Improving Robot Learning from Feedback and Demonstration using Natural Language

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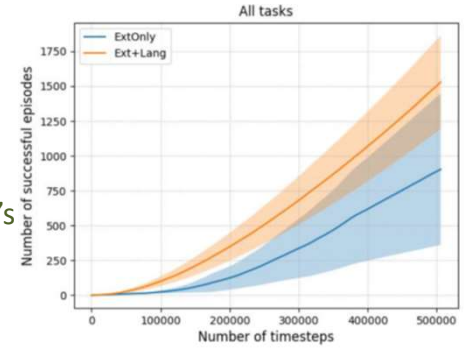
Goal: Augment robot learning from feedback and/or demonstration by allowing a human teacher to describe what they are doing in natural language, in order to provide context, clarification, and/or explanations for their evaluations or actions; thereby allowing more effective generalization from limited training examples.

- Methods needed to allow novice human users to easily train robots to perform novel tasks in new environments.
- Extant learning from user feedback and demonstration can fail to properly generalize from limited training data.
- Natural language narration can focus attention and support more effective generalization.
- Develop algorithms for improving robot training by integrating ideas from language grounding, explanation for deep learning, and learning from rationales.
- Develop methods for grounding natural language in a robot's perceptions, utilizing our prior work on video captioning and multi-modal linguistic grounding .

Approach:

1. **Use language as supervised attention:** Map linguistic narration to a saliency map over the perceptual field using methods for visually explaining the processing of a learned language-grounding network, then use this saliency map to supervise the attention mechanism of a deep reinforcement-learning network that learns from feedback and/or demonstration.
2. **Use language as reward shaping**: Map linguistic instructions to intermediate rewards that can be easily integrated into any reinforcement-learning method.

Preliminary experimental results on linguistic reward shaping for improving reinforcement learning in "Montezuma's Revenge" Atari game.



Societal Impact:

- Accelerate robot deployment in homes and workplaces by allowing novice users to train them to perform novel tasks.
- Enrich the lives of the elderly and disabled, and perform difficult, mundane, or dangerous tasks.

Educational Impact:

- Enhance graduate courses in Robotics and Natural Language Processing.
- Improve undergraduate research experience through UT's Freshman Research Initiative.
- Contribute to First Bytes, UT's week-long summer program that introduces female high school students to CS.

Measuring Impact:

- Experimentally evaluate reduction in training time required for a novice user to teach a robot to perform a novel task by comparing existing methods for learning from feedback and demonstration to our natural-language enhanced approach.

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