Modal SAT solving

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Modal Logic Intro/Refresher

- **Syntax**
  - Atomic formulae $p_n$
  - Formulae $\phi := p, \neg \phi, \Diamond \phi, \Box \phi, \phi_n \land \phi_m, \phi_n \lor \phi_m, \phi_n \rightarrow \phi_m$

- **Kripke semantics**
  - Kripke model $(W, R, v)$
  - Interpretation of modal connectives

- **Modal satisfiability**
  - $\phi$ is *satisfiable* iff $\exists (W, R, v)$ s.t. $\exists w \in W$ s.t. $w \models \phi$
## Previous work

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Table 1: main features of several existing solvers
Clausal technique

- Modal clauses:
  - \( \bot \)
  - \( \Box[p_1, \ldots, p_k] \)
  - \( \Box[p, \Box q] \)
  - \( \Box[p, \Diamond q] \)
  - \( \Box \Diamond q \)

- Clause conversion and tableau procedure
Measures of performance

- Performance on benchmarks
- Range of application - outside current scope
  - Particularly multimodal logics, for which the clause system was developed
  - Clause conversion procedure can be made to work for all normal modal logics

Figs 1,2: Efficiency of existing modal SAT solvers on different benchmarks. From Goré et al, 2014.
References