Overview

• Why? Lots of pieces in the literature. Work is disjoint. Not unified. Thanks to recent progress time is ripe for impact.
  - facilitate synergy and exchange of ideas
  - identify opportunities and challenges

Overview

• What?
  - equivalence/reductions
  - approximations/scalability
  - applications

Stochastic Planning and Probabilistic Inference

• Simplest setting: finite horizon, goal based formulation and atomic states and actions

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\[ P(\text{goal}|s_0, As) \sim P(As|s_0, \text{goal}) \sim P(As, \text{goal}|s_0) \]

- "Reward-weighted" distribution
\[ \hat{p}(s_{1:t}, a_{1:t}, t|\pi) = \frac{r_t(s_t, a_t)(s_{1:t}, a_{1:t}|\pi)}{U(\pi)} \]

generalizes this to Infinite horizon, reward per stage, stationary/non-stationary policy

Value iteration = alternating variable elimination

Factored states and actions

- All of these are correct/exact
- Can this scale to large problems?
- How to best approximate?
- Interaction b/w reduction and approx
How to Solve?

• Symbolic (lifted) dynamic programming
• Weighted model counting
• Search: And/Or, Branch and bound
• Expectation Maximization
• Variational approximations
• Belief propagation
• Policy gradients
• Planning as Mixed Integer Linear Program
• Particle filters / Point based methods
• ...

Problem Variants

• discrete vs. continuous
• single vs. multi-agent
• general vs. spatial problems
• propositional vs. relational
• model based planning vs. reinforcement learning
• exact/optimal vs. approximate vs. heuristic solutions

Applications

• Task planning in robotics
• Spatial management of invasive species
• Taxi fleet control
• Power flow in electric grids
• ...

Overview

• Program:
  - keynote talks
  - invited presentations
  - contributed papers

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  - facilitate synergy and exchange of ideas
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  → Please propose challenges/opportunities for all

Agenda

- Equivalence/reductions
  what works? when/why?
- Approximations/scalability
  what works? when/why?
- Applications
  what can we already do? what properties of problems/solutions are important in real-world large problems?