Active Reward Learning with Comparative Language Feedback

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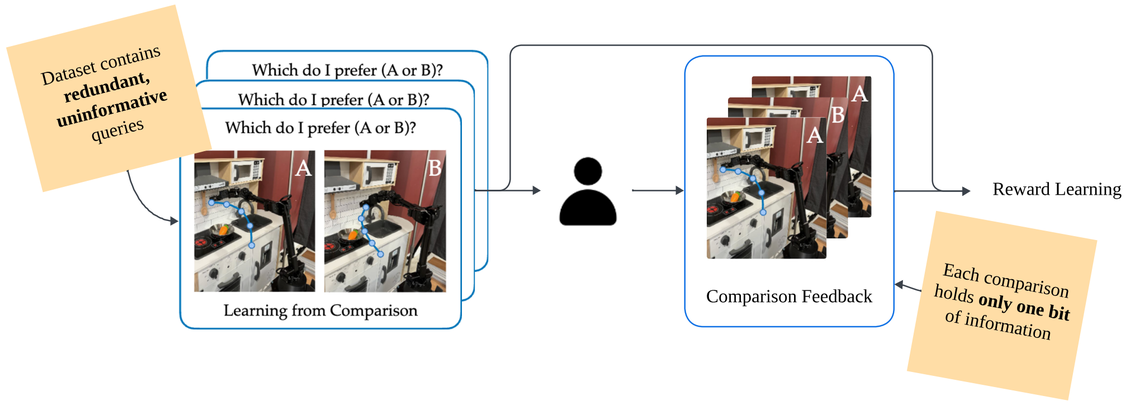
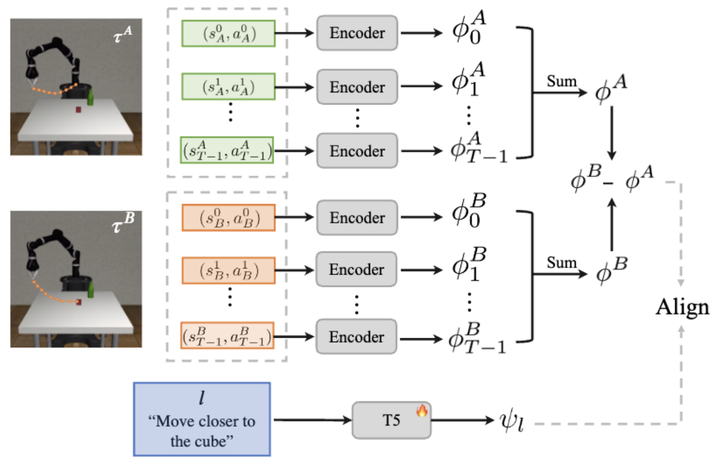
Our framework enables integrating Language Feedback for Active Reward Learning

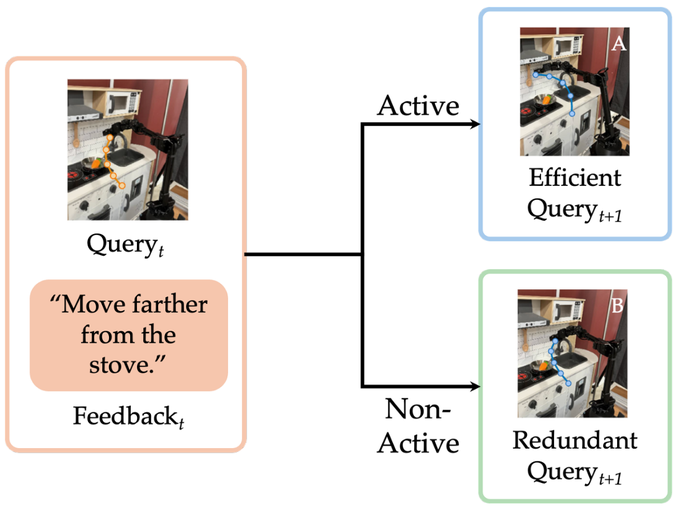
Naïve Reward Learning



Language Reward Learning



Language Active Reward Learning



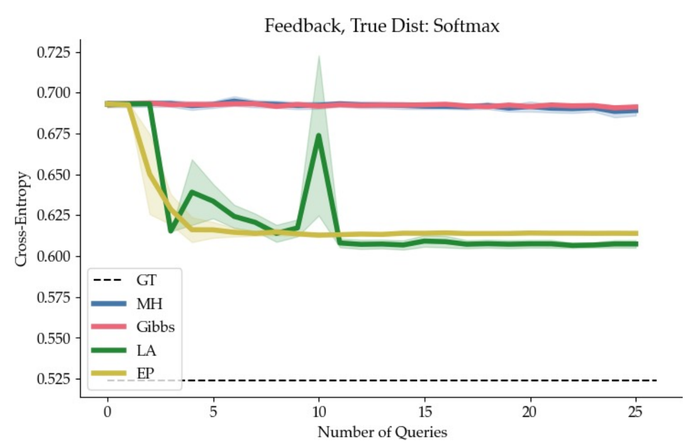
Algorithm 1 Active Learning Pseudocode

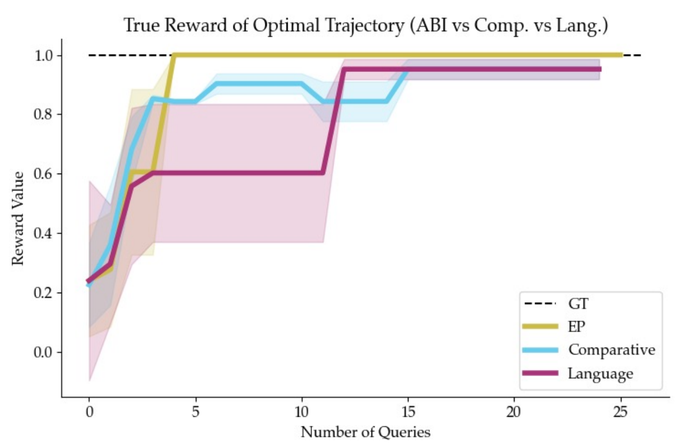
Require: $\mathcal{L}, \mathcal{T}, \text{fUpdater}(), \text{gUpdater}(), \text{infoGain}(), \epsilon$
$f = \mathcal{N}(\mathbf{0}_{512}, \mathbf{I}_{512})$ and $g = \mathcal{N}(\mathbf{0}_{512}, \mathbf{I}_{512})$
$\{\omega\}_{i=1}^m \sim f$ and $\mathbf{Q} = \{\}$
Score $= \infty$
while Score $> \epsilon$ **do**
  $f \leftarrow \text{fUpdater}(f, Q)$ and $\{\omega\}_{i=1}^m \sim f$
  $g \leftarrow \text{gUpdater}(g, Q, \{\omega\}_{i=1}^m)$ and $\{l\}_{i=1}^n \sim g$
  τ, Score $\leftarrow \text{infoGain}(\{\omega\}_{i=1}^m, \{l\}_{i=1}^n, \mathcal{L}, \mathcal{T})$
  Query the human with τ and receive l
  Append $\{\tau, l\}$ to $\mathbf{Q}$
end while

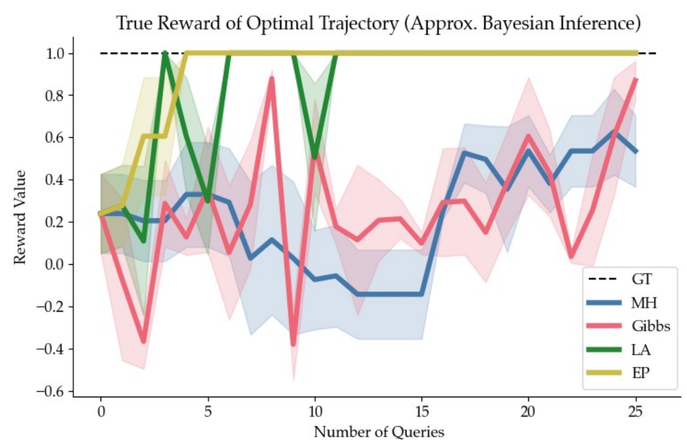
We experiment with four different Approx. Bayesian Inference methods:

- Metropolis-Hastings
- Stochastic Gibbs
- Laplace Approximation
- Expectation Propagation

Results and Key Insights







- We can learn a shared latent space between trajectories and language
- Using language feedback enables faster learning of the optimal reward function vs. comparison feedback
- Active Learning with language feedback enables extra speed up in terms of convergence

References

Tien, J., Yang, Z., Jun, M., Russell, S. J., Dragan, A., & Bıyık, E. (2024). Optimizing Robot Behavior via Comparative Language Feedback.

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