# UML-F - A modeling language for object-oriented frameworks

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# Agenda

- Motivation example
- Proposed solution
- UML-F
- Framework implementation
- Framework instantiation
- Related work
- Conclusions & future work

# Motivation example

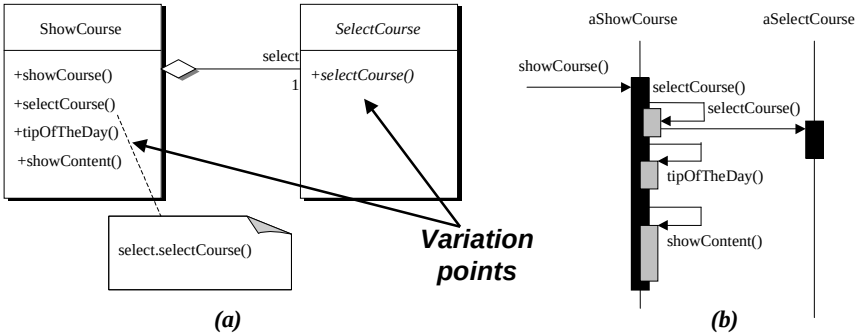



# Motivation example (i)

- Web-based educational system
- Requirements for the student subsystem (condensed example)
  - Several course selection mechanisms (e.g. require login, show all courses, show only the courses in which the student is enrolled)
  - Actions before the exhibition of the course content (e.g. tip of the day, course announcement)

# Motivation example (ii)

- Solution 1 (in UML diagrams)





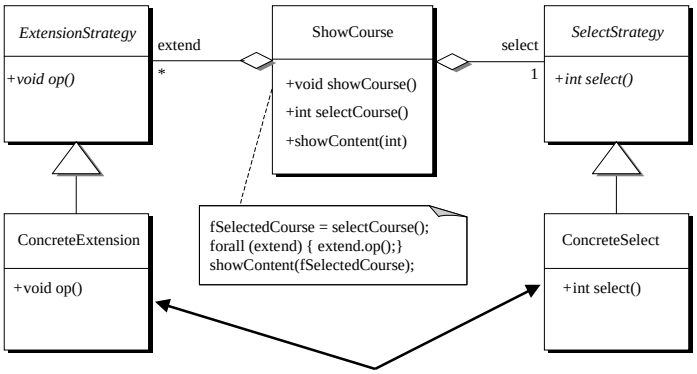



# Motivation example (iii)

- Problems with solution 1:
  - Identification of variation points
  - Instantiation process is not clear
  - Border between framework and application
  - Maintenance
    - What happens if the definition of variation points change?

# Motivation example (iv)

- Solution 2 (based on design patterns)







# Motivation example (v)

- Problems with solution 2:
  - Identification of variation points and instantiation process are clear (only if we know what patterns have been applied)
  - More complex design (especially for patterns based on recursive composition)
  - Maintenance

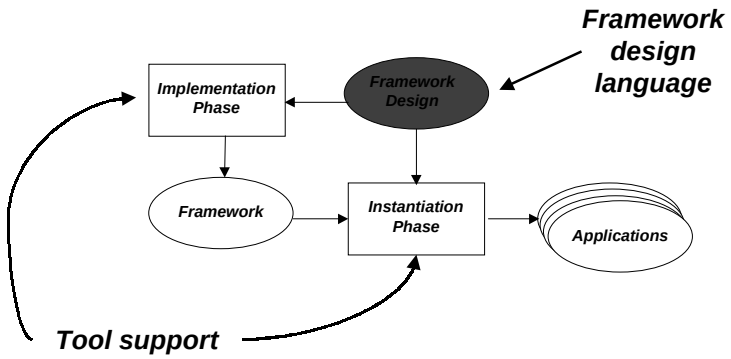
# The proposed solution




# The proposed solution (i)

- Problem generalization:
  - Identification of variation points
  - Assist development (how to implement the variation points)
  - Assist instantiation (how to instantiate the framework)
  - Assist maintenance (tool support)

# The proposed solution (ii)







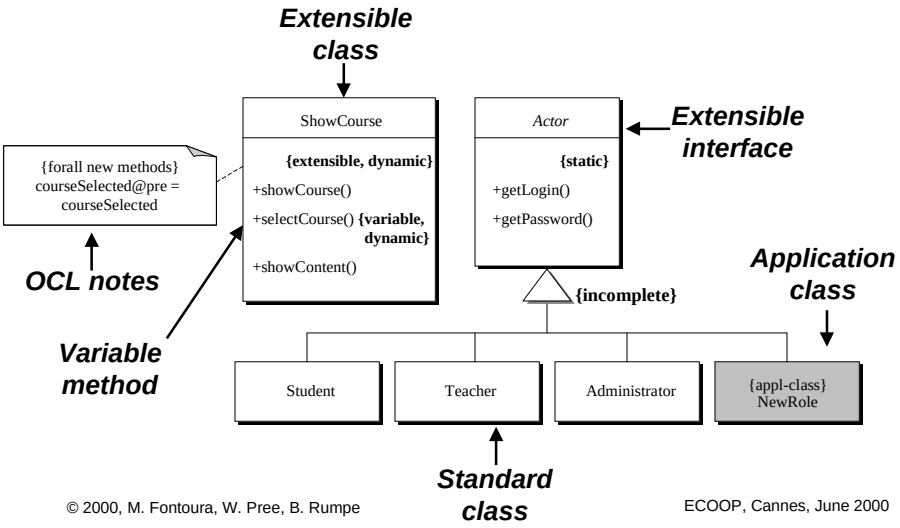
# UML-F

# UML-F (i)

- Functional view of the design
- Distinguish variation points from kernel
- Classify variation points (semantics)
- Instantiation restrictions
- Simple
- Allow the definition of new kinds of variation points when they are discovered (e.g. variations in structure)

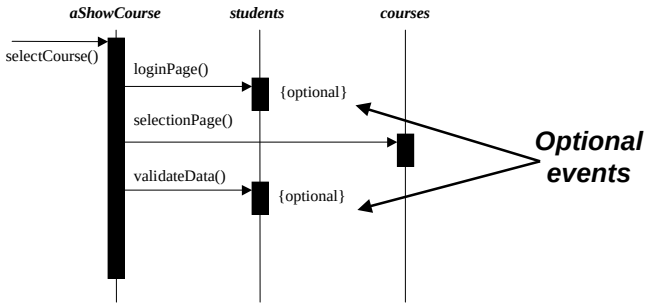



# UML-F (ii)



# UML-F (iii)

- Sequence diagram template for *selectCourse()*



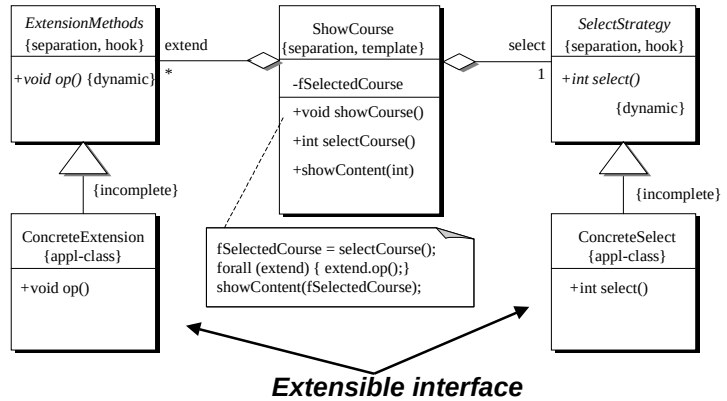




# Framework implementation

# Framework implementation (i)

- Design patterns

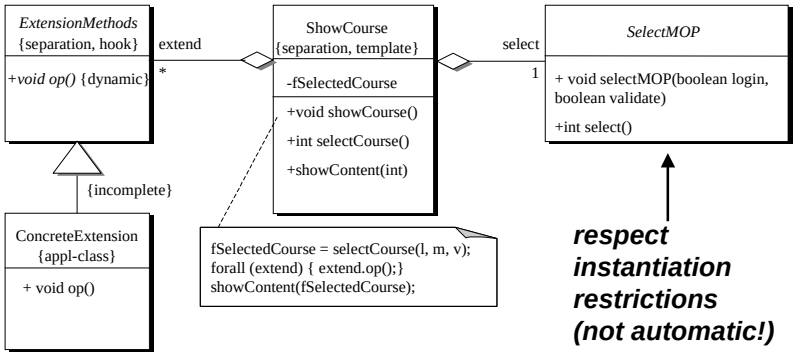






# Framework implementation (ii)

- Method parametrization (and MOPs)



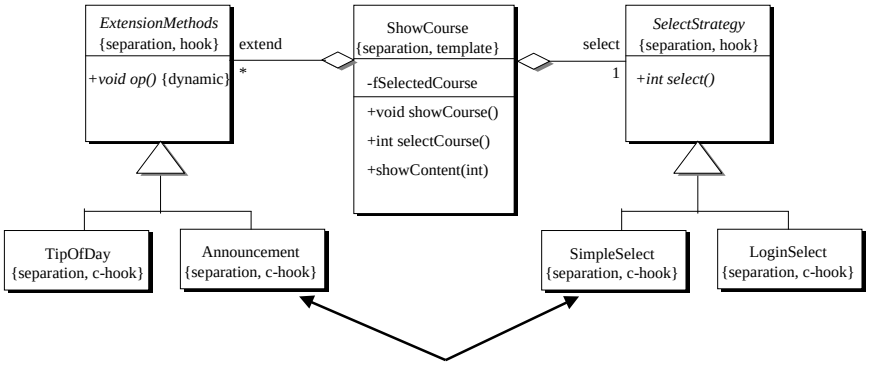
## Framework implementation (iii)

- Several other implementation techniques may be used
- Transformational tools assist maintenance




## Framework instantiation

# Framework instantiation (i)




***"Complete" generalizations***





# Framework instantiation (ii)

- UML-F descriptions are formal "cookbooks"
- Process-based: tool executes the "cookbooks"

# Related work




# Related work

- UML Collaborations &Catalysis
- Role modeling
- Design pattern tools
- Contracts & APPCs
- MOP, AOP, SOP

# Conclusions and future work




# Conclusions

- More than 5 large experiments (UML-F Book)
- Better design representation allows systematization of the further steps in the framework development process
- And leads to a better requirements elicitation phase
- Classification of frameworks variation points (semantics)
- Transformational tools (basis for the development of new tools)

## Future work

- Architectural patterns
- Automatic derivation of the design from the requirements artifacts (commonality analysis)
- New implementation techniques
- Visual tools