Training Large Behavioral Models for AI Robot Use

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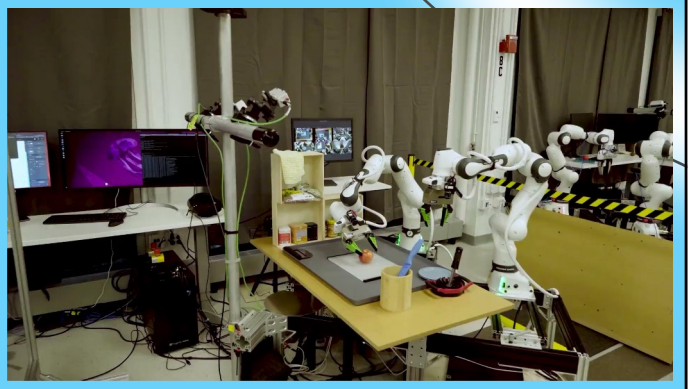
PAPER OVERVIEW

The paper aims to establish LBMs as a reliable system for general purpose physical embodied AI systems.



A Careful Examination of Large Behavior Models for Multitask Dexterous Manipulation

Large Behavior Models Team, Toyota Research Institute

TOYOTA RESEARCH INSTITUTE

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Large Behavioral Models

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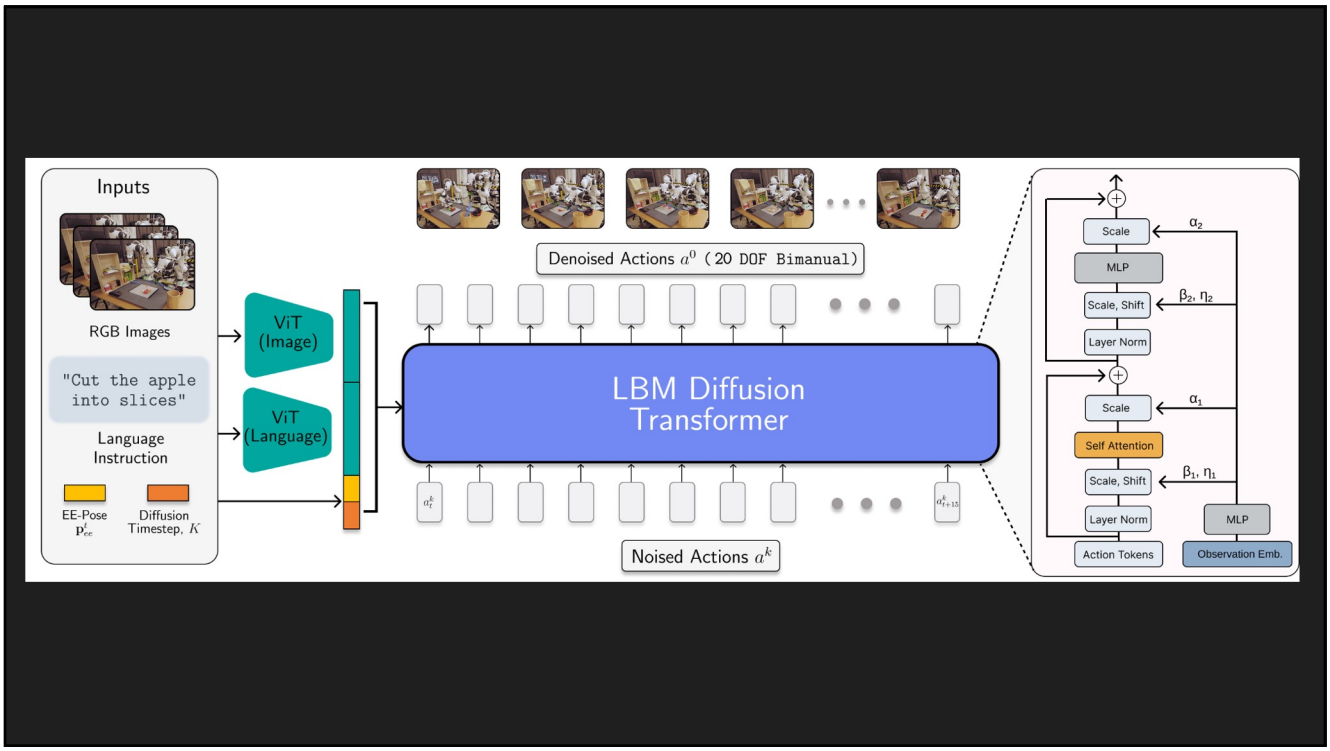

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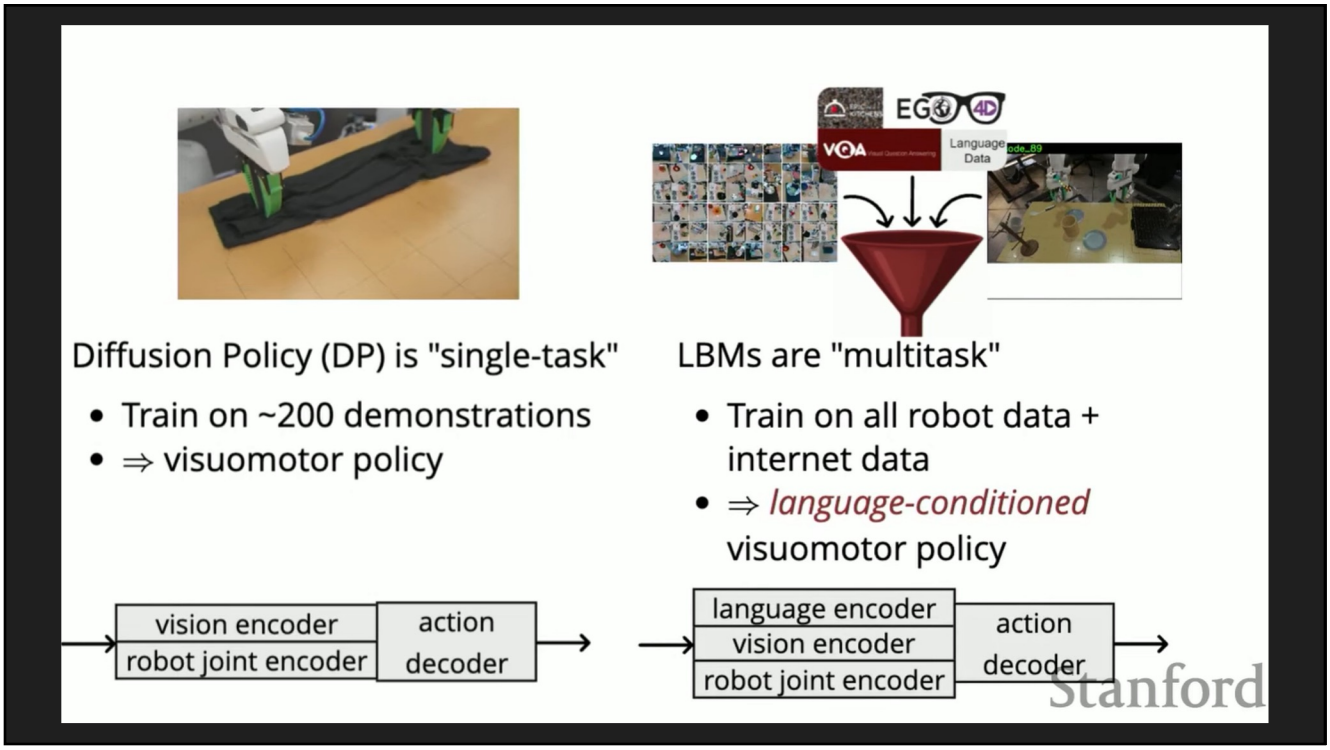
Diffusion Policy (DP) is "single-task"
Train on ~200 demonstrations
⇒ visuomotor policy
vision encoder
robot joint encoder
action decoder
LBMs are "multitask"
Train on all robot data + internet data
⇒ language-conditioned visuomotor policy
language encoder
vision encoder
robot joint encoder
action decoder
Language Data
Stanford

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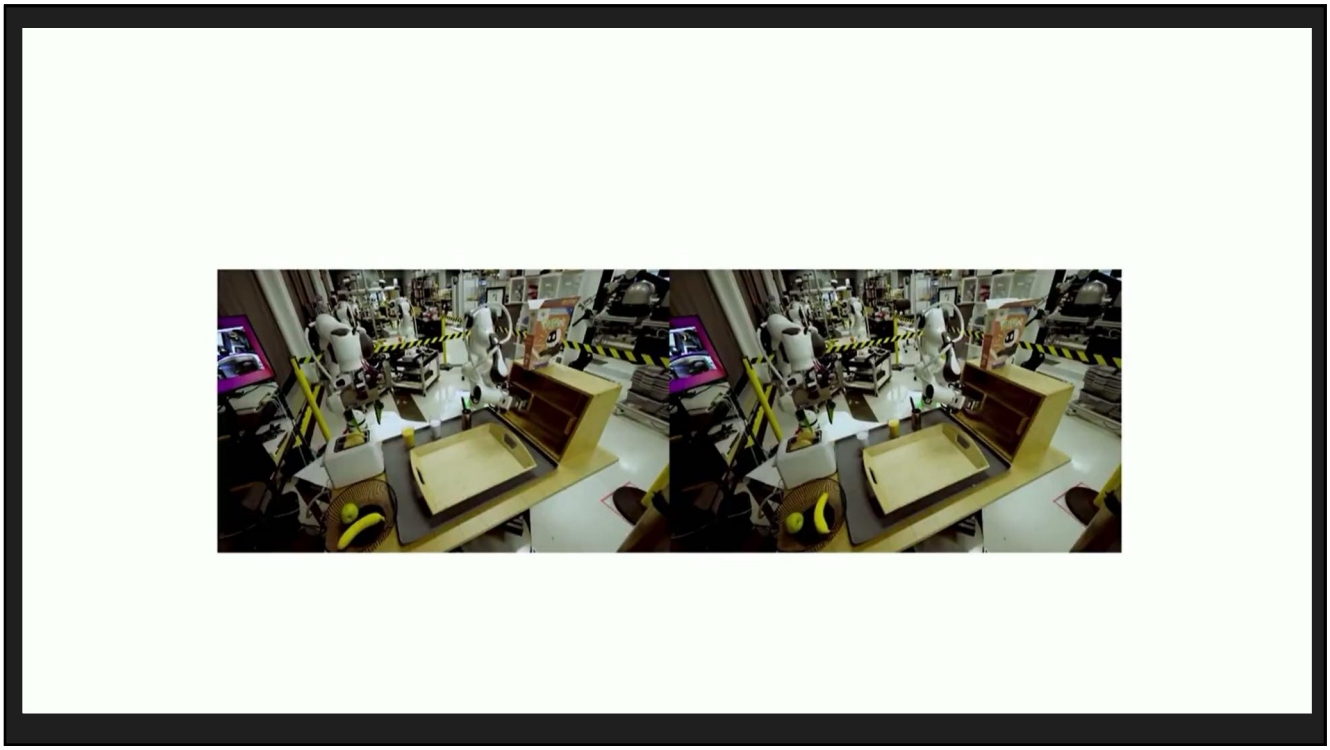

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Ramen Corpus

1700 Hours of Robot Training

High quality internal data from real robot teleoperation sessions

Heterogeneous Data

Various tasks, environments, objects, and platforms

Simulations

Over 47,000 full simulations created and utilized to train models

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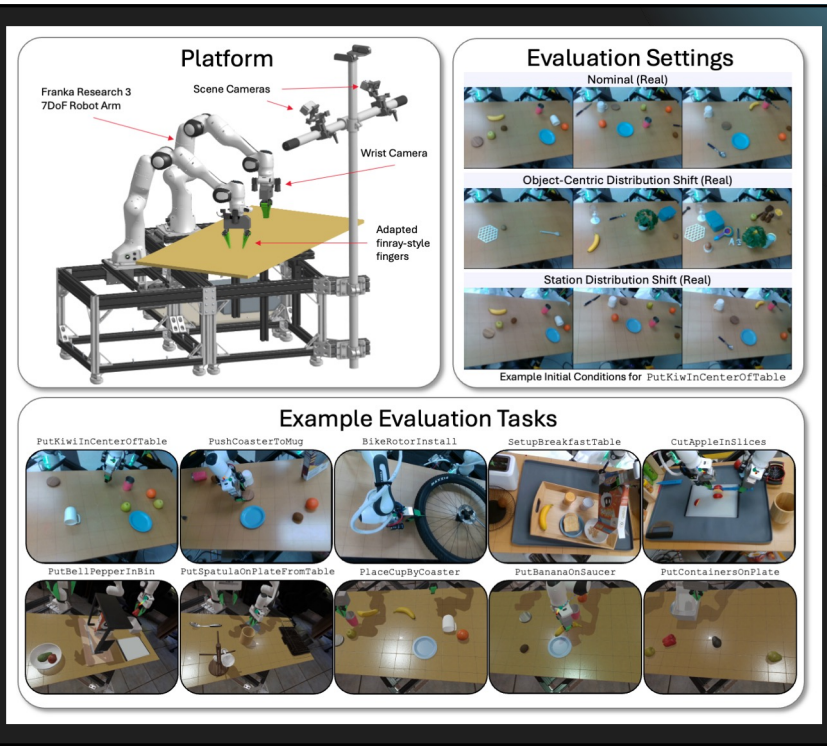

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Ramen Dataset Breakdown

OXE-Ramen

- Curated set of online OpenX-Embodiment datasets
- 1,150 hours of robot data
- Made to correspond with TRI format

TRI-Ramen

- high-quality data collected internally at TRI
- 545 hours of robot data

Fine tuning %

%: Fraction of available data used for fine tuning for a particular dataset

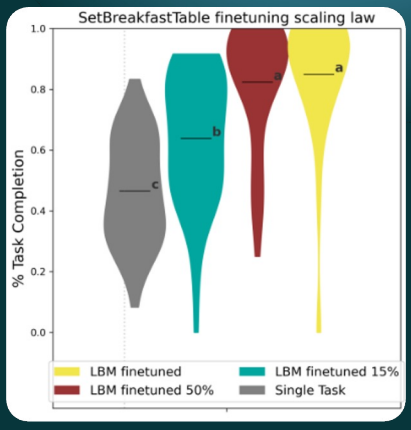

Figure 5:
Violin plot of various datasets in action for a particular task.

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Ensuring Evaluation Fairness & Metrics

A/B Testing

- Tester doesn't know which robot is using which training
- Blind testing

Randomization

- Policy order was randomized

Task Completion

Robot evaluator:
- Set of milestones per task
- Milestones achieved are counted up

Initial Condition Overlay

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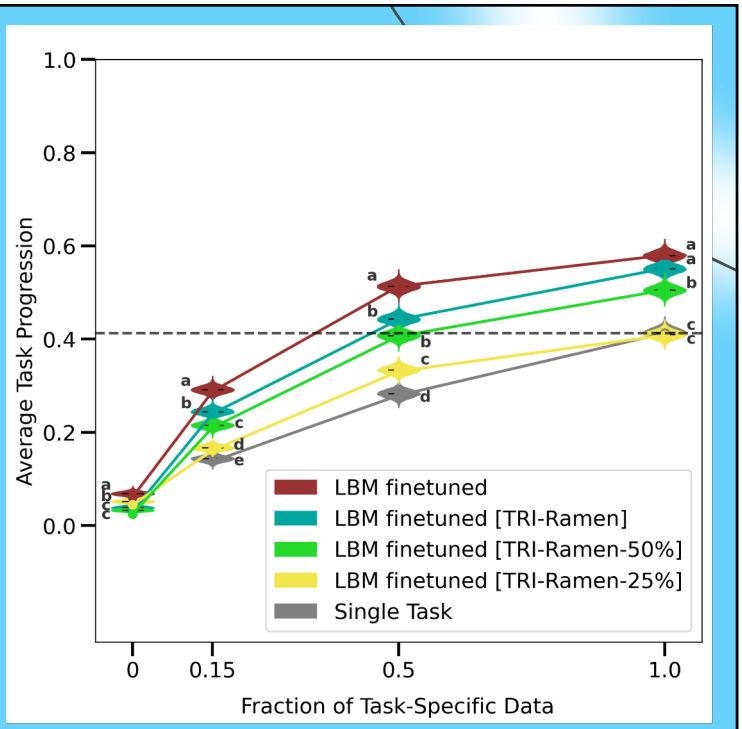
Scaling and Efficiency



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Limitation of LBM Capabilities

Non-fine tuned LBM

- Does not always outperform from-scratch single task training

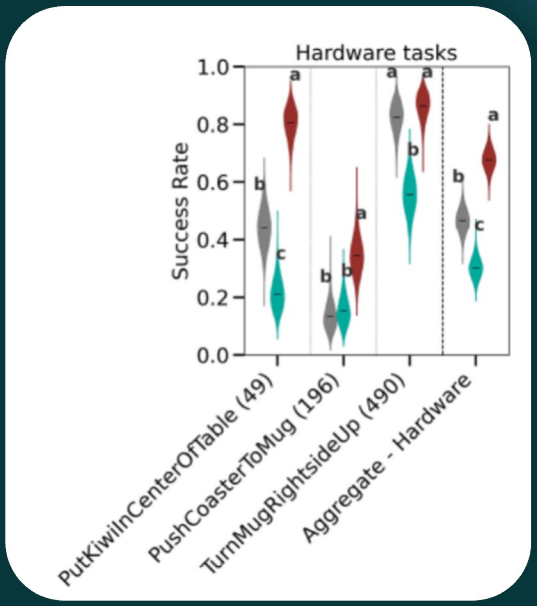

Figure 2. LBM performance on "seen" tasks in real-world

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The Opportunity

- New levels of dexterity (manipulating cloth, liquids, etc)
- Programmed via imprecise natural language and/or a few demonstrations
- “Common-sense” for physical intelligence, leading to open-world robustness
- AI
- Household Robotics

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Sources

https://bostondynamics.com/blog/large-behavior-models-atlas-find-new-footing/
https://toyotaresearchinstitute.github.io/lbm1/

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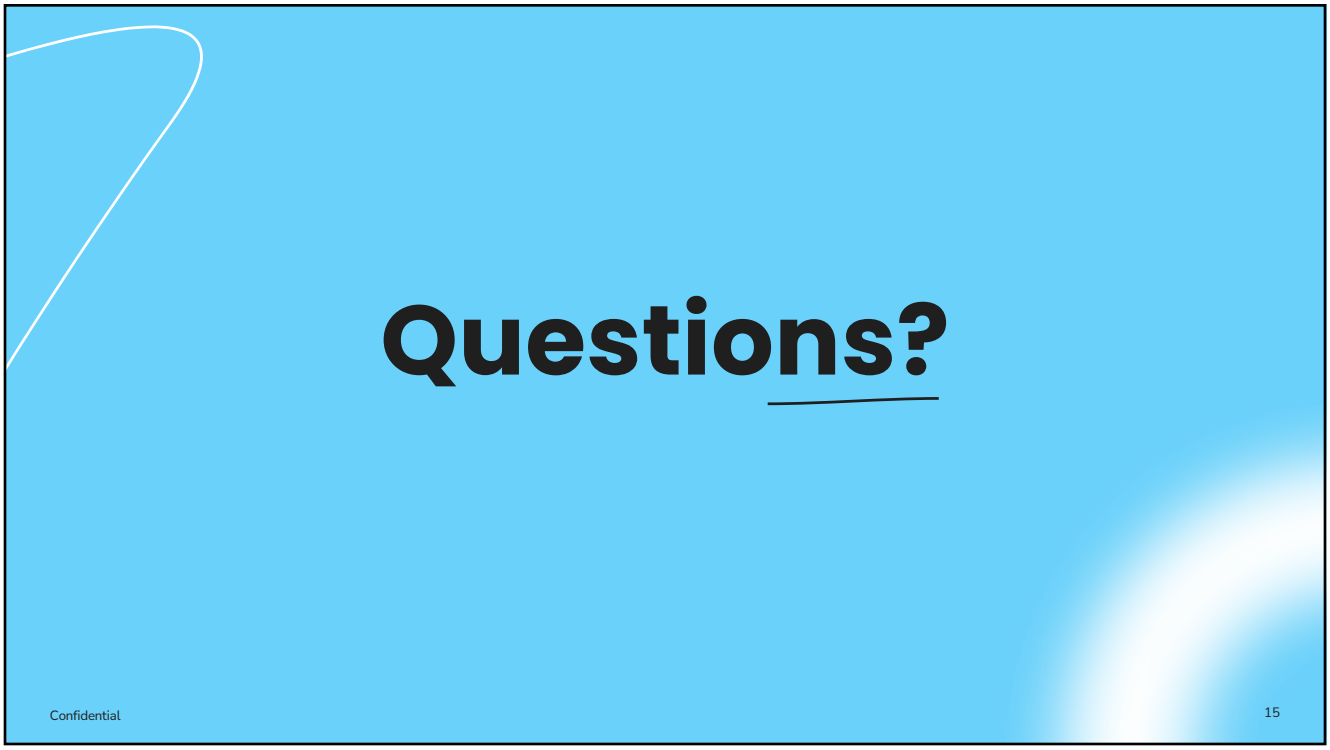

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