

Sequential Monte Carlo in Probabilistic Planning Reachability Heuristics

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Joint Work with: Subbarao Kambhampati & David E. Smith

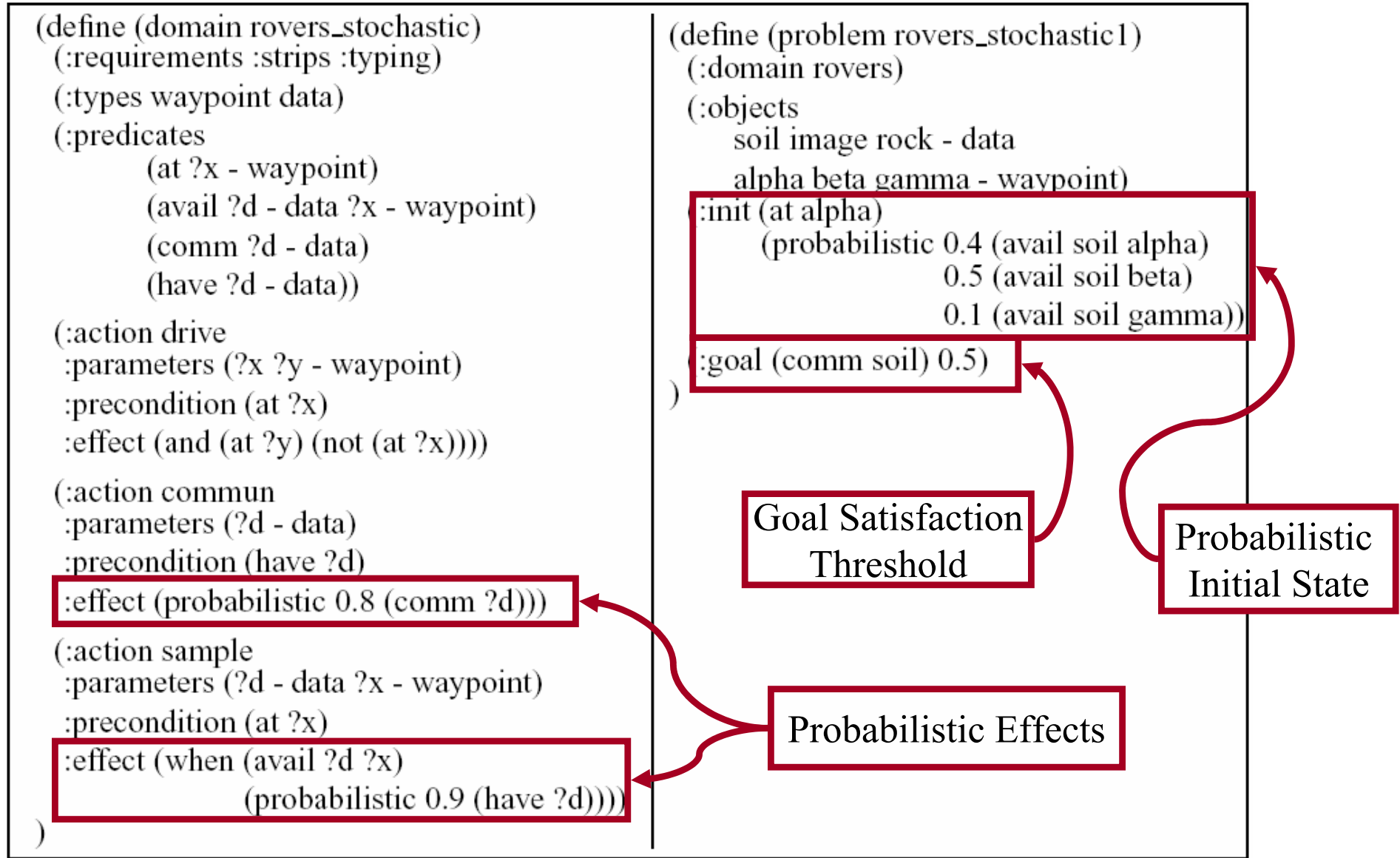
Supported By: NSF, ONR, NASA, IBM, ARCS



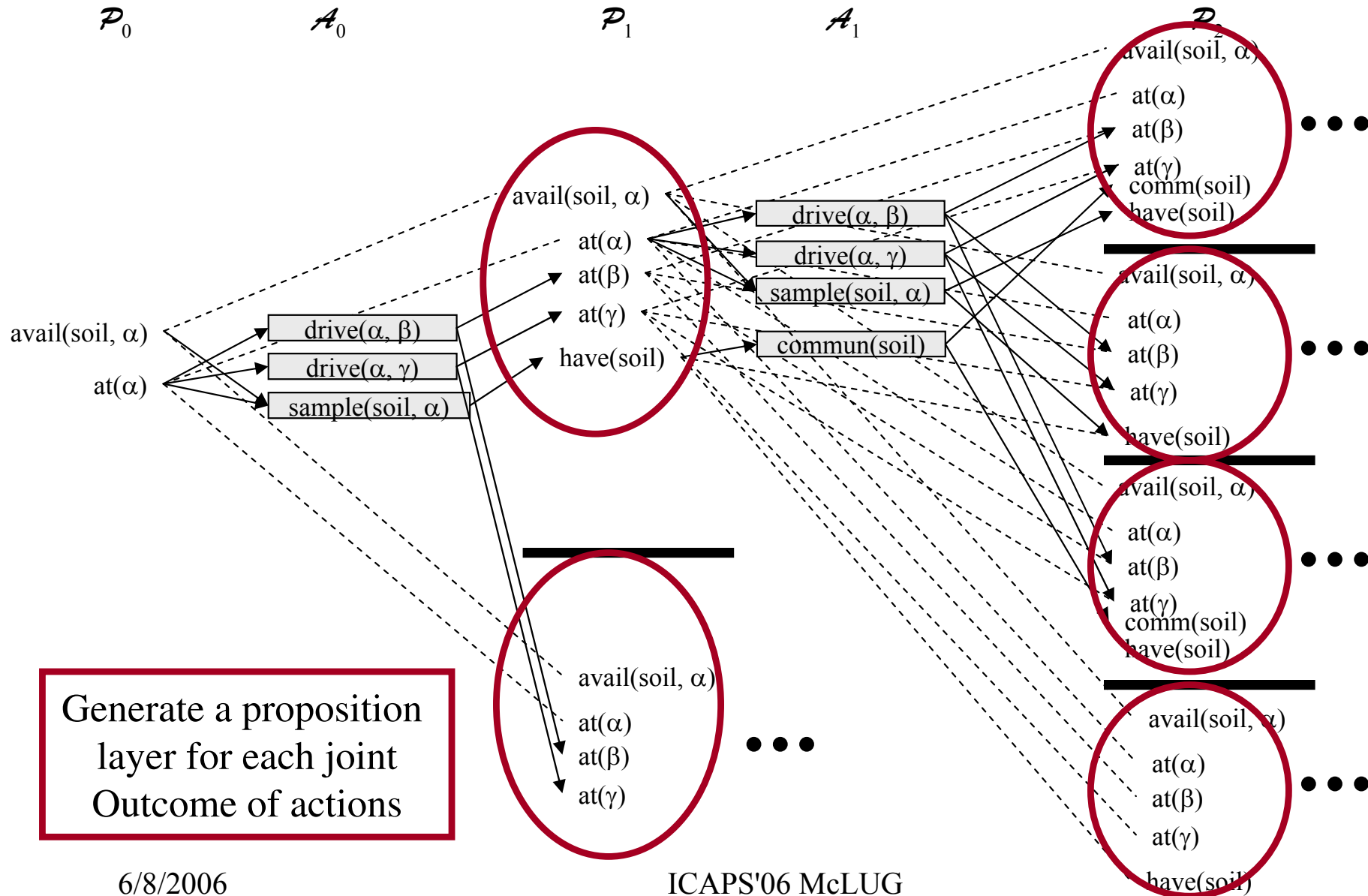
Overview

- Planning Graph Heuristics work in Non-Deterministic Planning
 - **But ...**
 - Problem 1: Do not handle uncertain action effects
 - Problem 2: Do not handle quantitative uncertainty
- Challenges:
 - Possible worlds grow exponentially with uncertain effects
 - Exact Representation of planning graph is costly
- Solution: Use Monte Carlo in Planning Graph Construction
 - **Why??:**
 - We have sampling distributions because of quantitative uncertainty
 - We don't need to worry about all uncertain outcomes of actions – especially in a heuristic!

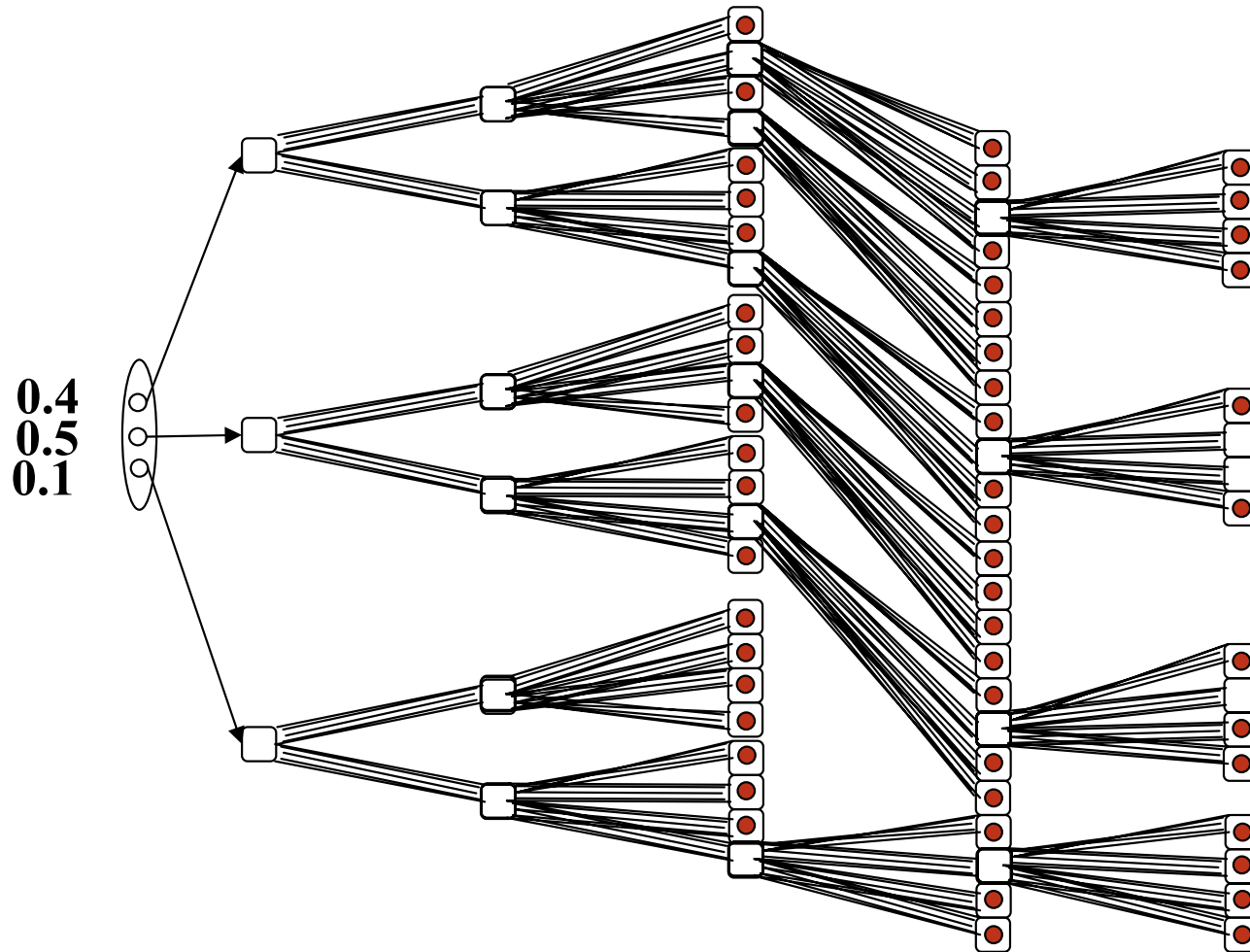
A CPP Domain



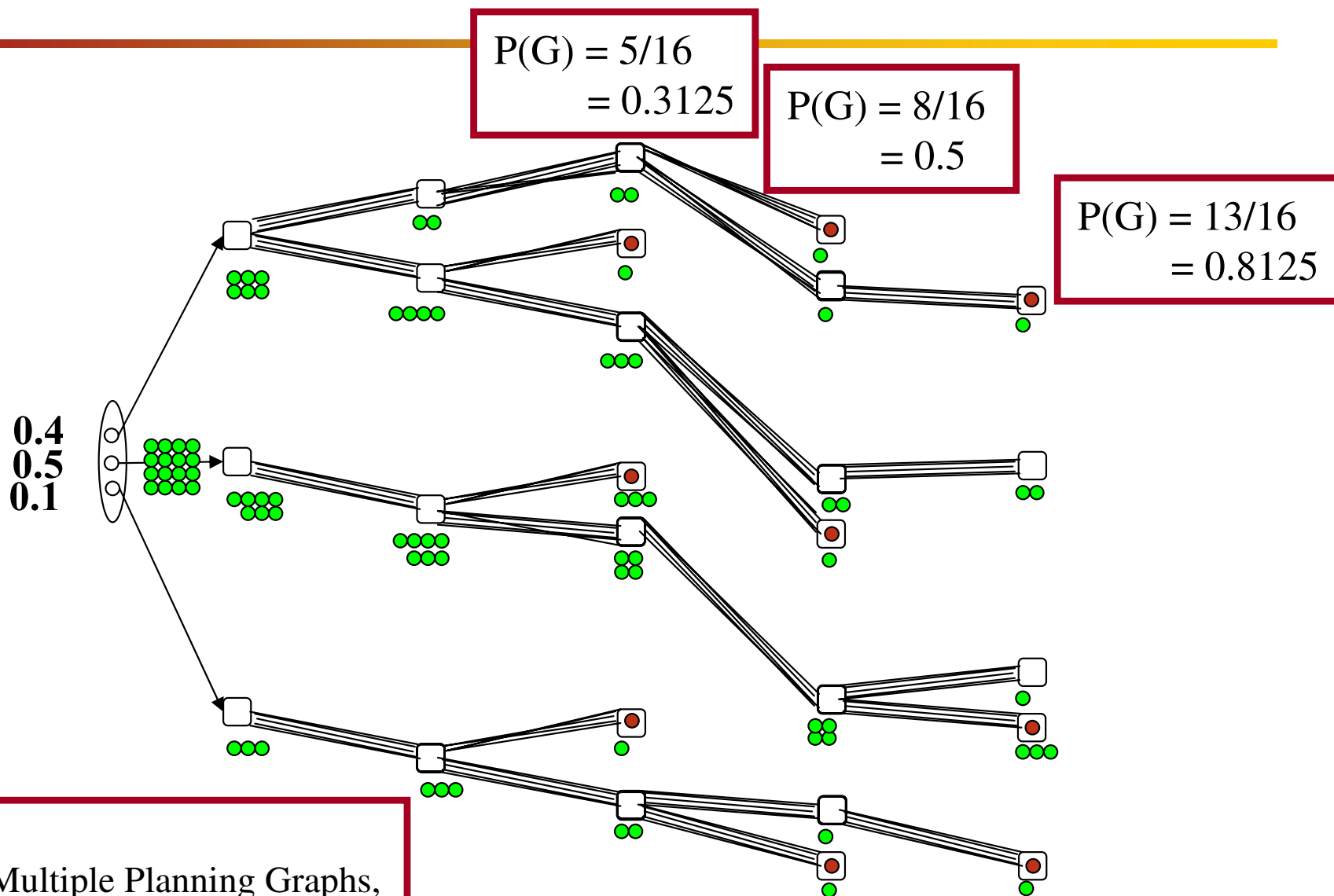
Conformant GraphPlan (CGP)



CGP-style planning graph

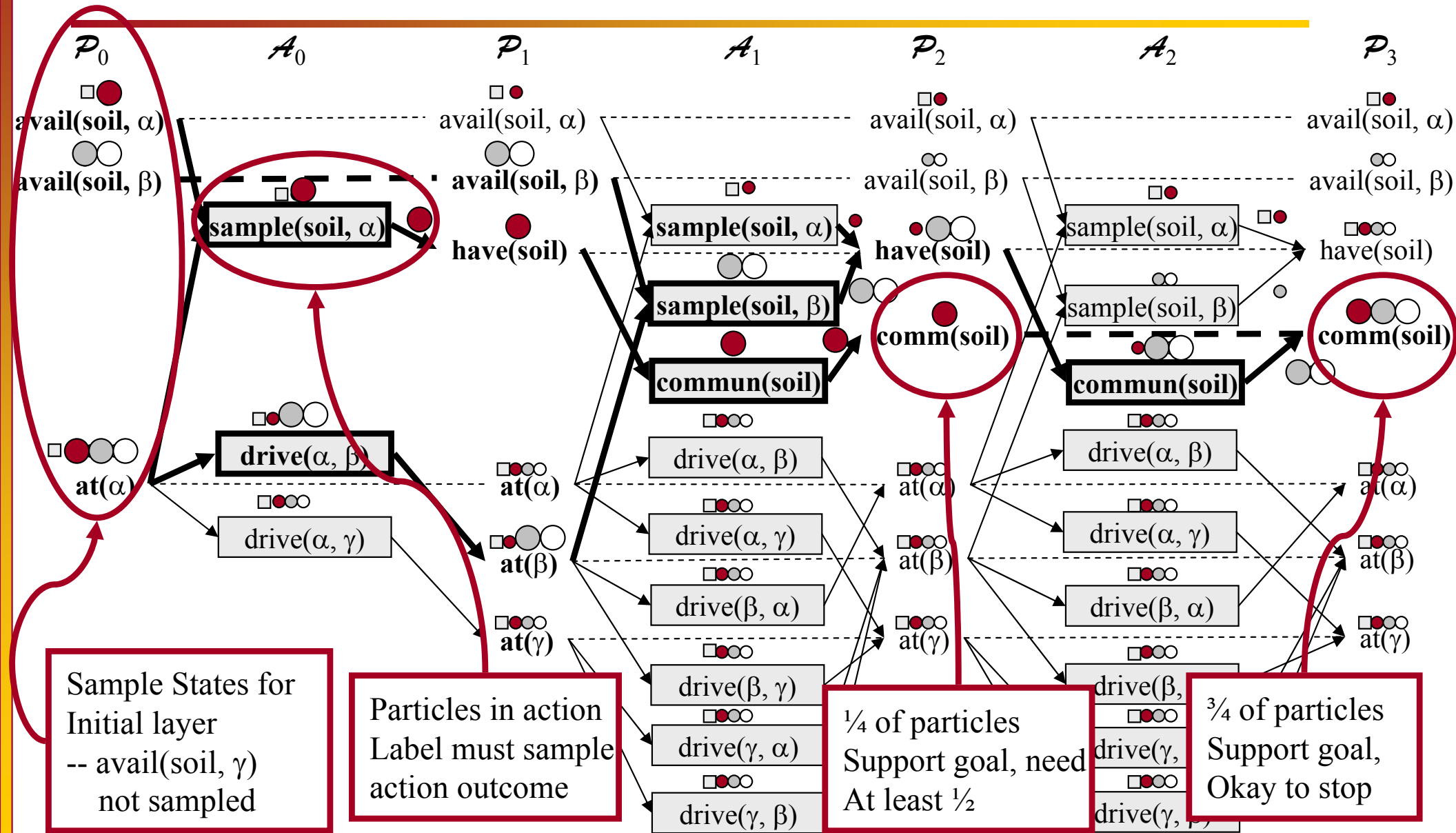


Monte Carlo CGP



- Problem:
 - Have Multiple Planning Graphs, Which can still be costly
- Solution:
 - Use Labeled Planning Graph

Monte Carlo LUG (McLUG)



Sample States for Initial layer
 -- $avail(soil, \gamma)$ not sampled

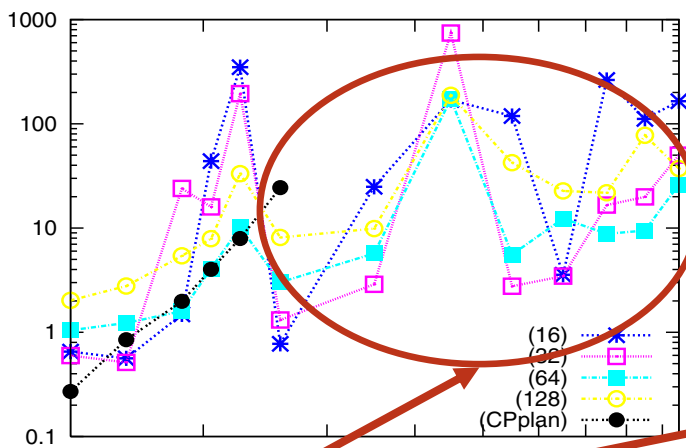
Particles in action
 Label must sample action outcome

$\frac{1}{4}$ of particles Support goal, need At least $\frac{1}{2}$

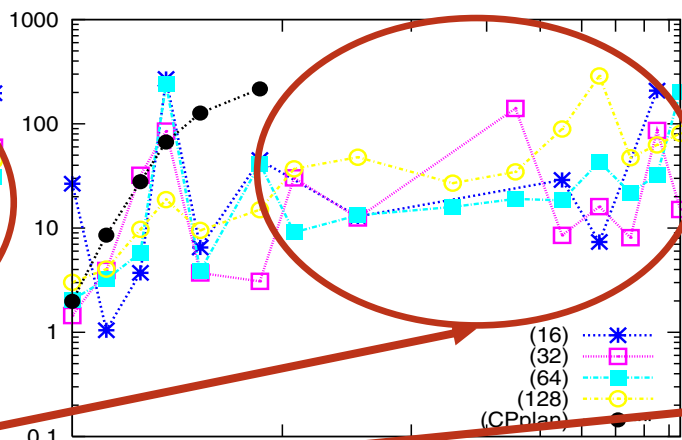
$\frac{3}{4}$ of particles Support goal, Okay to stop

Logistics

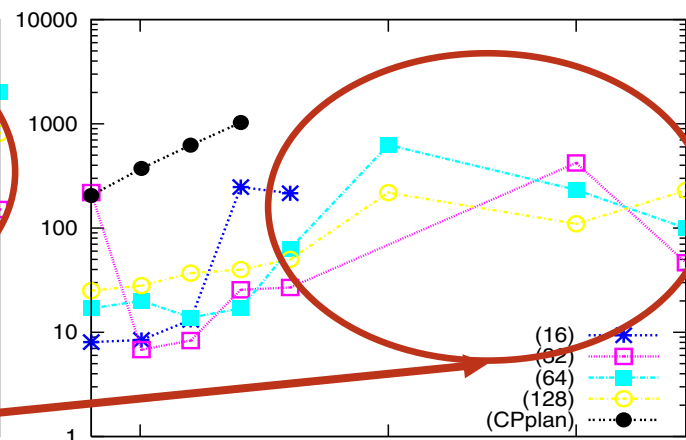
P2-2-2 time (s)



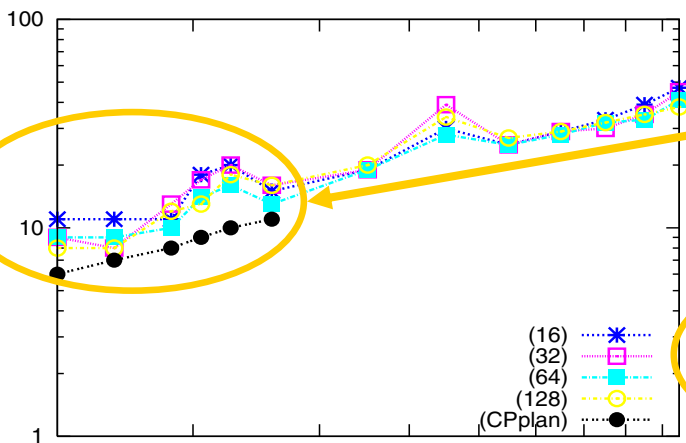
P4-2-2 time (s)



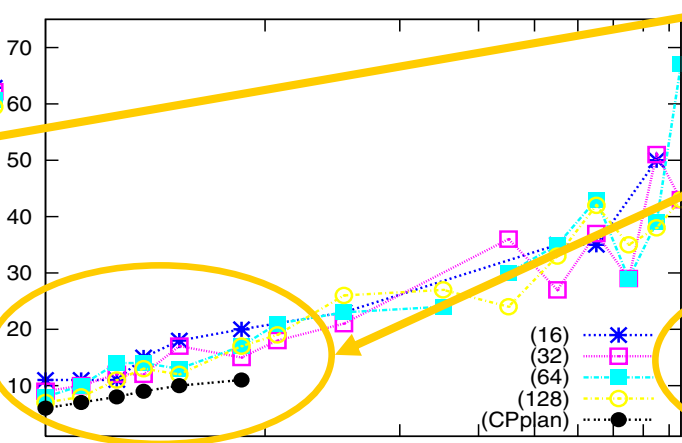
P2-2-4 time (s)



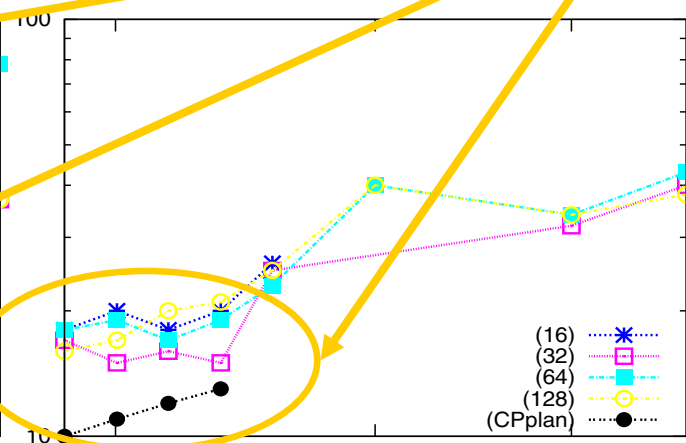
Significantly More Scalable, w/ comparable quality



6/8/2006

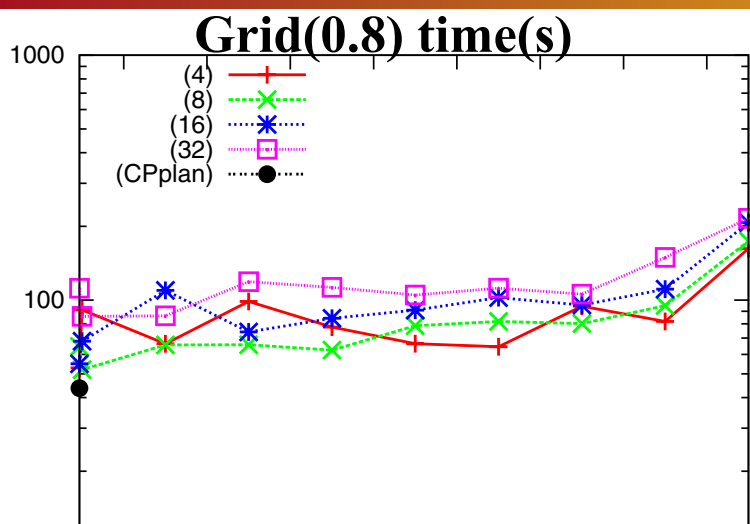


ICAPS'06 McLUG

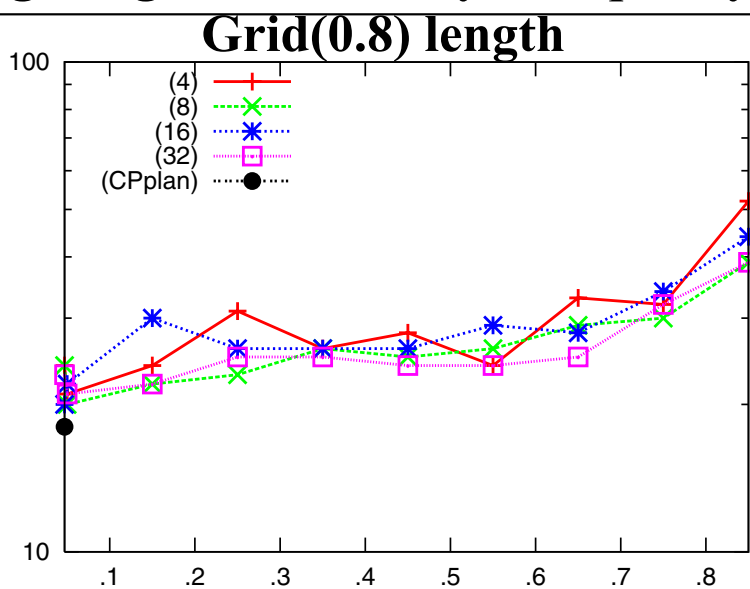


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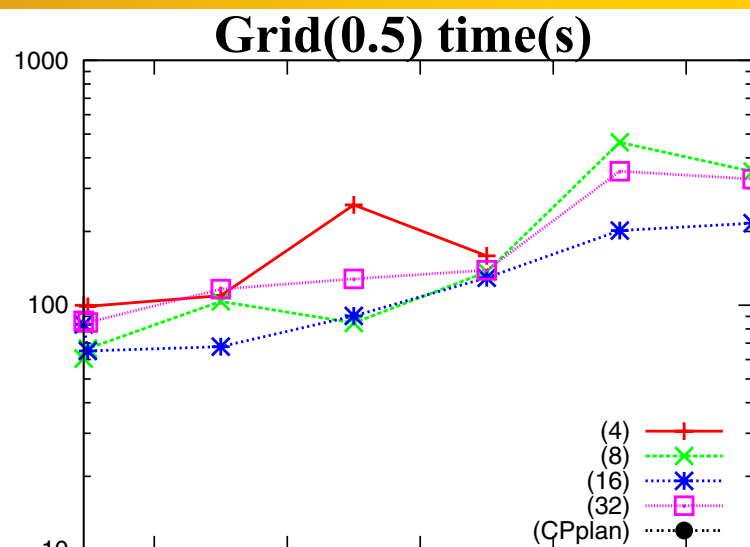
Grid



Again, good scalability and quality!



6/8/2006



Need More Particles for broad beliefs

