When to Commit to an Action in Online Planning

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Motivation

- Online planning using real-time search: agent has bounded time to search next action for execution (deterministic, single agent)
- The meta-level problem: commit or not commit an action?

Previous Approaches

- always commit one \(^1\) is too conservative
- always commit all \(^2,3\) is too risky

Flexible Action Commitment Search

- Our idea:
  - commit if an action in prefix is certainly the best
  - to gain more planning time for next iteration

Assumptions:

- system can’t be uncontrolled, so force to commit if action queue is empty
- search tree structure (order of decisions is fixed)
- no replanning required
- deterministic system
- only propose commitment strategy

We propose a principled way to make meta-level decision:

Compute Utility:

- \( U_{commit} = \mathbb{E} \left[ \min(X_{\alpha \rightarrow \beta}, X_{\beta \rightarrow \alpha}) \right] \)
- \( U_{don't \ commit} = P_{\text{choose } \alpha} \cdot U_{\alpha} + (1 - P_{\text{choose } \alpha}) \cdot U_{\beta} \)

commit when \( U_{commit} > U_{don't \ commit} \)

Experiments

Synthetic Grid Pathfinding:

- Left: tar pit area → high cost for reckless committing
- Right: corridor area → need long lookahead to observe the local minima
- Middle: empty area → gain lookahead, no harm to commit

FACS consistently performs better than fixed strategies!