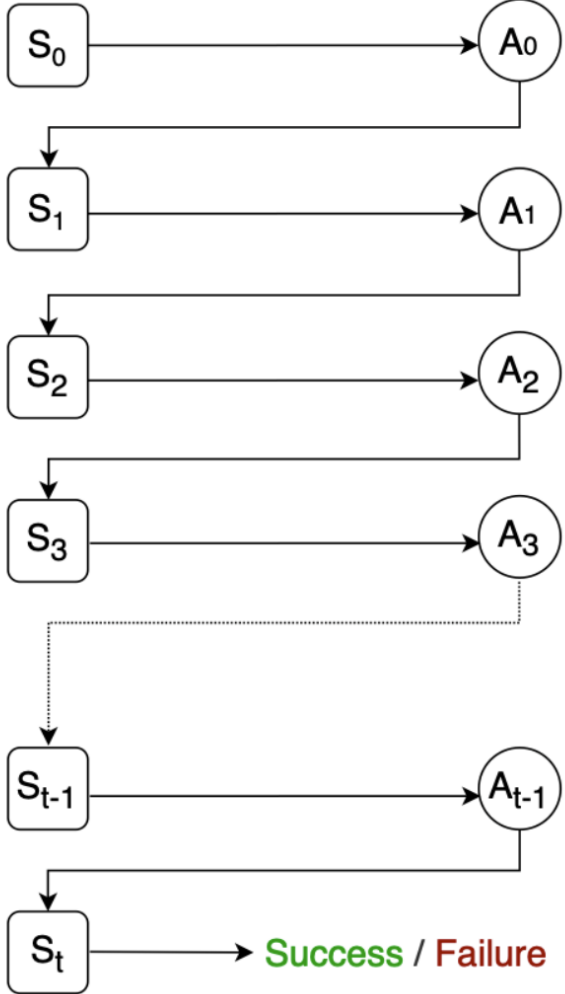
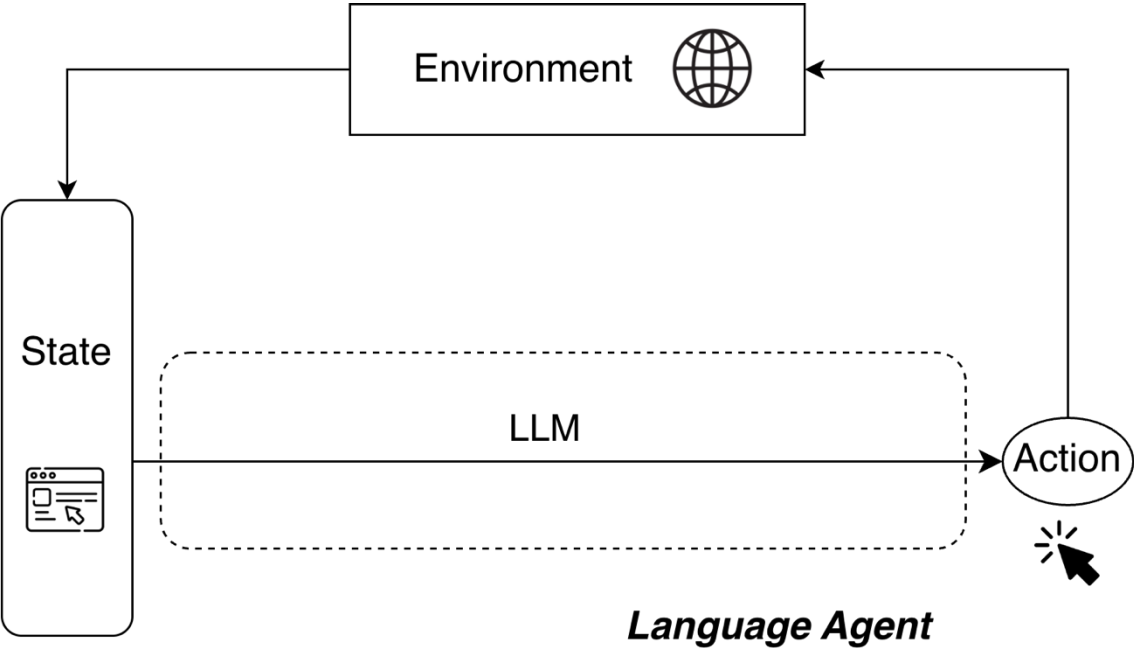
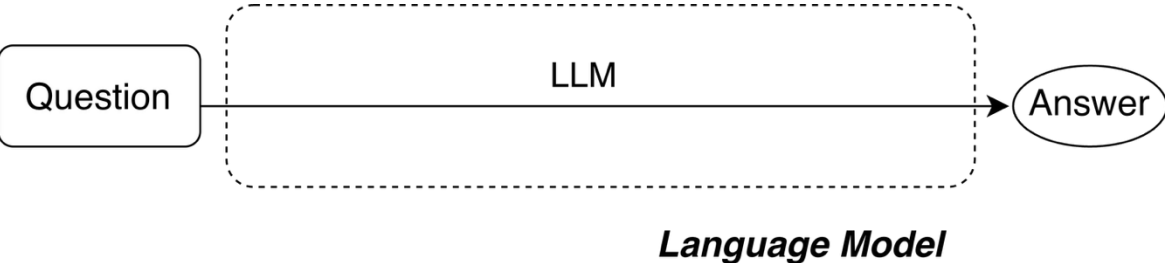


# AdaMEM: Test-Time Adaptive Memory for Language Agents

Yunxiang Zhang, Yiheng Li, Ali Payani, Lu Wang



# From Language Models to Language Agents

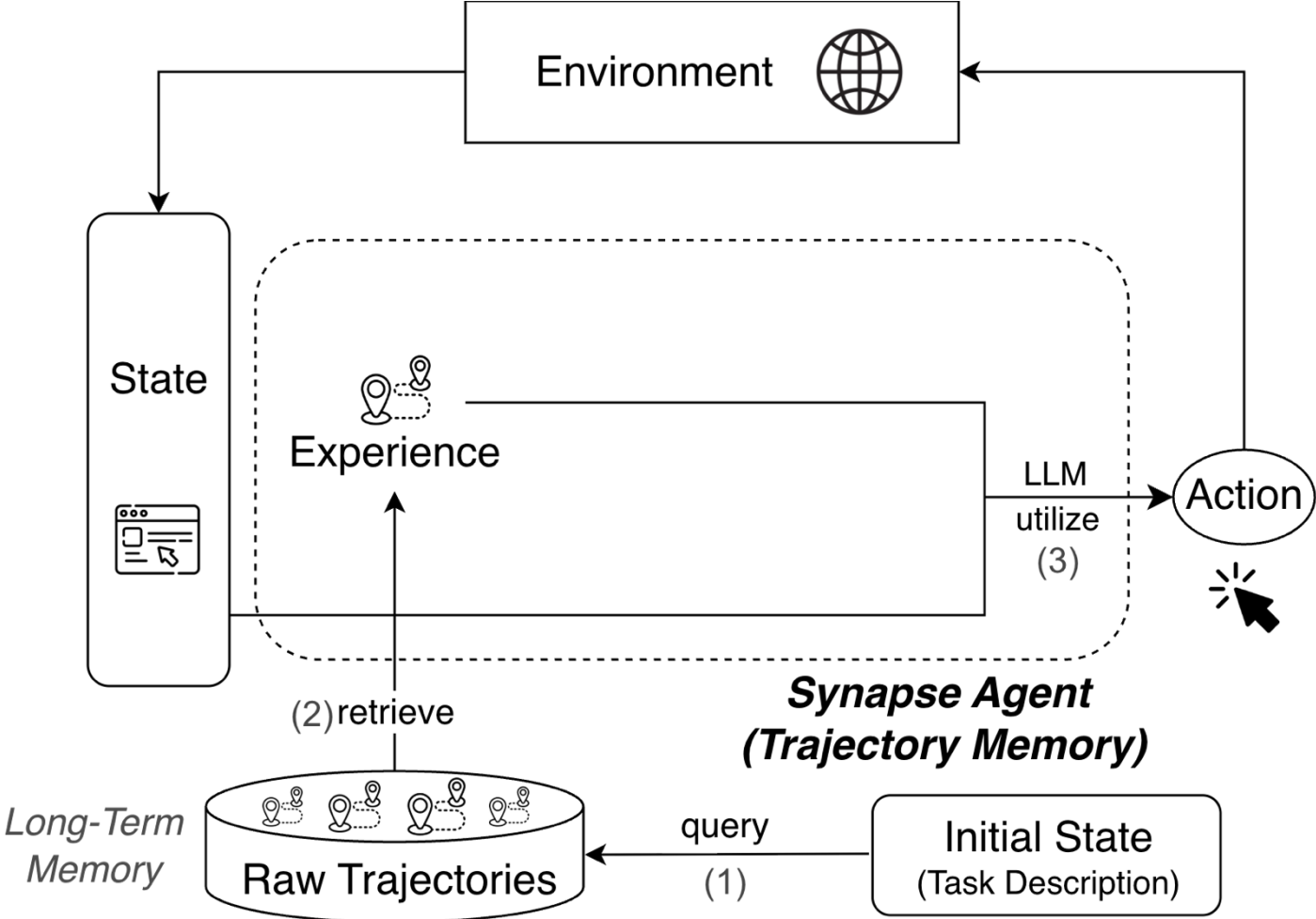


**S** State      **A** Action

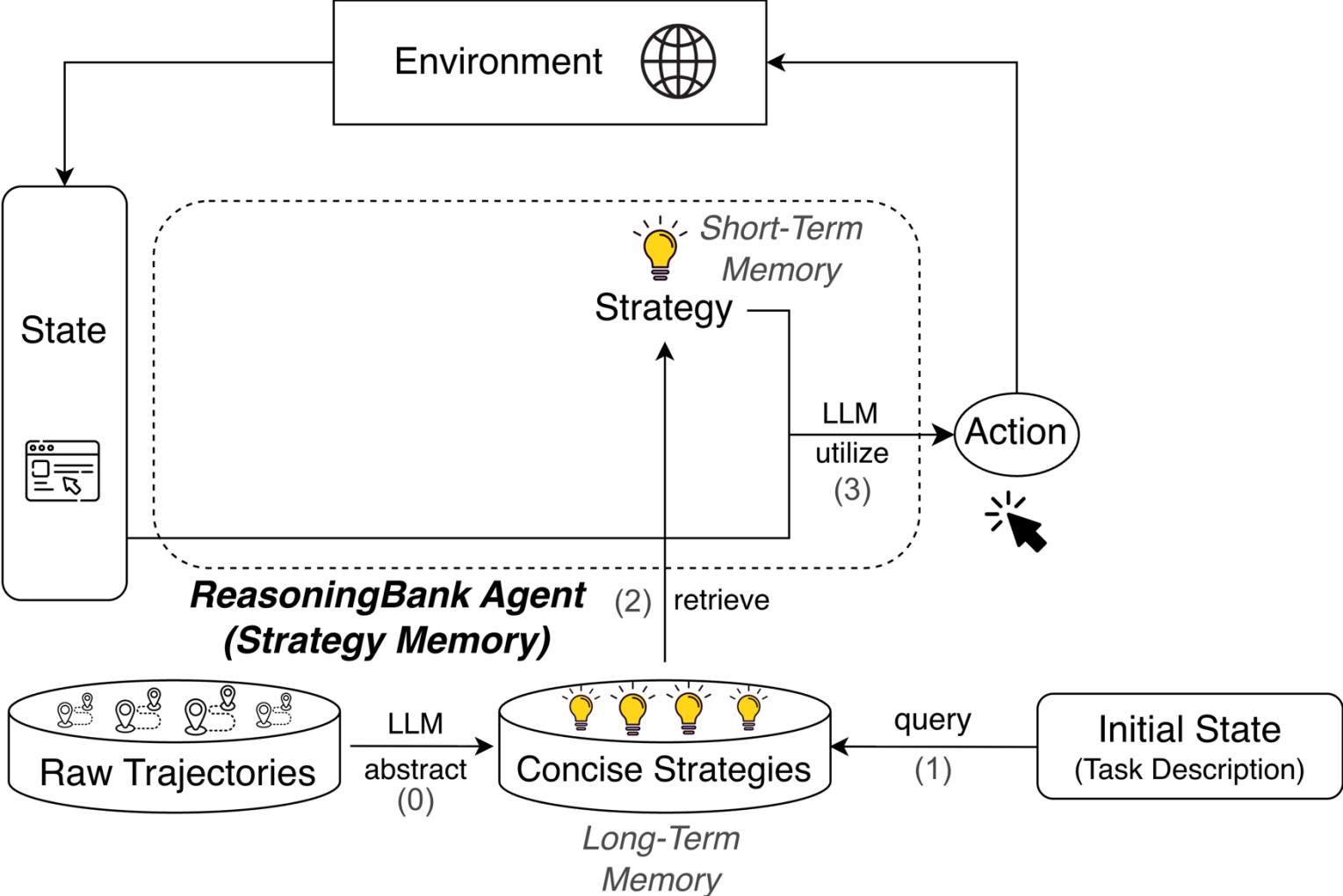
# Challenges

- Agents should learn from experience and adapt to new situations.
- Yet struggling with **Test-time adaptation**: the ability to effectively adjust strategies in dynamic environments during inference.

# Related Work: Trajectory Memory

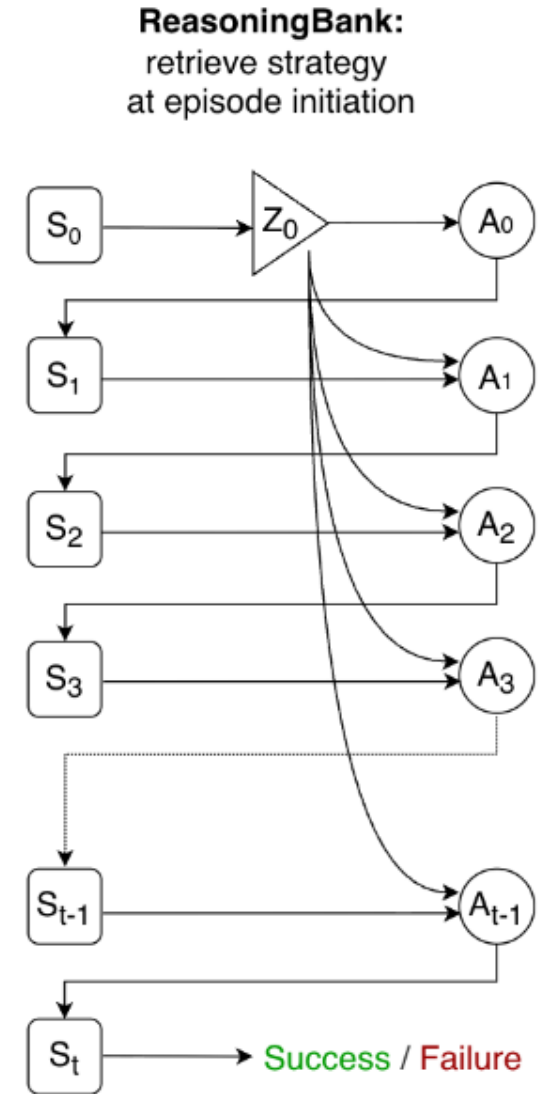
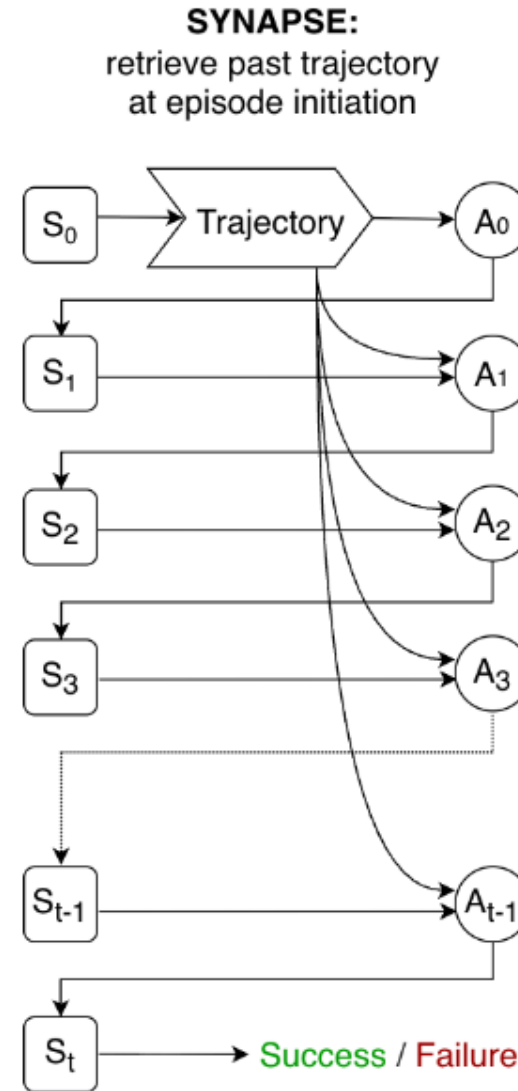


# Related Work: Strategy Memory



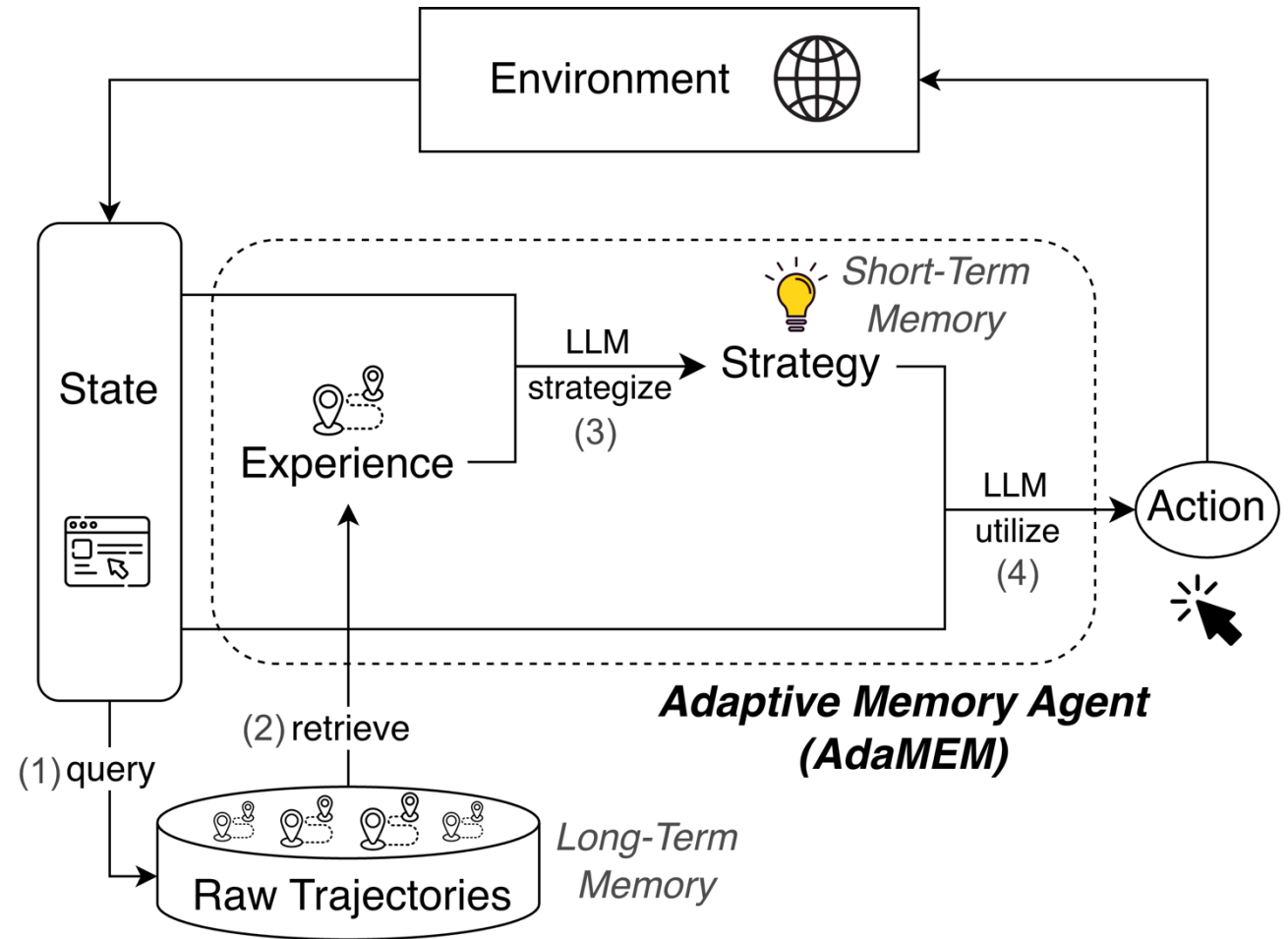
# Limitations

- **Rigid timing of memory retrieval:** only *once* at episode initiation.
- **Static guidance:** cannot adapt to evolving test-time conditions.
- **RQ: How can agent memory overcome the rigidity of static retrieval to adapt continuously during inference?**



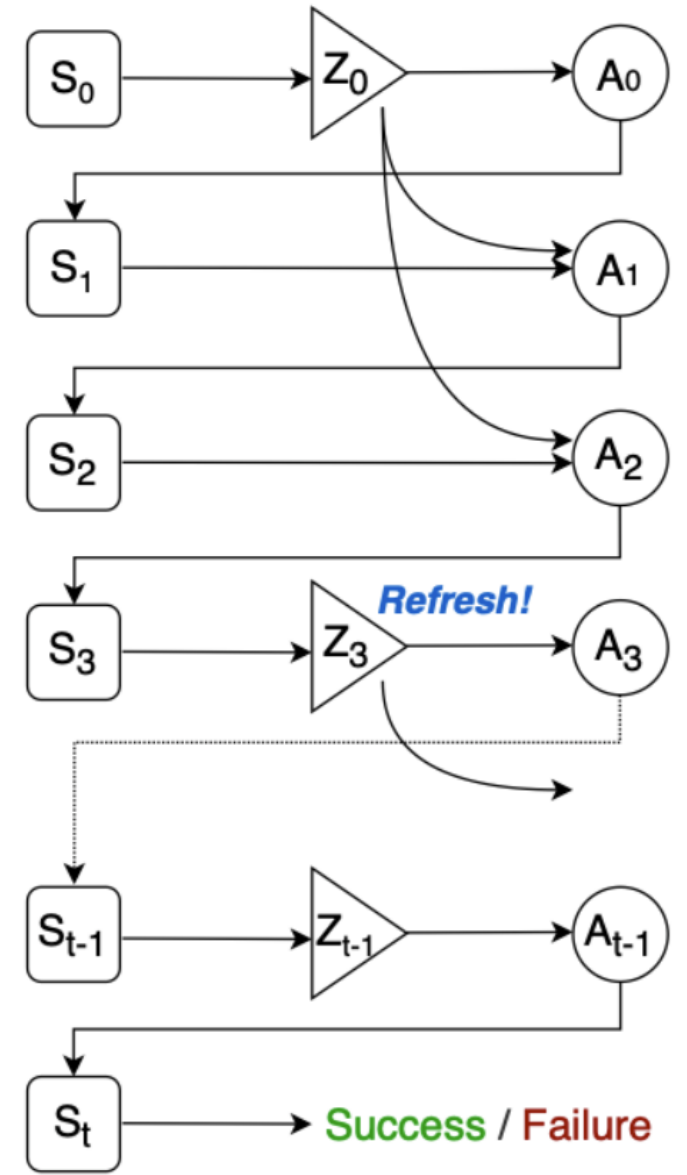
# Adaptive Memory Agent (AdaMEM)

- Long-term trajectory memory + short-term strategy memory
- Adaptive memory retrieval
- Context-relevant, dynamic strategy





# When to invoke retrieval?

- Synthesizing strategy from raw trajectory is token-consuming
- Reuse the strategy for multiple steps to *improve token efficiency*
- Let agent decide at each step, whether the strategy is “outdated” and needs refreshment.



# Results

- ADAMEM outperforms static memory baselines and generalizes to unseen tasks.
- Dynamic retrieval corrects negative transfer on WebShop.

Memory Mechanisms	Long Term	Short Term	ALFWorld		WebShop
			Seen	Unseen	
<b><i>On-Policy Long-Term Memory</i></b>					
 <i>Qwen3-4B-Instruct (ALFWorld)</i>					
 <i>Qwen2.5-7B-Instruct-RL (WebShop)</i>					
No Memory	-	-	45.2 $\pm$ 1.8	46.8 $\pm$ 2.5	71.4 $\pm$ 1.4
ReasoningBank	Strat.	Strat.	49.3 $\pm$ 0.7	51.2 $\pm$ 0.9	68.6 $\pm$ 2.0
Synapse	Traj.	Traj.	52.1 $\pm$ 1.9	52.2 $\pm$ 0.7	65.4 $\pm$ 0.9
ADAMEM	Traj.	Strat.	<b>54.0<math>\pm</math>2.9</b>	<b>58.2<math>\pm</math>3.9</b>	<b>74.2<math>\pm</math>0.3</b>



**Thank you!**

Any questions?