No One SATPlan Encoding To Rule Them All

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What is Planning?

- World state: instantiation of multivalued state variables
- Actions:
  - require certain values of state variables to be used (preconditions)
  - change values of state variables by their effects
- Objective:
  - Given a set of actions
  - Given an initial state (start) and goal conditions
  - Find a plan (sequence of actions to get from start to goal)
Planning by Satisfiability Solving

- If the formula $F_k$ is satisfiable then a plan (of length $k$) exists
- Solve $F_1, F_2, \ldots$ until a satisfiable formula $F_n$ is reached
- From a satisfying assignment of $F_n$ construct a plan

**Encoding**

- The encoding = How is $F_k$ defined
- The key aspect for the performance
- Many encodings invented in the last decades
- Each aims to be better than the others on all problems
Automatic Encoding Selection

General Idea

- No one can encoding can rule them all
- Take a set of encodings
  - Diversify! Diversify! Diversify!
  - Taking the best existing encodings is not that good
- Create a (heuristic) rule to select the best encoding for a problem
  - Rule should be simple – fast to evaluate
  - Rule should be smart to select well

Implementation

- Used Encodings:
  - $R^2\exists$-Step encoding with
    - Topological ranking
    - Input ranking
  - Reinforced encoding
- Selection Rule:
  1. $T =$ number of transitions
  2. if $T > 10$ use Reinforced
  3. else use $R^2\exists$-Step alternate between the two rankings for each makespan
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Experiments

- Number of solved problems within 30 minutes
- We Compared
  - Selective encoding
  - Its components
  - State-of-the-art Rintanen encodings
  - Their optimal combination (R*)
- IPC 2011 Benchmarks, 20 problems in each of 14 domains

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Total: 159, 172, 204, 180, 184, 188
Conclusion

- Combining diverse encodings is a perspective research direction
- Just combining the best (Rintanen) encodings is not optimal
- The proposed rule is very simple and the encoding pool small, but already the experiments show great improvement

Future Work
- Bigger and more diverse encoding pool
- More sophisticated selection rules