Open Problems in Simulation-based Control Optimization

- Function approximation for large-scale Markov decision processes
- Multi-step updates for value iteration (lack of a Bellman equation with multi-step updates)
- Step size rules that work universally
- Software with modules for reinforcement learning
- Real-world applications!

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Open Problems in Simulation-based Static Optimization

- Lack of convergence guarantees for algorithms of discrete simulation-based optimization

- Simulation-based constrained optimization

- Reliance on meta-heuristics can itself pose numerous difficulties if the problem structure is not known (typically true of simulation-based optimization).

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New areas for simulation-based optimization

- Solving stochastic games

- Hierarchical reinforcement learning with decision-making at multiple levels

- Continuous action spaces

- Function approximation that automatically acquires the shape of the value function.

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New areas for simulation optimization (continued)

- Beyond average and discounted reward in control optimization

- Applications outside of management science and robotic problems: problems in bio-medicine, physics.

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Reinforcement Learning

- Applications to airline revenue management (Gosavi *et al.*, 2002*, IIE Transactions*)
- Applications to productive maintenance (Das *et al.*, 1999; *Management Science*)
- Applications of learning automata (Gosavi *et al.*, 2004; *IIE Transactions*)
- Policy iteration based algorithms (Gosavi, 2004; *Machine Learning*).
- Boundedness of iterates in Q-Learning (Gosavi, 2006; *Systems and Control Letters*)
- Simulation-based Optimization (Gosavi, 2003; textbook by Springer)

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