



ProjectPage & code

M²-Miner: Multi-Agent Enhanced MCTS for Mobile GUI Agent Data Mining

Rui Lv^{1,*}, Juncheng Mo^{1,2,*}, Tianyi Chu², Chen Rao^{1,2}, Hongyi Jing¹, Jiajie Teng¹, Jiafu Chen^{1,2}, Shiqi Zhang¹, Liangzi Ding¹, Shuo Fang¹, Huaizhong Lin², Ziqiang Dang¹, Chenguang Ma¹, Lei Zhao²

¹Ant Group, ²Zhejiang University

* equal contribution; ✉ corresponding authors

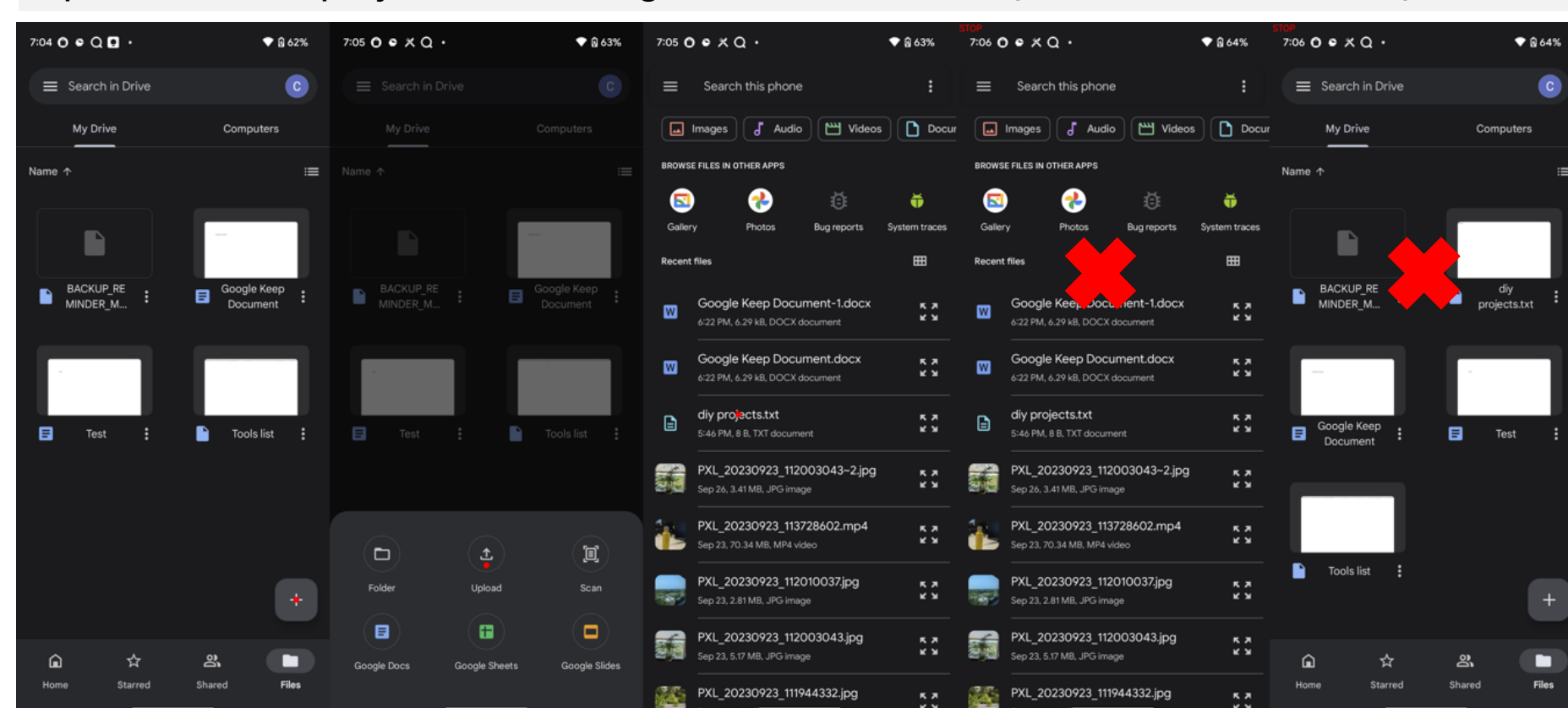


ICLR

Introduction

Problem

Intent: My phone is not functioning properly, therefore I'm going to turn it on service. Upload the DIY project file to Google Drive to save it. (From AndroidControl)



High Construction Cost

Poor Data Quality

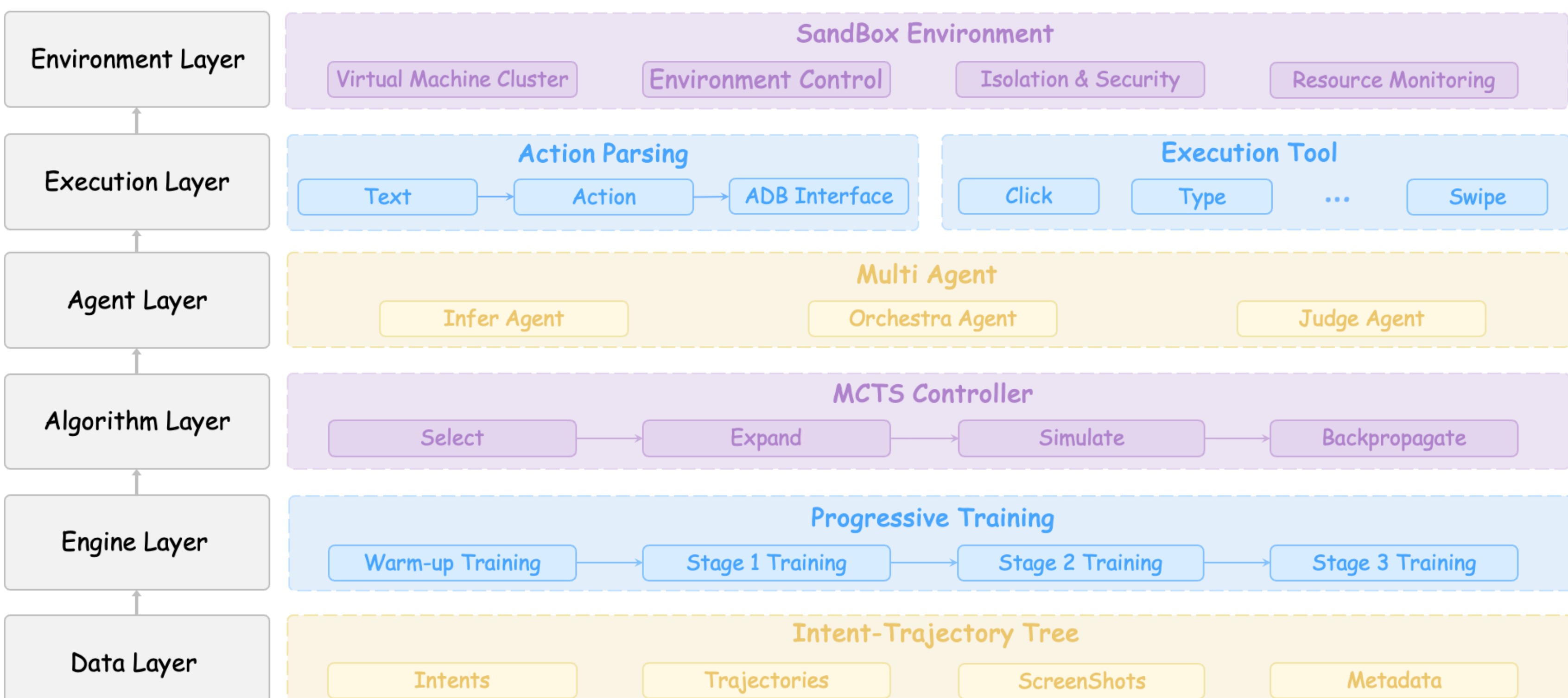
Low Data Richness

Contributions

- We propose M²-Miner, the first automated mobile GUI agent data-mining framework based on MCTS, which incorporates a collaborative multi-agent framework consisting of InferAgent, OrchestraAgent, and JudgeAgent, to jointly enhance mining efficiency and data quality.
- To enhance intent richness and further improve mining efficiency, a novel intent recycling strategy is introduced for extracting additional valuable trajectories.
- To improve the mining success rate and enhance generalization in unseen environments, we present a progressive model-in-the-loop training strategy.
- Extensive experiments demonstrate the superiority of our approach in mining high-quality and rich intent trajectory data. Specifically, GUI agents trained on our mined data achieve SOTA performance.

Method

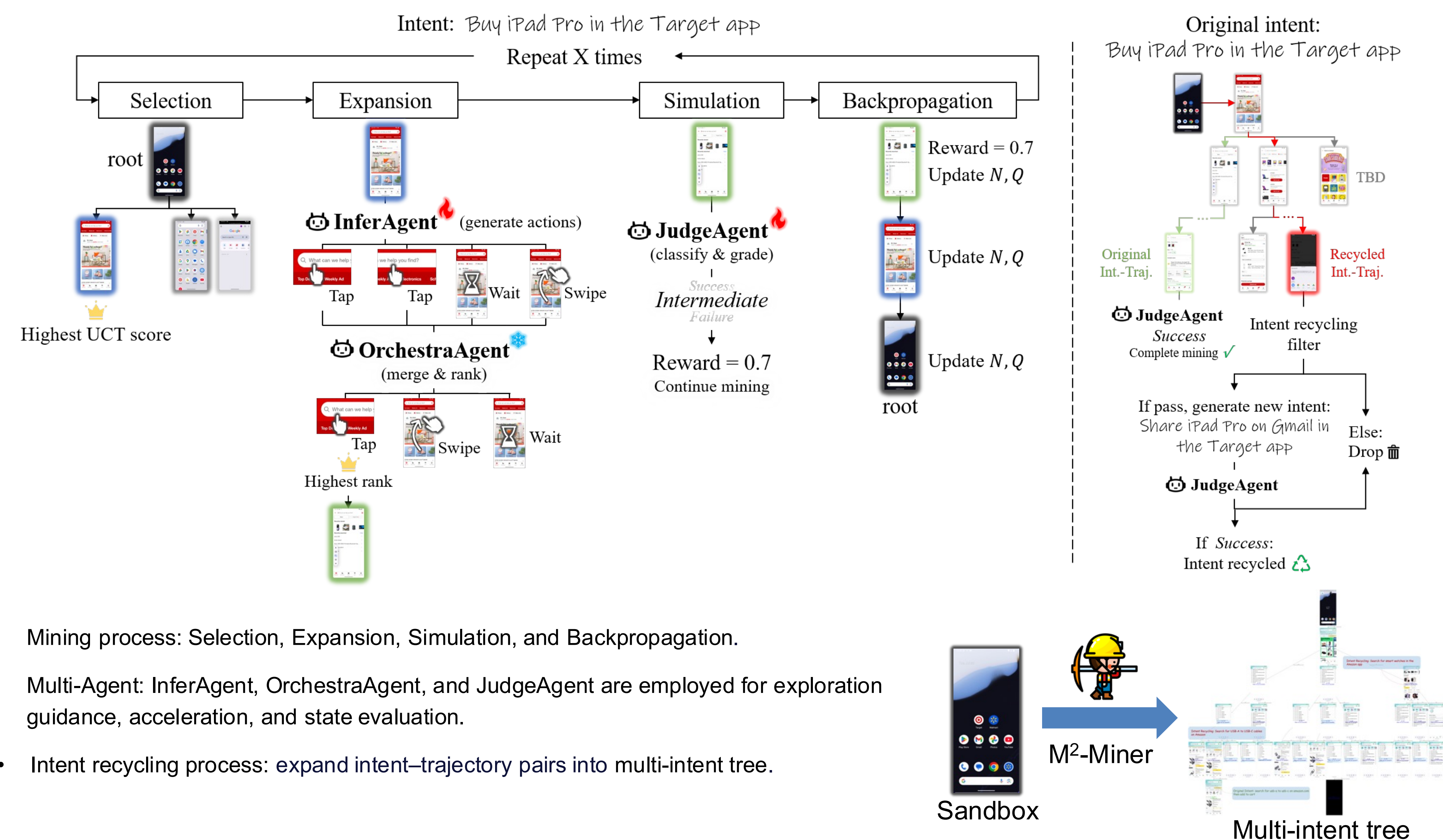
Infrastructure Framework



A layered framework for GUI agent data mining with model-in-the-loop training, comprising data, engine, algorithm, agent, execution, and environment layers.

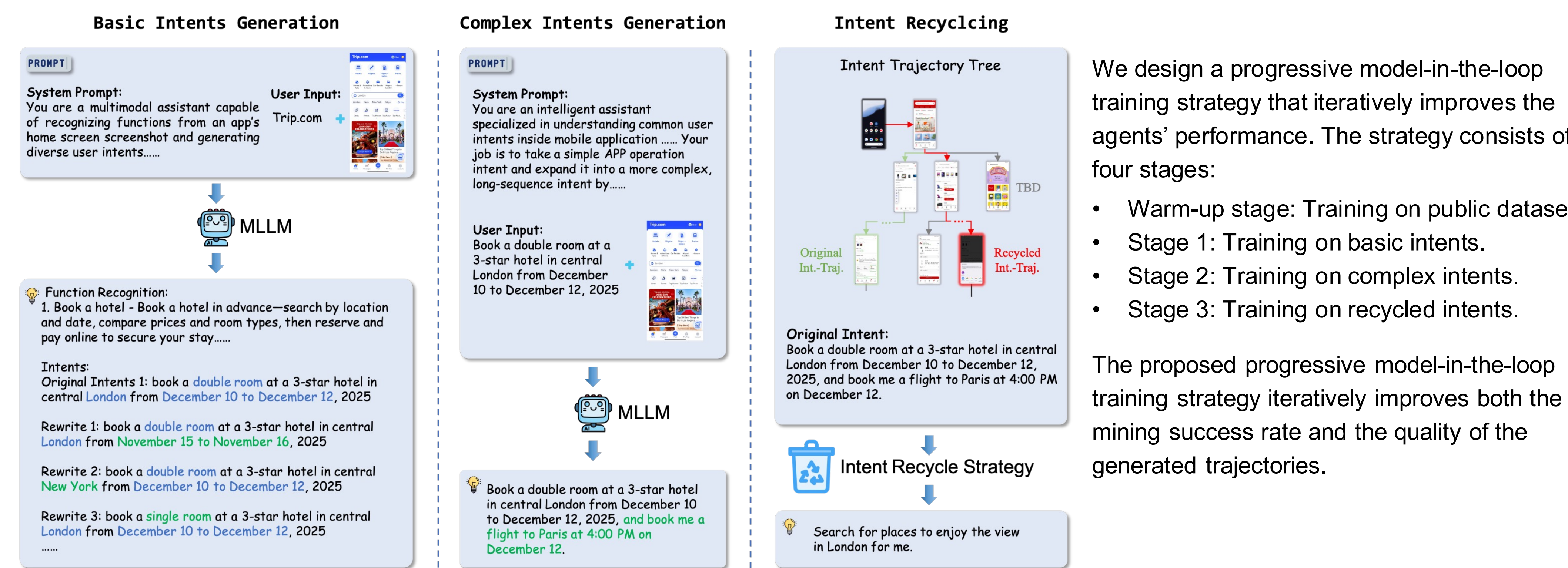
M²-Miner

MCTS based M²-Miner Framework



- Mining process: Selection, Expansion, Simulation, and Backpropagation.
- Multi-Agent: InferAgent, OrchestraAgent, and JudgeAgent are employed for exploration guidance, acceleration, and state evaluation.
- Intent recycling process: expand intent-trajectory pairs into multi-intent tree.

Model-In-The-Loop Training Strategy

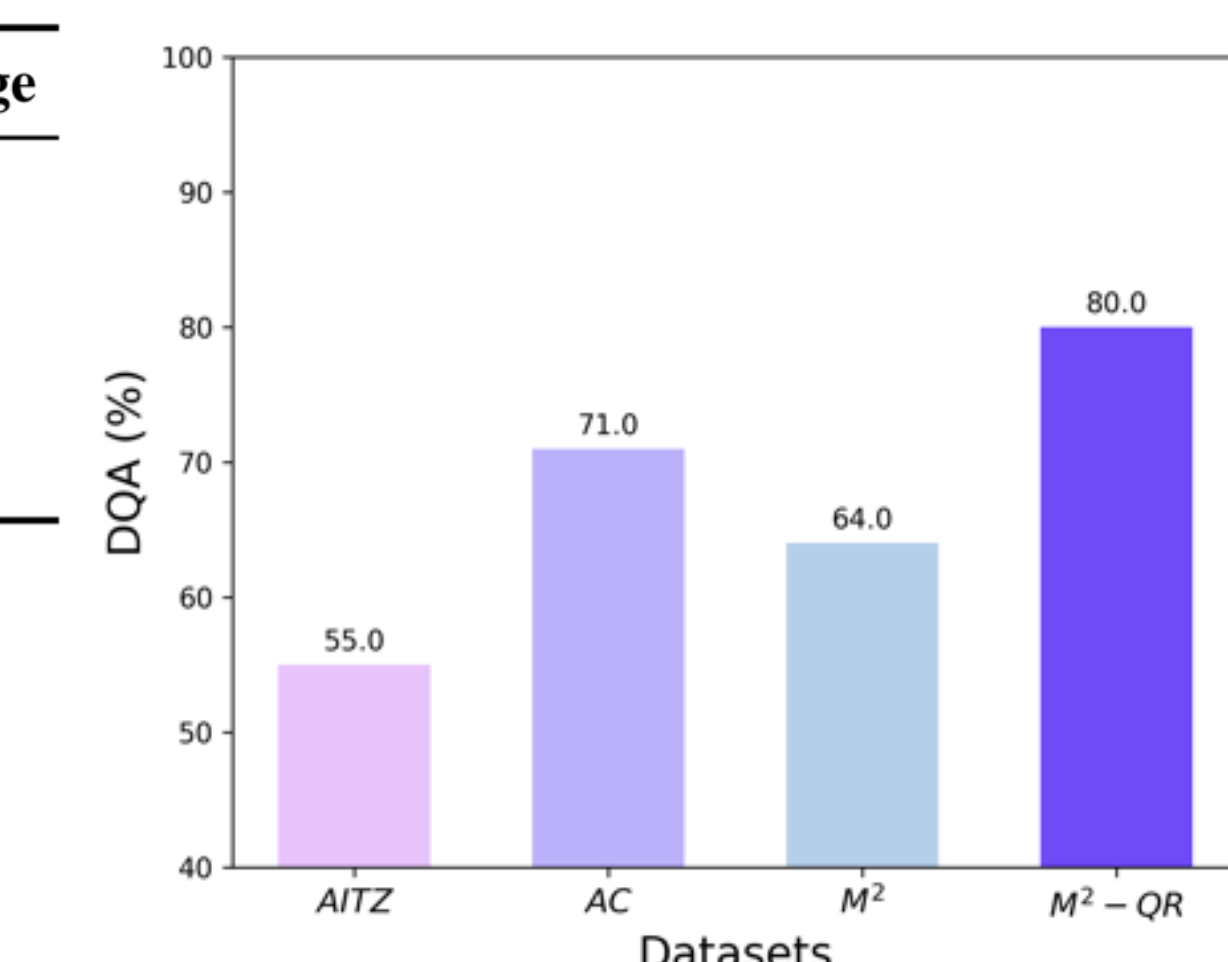


Experiments

Statistics of different datasets

Dataset	Size	Su.RL	Auto	AvgStp	Trajs	Cost	Cost per image
Android Control	88k	X	X	5.5	15,283	31,662	0.36
AMEX	38k	X	X	12.8	2,946	13,680	0.36
GUI-Odyssey	119k	X	X	15.4	7,735	42,816	0.36
AITZ	18k	X	X	7.5	2,504	6,476	0.36
M ² -Miner-Agent	20k	✓	✓	7.8	2,565	466	0.02

Evaluation of data quality

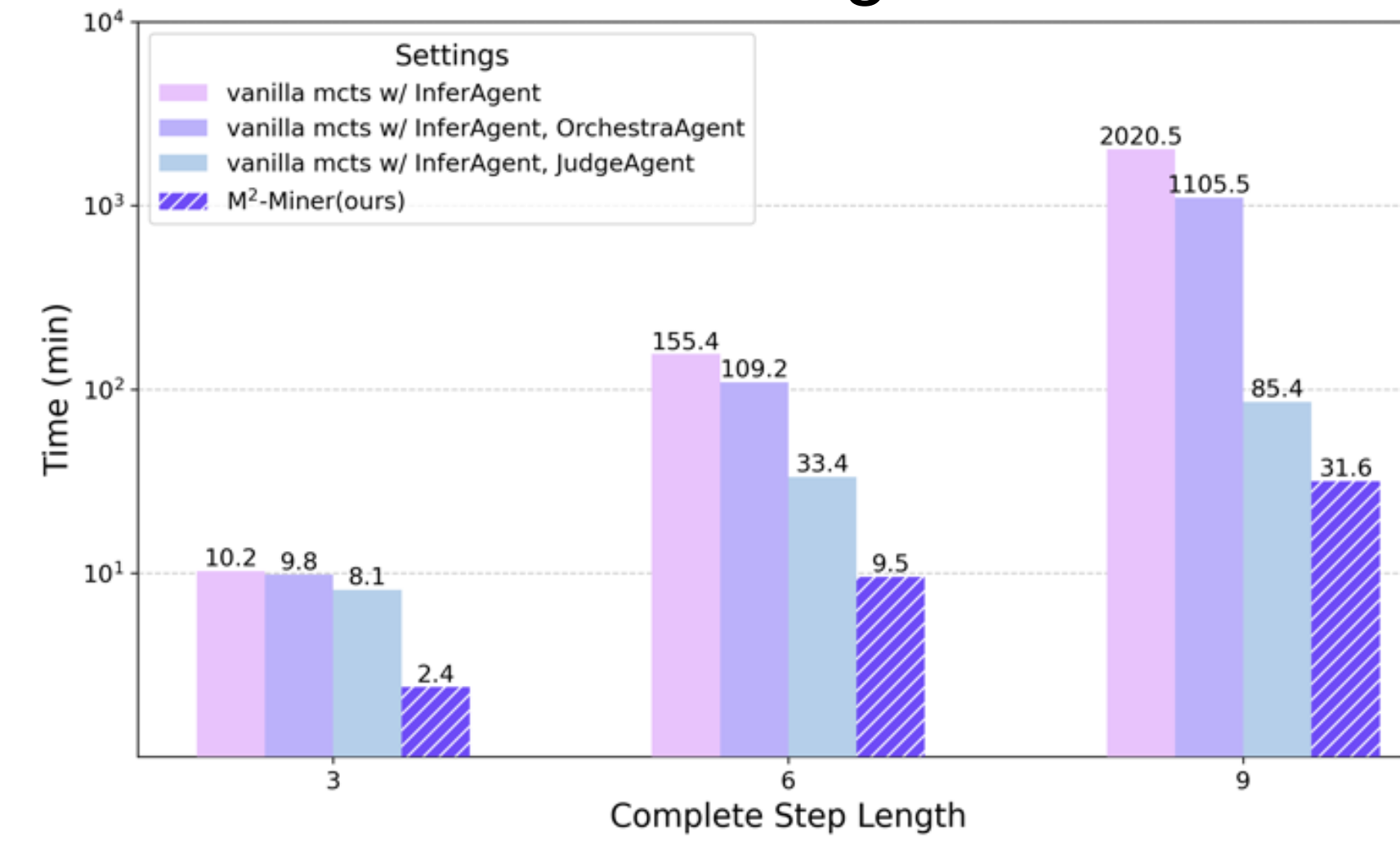


- In comparison to AITZ, which is of a similar scale, our method reduces construction costs by \$6,010.
- Comparing on per-image cost, our method is 18 times more cost-effective than all other datasets.

Performance comparison on GUI agent benchmarks

Models	AC-Low		AC-High		AITZ		GUI-Odyssey		CAGUI	
	TP	SR	TP	SR	TP	SR	TP	SR	TP	SR
<i>Closed-source Models</i>										
GPT-4o Hurst et al. (2024)	74.3	19.4	66.3	20.8	70.0	35.3	-	-	3.67	3.67
Gemini 2.0 Deepmind (2024)	-	28.5	-	60.2	-	-	-	-	-	-
Claude Anthropic (2024)	74.3	19.4	63.7	12.5	-	-	60.9	-	-	-
<i>Open-source Models W/ Private Human-Annotated Datasets</i>										
UI-TARS-7B* Qin et al. (2025)	98.0	90.8	83.7	72.5	80.4	65.8	90.1	87.0	88.6	70.0
<i>Open-source Models W/ Public Datasets</i>										
OdysseyAgent Lu et al. (2025a)	65.1	39.2	58.8	32.7	59.2	31.6	-	78.2	67.6	25.4
SpiritSight-8B Huang et al. (2025)	-	87.6	-	68.1	-	-	-	75.8	-	-
GUI-R1-7B Luo et al. (2025)	85.2	66.5	71.6	51.7	56.8	50.5	65.5	38.8	-	-
OS-Atlas-7B Wu et al. (2025a)	93.6	85.2	85.2	71.2	74.1	58.5	84.5	62.0	81.5	55.9
Aguvis-7B Xu et al. (2025b)	-	80.5	-	61.5	35.7	19.0	26.7	13.5	67.4	38.2
InfGUI-R1 Liu et al. (2025)	96.0	92.1	82.7	71.1	70.7	52.9	74.5	55.0	-	-
Qwen2.5-VL-3B Bai et al. (2025)	92.2	80.4	76.5	60.2	75.1	52.7	81.2	57.8	71.9	53.1
Qwen2.5-VL-7B Bai et al. (2025)	94.1	85.0	75.1	62.9	78.4	54.6	83.7	60.3	74.2	55.2
<i>Open-source Models W/ Auto-Mined Datasets</i>										
OS-Genesis-7B Sun et al. (2025)	90.7	74.2	66.2	44.5	20.0	8.5	11.7	3.6	38.1	14.5
GUI-Owl-7B Ye et al. (2025)	93.8	90.0	81.5	72.8	78.9	65.1	83.4	60.7	80.0	59.2
M ² -Miner-3B	97.2	93.2	81.3	71.2	78.6	66.6	88.2	77.1	88.5	67.3
M ² -Miner-7B	97.5	93.5	81.8	72.9	81.3	69.4	90.5	79.3	88.8	70.2

Ablation study of the collaborative multi-agent framework



Ablation study on model-in-the-loop for data quality

