Executing Models: Enhancing Validation by Filmstrip Templates and Transformation Alternatives

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Outline

» Introduction
» Approach to Behavior Modeling: Filmstripping
» Motivation
» Overview on Validation Process
» Architectures for Filmstripping
» Filmstrip Templates
» Study Execution
» Study Results and Comparison
» Conclusion and Future Work

Introduction

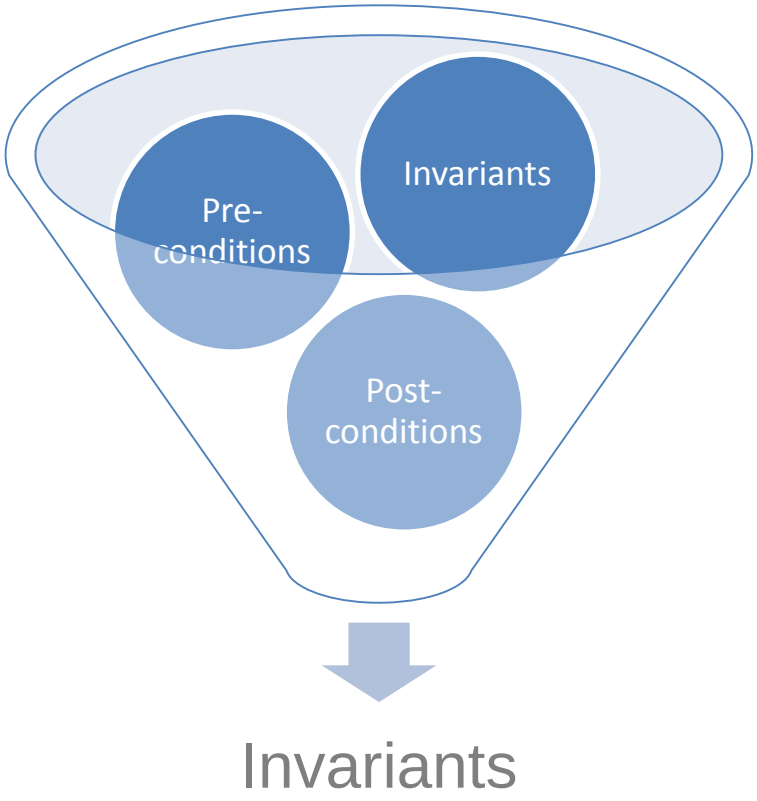
- Model analysis and property validation and verification crucial for success of MDE
- USE model validator:
  - Automatic test case construction
  - Model validation and consistency check
  - Analysis of structural properties
- Application models involve structural and dynamic aspects
- Filmstripping is used for validation of dynamic aspects

Filmstripping

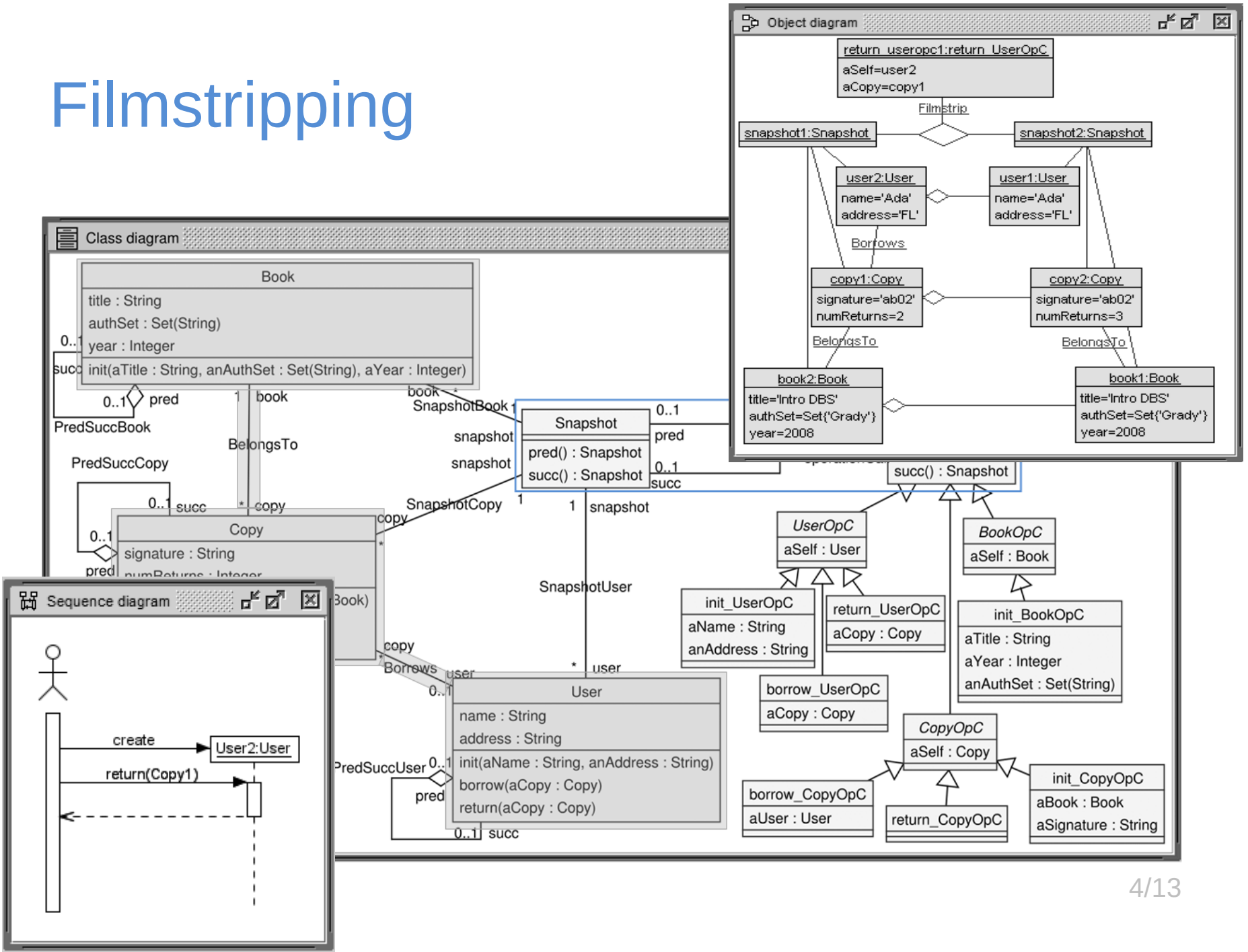
» Filmstripping transforms pre- and postconditions to invariants

» Filmstrip model has only structural aspects

» Dynamic and structural aspects of a UML/OCL model can be explored using filmstripping

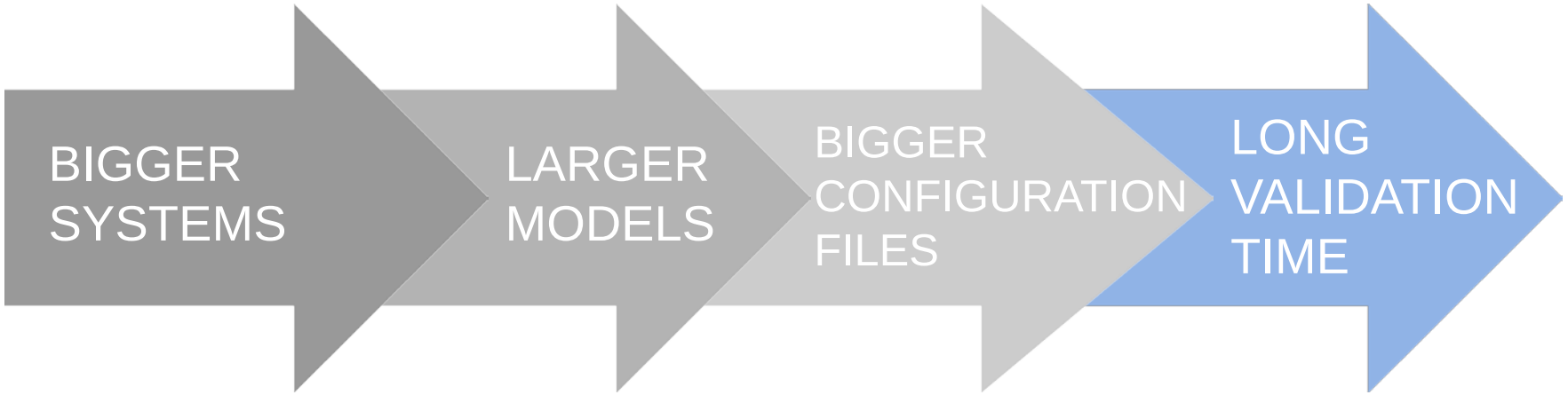


Filmstripping

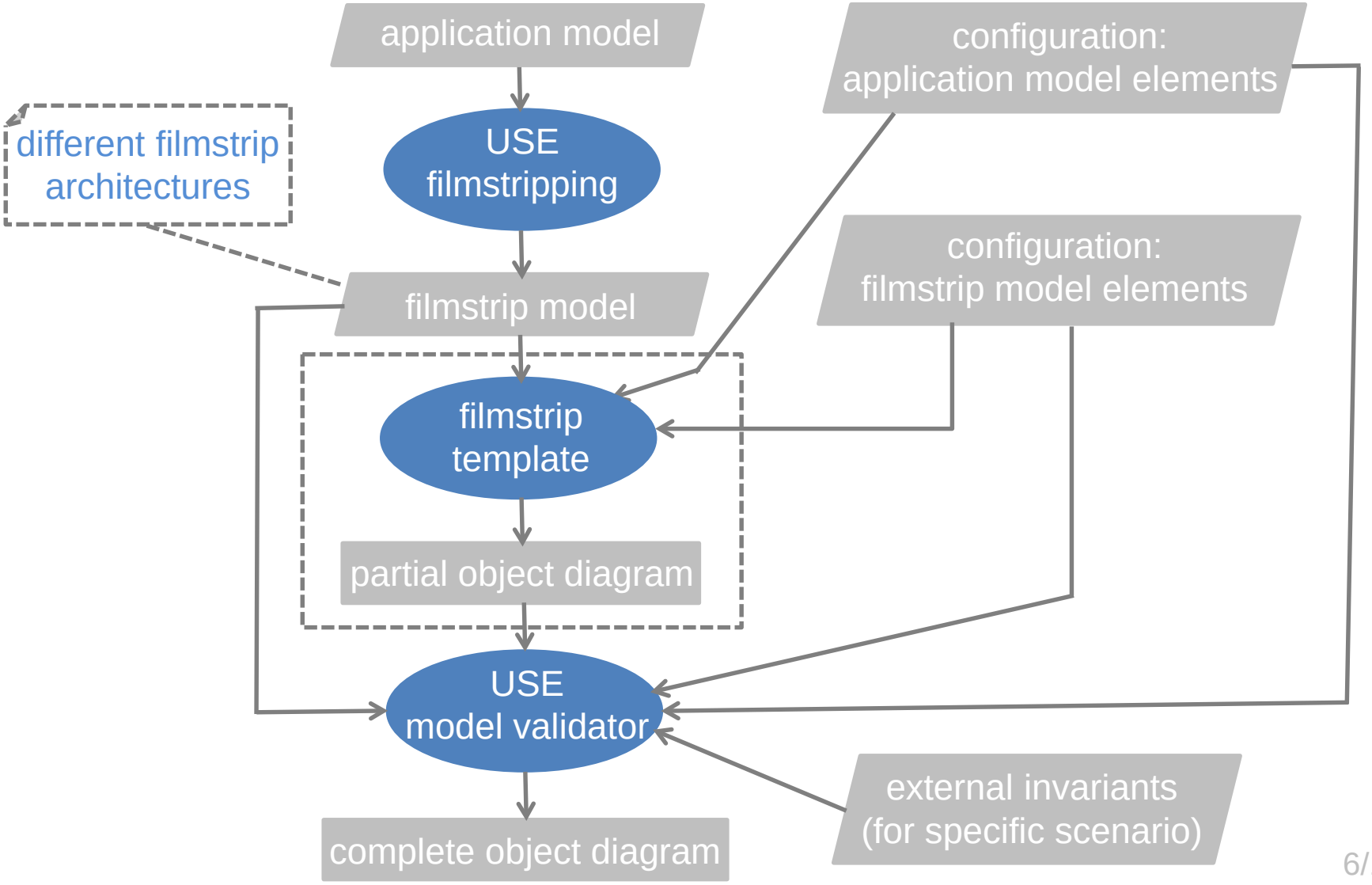


Motivation

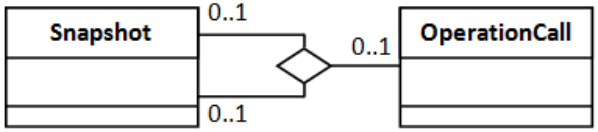
* ANALYZING THE IMPACT OF DIFFERENT ARCHITECTURES AND FILMSTRIP TEMPLATES ON EXECUTION TIME OF VALIDATION PROCESS



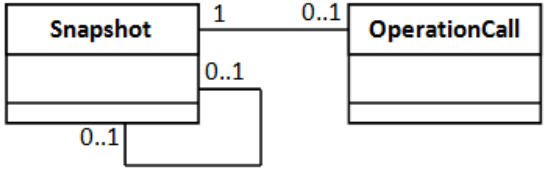
Overview on Validation Process



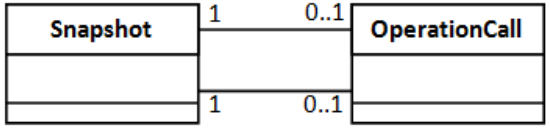
Architectures for Filmstripping



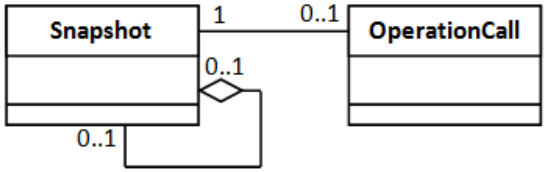
(A) Ternary association [short: Tern Assoc]



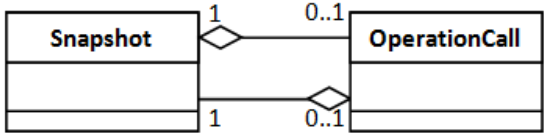
(B) OpCall at Snapshot + Association
[short: C@Snap Assoc]



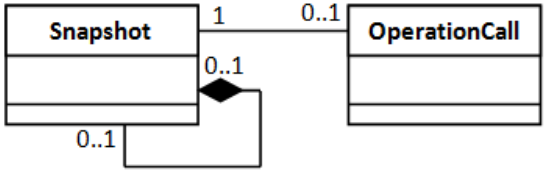
(E) Snapshot OpCall Snapshot as Association
[short: SnapCSnap Assoc]



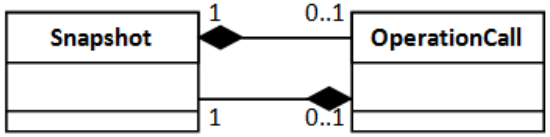
(C) OpCall at Snapshot + Aggregation
[short: C@Snap Agg]



(F) Snapshot OpCall Snapshot as Aggregation
[short: SnapCSnap Agg]

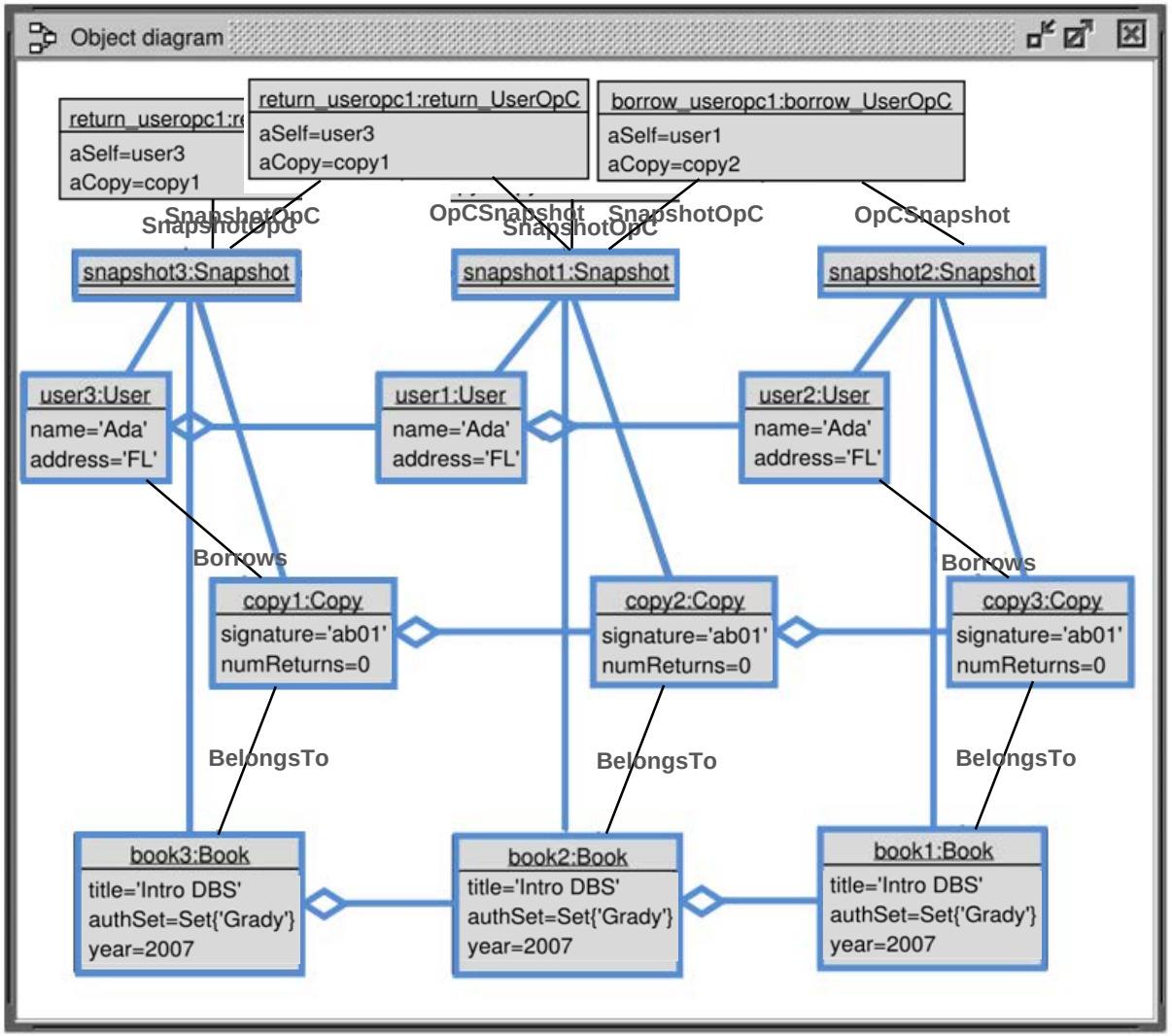


(D) OpCall at Snapshot + Composition
[short: C@Snap Comp]



(G) Snapshot OpCall Snapshot as Composition
[short: SnapCSnap Comp]

Filmstrip Templates



» Templates consist of the elements which are known from the filmstrip model and given configurations

» Filmstrip template is constructed before the model validation

» Templates of architecture B, C and D have extra snaphot-snaphot links compared to all other architectures

Study Execution

» Check the performance of different architectures with filmstrip templates

» 2 models selected:

- » Library model
- » ConcurrentAppend model

» Two test case scenarios are considered for the study

» Each test case is executed five times and trimming mean method has been used for average calculation

Study Execution

	Test case 1 **Library model**	**Test case 2** **ConcurrentAppend model**
Application configuration	1 User, 1 Book, 1 Copy	3 Cells, 1 Append
Invariants	**Inital condition:** Copy is in library and number of returns is zero. **Final condition:** Number of returns of the copy is three.	**Inital condition:** Mention three Cells and one Append with values. **Final condition:** Append should be finished.
Filmstrip configuration	Snapshot = 7..7 borrow_UserOpC = 0..6 return_UserOpC = 0..6 borrow_CopyOpC = 0..6 return_CopyOpC = 0..6	Snapshot = 5..5 append_AppendOpC = 0..4 return_AppendOpC = 0..4 found_AppendOpC = 0..4 next_AppendOpC = 0..4
Expected Results	3 Borrow-Return operation calls.	Next-Next-Append-Return operation calls.

Study Results and Comparison

» Result comparision - test case 1

Archi-tecture	A Tern Assoc (min)	B C@Snap Assoc (min)	C C@Snap Agg (min)	D C@Snap Comp (min)	E SnapCSnap Assoc (min)	F SnapCSnap Agg (min)	G SnapCSnap Comp (min)
Test case 1	32.73	0.43	1.34	1.41	2.50	3.23	3.28
	0.13	0.07	0.09	0.08	0.15	0.16	0.16

» Result comparision - test case 2

Archi-tecture	A Tern Assoc (min)	B C@Snap Assoc (min)	C C@Snap Agg (min)	D C@Snap Comp (min)	E SnapCSnap Assoc (min)	F SnapCSnap Agg (min)	G SnapCSnap Comp (min)
Test case 2	90.47	29.13	20.00	20.46	20.15	29.24	27.90
	0.33	0.21	0.22	0.23	0.25	0.29	0.29

Study Results and Comparison

» Average execution time of the test cases using templates

Archi-tecture	A Tern Assoc (min)	B C@Snap Assoc (min)	C C@Snap Agg (min)	D C@Snap Comp (min)	E SnapCSnap Assoc (min)	F SnapCSnap Agg (min)	G SnapCSnap Comp (min)
Test case 1	0.13	0.07	0.09	0.08	0.15	0.16	0.16
Test case 2	0.33	0.21	0.22	0.23	0.25	0.29	0.29
Sum	0.46	0.28	0.31	0.31	0.40	0.45	0.45

Conclusion and Future Work

» Introduced filmstrip templates and proposed different filmstrip architectures

» Study revealed that employing filmstrip templates are more efficient in terms of execution time

» Architecture B, C and D yield better results compared to others

» Future work:

- » Development and implementation of automatic generation of the filmstrip templates
- » Distinguishing application and filmstrip elements in the configuration and user interface

Thanks for your attention!

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