Principles of AI Planning

Thesis and project topics

Malte Helmert

Albert-Ludwigs-Universität Freiburg

February 14, 2007

What I did earlier

I mostly worked in classical (deterministic) planning, with an emphasis on

- heuristic search algorithms and
- complexity results for specific planning domains.

What I did earlier
Work on planning: algorithms

1999 invariant synthesis algorithm for STRIPS

1999 automatic translation from STRIPS to multi-valued encodings

2000 deterministic planning system based on BDD exploration (MIPS); participated in IPC 2

2004 "causal graph heuristic" for planning tasks with multi-valued encodings

2004 automatic translation from general PDDL2.2 to multi-valued encodings

2004 deterministic planning system based on the causal graph heuristic; participated in IPC 4

What I did earlier
Work on planning: complexity

2001 complexity of planning in the IPC 1/2 domains

2002 decidability for planning with numbers

2006 complexity of planning in the IPC 3/4 domains

2006 approximation properties of the IPC 1–4 domains

Supervision
Supervised semester projects

2003 Untersuchung von Zustandsräumen in Zwei-Personen-Spielen

2005 Approximationsverfahren für Planungsprobleme in den Domänen Satellite, Depots und DriverLog

2005 Approximatives Planen in der Grid-Domäne

2006 A Generic Reasoner for Qualitative Calculi

2006 Natürlichere Problemspezifikation in PDDL

now Zielordnungen und Landmarken für SAS$^+$-Planer

Supervision
Supervised diploma theses

2003 Entwicklung eines Double-Dummy Skat Solvers mit einer Anwendung für verdeckte Skatspiele

2005 Pfadplanung unter Unsicherheit

2006 Approximationseigenschaften von Transportproblemen in der Handlungsplanung

now Eine automatentheoretische Heuristik für klassische Planungsprobleme

now Algorithmen für teilerfüllendes Planen

What I do currently

Current interests:

- optimal sequential planning with pattern databases
- automatic problem simplification
- relationship between SAT planning and heuristic planning
- limitations of relaxation heuristics for optimal planning
- IPC 6

Current thesis and project opportunities

State of the art in optimal sequential planning

Literature survey and experimental study

- What are the main approaches for optimal sequential planning?
- How can they be classified?
- How do they perform on the standard benchmarks?

Current thesis and project opportunities

Compact encodings of monotonic Boolean functions

Design and comparison of synthesis heuristics

- How can we efficiently synthesize circuits for monotonic Boolean functions?

$\rightsquigarrow$ relaxation heuristics

$\rightsquigarrow$ disjunctive pattern database heuristics

$\rightsquigarrow$ line of sight algorithms

Current thesis and project opportunities

What is the difference between SAT and heuristic planning?

Explain SAT planner behaviour

- How does a SAT planner behave when restricted to progression or regression search?
- How does a SAT planner behave when using a standard planning heuristic to guide the variable selection process?
- How can this data explain differences in performance between SAT planners and heuristic planners?