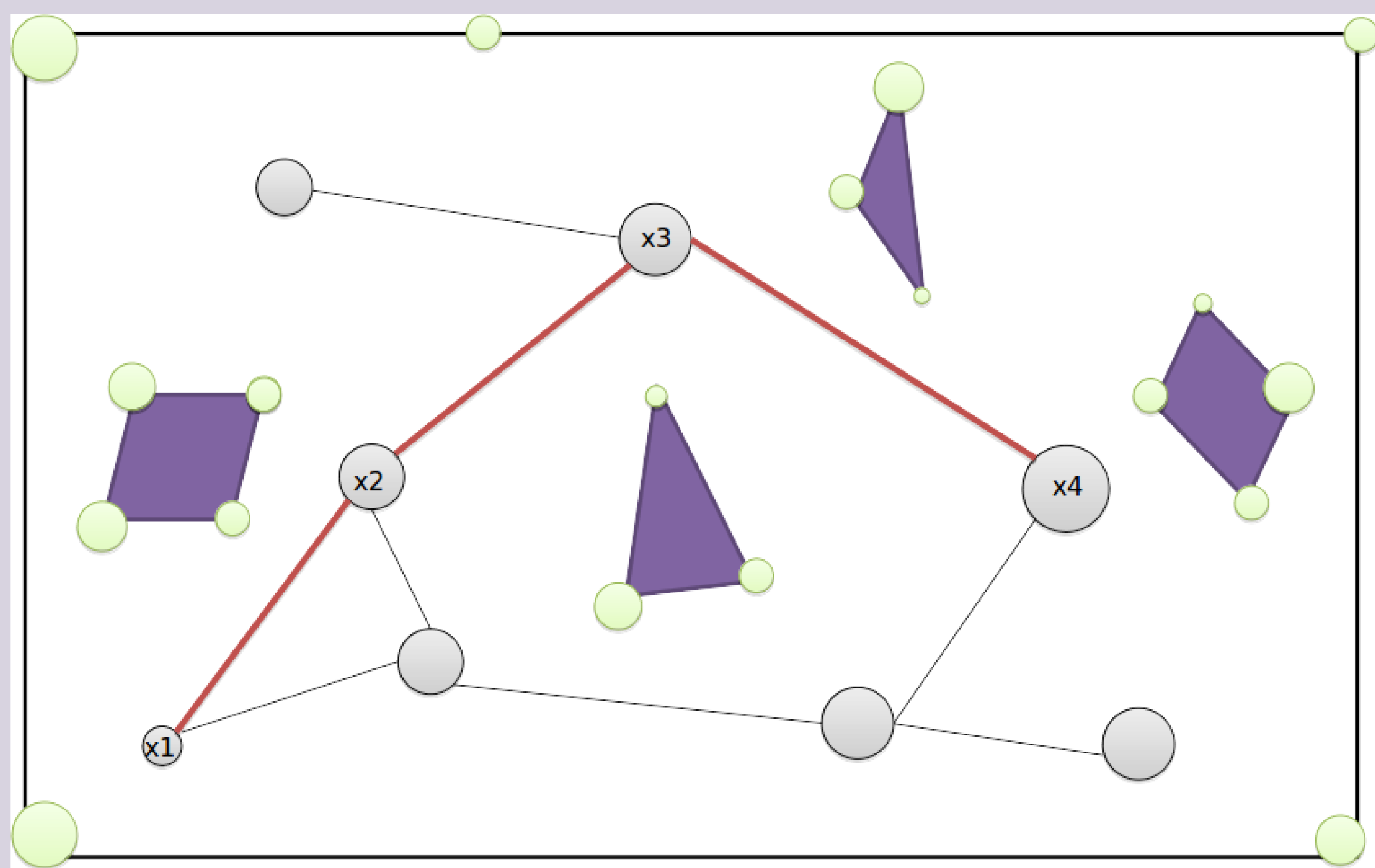


Information-based Active SLAM via Topological Feature Graphs

Beipeng Mu, Liam Paull, Ali-akbar Agha-mohammadi, John Leonard, Jonathan How
 {mubp, lpaull, aliaphamc, jhow, jleonard}@mit.edu

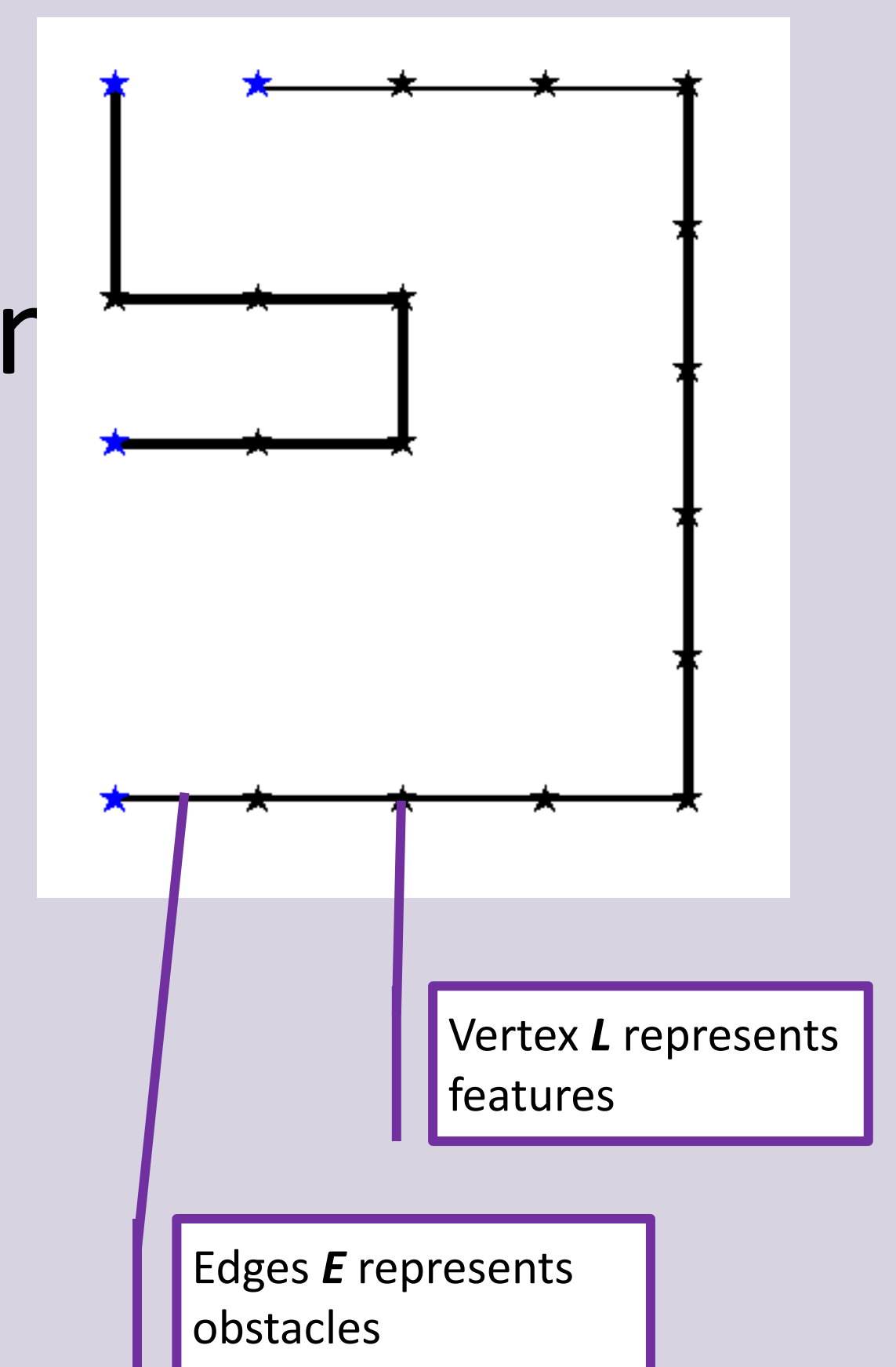
In a Nutshell

Problem: Actively plan trajectory to do SLAM (simultaneously localization and mapping)



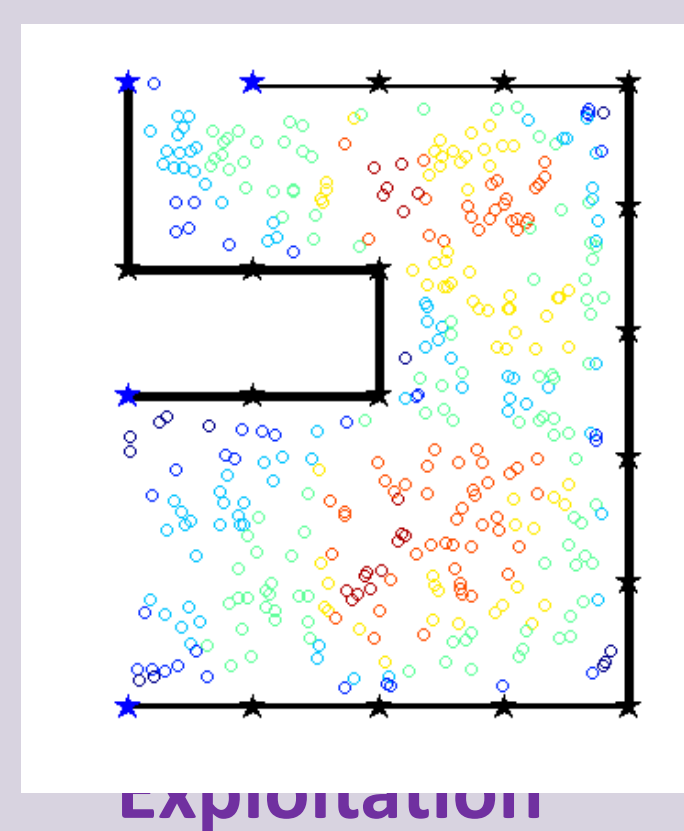
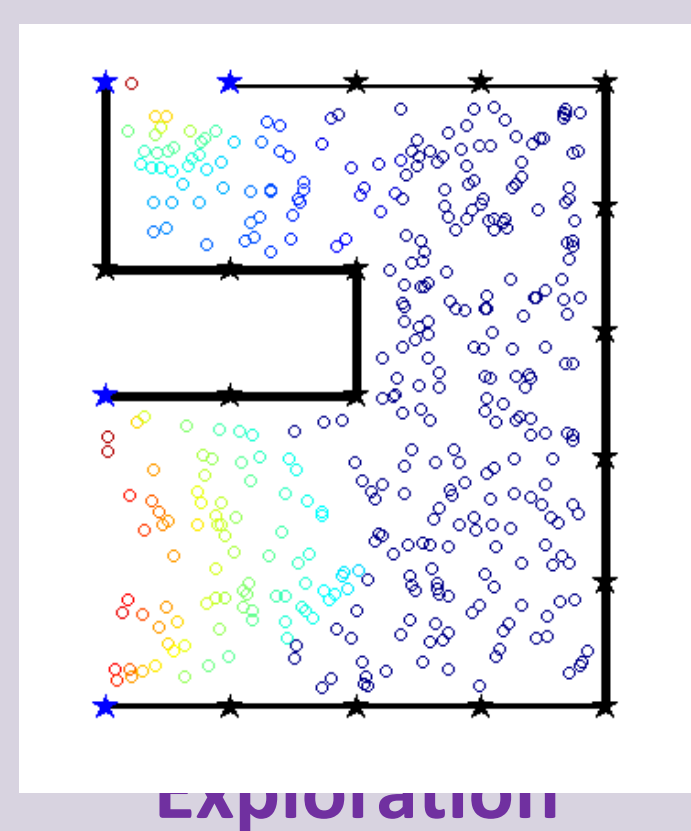
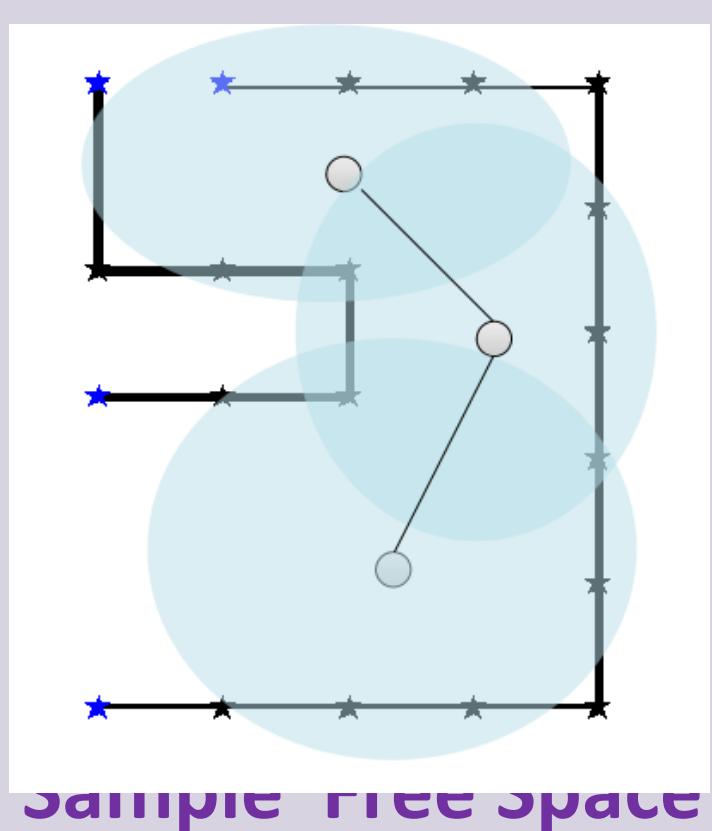
Topological Feature Graph

- Graphical model
 - Scalability
 - Robustness
- Lack geometry information
 - Hard for path planning
- Augment with topological graph $\mathcal{G} = \{L, E\}$
 - Node => features
 - Edge => obstacles



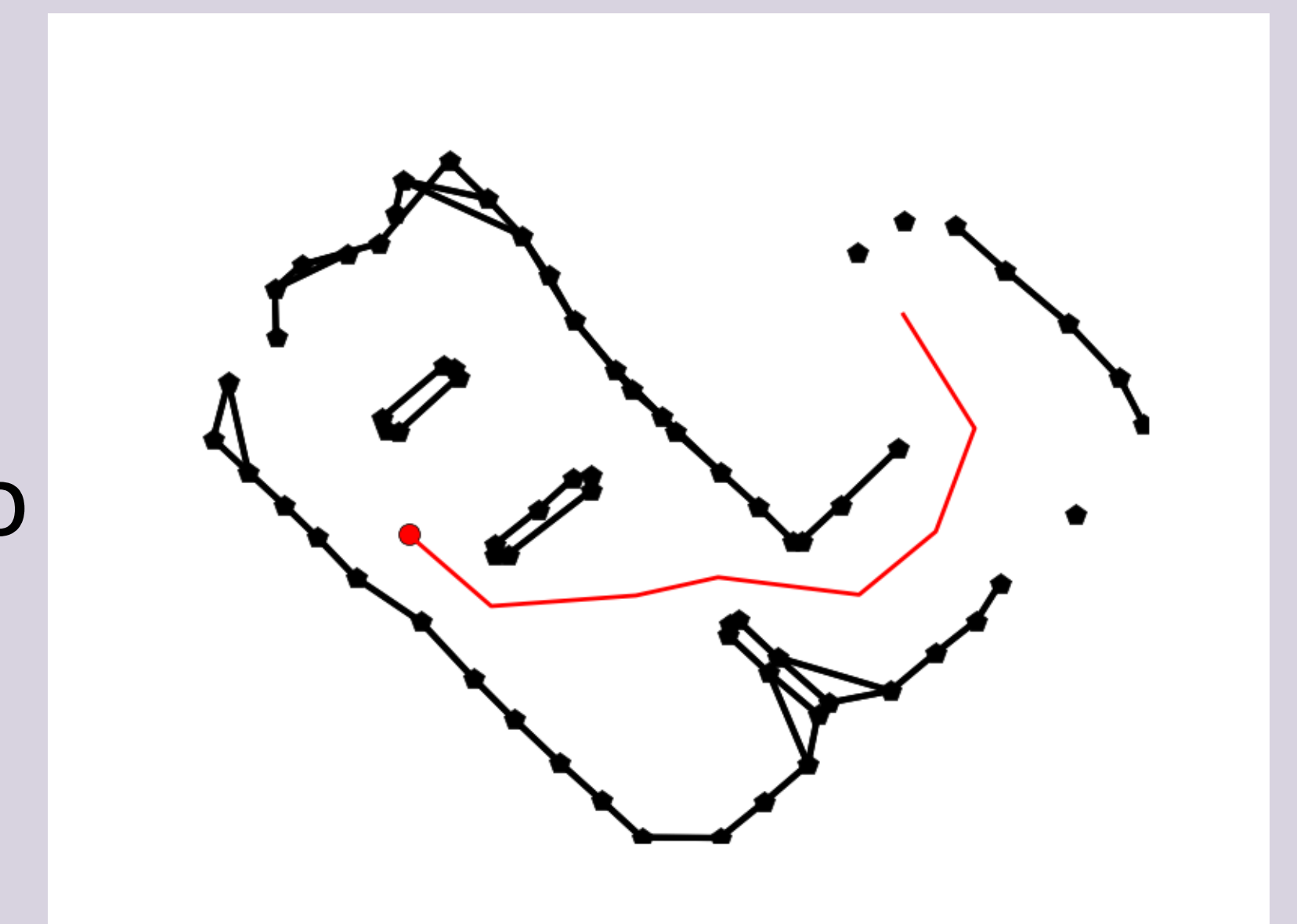
Exploration vs Exploration

- Features and robot poses \sim Gaussian
 - Coupled via factor graph
- Direct quantify information gain
- Information decouples into
 - Explore frontier
 - Revisit known areas

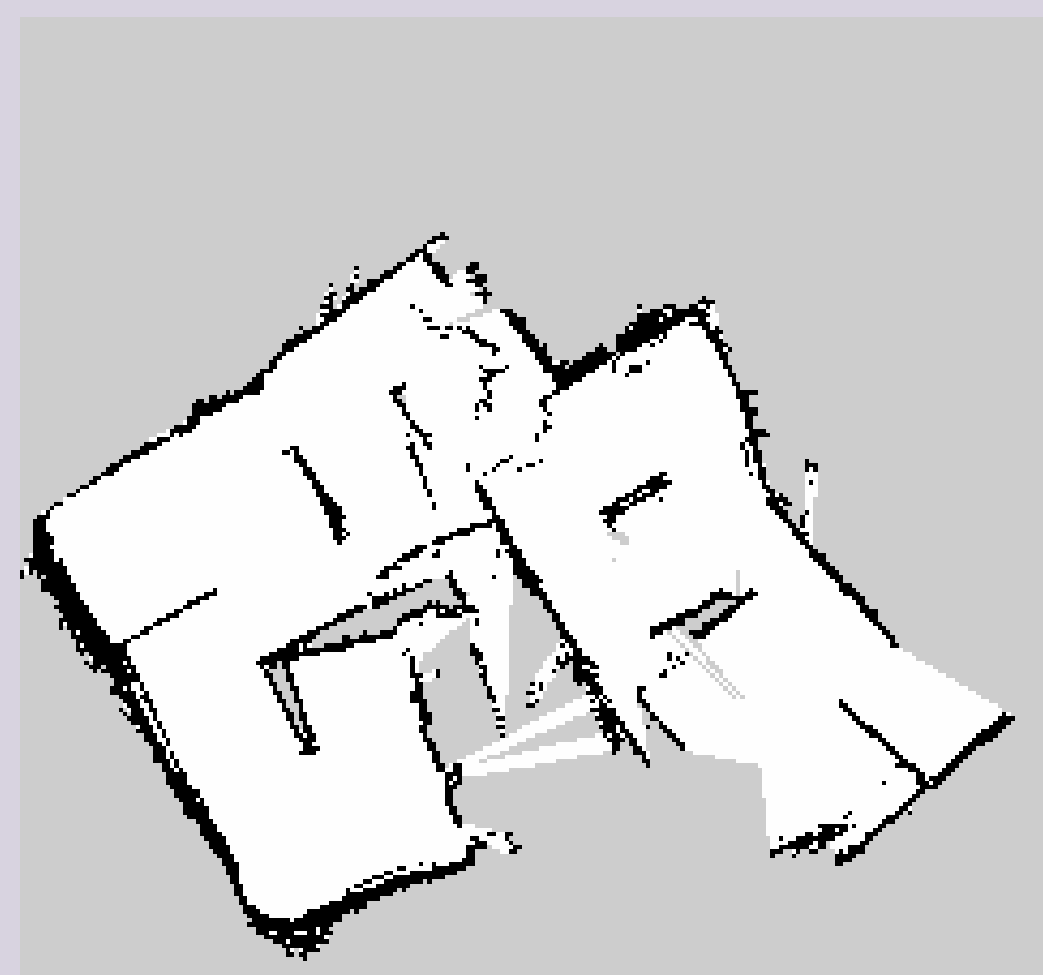
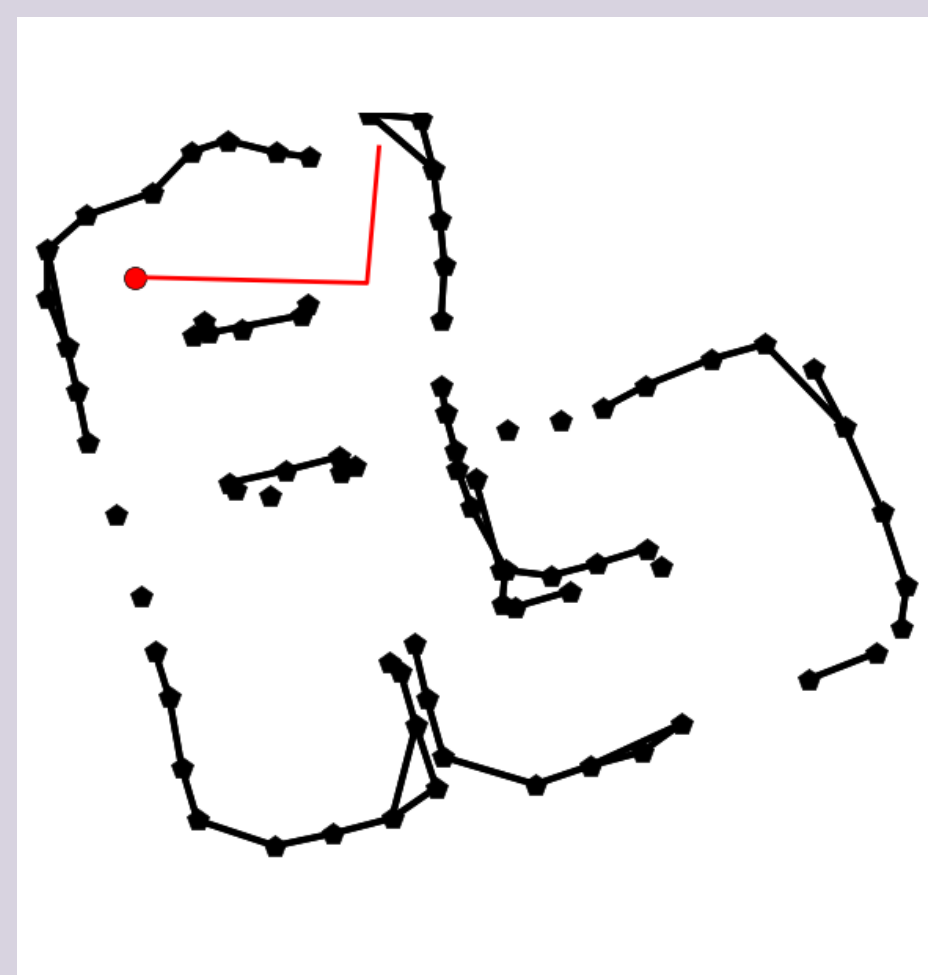
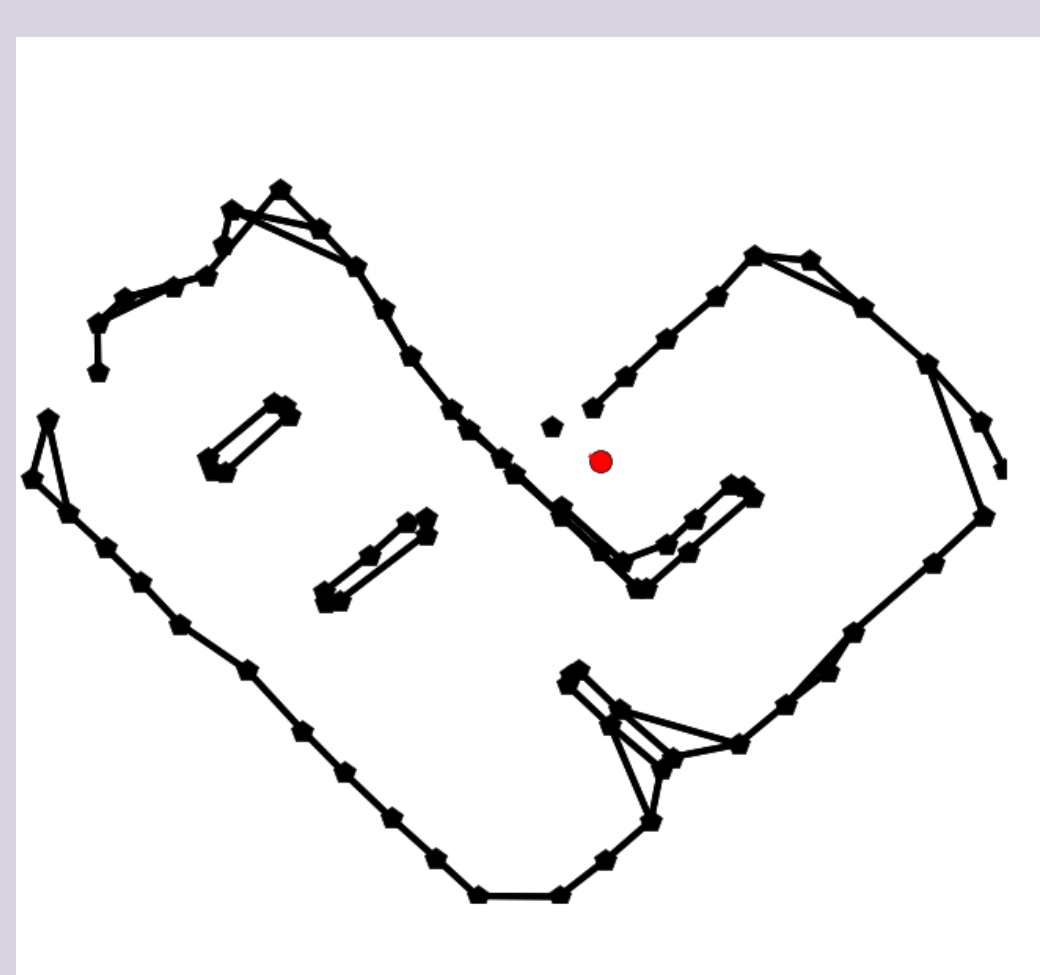


Path Planning

- Select **goal point** with maximal info gain
- Compute travelability between samples
 - Closed form feasibility check
 - Cost reflect uncertainty of map
- Probabilistic Roadmap (PRM)
- Replan if
 - Significant new info
 - new obstacle



Results Comparison



TFG Active SLAM
 • Real-time
 • Most accurate

Human operated
 • Imprecise
 • missed obstacles

gmapping
 • Magnitude slower
 • Significant drift under disturbance

Hardware

