Introduction

(Minimal) model generation is useful for several tasks such as hardware and software verification, fault analysis, and commonsense reasoning.

For classical logics, several minimality criteria have already been studied (domain minimality, minimisation of a certain set of predicates, minimal Herbrand models).

These minimality criteria can be applied to modal logics, and it is also possible to adopt a more “modal” criterion: minimality with respect to bisimulation.

Domain Minimality

Minimality is based on the size of the domain.

Example for $\diamond p$

Termination for logics with the finite model property is easily achievable

All possible diamond expansions must be tried

Minimal model completeness is neither easy to achieve nor desirable

Minimisation of a Set of Predicates

Minimality is based on the subset relation over the extensions of a specific set of predicates.

Example for $\diamond (p \lor q)$

In theory: no constraint for expanding diamond formulae is needed

In practice: constraints are necessary for minimal model completeness

Domains of different models must be comparable

Minimal Modal Herbrand Models

Minimality is based on the subset relation over the extensions of all predicates.

Example for $\diamond p \land \Box (p \lor q \lor \top)$

Diamond expansions are completely deterministic

Herbrand models are widely used in automated reasoning

A blocking technique is necessary for termination

Domains of different models must be comparable

Minimal Under Bisimulation

Minimality is based on the existence of bisimulation between (sub)models.

Example for $p \lor \diamond p \lor (p \land \top)$

It is more semantic than other minimality criteria

Bisimulation is too strong, it only closes models that contain generated submodels

References

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