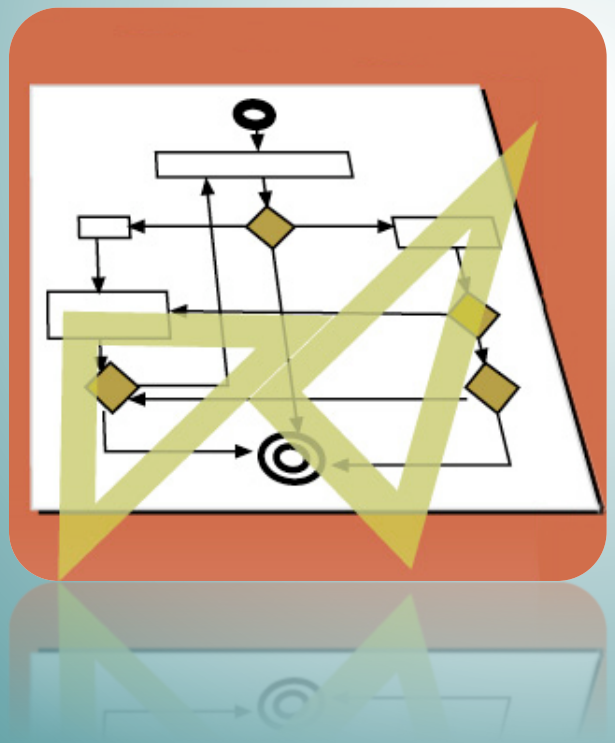
Ingeniería del Software II

Seminario. Programación Orientada a Aspectos



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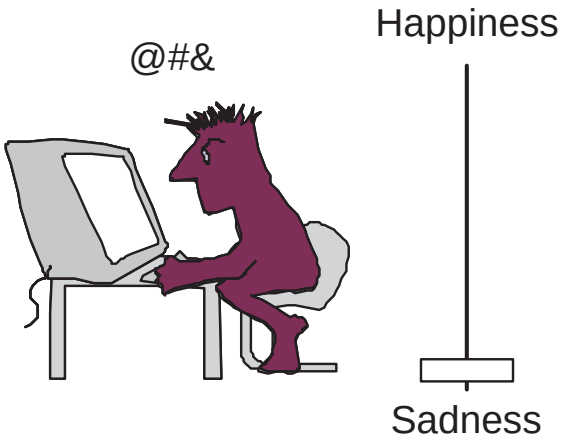
Crosscutting Concerns Drawbacks

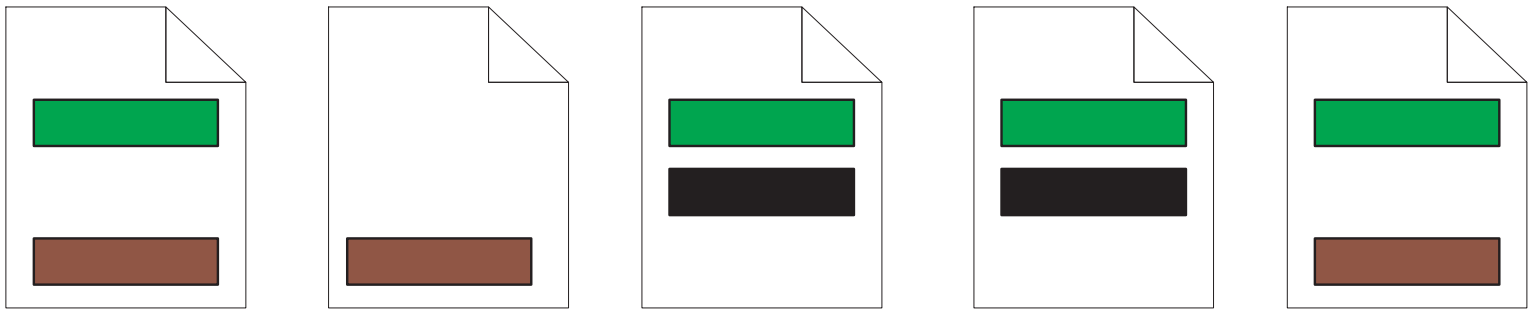


Base Functionality

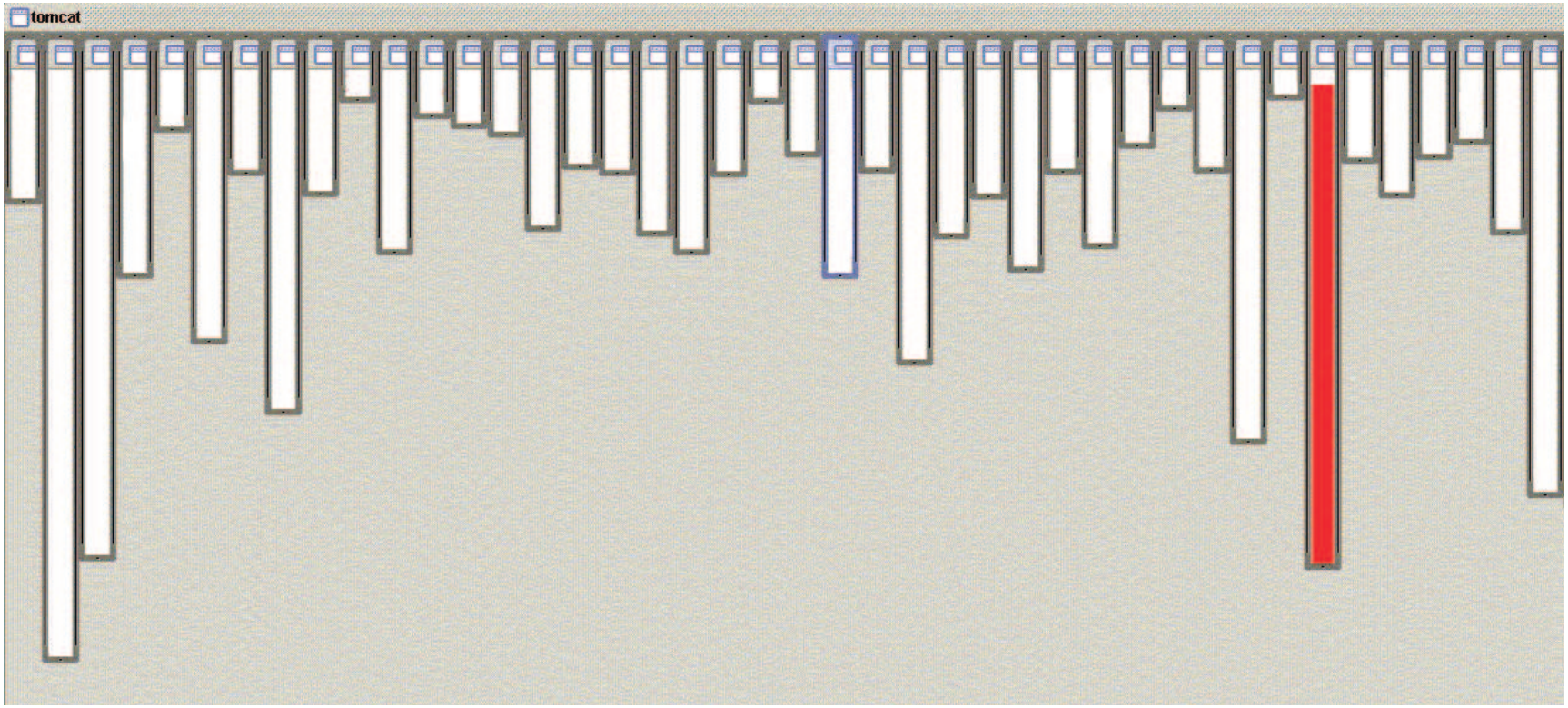
Access Control

Fault Tolerance v2.0

Encryption

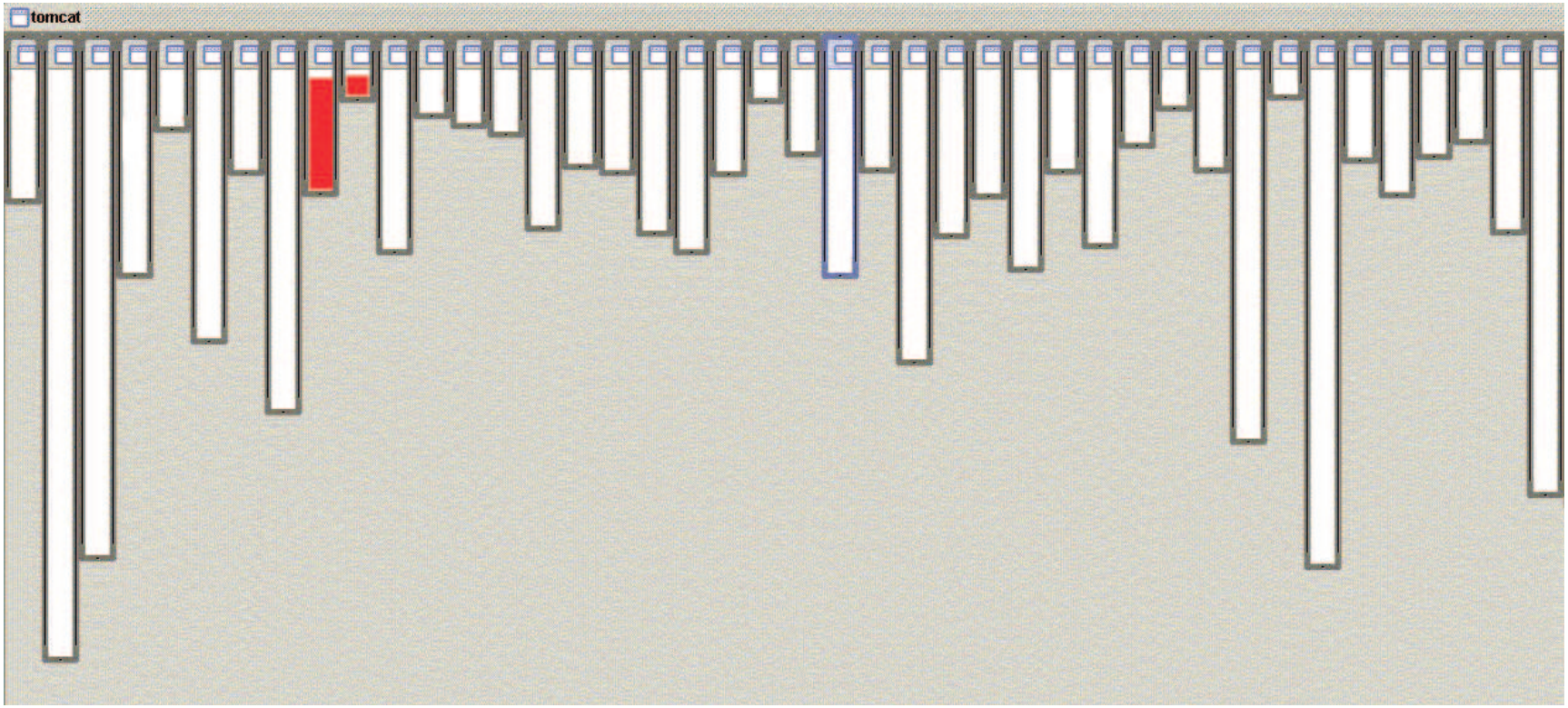


Case Study: Apache Tomcat



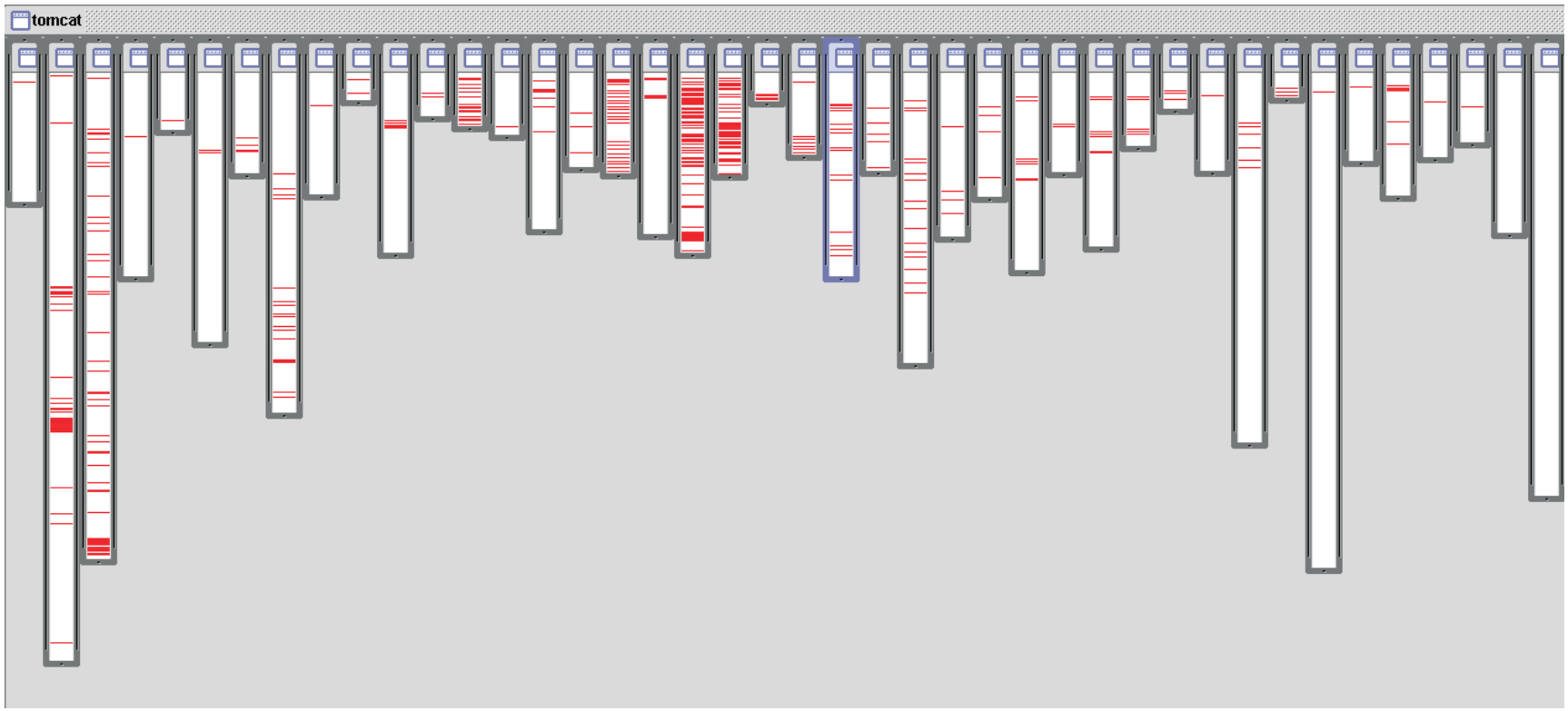
XML parsing

Case Study: Apache Tomcat



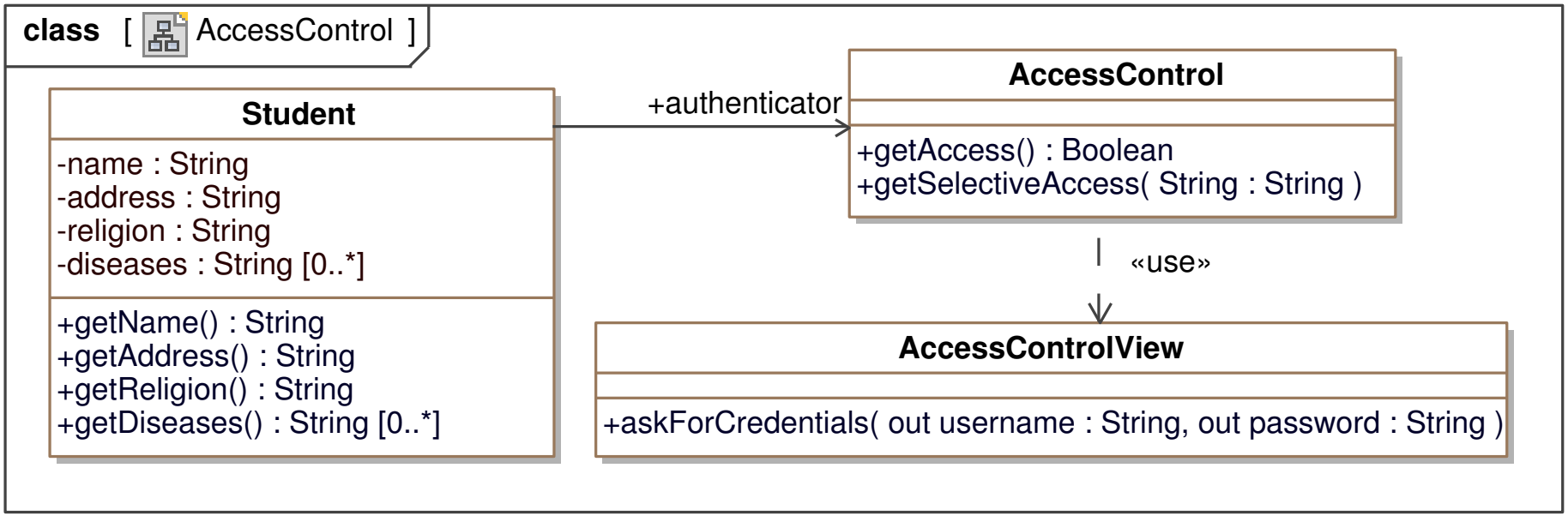
URL pattern matching

Case Study: Apache Tomcat



Logging

Motivating example: Access Control



Motivating example: Access Control

```
public class Student {

  protected String religion;
  protected AccessControl authenticator =
                          new AccessControl();

  public String getReligion() {

     String result = null;

     if (authenticator.getAccess()) {
          result = this.religion;
     } // if

     return result;
  } // getReligion
} // Student
```

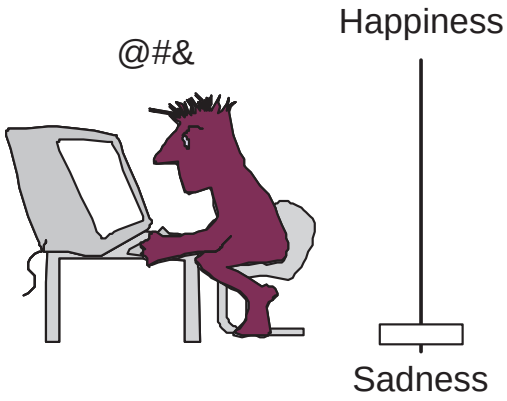
Crosscutting code

Motivating example: Access Control

```
public List<String> getDiseases() {

  List<String> result = null;

  if (authenticator.getAccess()) {
     result = this.diseases;
  }  // if

  return result;
} // getDiseases
```

Crosscutting code

Main Shortcoming of Crosscutting Concerns



Base Functionality

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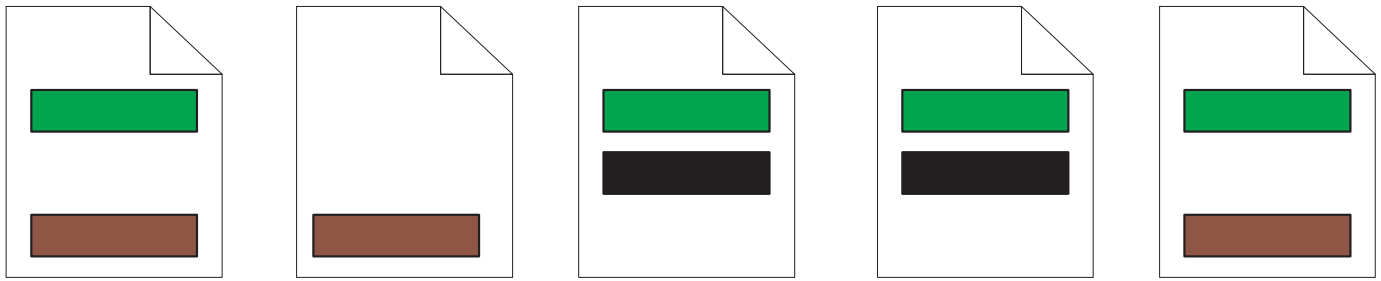


Module A | Module B | Module C | Module D | Module E

Conclusions

Scattering

A concern appears spread over several software modules.

Tangling

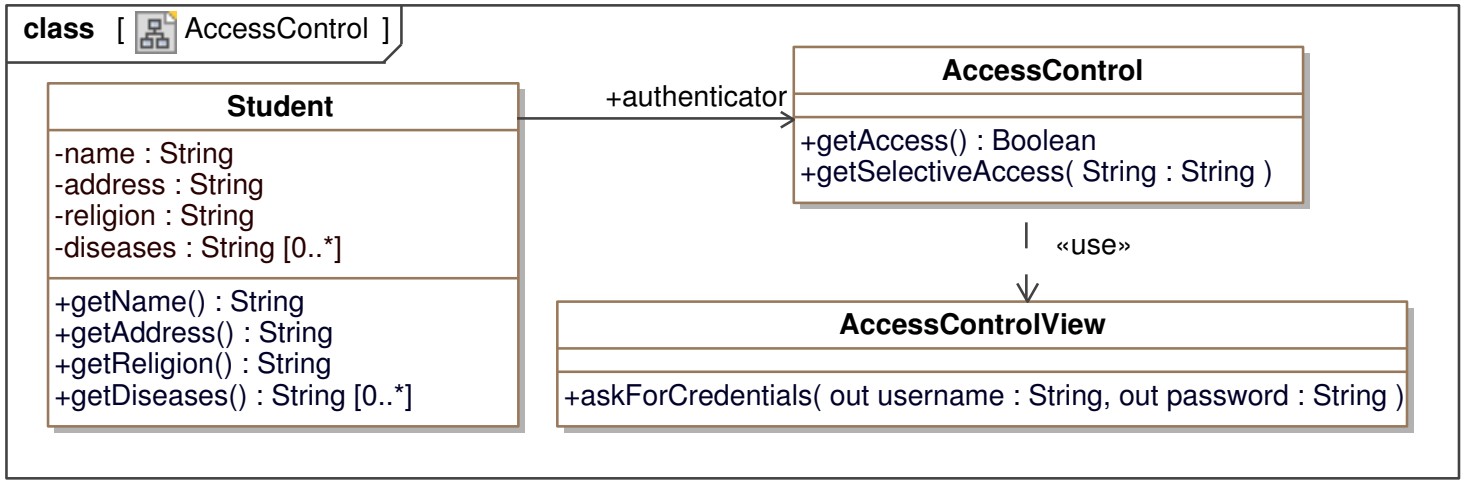
Several concern appears software modules.

1. **Scattering:** Decreases encapsulation, (consequently decreases cohesion), creates redundancies, hinders reutilization of the crosscutting concern and increase coupling.
2. **Tangling:** Decreases cohesion, (consequently hampers reutilization), and increases coupling.

Concern-Oriented Metrics [Sant'Anna et al., 2007]

CDC	Concern Diffusion over Classes
CDO	Concern Diffusion over Operations
CIC	Class-Level Interlacing between Concerns
OOC	Operation-Level Overlapping between Concerns
ACC	Afferent Coupling between Classes
ECC	Efferent Coupling between Classes
LCC	Lack of Concern-Based Cohesion

Concern-Oriented Metrics [Sant'Anna et al., 2007]



	CDC	CDO	CIC	OOC
Data Storage (base)	1	4	1	1
AccessControl	3	5	1	1

	ACC	ECC	LCC
Student	0	1	2
AccessControl	1	1	1
AccessControlView	1	0	1

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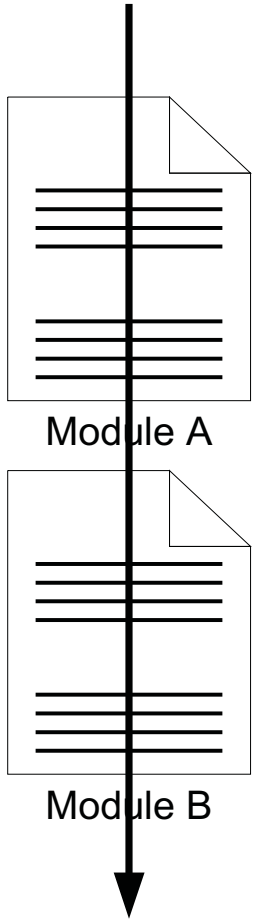
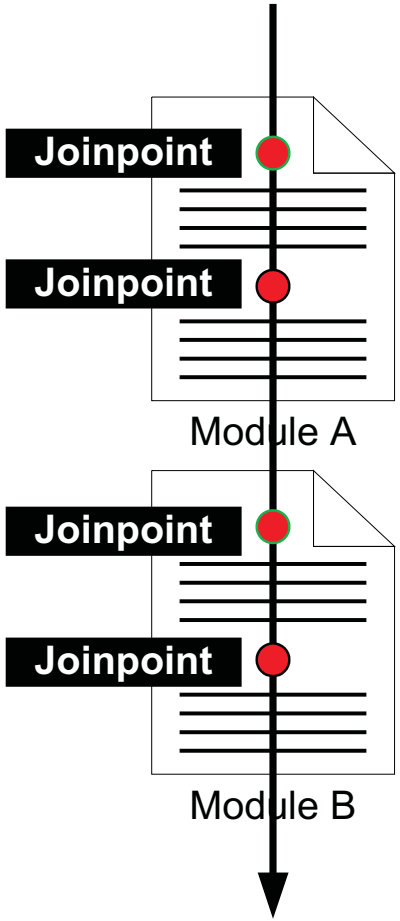
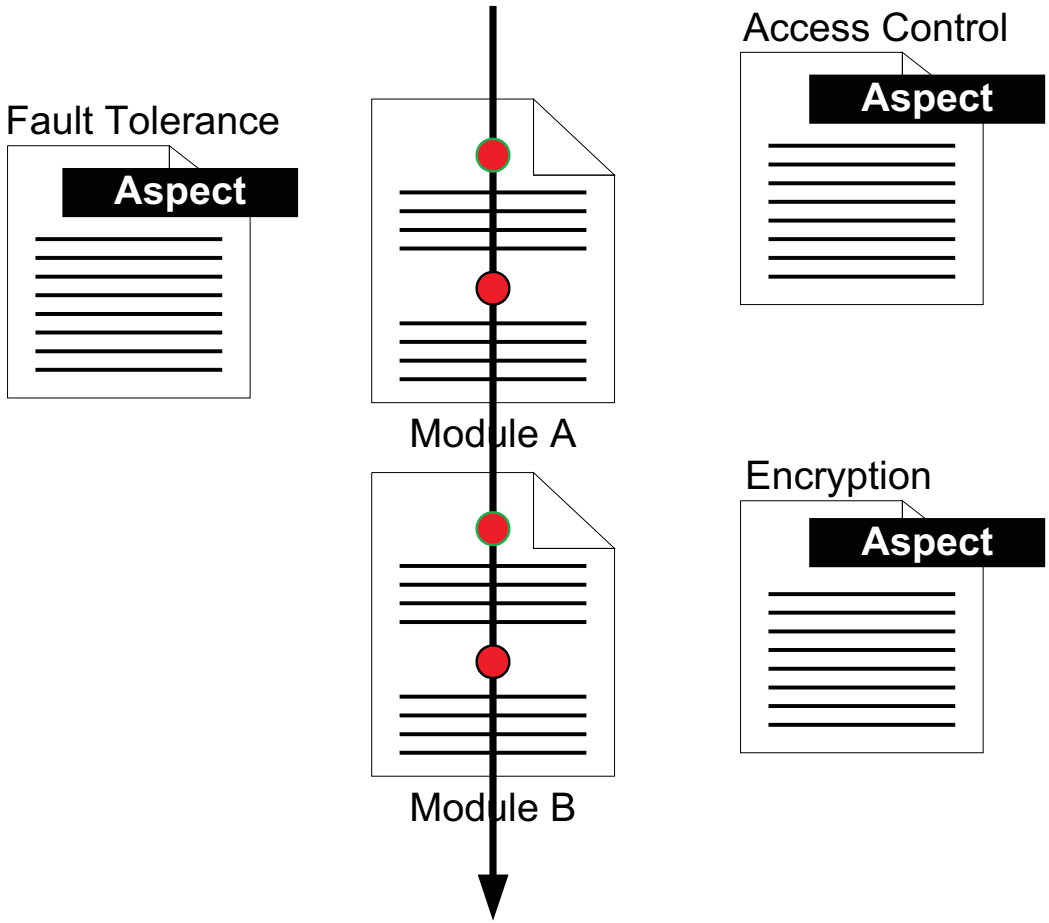
Aspect-Oriented Programming Principle



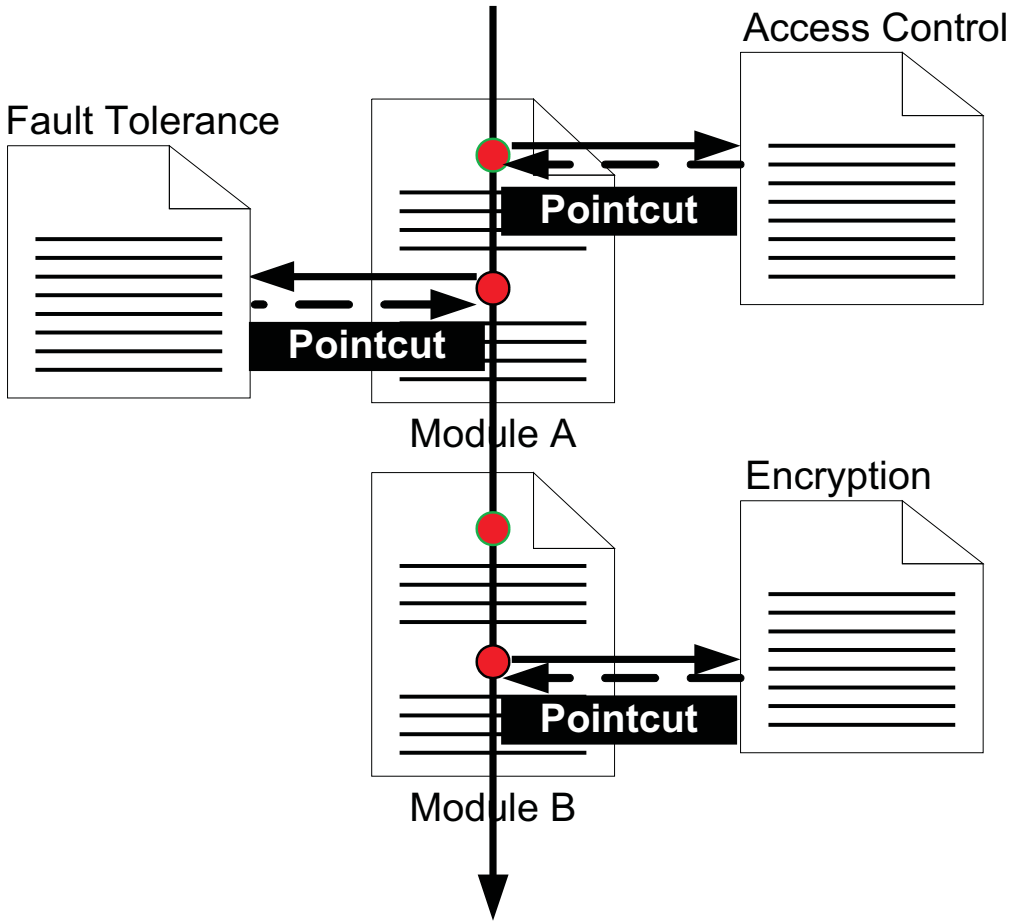
Aspect-Oriented Programming Principle



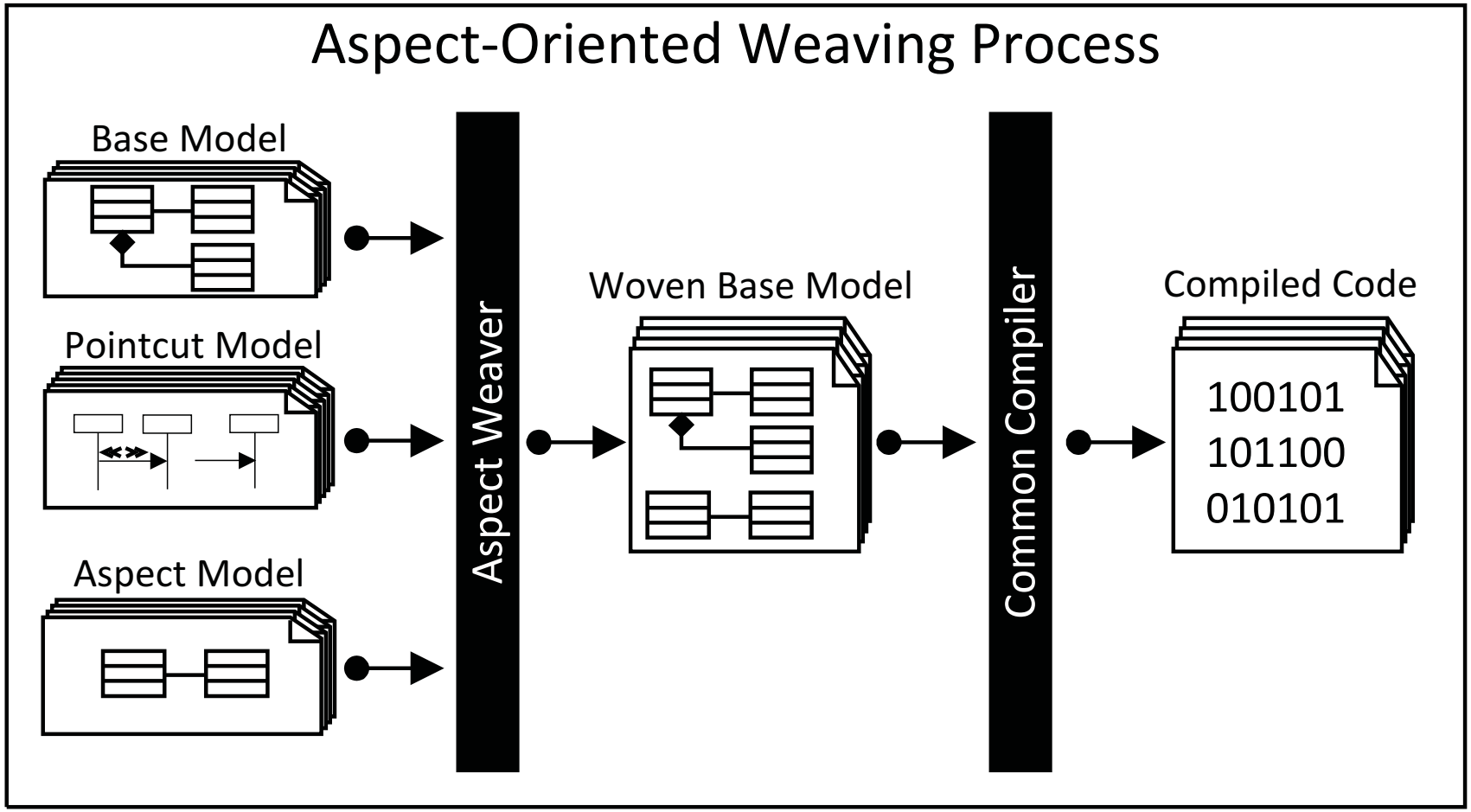
Aspect-Oriented Programming Principle



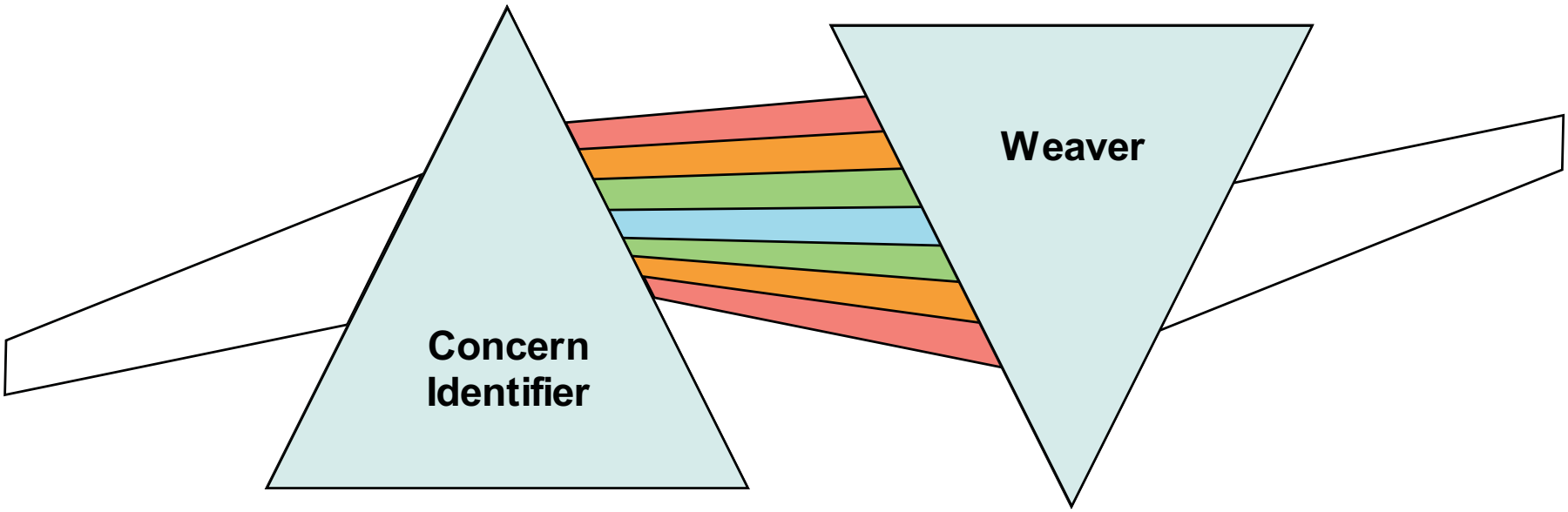
Aspect-Oriented Programming Principle



Weaving Process



Weaving Process



Kinds of Aspect-Oriented Weaving

Static Weaving Aspects are woven at compile time [Kiczales et al., 2001].

Load-Time Weaving Aspects are woven at class load-time [Laddad, 2001, Chiba, 2000].

Dynamic Weaving Aspects can be woven and even unwoven at runtime [Pinto et al., 2005, Suvée et al., 2003]. It is particulary interesting for context-aware systems [Fuentes et al., 2009].

Access Control With AspectJ

```
public aspect AccessControlAspect {

  pointcut guardedMethods():
              call(String Student.getReligion());

  String around() : guardedMethods() {

    AccessControl guard = new AccessControl();

    String returnValue = null;

    if (guard.getAccess()) {
        returnValue = proceed();
    } // if

    return returnValue;
 } // around guardedMethods
} // AccessControlAspect
```

A Clean Student Class

```
public class Student {

      protected String religion;

      public String getReligion() {
            return this.religion;
      } // getReligion

} // Student
```

Wildcard-based Quantified Pointcuts

```
public aspect QuantifiedAccessControlAspect {

   pointcut guardedMethods(): call(* Student.get*(..));

   Object around() : guardedMethods() {

      AccessControl guard = new AccessControl();

      Object returnValue = null;

      if (guard.getAccess()) {
         returnValue = proceed();
      } // if

      return returnValue;
   } // around guardedMethods

} // QuantifiedAccessControlAspect
```

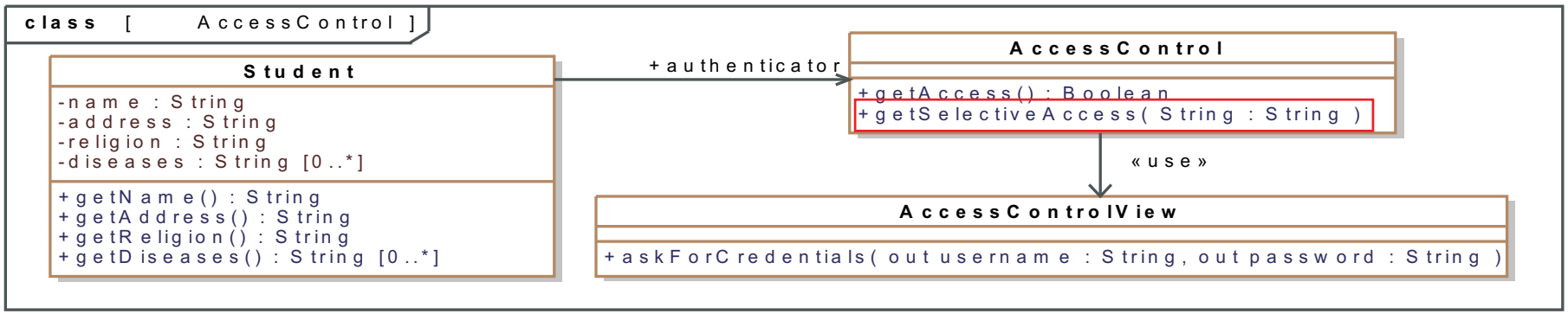
Annotation-based Quantified Pointcuts

```
public class Student {

      protected String religion;

      @AccessControlRequired
      public String getReligion() {
            return this.religion;
      } // getReligion

} // Student
```

Annotation-based Quantified Pointcuts

```
public aspect AnnotationBasedAspect {

  pointcut guardedMethods():
                call(@AccessControlRequired * *.*(..));

  Object around() : guardedMethods() {

    AccessControl guard = new AccessControl();

    Object returnValue = null;

      if (guard.getAccess()) {
         returnValue = proceed();
      } // if

      return returnValue;
  } // around guardedMethods

} // AnnotationBasedAspect
```

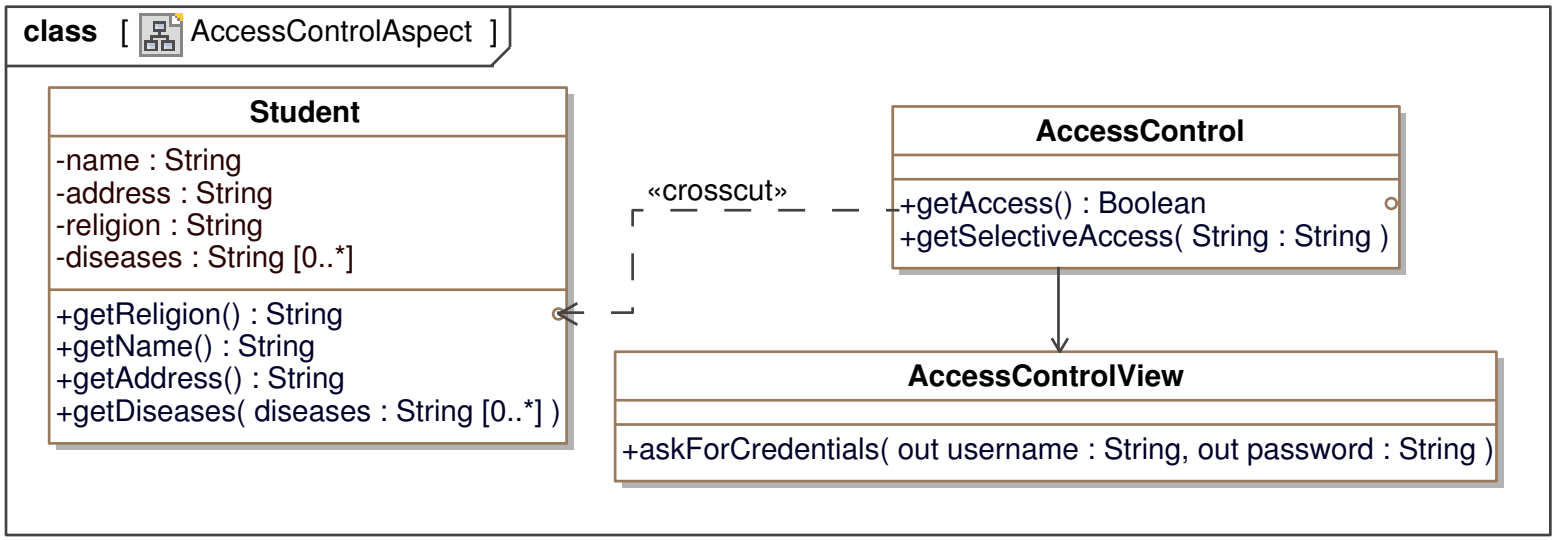
Some Basic & Free Reflection



Some Basic & Free Reflection

```
public aspect ReflectionAccessControlAspect {

   pointcut guardedMethods():
            call(String Student.getReligion());

   String around() : guardedMethods() {

      AccessControl guard = new AccessControl();

      String returnValue = null;

      if (guard.getSelectiveAccess(
                  thisJoinPoint.getSignature().
                                getName())) {
            returnValue = proceed();
         } // if

         return returnValue;
      } // around guardedMethods


} // ReflectionAccessControlAspect
```

Concern-Oriented Metrics Revisited



	CDC	CDO	CIC	OOC
Data Storage (base)	1 (1)	4 (4)	0 (1)	0 (1)
AccessControl	2 (2)	3 (5)	0 (1)	0 (1)

	ACC	ECC	LCC
Student	1 (0)	0 (1)	1 (2)
AccessControl	0 (1)	2 (1)	1 (1)
AccessControlView	1 (1)	0 (0)	1 (1)

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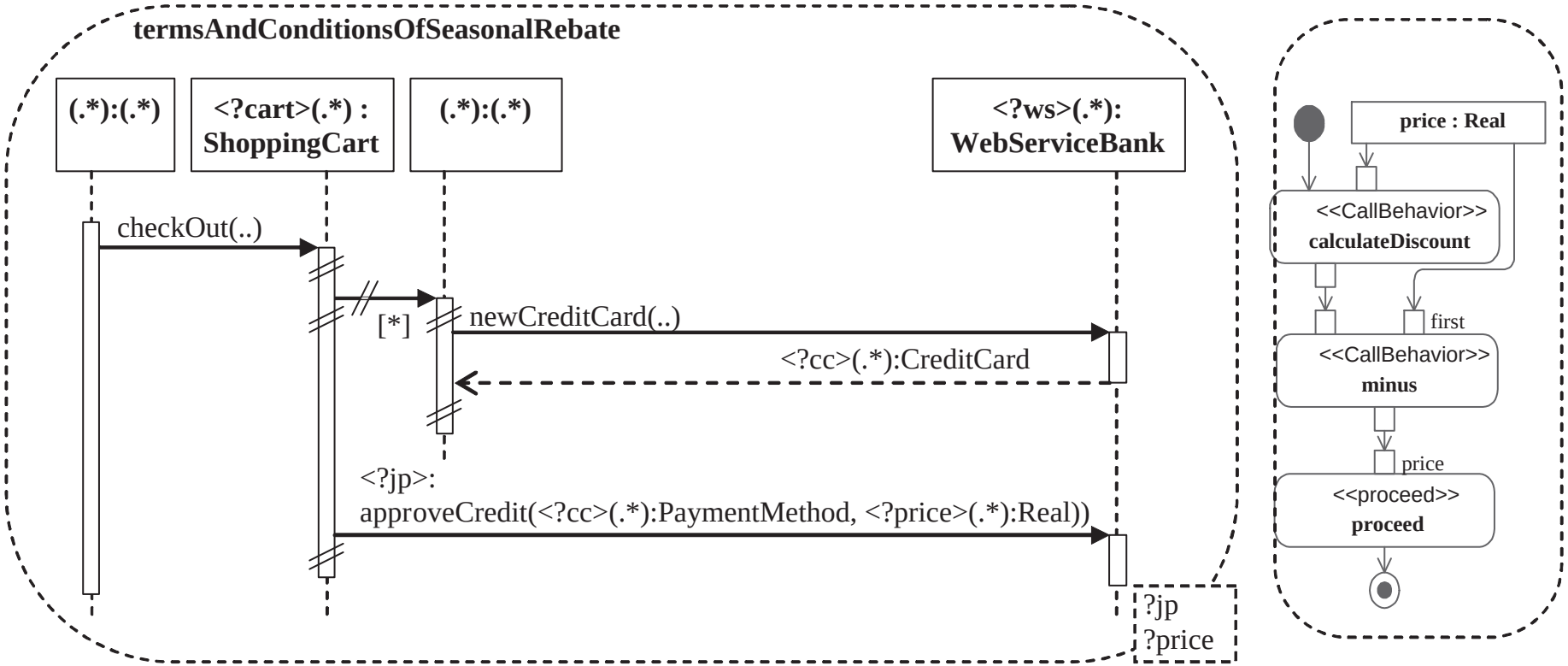
Current Hot Research Topics on AOSD

1. Semantic pointcuts [Ostermann et al., 2005].
2. Reusable aspects (e.g Complex Transaction Management) [Kienzle and Gélineau, 2006].
3. Aspect interference/conflicts [Douence et al., 2002, Douence et al., 2004, Altahat et al., 2008].
4. Complex pointcuts [Allan et al., 2005].
5. Aspect Influence on Interfaces [Ostermann, 2008].

Current Hot Research Topics on AOSD



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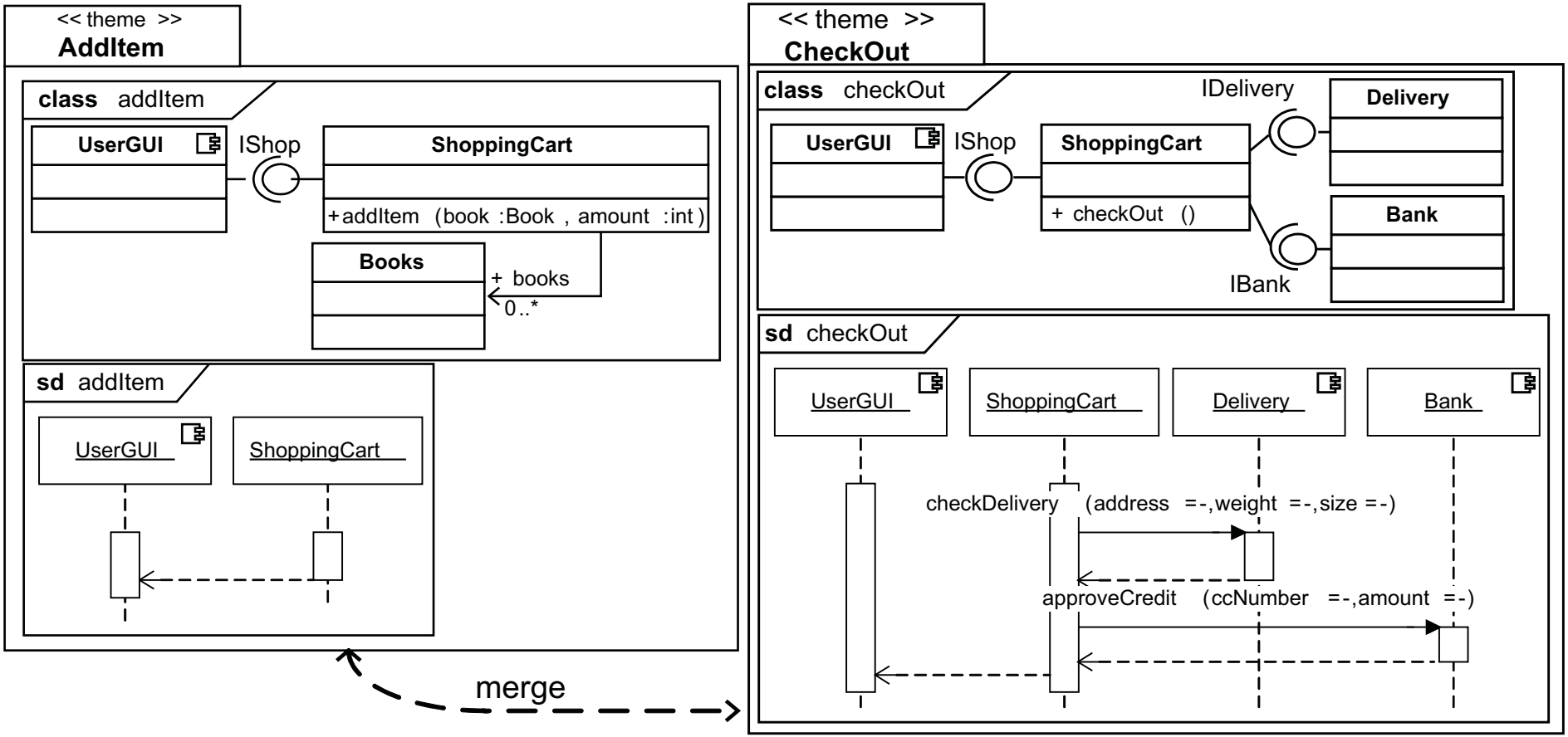
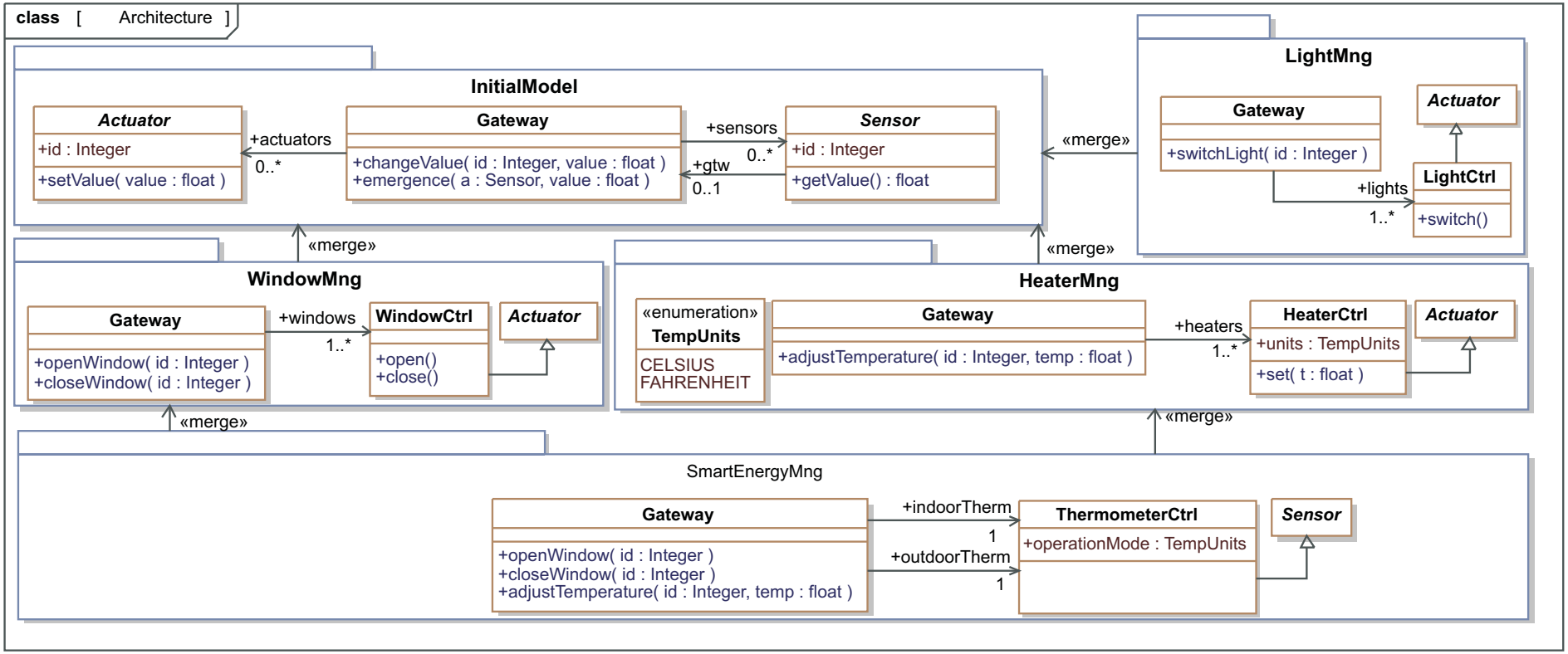
AOSD is not View-Based Software Development



AOSD is not Feature-Oriented Software Development



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AOSD and Related Technology

1. **Component platforms/Application Servers/Container Technology**
   - Component platforms offer a set of fixed services.
   - Configuration of each service is often different.
   - Component platforms are often heavier.
2. **Reflection:** AOP is reflection for human beings.
3. **Design Patterns, Dynamic Proxies:** The aspect-oriented weaver does it for you.

AOSD in Industry

1. Spring framework for Enterprise Java.
2. SpringSource dm Server, SpringSource tc Server, Spring Roo y Magma.
3. GlassBox, Perf4J, Contract4J, JXInsight, MaintainJ.
4. Websphere, MySQL, JBoss, Oracle Toplink, J2ME [Rashid et al., 2010].
5. Siemens Healthcare [Rashid et al., 2010].
6. Motorola Weavr [Cottenier et al., 2007].
7. Oficina Virtual Fundación Retevisión [Pinto et al., 2005]
8. Digital Publishing [de Beeck et al., 2009].
9. Isis Project (Stop Pedophilia).

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Conclusions

Aspect-Oriented Software Development

Aspect-Oriented Software Development can help to improve modularization of crosscutting concerns, easing maintenance and evolution.

Access Control Code:
`http://personales.unican.es/sanchezbp/teaching/ao/accesscontrol.zip`

More Information:
`http://www.aosd-europe.net`

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Questions ?