Many countries are experiencing a shortage of healthcare professionals. There are different economic and cultural factors that have led to this shortage, but two primary reasons are an aging population with increasing demands on the health care system, and an accompanying growth in the number and kinds of activities that caregivers must provide. Robotic assistive technology is appealing as a way to alleviate the strain on such resources, since autonomous mobile robots can be readily used in a wide range of settings. Nursing duties vary from basic tasks such as monitoring, walking assistance and medication reminding to complex tasks such as patient health assessment and treatment programs. While no technology will ever replace human caregiving, robotic assistive technology is particularly well-suited for basic, repetitive tasks such as monitoring and walking assistance. Augmenting caregivers with robotic assistants may allow us to better use our existing resources.

Our Approach

- **POMDP framework:** a Bayesian approach to model uncertainty (solved approximately using Bayes risk).
  - The agent is aware of its model uncertainty.
- **Meta-queries:** Ask for policy information when confused.
  - The agent can actively reduce model uncertainty.
- **Resulting approach:** combines Bayesian and inverse reinforcement learning to robustly learn the reward, transition, and observation models simultaneously.

**Asking for Help:** Policy Queries

We ask for help because:
- Agent does not need to take large risks to determine that a particular decision may be poor.
- User only needs to provide reinforcement when the agent is sufficiently confused.
  - ...plus allows us to provide bounds on performance throughout the learning process!

Questions of the form:
- “I think you might want to go to the printer. Should I go to the printer?”
- “I’m certain you want to go to the printer. Should I go to the printer?”
- “Instead, should I ask for you to confirm your location?”

Ask these questions to determine the correct action; thus a query results in discovering the optimal action.

**Agenda**

- **Reinforcement Learning Paradigm**
  - Agent performs actions, receives observations and rewards.
  - Assume a Markov world; world dynamics consists of reward R(s,a), transition T(s'|s,a) and observation O(s|a) models.
- **Problems with the Traditional Framework**
  - Must make mistakes to learn.
  - Aside from competence and coverage, no reasoning about partial information.
  - Format of required reinforcement may be unnatural.

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