Autonomous Capability Assessment of Sequential Decision-Making Systems in Stochastic Settings

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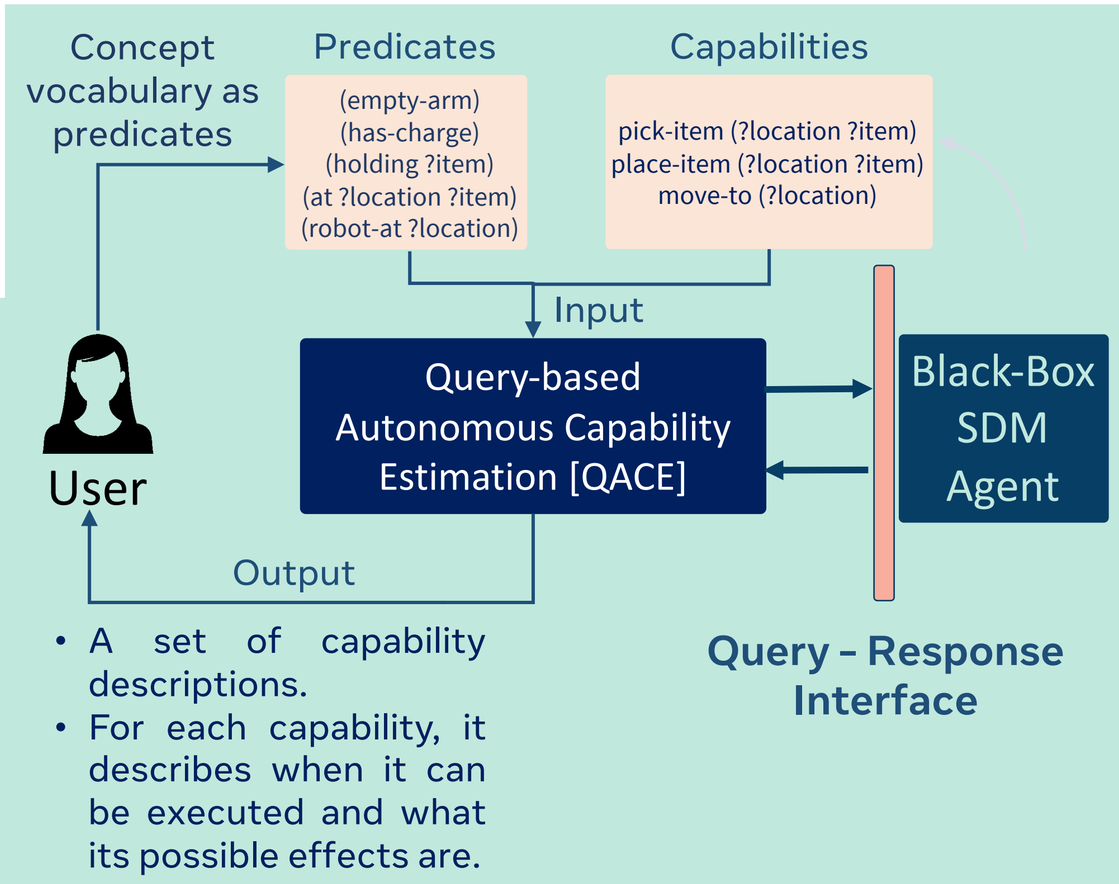
A new approach for independent assessment of the capabilities of AI systems that can plan and learn.

What is a capability?

- A high-level task that an SDMA can perform.
- Combination of multiple low-level functionalities of the SDMA.

Why learn capability descriptions?

- Easier to reason about in terms of capabilities than low-level functionalities.

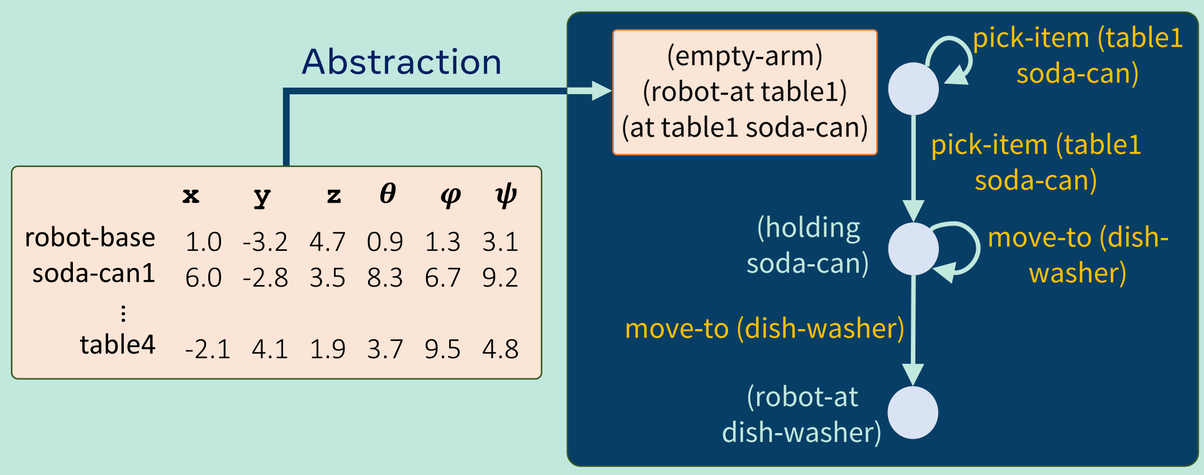


- A set of capability descriptions.
- For each capability, it describes when it can be executed and what its possible effects are.

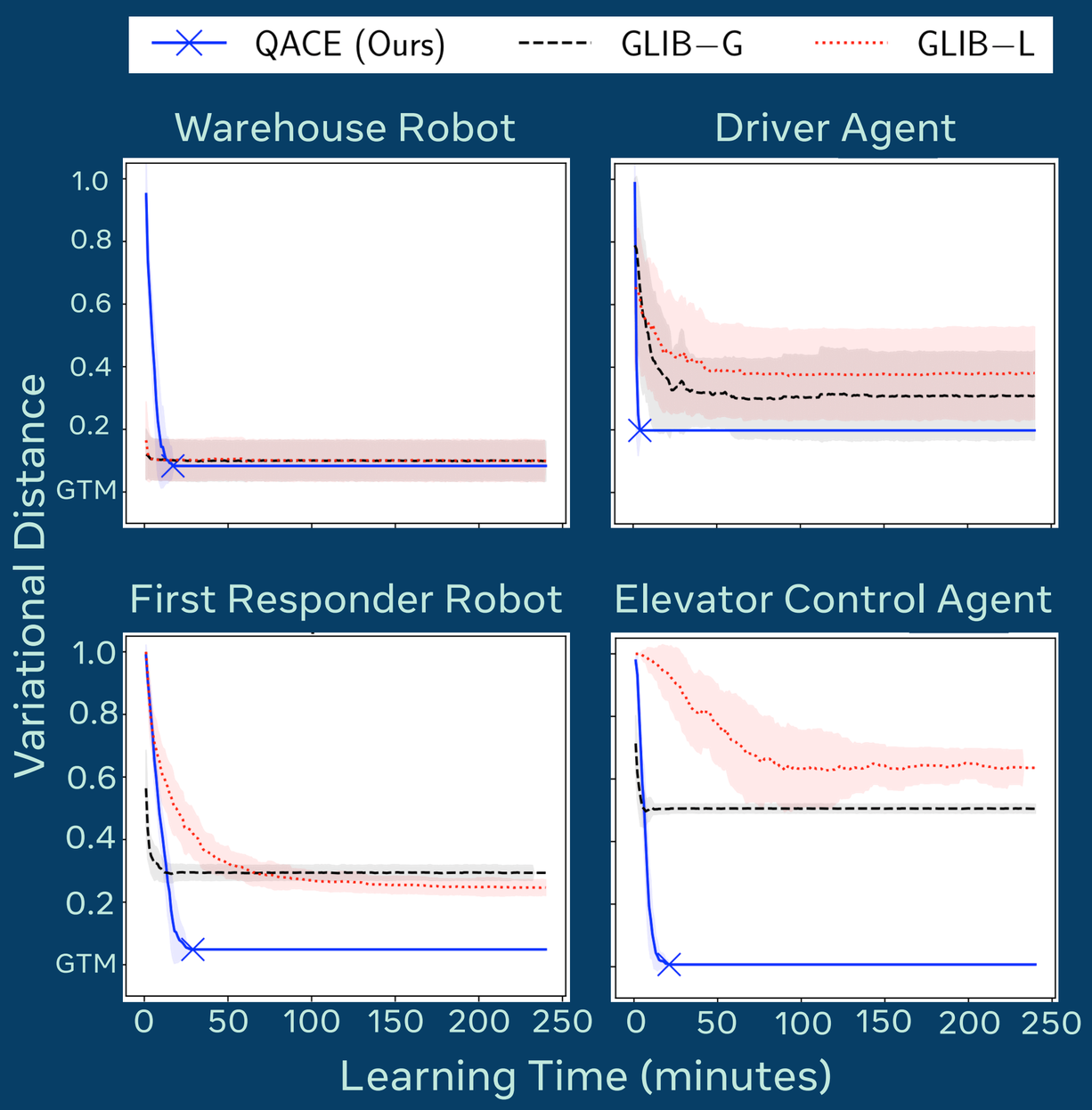
Query – Response Interface

- Puts minimal requirements on the SDM agent.

Example of a Query



QACE learns accurate models faster



- Sample Efficiency
- Faster Convergence
- Few Shot Generalization

Learned Capability Model

```
(:capability pick-item
 :parameters (?location ?item)
 :precondition (and
   (empty-arm) (has-charge)
   (robot-at ?location)
   (at ?location ?item))
 :effect (and (probabilistic
   0.7 (and (not (empty-arm))
            (not (at ?location ?item))
            (holding ?item))
   0.2 (and (not (has-charge)))
   0.1 (and)))              #No-change
```

Example of Learned Capability

- Easily convertible to natural language
- Supports generalization and transfer

Robot can pick an item at a location when:
- Its arm is empty.
- It has charge.
- It is at the location.
- The item is also at the same location.

After executing the action. With 70% probability:
- It is holding the item.
- Its arm is not empty.
- Item is not at that location.

With 20% probability:
- It will lose all its charge.

With 10% probability:
- The action will fail.

Theoretical Guarantees

- Learned model sound and complete w.r.t. the SDMA transition model.
- Learned model captures the correct distribution in the limit.

What Next?

- Discovering Capabilities.
- Using Capability Models to Make Task Transfer Sample Efficient.

Checkout these at GenPlan Workshop

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