Towards a Low-Level Perceptual System for Soar

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Soar Workshop 29

Introduction

- Motivation: Soar in robotics domains
  - Explore continuous space, use sensors, avoid obstacles, remember places
- Besides planning and learning, now need to deal with perception
- How does this connect to the existing Soar architecture?
- What can we build now to support research?

Outline

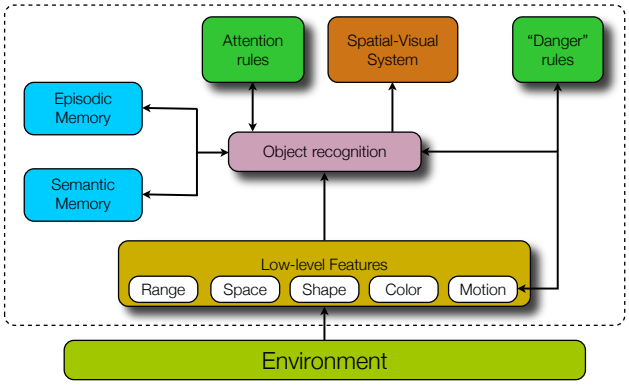
- Connecting to the existing Soar framework
- Implementating a perceptual system
- Goals
- Nuggets/Coal

A Soar Cognitive Robot

"Begin at the park, and explore until you reach a blue building beside a tree. Go to the object in front of the tree. Return to your starting location."

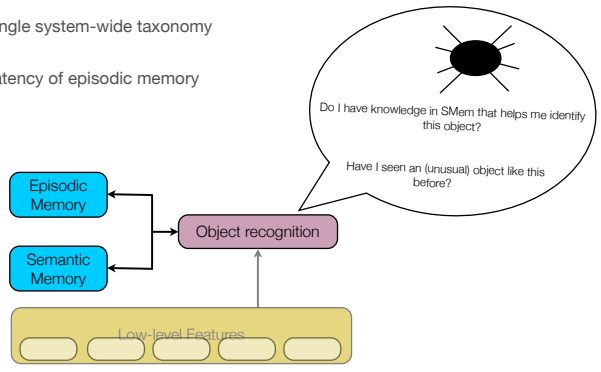
- Explore continuous space
- Use sensors
- Avoid obstacles
- Remember places

Perception and the Soar Framework



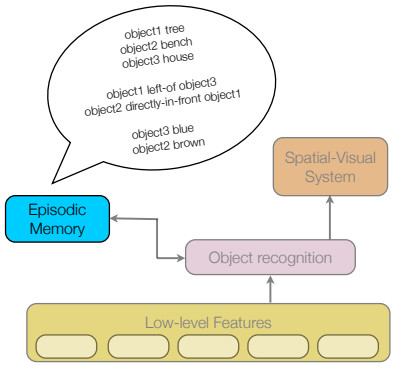
Semantic Memory: Identifying/Classifying Objects

- Single system-wide taxonomy
- Latency of episodic memory

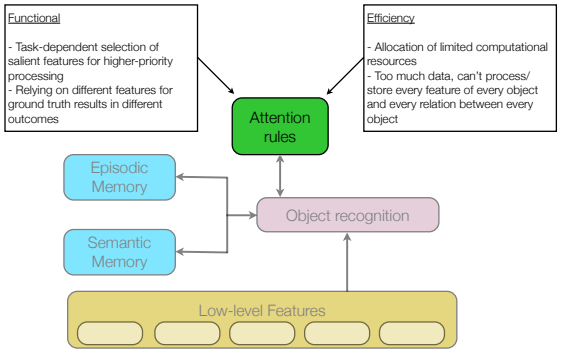


Episodic Memory: Remembering/Recognizing Places

- Object names/categories
- Spatial relations between objects
- Low-level features
  - Visual memory is surprisingly detailed
  - For recreating object in mental imagery later

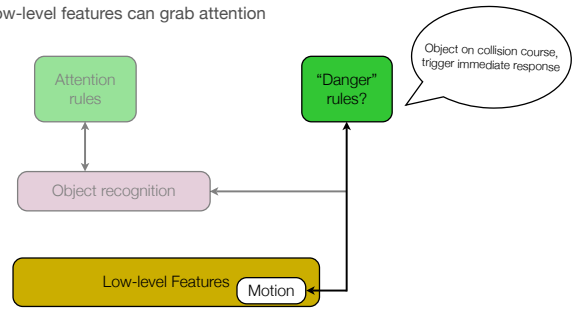


The Role of Attention



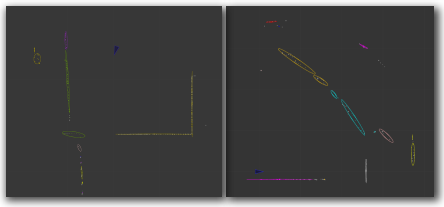
Threat Perception

- Not all perception is conscious: human dual-vision system
- Low-level features can grab attention



Implementation: LIDAR

- SplinterSoar platform: Splinter robot + SICK LIDAR scanner
  - 180 laser range scans agglomerated into N sectors
- Simple object tracking from LIDAR scans

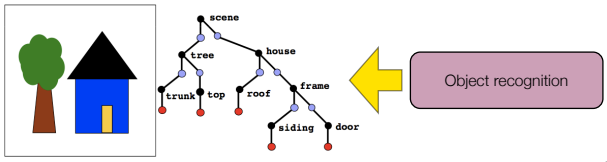


Implementation: Vision

- Webcams + CamUnits capture library + OpenCV computer vision library
- Ongoing: Implement detection of basic features we think are useful
  1. Color, shape, motion
  2. Face detection/recognition
  3. Depth estimation (using 2 webcams)
- Next, object recognition module
  - Bind color and shape, estimate object spatial relations

Implementation: Immediate Obstacles

- SVS currently represents world as scene graph
  - How to derive object (and object-part) relations?
- What about volumes of free space?
  - May be more useful for motion planning and obstacle avoidance



Goals and Directions

- Immediate:
  - Implement system for capturing and interpreting real-world perceptual data for Soar agent controlling robots
- Longer-term questions:
  - Attention: Which features are salient for the task? Guide the “gaze” of our sensors to simulate “active vision” and minimize unnecessary computation?
  - Encoding: How many abstraction layers does perceptual information filter through? Where do bottom-up and top-down processes meet?

Finally...

- Nuggets:
  - Connects Soar to the real world and enables a variety of robotic application domains
- Coal:
  - Which features to use? Will be somewhat arbitrary to begin with...

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