Finding Minimal Unsatisfiable Subsets of Temporal Logic

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March 13, 2013
Outline

1. Overview of Temporal Logic
2. The problem: Introducing Unsatisfiability
3. Applying BDDs
Introduction to Propositional Logic

- Uses boolean statements to express conditions about the world
- Connectives (and, or, not, implication, ...) build up atoms into complex expressions
- Eg: $a \land b$, $(p \rightarrow q) \lor (q \rightarrow r)$.
Introduction to Temporal Logic

- Extends propositional logic with a sense of time
- Long chain of states, each is like a self contained propositional world
Temporal Logic Operators

- New operators to express relationships between states
  - $X\Phi$: $\Phi$ is true in the next state
  - $\Phi U \Psi$: Somewhere in the future $\Psi$ is true, until then $\Phi$ is true
  - Globally, Future, Before
- Allow us to build models of quite complex systems
Connectors operate on states in complex ways
Writing large specifications becomes error prone
Reducing to a minimal unsatisfiable subset would give a hint for the cause
Quite expensive to compute (naive method is exponential)
Applying Binary Decision Diagrams

- Jinbo Huang: Minimal Unsatisfiability Prover for propositional logic
- Reduces large propositional formula into a Binary Decision Diagram
- Easily check if the set is Minimal Unsatisfiable. If not, eliminate a clause and try again
- Expand these ideas to cope with temporal operators