# **INQUIRE:** INteractive Querying for User-aware Informative REasoning Tesca Fitzgerald<sup>1</sup>, Pallavi Koppol<sup>2</sup>, Pat Callaghan<sup>2</sup>, Russell Wong<sup>2</sup>, Reid Simmons<sup>2</sup>, Oliver Kroemer<sup>2</sup>, Henny Admoni<sup>2</sup>

Goal:

<u>Optimize</u>

content

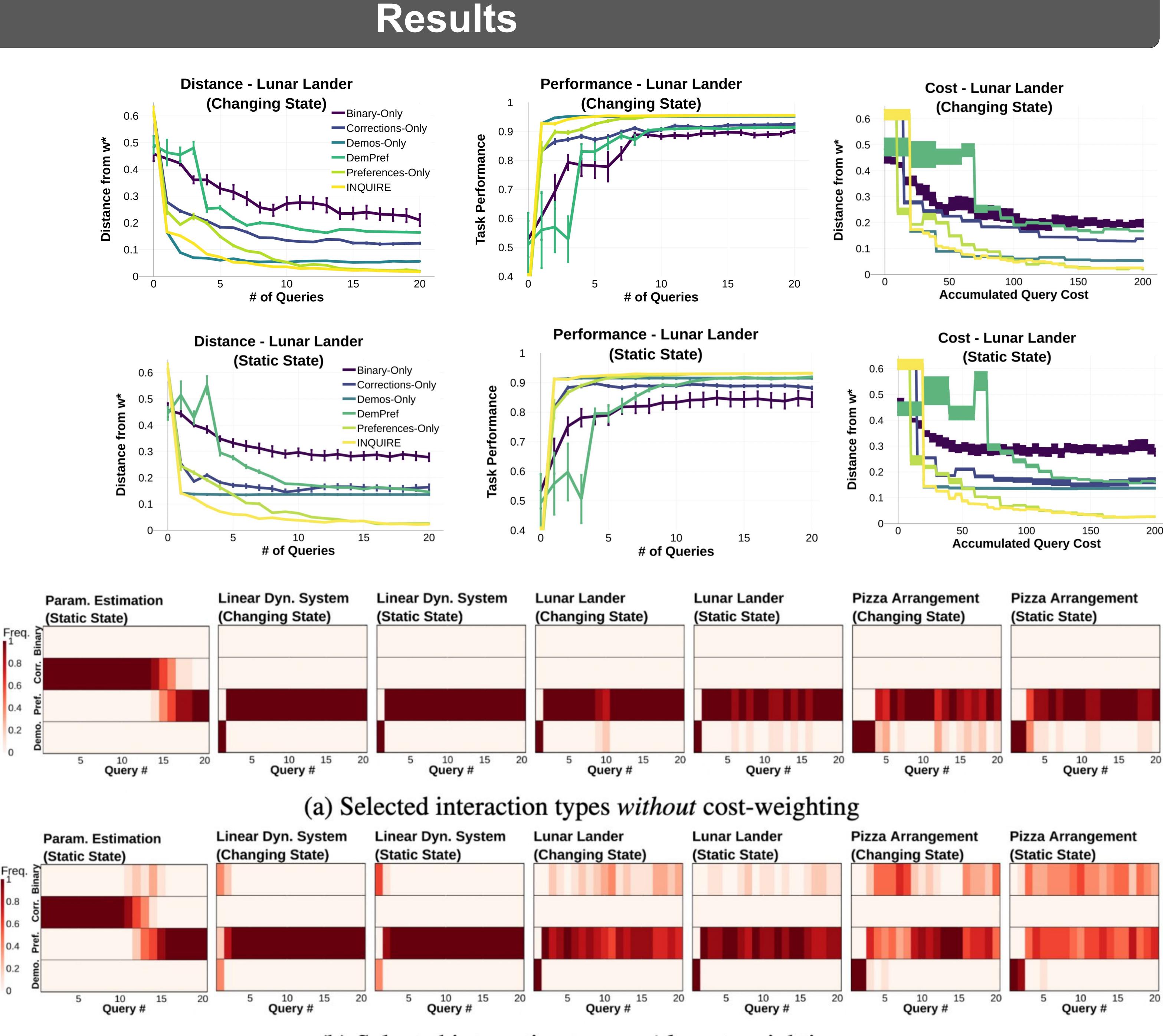
Summary

Robots can learn from many types of interaction: demonstrations, preferences, corrections, rewards, and more.

Instead of restricting robots to learn from one interaction type... > Can we enable the robot to select the most informative interaction based on what it knows and what state it's in?

### INQUIRE is a generalized model of information gain for multiple interaction types, resulting in:

- Faster learning compared to heuristic-based or single-interaction baselines
- Robust querying across high- and low-information states
- Cost-aware querying that balances informativeness with the teacher's time/effort to respond
- Varying the interaction type results in faster learning than fixed baselines:
- INQUIRE can accommodate low-information states better than baselines:
- INQUIRE can directly incorporate cost metrics to take advantage of "inexpensive" query types:



# <sup>1</sup>Yale University

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For maximally informative update

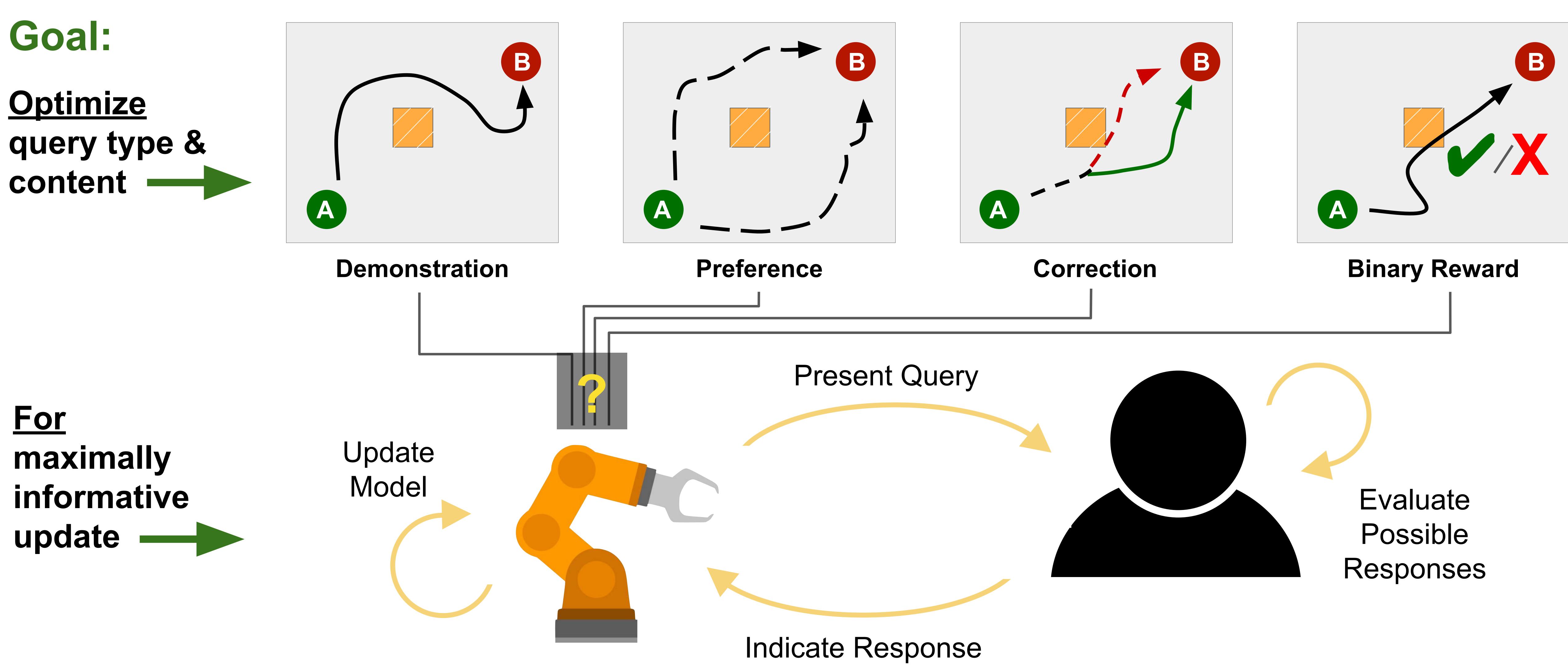
<u>Challenge</u>: All interaction types provide training data, but differ based on: Number of proposed actions by robot • Constraints on teacher's response

model distribution W

(b) Selected interaction types with cost-weighting

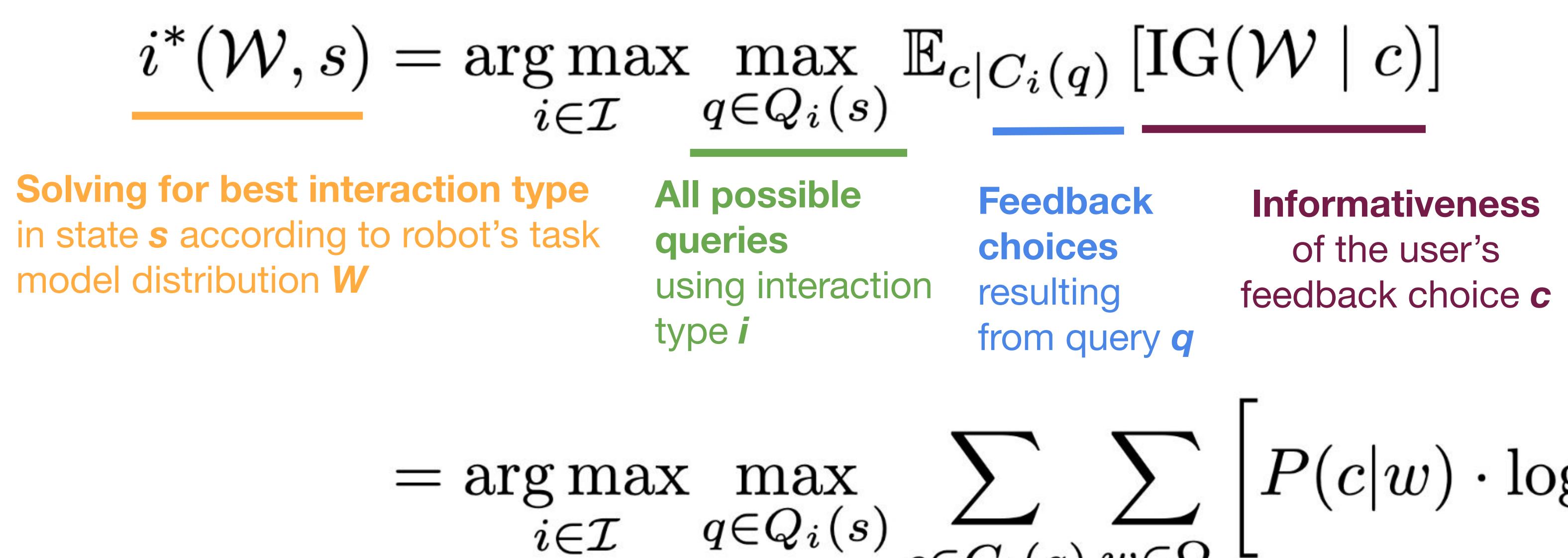
# <sup>2</sup>The Robotics Institute, Carnegie Mellon University

## **Problem Overview**



### Approach

 $c \in C_i(q) \ w \in \Omega^{\mathsf{L}}$ 





# Informativeness of the user's

P(c|w)· log – P(c|w')