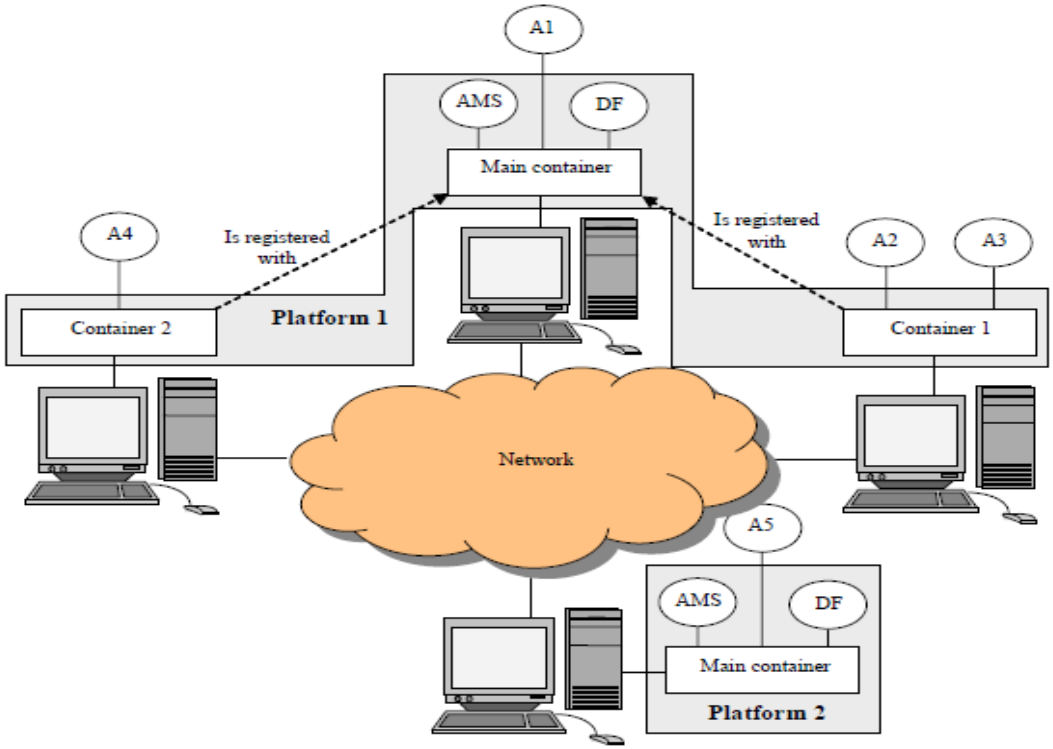


Figure 1Containers and Platforms

New Concerns: Agent Based Communication

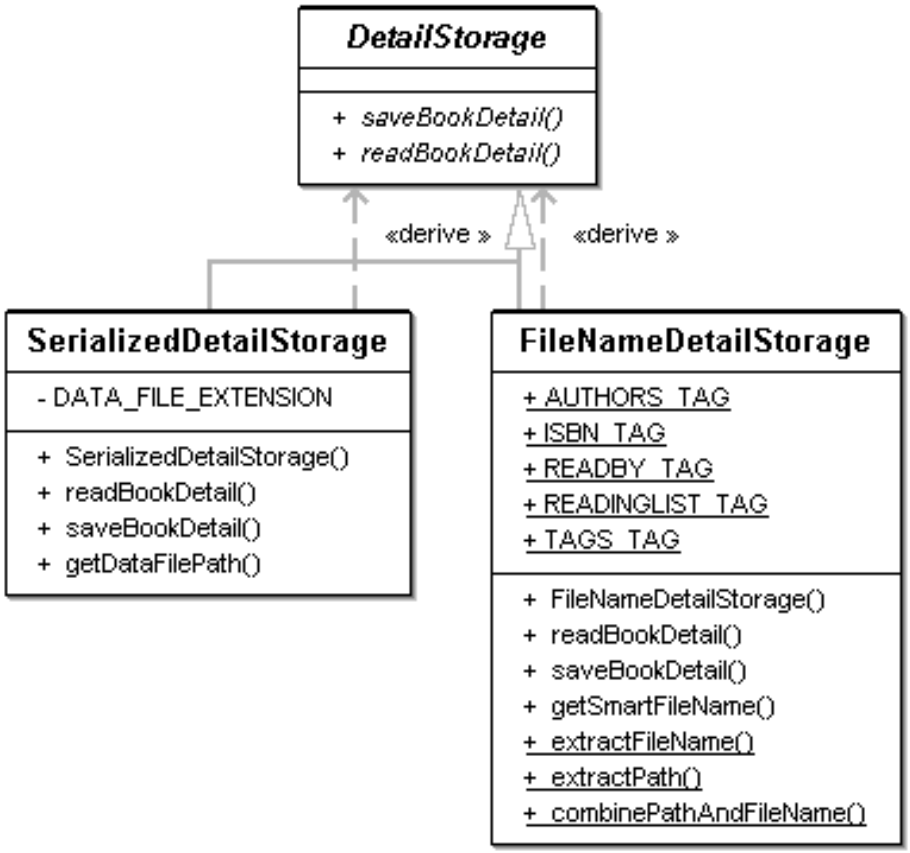
```
public aspect DistributedSellerAgent {

pointcutloadFilesIntoModel(BookTableDataModel btdm) :call(*
     BookTableDataModel.loadFilesIntoModel(..)) && target(btdm);

//Advice to create a seller agent after execution of the pointcut
after(BookTableDataModel btdm) : loadFilesIntoModel(btdm){
     ...

     }
}
```

Our Strategies: Dealing crosscutting concerns by Object-Oriented re-factoring without AOP

- Existing Concerns
  - Detail Storage
  - Checkout
  - Web Service
- New Concerns
  - Internationalization
  - Look&Feel

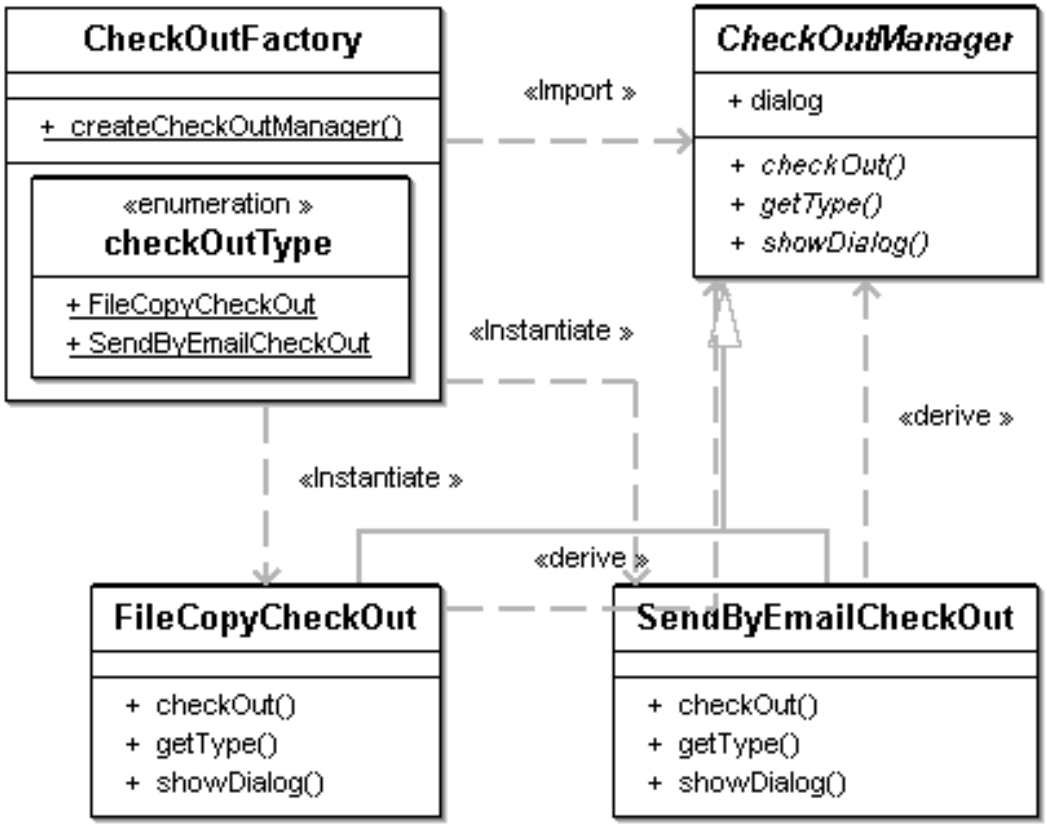
Existing Concerns :Detail Storage

- By rearranging the Code



Existing Concerns :Checkout

- By rearranging the Code



New Concerns

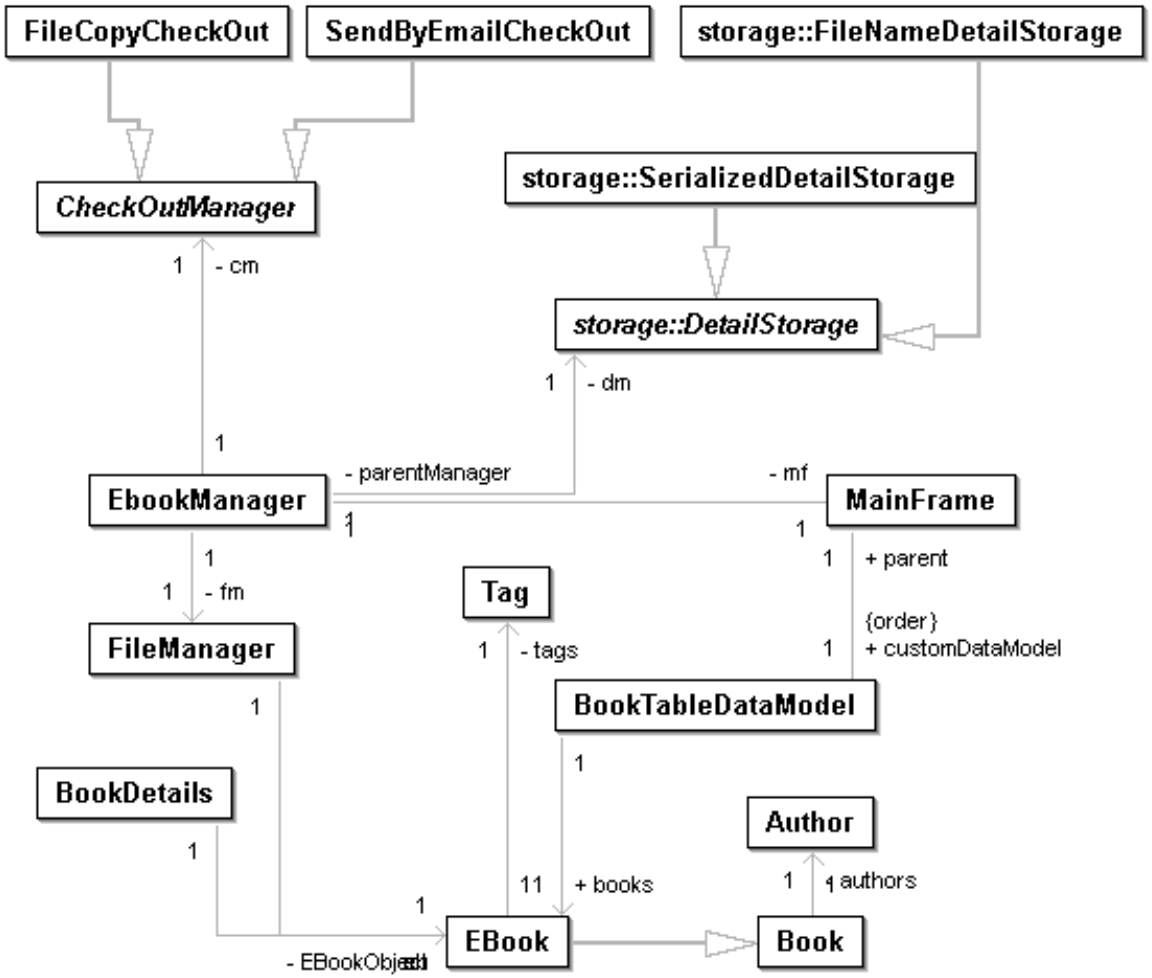
- Internationalization
  - require many changes to be done on the existing code
- Look& Feel
- Agent Based Communication

Our Strategies: Applying AOP After Object-Oriented Re-factoring

- Existing Concerns
  - Detail Storage
  - Checkout
  - Web Service
- New Concerns
  - Internationalization
  - Look&Feel

Existing Concerns :Detail Storage

- By rearranging the Code



Existing Concerns:Checkout

- Refactorization strategy
- Adding new functionality to menu

Existing Concerns: Web Service

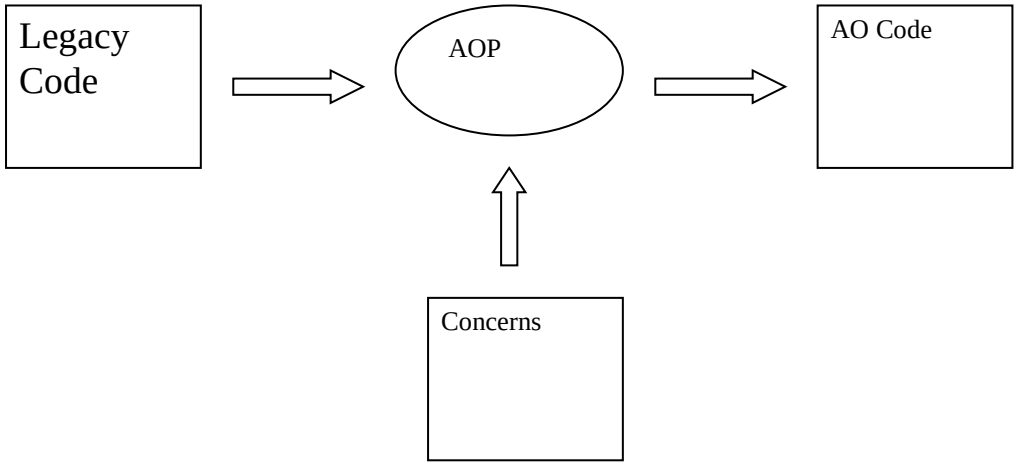
- Changed the code in place
- Could be done in a separate class

Our Strategies:New Concerns

- Internationalization
- Look&Feel
- Agent Based Communication

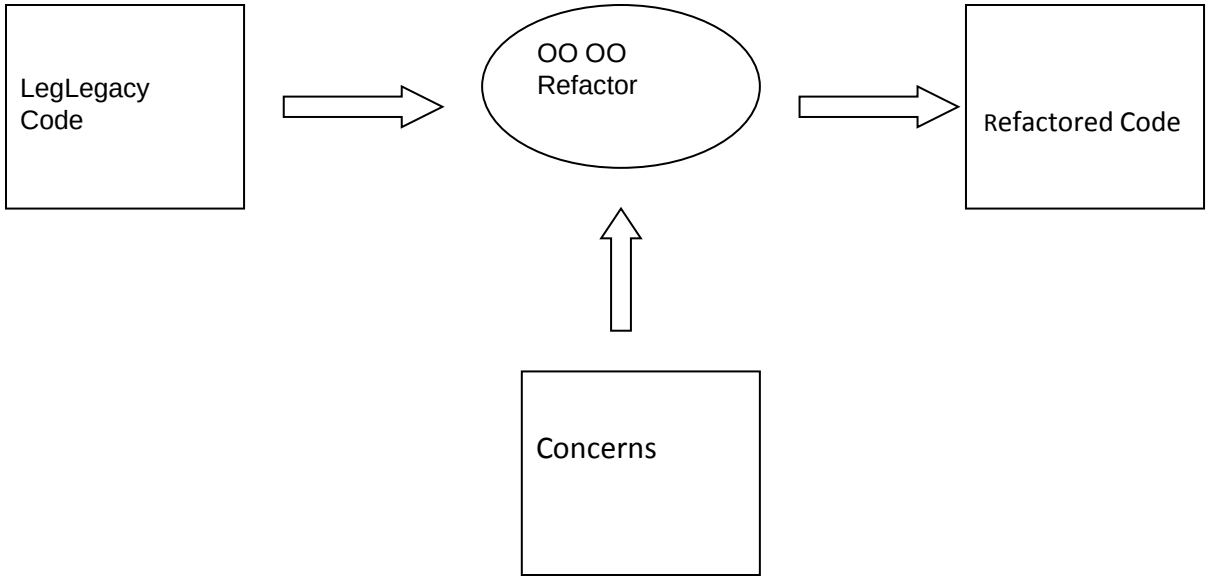
Discussion

- Direct application of aspects to legacy code without re-factoring



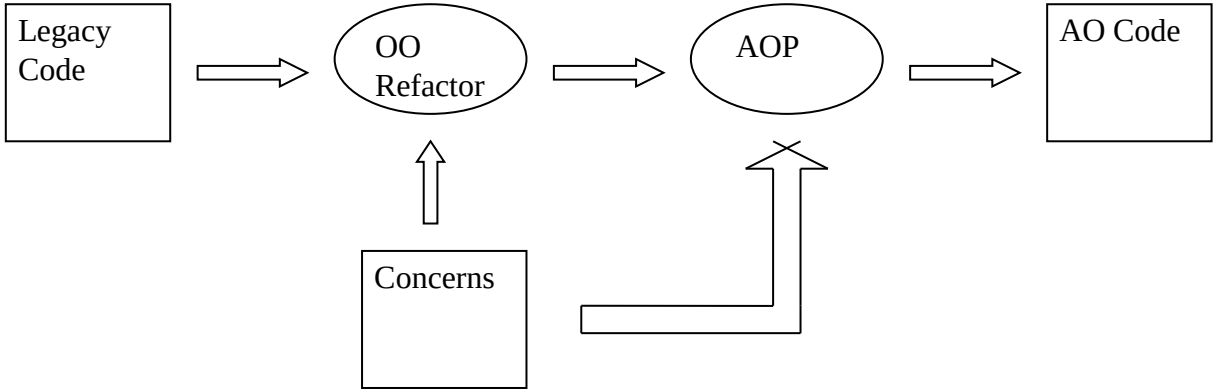
Discussion

- Dealing crosscutting concerns by Object-Oriented re-factoring without AOP



Discussion

Applying AOP after Object-Oriented refactoring



Discussion

	Existing Concerns	New Concerns
Directly Applying AOP	• Easy to implement Does not require understanding all parts of code. No need to make change on existing code.	Easy to implement Do not require wide understanding on existing code. Could be applied to the project easily Improves extendibility for future aspectual concerns.
Re-factorization	Decreases crosscutting concerns In some cases may not be possible. Hard to understand existing scattered code Time consuming Increases code reuse-ability	For some concerns not possible to solve by re-factorization Requires hard coding within existing classes
Re-factorization and AOP	Could deal with crosscutting concerns which OOP re-factorization could not solve itself Improves modularity	Prevents crosscutting concerns Improves modularity

Demo

Thank You…

Questions are Welcomed…