Explainable and Scalable Planning with Probabilistic Temporal Logic Specifications

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Project personnel: One Ph.D. student (three years) + one postdoctoral scholar (in years 1 and 2)

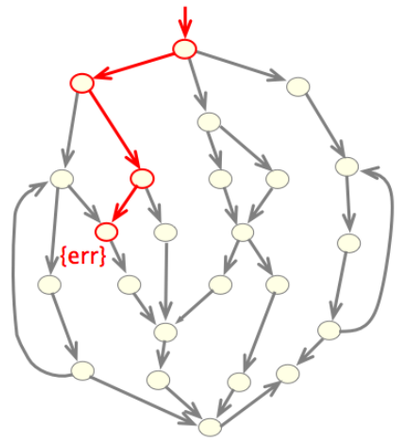
Research Objectives

Develop formal specifications and automated learning and synthesis algorithms for planning under probabilistic temporal logic constraints

- Scalability via architectural and algorithmic measures
- Planning interpretable by and feedback explainable to care members and designers

Initial TRL: 1 (preliminary theory)
Final TRL: 3-4 (proofs of concept + validation on representative data)

Image:https://www.exploremars.org



Theory and algorithms for automated planning with scalability and interpretability necessary for future human spaceflight operations

Approach

Thrust I -- Compositional and hierarchical synthesis

Thrust II -- Learning-based synthesis for interpretable plans in practically infinite-state systems

Thrust III -- Explainable feedback through structured counterexamples

Demonstration and yearly assessment with concrete metrics: case study on human spaceflight operations with representative models, specifications, objectives, contingency scenarios

Potential Impact

Paradigm shift in the planning+execution (and re-planning loop):

- Systematic, composable, unambiguous mission specifications
- Automated planning with rich models, constraints and uncertainties
- Naturally suitable for re-planning
- Integrated planning → system-level optimization, e.g., in performance, weights and overall cost.
- Suitable for emerging crew/designer interfaces