Latest Trends in Abstraction Heuristics for Classical Planning
4. Outlook

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Summary

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Further Reading
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Research Challenges
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Summary: Abstractions

What we talked about: abstractions

- principled approach for deriving admissible heuristics
- formalized as mapping/equivalence relation on states inducing (typically much smaller) abstract state space
- hierarchy of increasingly general classes of abstractions:

        projection
     $\rightarrow$ domain abstraction
     $\rightarrow$ Cartesian abstraction
     $\rightarrow$ merge-and-shrink abstraction

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Summary: Cartesian Abstractions

What we talked about: Cartesian abstractions

- abstract states = "rectangular" state sets,
  allowing simple and fine-grained refinement
- counterexample-guided abstraction refinement
  (CEGAR) approach
- diverse and additive abstractions
  via focus on subtasks and cost saturation

Summary: Merge-and-Shrink Abstractions

What we talked about: merge-and-shrink abstractions

- collection of small transition systems synchronized by common labels compactly represent state spaces
- structured transformations such as merging, shrinking and label reduction to improve heuristics, abstract and simplify
- very general and flexible approach for deriving abstractions

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Further Reading

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Further Reading: Pattern Databases

What we did not talk about: details on pattern databases

- Culberson and Schaeffer, Comp. Int. 1998:
  PDBs introduced for 15-puzzle and Rubik's Cube
- Korf and Felner, AIJ 2002: additive PDBs
- Edelkamp, ECP 2001: (additive) PDBs for planning
- Edelkamp, MoChArt 2006: genetic algorithm pattern selection
- Haslum et al., AAAI 2007: iPDB selection, canonical heuristic
- Sievers et al., SoCS 2012: efficient PDBs for planning
- Pommerening et al., IJCAI 2013: post-hoc optimization

. . . and lots and lots of papers in the heuristic search community

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Further Reading: Implicit Abstractions

What we did not talk about: implicit a.k.a. structural abstractions

- Katz & Domshlak, ICAPS 2007: identified tractable patterns
- Katz & Domshlak, ICAPS 2008: fork decomposition
- Katz & Domshlak, ICAPS 2009: efficient implementation using structural pattern databases
- Katz & Keyder, AAAI 2012: semifork and hourglass patterns

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Further Reading: Symbolic Abstractions

What we did not talk about: symbolic abstractions

- Edelkamp, AIPS 2002: symbolic PDBs
- Edelkamp, ICAPS 2005: . . . with external symbolic search
- Ball and Holte, ICAPS 2008: studied effectiveness
- Edelkamp et al., ECAI 2012: symbolic merge-and-shrink
- Torralba et al., IJCAI 2013: ditto
- Torralba, PhD, 2015: many improvements & state of the art

SYMBA*: winner of optimal sequential planning track of IPC 2014

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Now It's Your Turn!

Some research challenges:

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Now It's Your Turn!

Some research challenges:

- additive merge-and-shrink heuristics
  - ↝ What is good for the PDB goose
    should be good for the M&S gander!

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Now It's Your Turn!

Some research challenges:

- additive merge-and-shrink heuristics
  - ⤳ What is good for the PDB goose
    should be good for the M&S gander!
- less dumb strategies!
  - ⤳ CEGAR refinement, merge strategies, PDB selection
    not very elaborate
  - ⤳ we should be better than random! (cf. SYMBA*)

Now It's Your Turn!

Some research challenges:

- **additive** merge-and-shrink heuristics
  - ⤳ What is good for the PDB goose
    should be good for the M&S gander!
- less dumb **strategies**!
  - ⤳ CEGAR refinement, merge strategies, PDB selection
    not very elaborate
  - ⤳ we should be better than random! (cf. SYMBA*)
- proving **unsolvability** of planning tasks
  - ⤳ competition in 2016?
  - ⤳ of the "four classes of heuristics",
    abstractions uniquely suited for this
  - ⤳ great promise with merge-and-shrink
    (Hoffmann et al., ECAI 2014)

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Now It's Your Turn!

Some research challenges:

- additive merge-and-shrink heuristics
  - ⤳ What is good for the PDB goose
    should be good for the M&S gander!

- less dumb strategies!
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- proving unsolvability of planning tasks
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- applying all this outside of classical planning!

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Final Words

There is lots more to do!

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The End

Thank you for your attention!