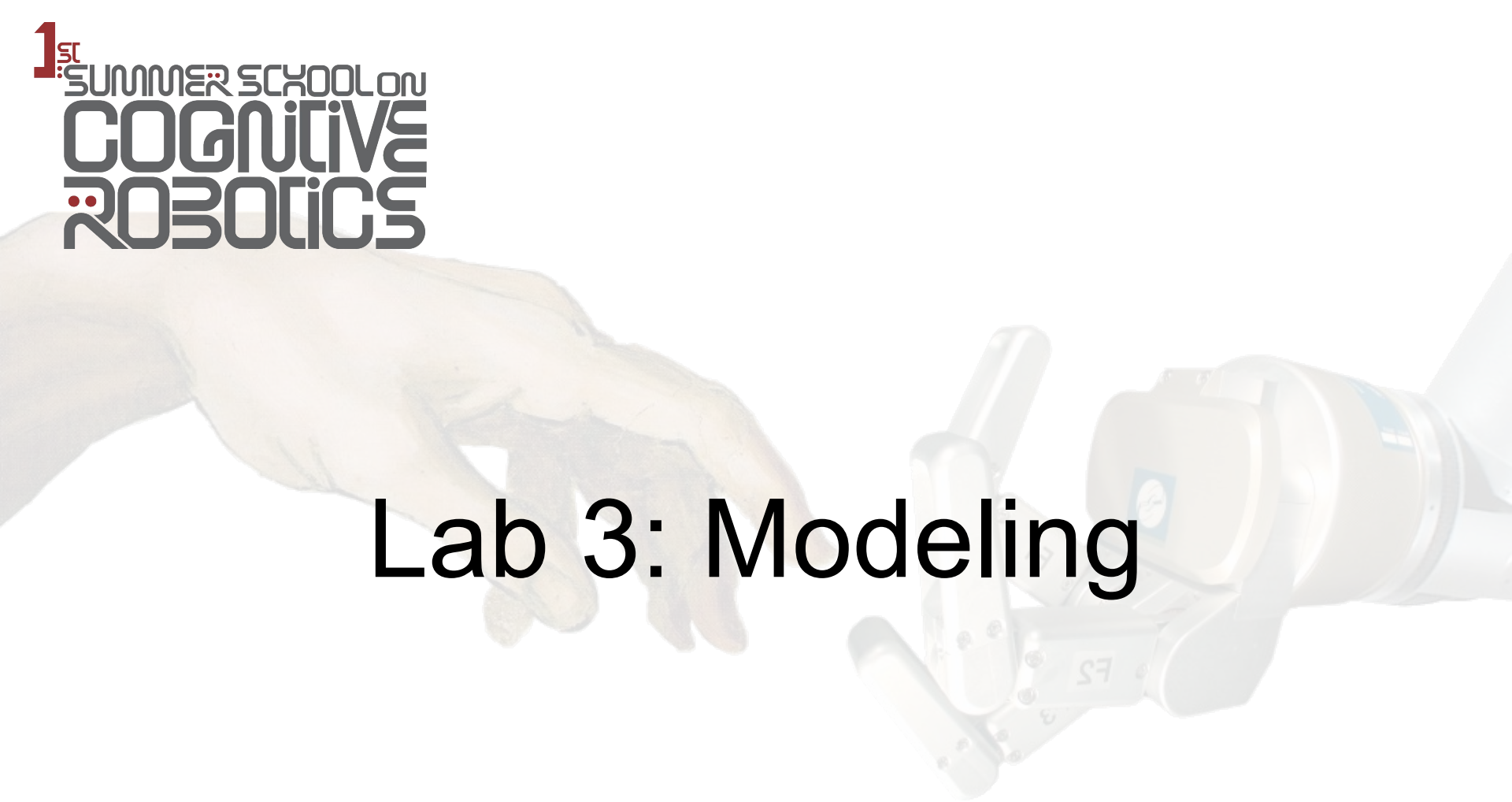
1st Summer School on Cognitive Robotics

Lab 3: Modeling



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Tutorials and Labs

1st SUMMER SCHOOL on COGNITIVE ROBOTICS
MERS Model-based Embedded & Robotic Systems group CSAIL@MIT

Day 1: Robust Execution
Introduction 1: Architectures for Autonomy
Tutorial 2: Self-Monitoring, Self-Diagnosing Systems
Tutorial 3: Temporal Networks for Dynamic Scheduling

Lab: Enterprise/ROS Familiarization and Robust Execution

Day 2: Motion Planning
Tutorial 4: Sampling-based Motion Planning
Tutorial 5: Single-Robot and Multi-Robot Path Planning with Quality Guarantees
Tutorial 6: Trajectory Optimization for Underactuated Robots

Lab: Incorporating Trajectory Planning for Autonomous Vehicles

Day 3: Activity Planning
Tutorial 7: Classical Planning@Robotics: Methods and Challenges
Tutorial 8: Planning in Hybrid Domains
Tutorial 9: Planning of Concurrent Timelines

Lab: Incorporating Activity Planning

Day 4: Perception and Manipulation
Tutorial 10: Multi-vehicle Routing with Time Windows
Tutorial 11: Generative Models for Perception
Tutorial 12: Fundamentals of Robotic Manipulation and Grasping

Lab: Manipulation and Multi-vehicle Routing

Day 5: Planning with Uncertainty and Risk
Tutorial 13: Probabilistic Planning
Tutorial 14: Localization and Mapping
Tutorial 15: Risk-bounded Planning and Scheduling

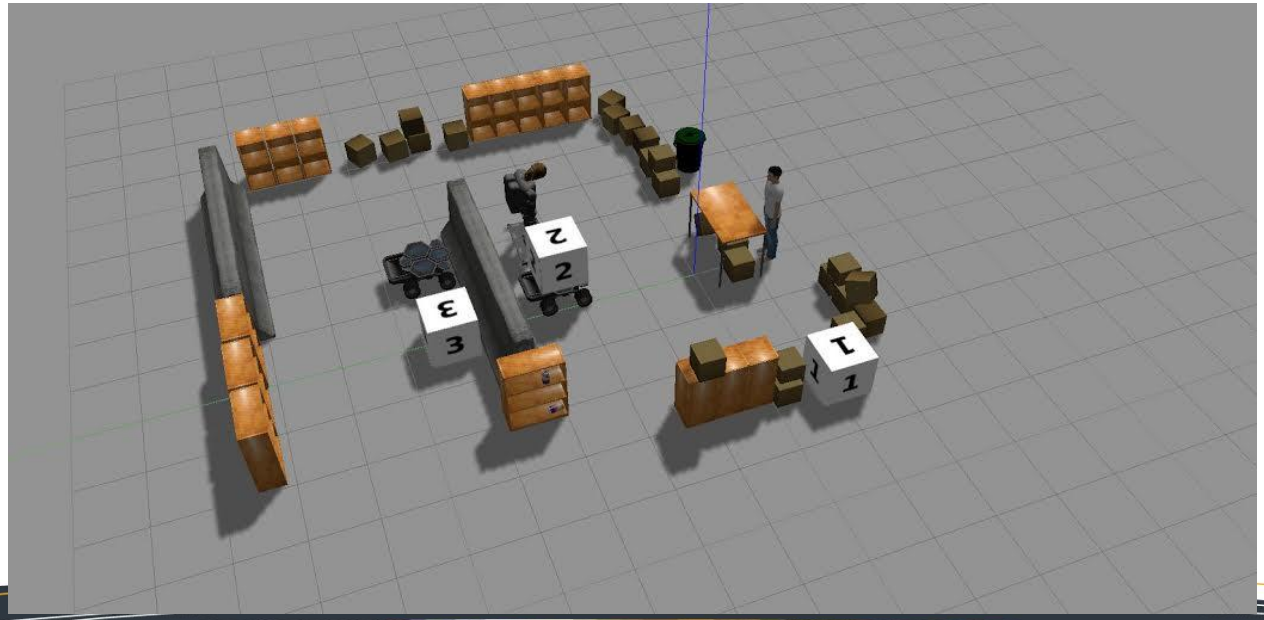
Lab: Challenge. And all comes together ….

Objective

- Today's lab will be a program modeling challenge that is similar to other modeling competitions.
- Teams can have up to **6 people**.
- There will be **3 different modeling challenges**.
- Submit your domain/problem files by **midnight today.**
- **Winners** will be chosen based on how fast our solvers are able to find an answer using your model.

Problem 1: Modelling in RMPL

- Model the same scenario of lab 1 in RMPL
- Objects with properties, and actions with duration, condition, effect defined using these properties



Scenario

- Three numbered blocks, 1,2 and 3.
- Take pictures for different set of blocks? No more scripts!
- Model the world in RMPL, and only specify goals each time

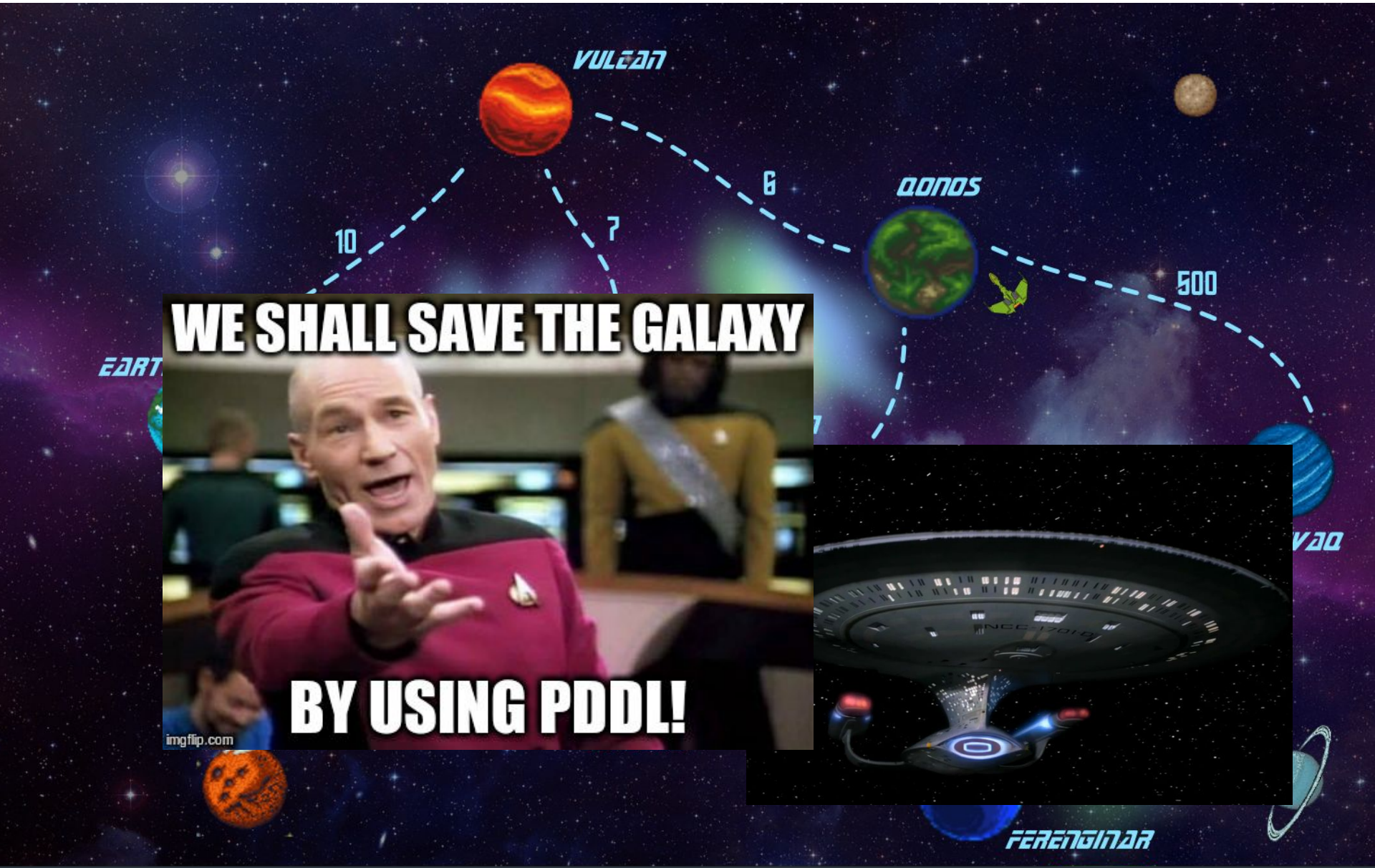
Assume that robot is a uav:

- the photo can be taken when uav is above the block
- orientation of the robot when taking photos does not matter.

Requirement

- Photos taken for some numbered-blocks of your choice.
- Go back to the original home-location for the robot.

Problem 2: Star Trek in PDDL!



Star Trek in PDDL

Your Task: Rescue planet Levaq.

Your Tools: PDDL Planners

Your Reward: Captainship of your own galaxy-class star ship.

Star Trek in PDDL

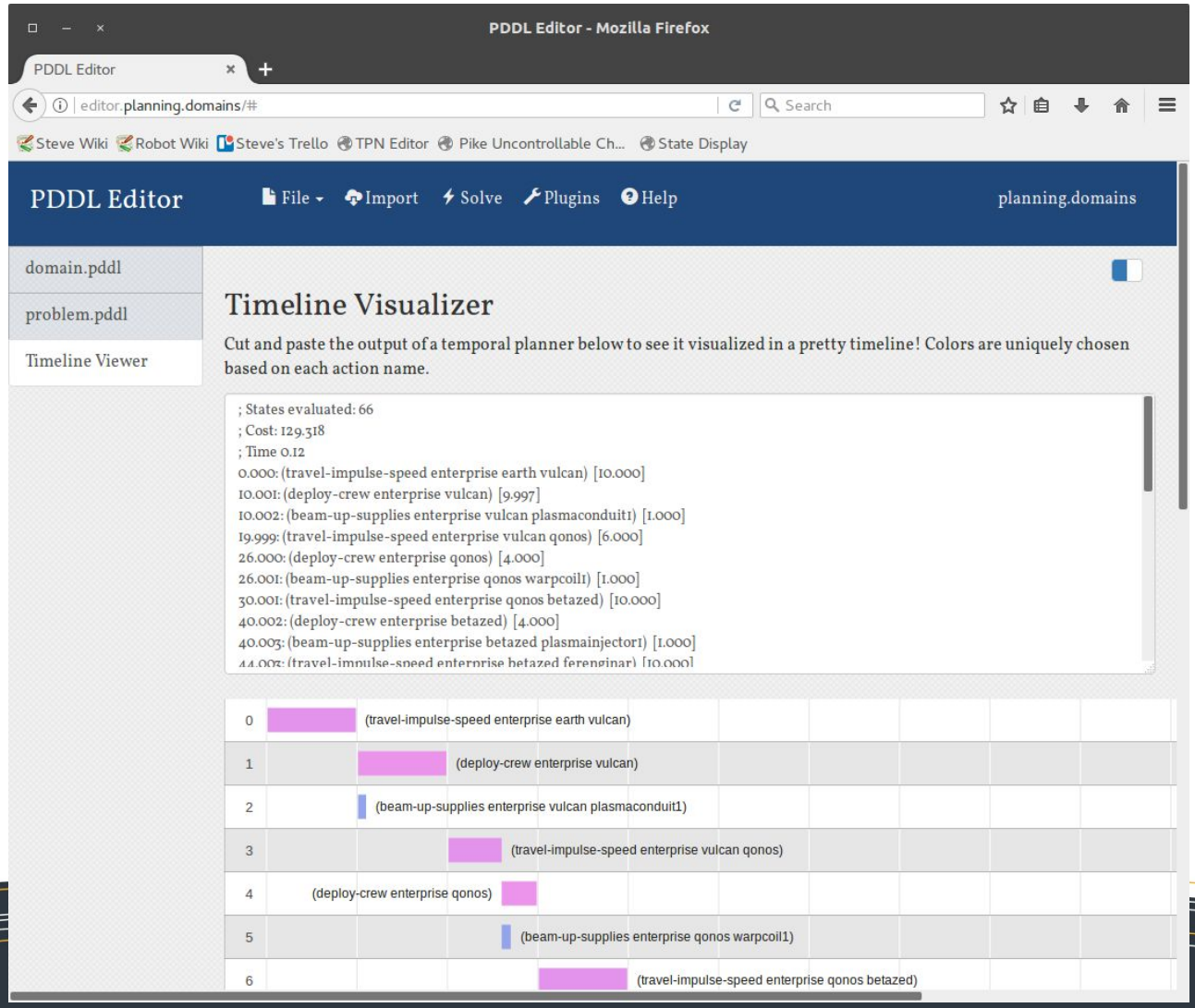
General goals:

- Fly around galaxy, collecting parts to build a warp drive
- Construct the warp drive (blocksworld-like challenge)
- Rescue Levaq by the deadline

Planner: Optic (Planning Research Group @ King's College London)

Suggested Editor / Visualizer: http://editor.planning.domains/ + temporal plugin

editor.planning.domains



Problem 3: Autonomous Exploration of Mars

In this task you will use the **Scotty** mixed discrete-continuous activity planner to design plans for the autonomous exploration of Mars regions using a rover and a quadcopter.

Description of the task:

- Take pictures of four regions that can only be accessed with the quadcopter
- The rover and the quadcopter need to end at the dock region
- The quadcopter can only be within distance d of the rover

Scotty planner

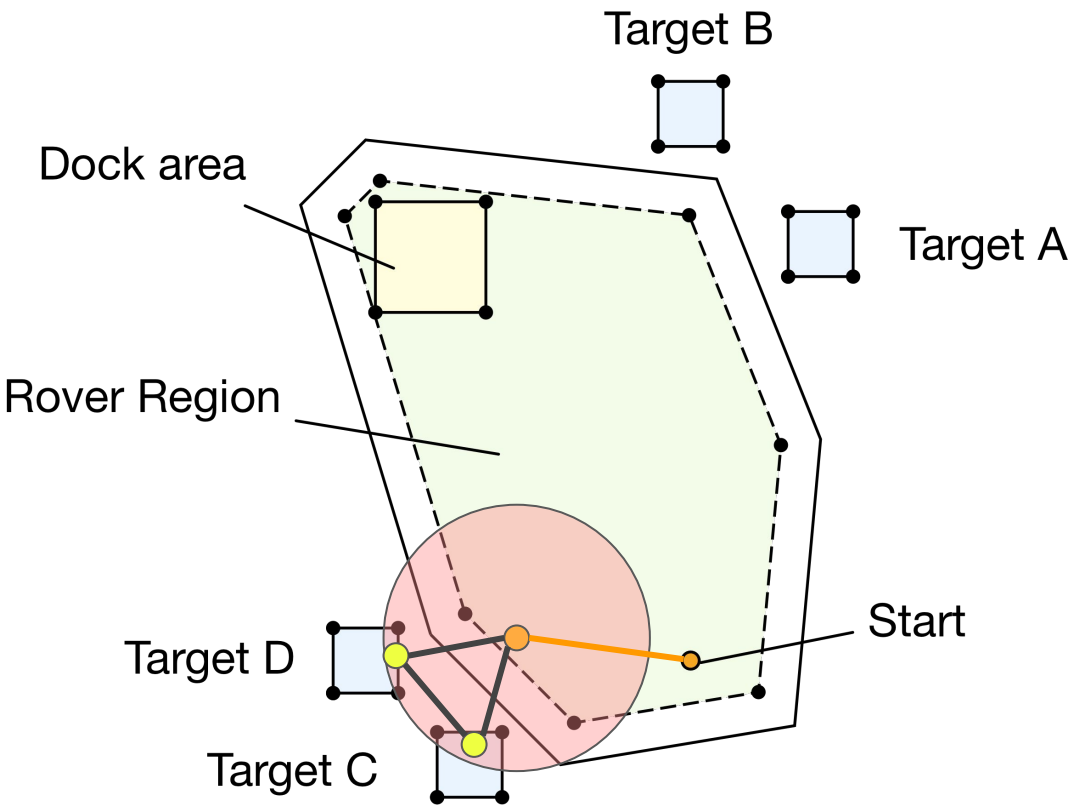
Mixed discrete-continuous activity planner (hybrid planner) that supports control variables.

Scotty decides:

- What activities to do
- When to schedule them
- The trajectories for the vehicles

(Fernandez et al, IJCAI-15)
(Fernandez et al, AAAI-17)

Autonomous Exploration of Mars



Problem 3: Demo

Scotty with example problem that can be run off the shelf:

http://mers-helm.csail.mit.edu:5000

Starting point for Problem 3

http://mers-helm.csail.mit.edu:5000/mars

Getting Started

- To get started, run **`update-vm`** from within your VM to fetch all the latest files.
- Inside the **`lab-3`** folder, you'll find descriptions of all the problems as well as sample domain/model files that you can use to test the solvers.
- Good luck!