MAV-Vis: A Notation for Model Uncertainty

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Problem Statement

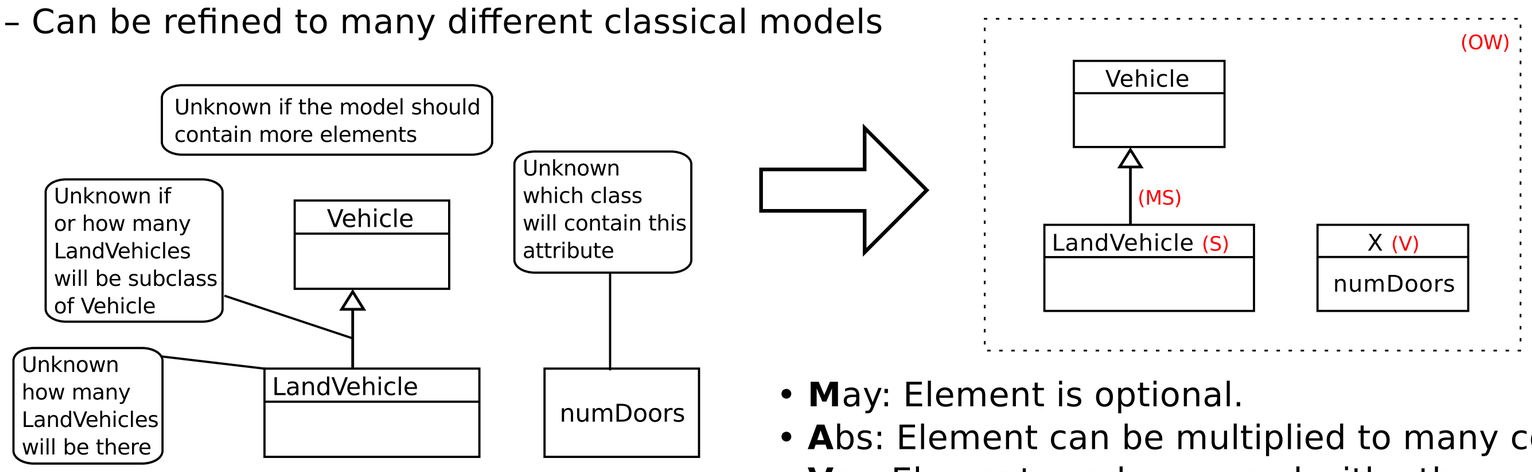
Partial models are effective for automated reasoning. [ICSE'12, RE'12, ..]

Are Partial Models effective for ***human communication***?

What we did:
- Developed a new notation: **MAV-Vis** "Physics of Notations" [Moody, 2009]
- Evaluated our implementation of the theory with user study

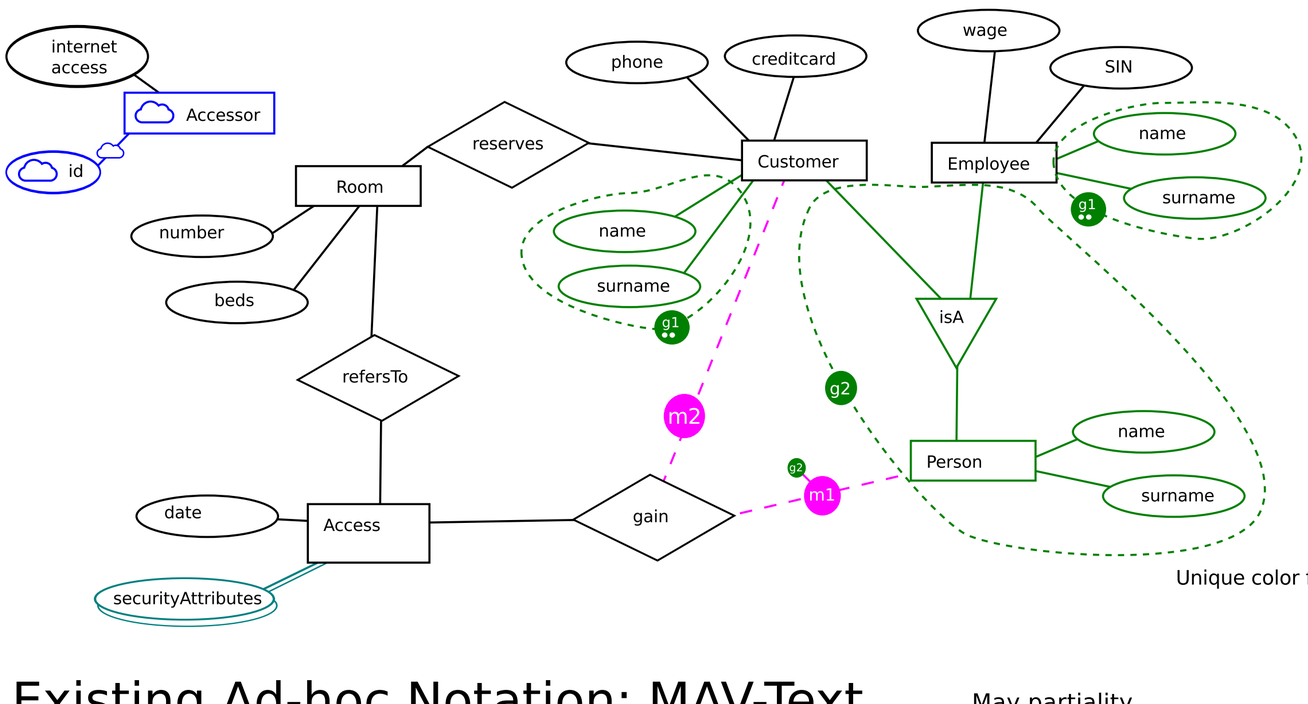
Partial Models: Modeling Design Uncertainty with MAVO

Uncertainty about design decisions – the contents of a model [FASE'12]
– Represent choice among many possibilities
– Can be refined to many different classical models

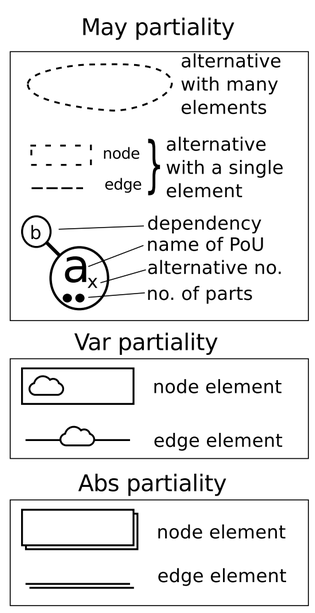


- **M**ay: Element is optional.
- **A**bs: Element can be multiplied to many copies.
- **V**ar: Element can be merged with others.
- **O**W: Model is incomplete.

Designing MAV-Vis



Unique color for each Point of Uncertainty (PoU)



Limitations

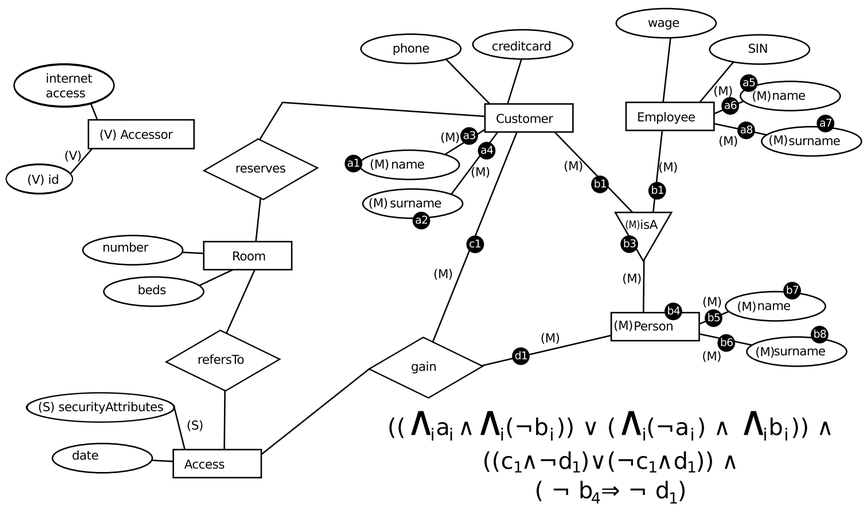
Portability:
- Annotation language: cannot guarrantee symbols won't conflict!
- Implemented for Class Diagrams, E-R Diagrams.
- Porting to other notations not easily automatable.
- But can use with any abstract syntax (MOF)

Expressive Power:
- Less powerful than propositional logic (of course)
- But dependency sub-language can be extended.

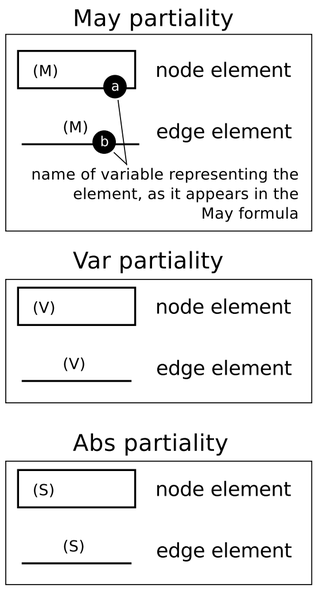
No OW:
- OW annotates entire model.
- Need megamodeling or tight tooling integration

No tooling
- Out of scope here: focus on ideal notation.

Existing Ad-hoc Notation: MAV-Text



$$((\bigwedge_i a_i \wedge \bigwedge_i(\neg b_i)) \vee (\bigwedge_i(\neg a_i) \wedge \bigwedge_i b_i)) \wedge ((c_1 \wedge \neg d_1) \vee (\neg c_1 \wedge d_1)) \wedge (\neg b_4 \Rightarrow \neg d_1)$$



Assessment Based on [Moody, 2009]

	MAV-Text	MAV-Vis
Semiotic Clarity	++	++
Perceptual Discriminability	--	++
Semantic Transparacy	-	+
Complexity Management	-	++
Cognitive Integration		
Visual Expressiveness	--	++
Dual Coding	--	++
Graphic Economy	++	+
Cognitive Fit	+/-	+

User Study

Goal:
Evaluate our implementation of the principles in [Moody, 2009].

Confirm or refute:
"MAV-Vis improves Ease, Speed, Accuracy for reading and writing compared to MAV-Text"

Measurements:
- Ease: Questionnaire responses
- Speed: Task completion time
- Accuracy: Error counts and comprehension scores

Setup

Design:
- Within subjects to allow comparison and minimize selection bias
- 2x2 Latin square to control for:
  - Order of syntaxes (MAV-Vis, MAV-Text)
  - Modeling scenario
    - "Hotel Admin" in UML
    - "School Personnel" in E-R

Procedure:
- Tutorial
- Freeform excercise
- [Reading, Writing]x2
- Questionnaire

Participants:
- 12 unpaid participants, with Bach. in CS or higher
- Average experience in MAVO: 2.2/5

Results

	Speed	Ease	Accuracy
Reading	MAV-Vis	MAV-Vis	MAV-Vis
Writing	not significant difference		MAV-Text

most errors in MAV-Vis: PoU colors

Threats To Validity:
Small sample size (no stats), Prior exposure to MAVO/prop logic, Confusion about MAVO, 1 subject not good with E-R

Conclusion

- MAV-Vis more efficient overall, more writing errors.
- Solution not necessarily universal: principle of Cognitive Fit (learning styles, expertise)

Next Steps:
- Focus on tooling
- Dependencies sublanguage
- MAVOisation of arbitrary languages
- Uncertainty patterns

References

[Moody, 2009] D. Moody, *The "Physics" of Notations: Toward a Scientific Basis for Constructing Visual Notations in Software Engineering.* TSE, 35(6):756–779, 2009.

[FASE'12] R. Salay, M. Famelis and M. Chechik, *Language Independent Renement using Partial Modeling*

[RE'12] R. Salay, M. Chechik and J. Horkoff, *Managing Requirements Uncertainty with Partial Models*

[ICSE'12] M. Famelis, R. Salay and M. Chechik, *Partial Models: Towards Modeling and Reasoning with Uncertainty*