Concern Metrics

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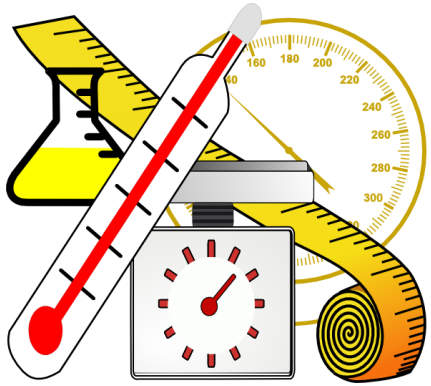
Measurement and Quality

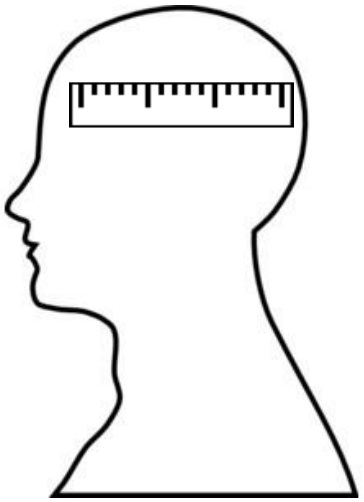
- Achievement of a good design is not trivial
  - It requires different sorts of metrics



- Some concerns deteriorate the system quality (e.g., maintainability)
  - Conventional metrics cannot easily detect some design problems related to poor separation of concerns

Concern Metrics

- Measurement of concern modularity is required
- Concern metrics capture information about (crosscutting) concerns
  - A concern traverses one or more structural modular units
  - Modular units can be classes, methods, attributes, etc.



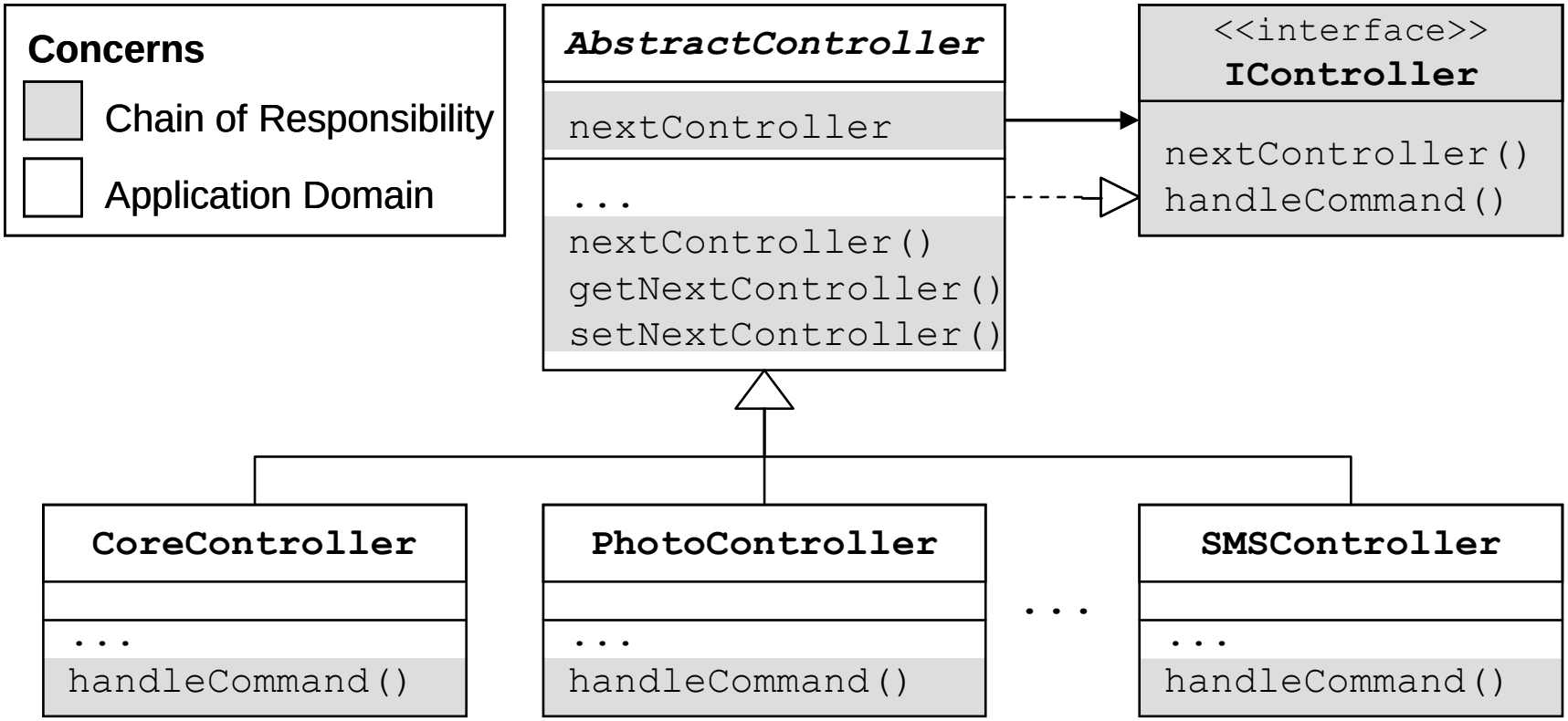
Examples of Concern Metrics

- Concern Diffusion over Components (CDC)
- Concern Diffusion over Operations (CDO)
- Concern Diffusion over Lines of Code (CDLOC)
- Number of Concerns per Component (NCC)
- Lines of Concern Code (LOCC)

CDC – Concern Scattering

- CDC counts the number of classes and interfaces related to a concern
  - In architecture models, CDC can count the number of architecture components related to a concern
- Less scattered concerns are easier to understand and to maintain

Example of CDC

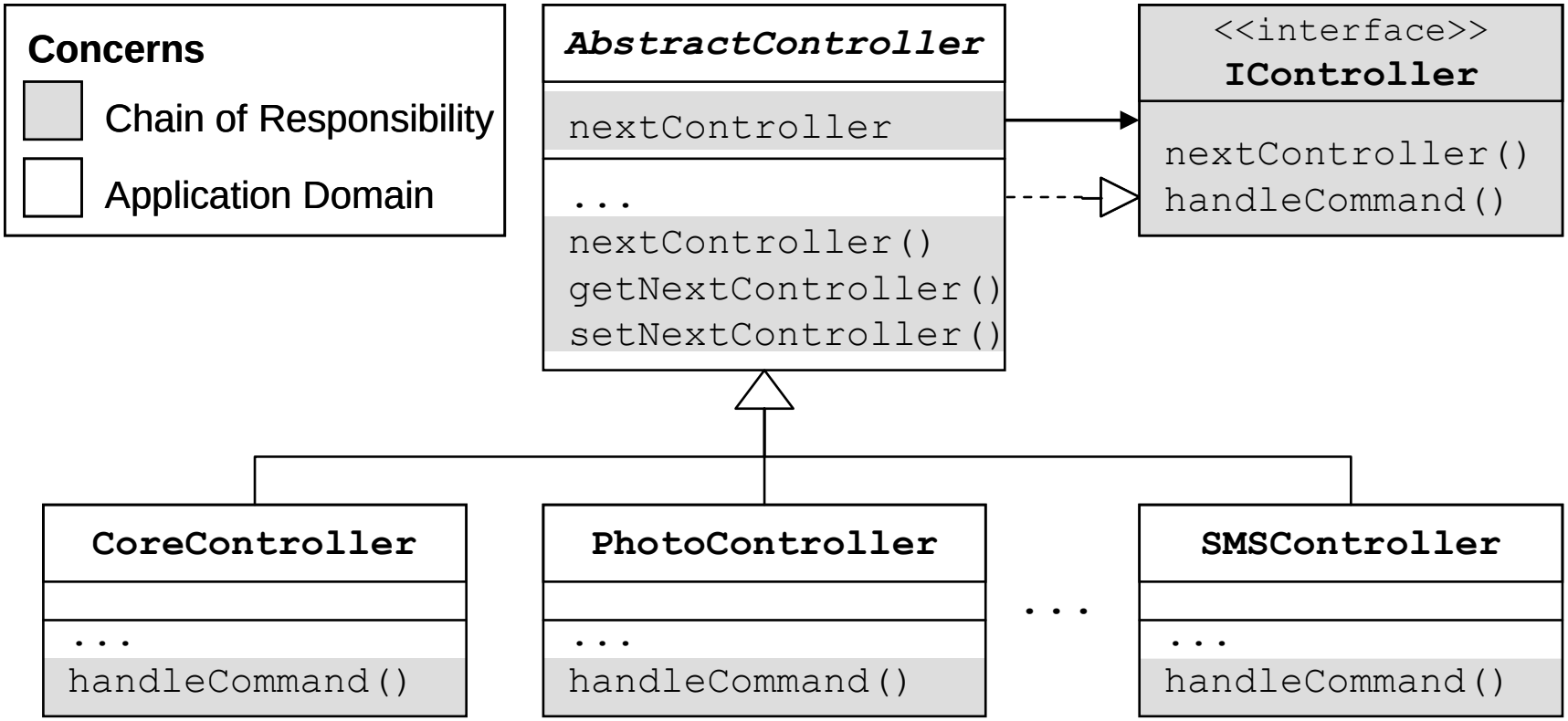


CDC = 5

CDO – Methods with Concern

- CDO counts the number of methods and constructors related to a concern
- CDC and CDO quantify concern scattering at different entities
  - CDC counts classes and interfaces
  - CDO counts methods and constructors

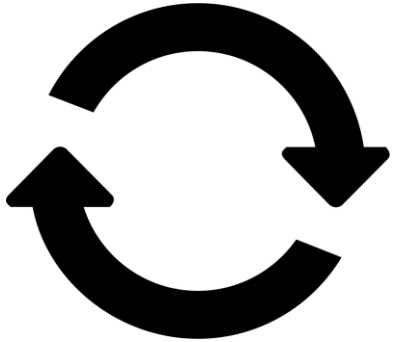
Example of CDO



CDO = 8

CDLOC – Concern Tangling

- CDLOC counts the number of concern switches through the lines of code
  - A concern switch is a place in the source code where there is a concern change
- Tangled concerns in code are harder to understand



Class AbstractController

```
public class AbstractController
                  implements IController {
  private IController nextController;

  ...

  public void nextController(Command command) {
    if (handleCommand(command) == false)
      getNextController().handleCommand(command);
  }
  public IController getNextController() {...}
  public void setNextController(...) {...}
}
```

concern switch

concern switch

concern switch

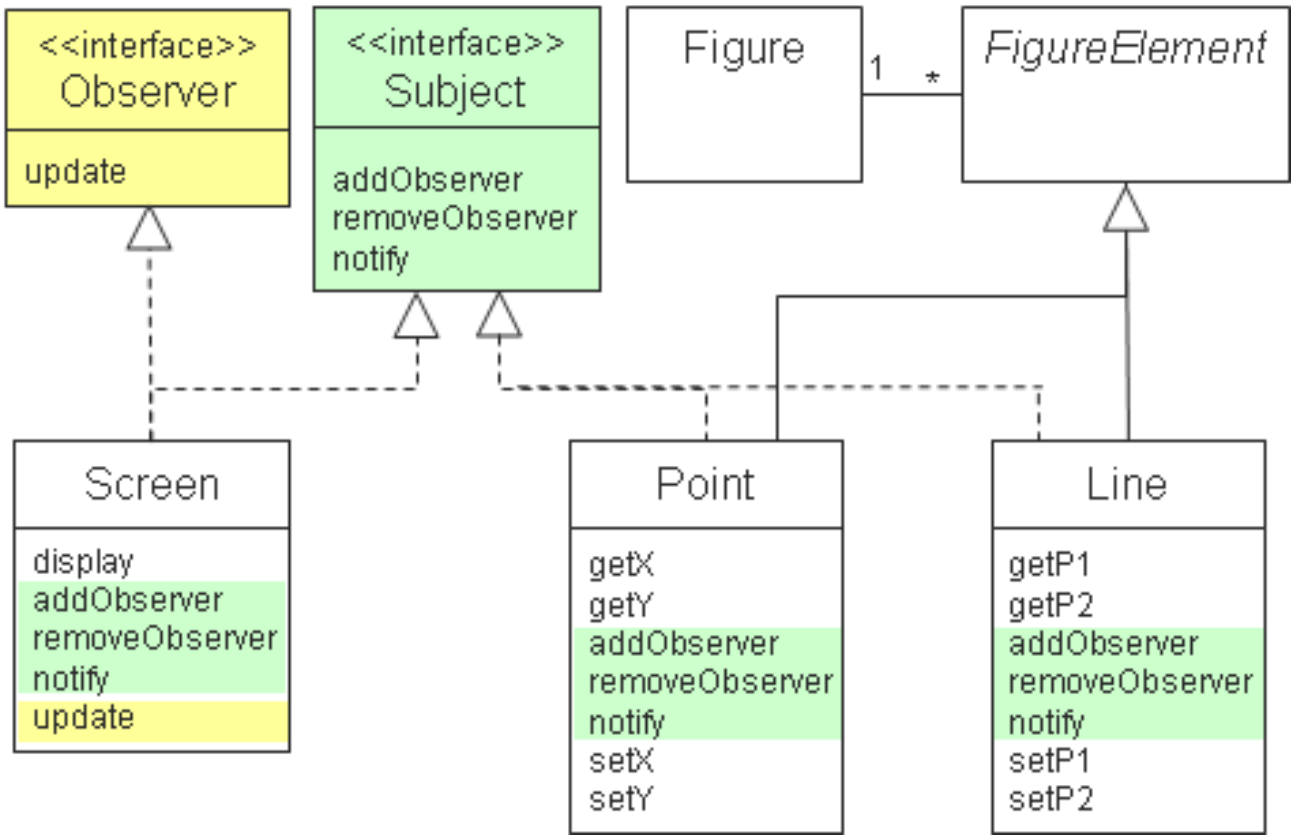
concern switch

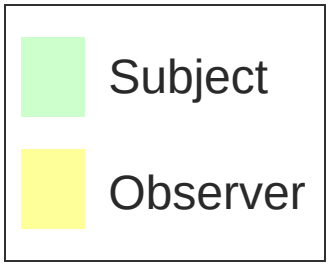
CDLOC = 4

NCC – Tangled Class

- NCC counts the number of concerns of interest implemented by a component
  - Components are classes and interfaces in an object-oriented system
- Components with tangled concerns are harder to reuse

Example of NCC





Class	NCC
Observer	1
Screen	2
Point	1
Figure	0
...	

LOCC – Concern Size

- LOCC counts the number of lines of code which implement a concern
- Large concerns go against modular reasoning
  - We should be able to reason about a small part of the problem each time

Class AbstractController

```
public class AbstractController
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  ...

  public void nextController(Command command) {
    if (handleCommand(command) == false)
      getNextController().handleCommand(command);
  }
  public IController getNextController() {...}
  public void setNextController(...) {...}
}
```

concern switch

concern switch

concern switch

concern switch

LOCC = 8

Bibliography

- CDC, CDO and CDLOC
  - C. Sant'Anna et al. On the Reuse and Maintenance of. Aspect-Oriented Software: an Assessment Framework. SBES 2003.
- NCC
  - E. Figueiredo et al. On the Maintainability of Aspect-Oriented Software: A Concern-Oriented Measurement Framework. CSMR 2008.
- LOCC
  - M. Eaddy et al. Do Crosscuting Concerns Cause Defects? TSE 2008.