Logical
Inference 1
introduction
Chapter 9

Some material adopted from notes by Andreas Geyer-Schulz,, Chuck Dyer, and Mary Getoor

Overview

- Model checking for propositional logic
- Rule based reasoning in first-order logic
 - Inference rules and generalized modes ponens
 - -Forward chaining
 - -Backward chaining
- Resolution-based reasoning in first-order logic
 - Clausal form
 - -Unification
 - -Resolution as search
- Inference wrap up

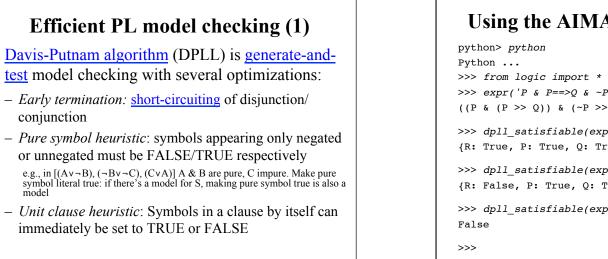
PL Model checking

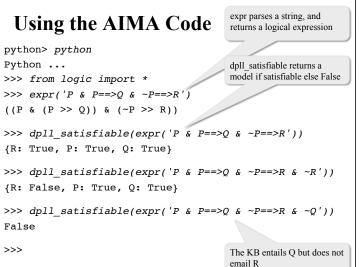
- Given KB, does sentence S hold?
- Basically generate and test:
 - -Generate all the possible models
 - -Consider the models M in which KB is TRUE
 - $-\operatorname{If} \forall M \ S$, then S is provably true
 - -If $\forall M \neg S$, then S is **provably false**
 - -Otherwise ($\exists M1 \ S \land \exists M2 \neg S$): S is satisfiable but neither provably true or provably false

From Satisfiability to Proof (1)

- To see if a satisfiable KB entails sentence S, see if $\underline{KB} \land \neg \underline{S}$ is satisfiable
 - -If it is not, then the KB entails S
 - -If it is, then the KB does not email S
 - -This is a refutation proof
- Consider the KB with (P, P=>Q, ~P=>R) -Does the KB it entail Q? R?

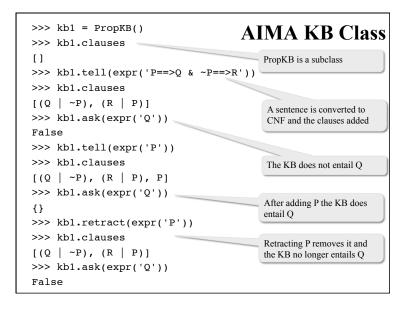
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Efficient PL model checking (2)

- <u>WalkSAT</u> is a local search for satisfiability: Pick a symbol to flip (toggle TRUE/FALSE), either using min-conflicts *or* choosing randomly
- ... or you can use *any* local or global search algorithm!
- There are many model checking algorithms and systems
 - -See for example, MiniSat
 - -International SAT Competition (2003, ... 2012)



Reminder: Inference rules for FOL

- Inference rules for propositional logic apply to FOL as well
 - Modus Ponens, And-Introduction, And-Elimination, ...
- New (sound) inference rules for use with quantifiers:
 - -Universal elimination
 - -Existential introduction
 - -Existential elimination
 - -Generalized Modus Ponens (GMP)