

# Outline

Satisfiability Checking

# Satisfiability Checking in FOL

- ▶ Set of satisfiable formulas is not r.e., so **no complete procedure**;
- ▶ Various methods developed:
  - ▶ **Saturation** (no good model representation)
  - ▶ **Finite model building**
  - ▶ **Instantiation based methods**

# Satisfiability Using Saturation

- ▶ A **complete strategy** must be used;
- ▶ **Non-redundant clauses** cannot be discarded;
- ▶ In the case of success, **no good representation of a model** can be built.

vampire SYN901-1.p

# Instance Generation

There are several powerful methods of **instance generation**.

- ▶ Different from **SMT**: use **unification**;
- ▶ Use **SAT solver**;
- ▶ Lots of **implementation can be reused** (clauses, indexing, unification, SAT solver);
- ▶ Can **cooperate with saturation**;
- ▶ **Decision procedure** for EPR (clauses without function symbols).

```
vampire --saturation-algorithm inst_gen
```

# Finite Model Building

- ▶ The class of problems having finite models is r.e., so **complete methods** exist.
- ▶ In practice, the **most powerful** method of checking satisfiability (but not always!)
- ▶ Increment **model size**, starting with very small sizes.

# Finite Model Building

- ▶ The class of problems having finite models is r.e., so **complete methods** exist.
- ▶ In practice, the **most powerful** method of checking satisfiability (but not always!)
- ▶ Increment **model size**, starting with very small sizes.
- ▶ Based on various translations of the following problem into SAT (or into EPR):

*Given a first-order formula  $F$  and a positive integer  $n$ , find out whether  $F$  has a model of the size  $n$ .*

# Finite Model Building

- ▶ The class of problems having finite models is r.e., so **complete methods** exist.
- ▶ In practice, the **most powerful** method of checking satisfiability (but not always!)
- ▶ Increment **model size**, starting with very small sizes.
- ▶ Based on various translations of the following problem into SAT (or into EPR):

*Given a first-order formula  $F$  and a positive integer  $n$ , find out whether  $F$  has a model of the size  $n$ .*

- ▶ Two main ingredients:
  - ▶ algorithm for translation;
  - ▶ SAT solver.

# Finite Model Building

- ▶ The class of problems having finite models is r.e., so **complete methods** exist.
- ▶ In practice, the **most powerful** method of checking satisfiability (but not always!)
- ▶ Increment **model size**, starting with very small sizes.
- ▶ Based on various translations of the following problem into SAT (or into EPR):

*Given a first-order formula  $F$  and a positive integer  $n$ , find out whether  $F$  has a model of the size  $n$ .*

- ▶ Two main ingredients:
  - ▶ **algorithm for translation**;
  - ▶ **SAT solver**.

Vampire can search for finite models using the BFNT translation into EPR:

```
vampire --bfnt on
```