

Data will solve Robotics?

Is the Robotics Handbook Obsolete?

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We have been at it...
For a while now!

Structure

Structure of the Problem

- Priors
- Inductive Biases
- Models of $\{X\}$
- Modularity



1968: Aspirational Robotic Assistant

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For a while now!

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2023: Astribot Robot Demo

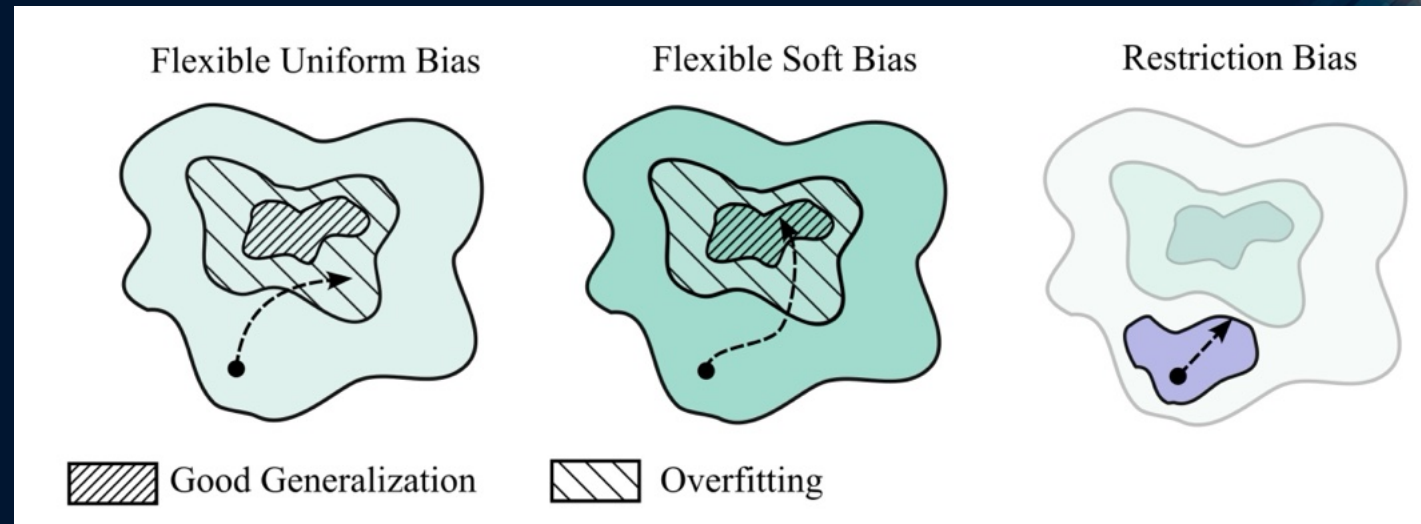
Data will Solve Robotics & Automation

1. Too much structure hurts! (sad... but true)

Optimal solution **not** in the
hypothesis space

Or

Optimal solution is
representable but **not**
findable!



Data will Solve Robotics & Automation

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Data

From

"Scaling Data"

To

"Science of Scaling"

How to Scale?

“WHAT”

Multimodal Foundation Model
Does High-level Reasoning

“Reasoning” + “Common Sense”

Grounding what needs to “Happen”
Create an abstract plan
Generate reference for expected change

Replanning with “Prospection”

“HOW”

Generic Observation-to-control
Low-level Reasoning

“Self-Aware Motor-Control”

Control to “effect” the change
Closed-Loop Reference Following
Affordance aware solutions

Reactive (Sys 1) or Deliberative (Sys 2)

How to Scale?

“WHAT”

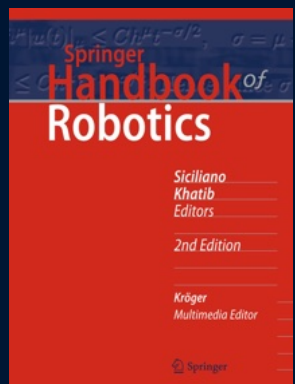
Multimodal Foundation Model
Does High-level Reasoning

“HOW”

Generic Observation-to-control
Low-level Reasoning

2. Data helps with Ambiguity & Robustness

Data Unlocks Complex Problem-Solving **beyond Manually Engineered Solutions**
From Specific tasks to versatile recipes and ideally **Generalizable Foundation Models**.
Flywheel Effect: Data Fuels Continuous Improvement



Is the **Handbook of Robotics** Obsolete?

Robotics has been a community of communities.

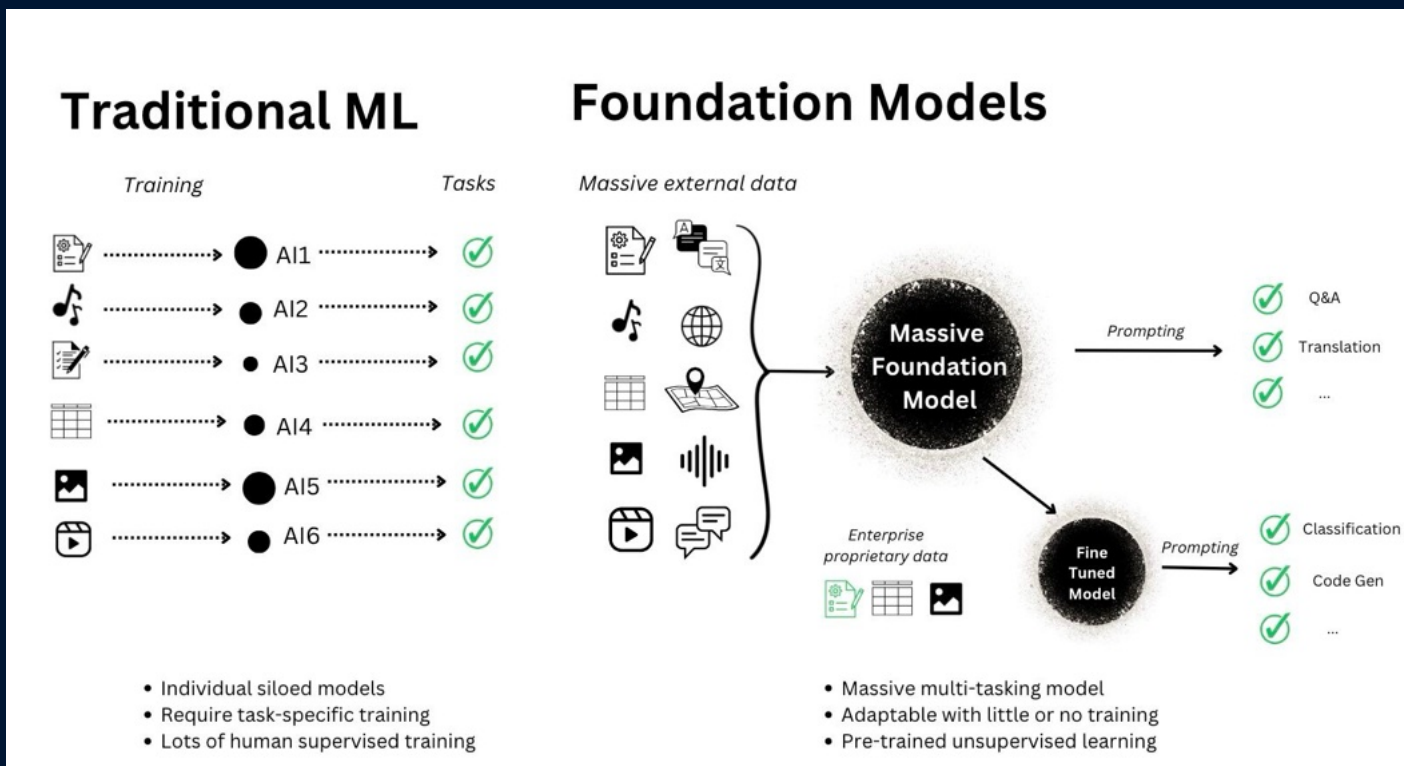
80+ **Chapters** on Robotics Foundations, Design, Sensing & Perception, Manipulation, Navigation, Applications, HRI!

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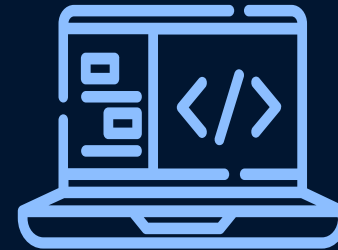
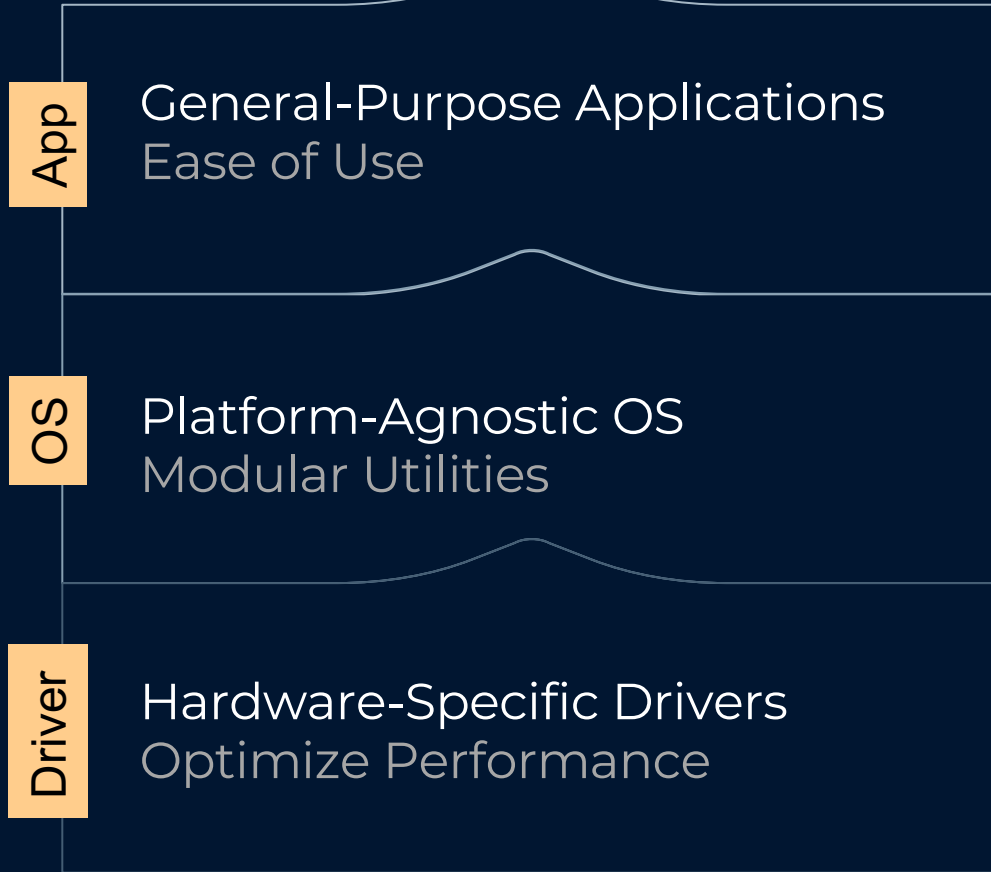
Is the **Handbook of Robotics** Obsolete? Build foundations before specializing!

3. Data leads to a Unifying Perspective!



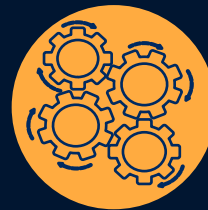
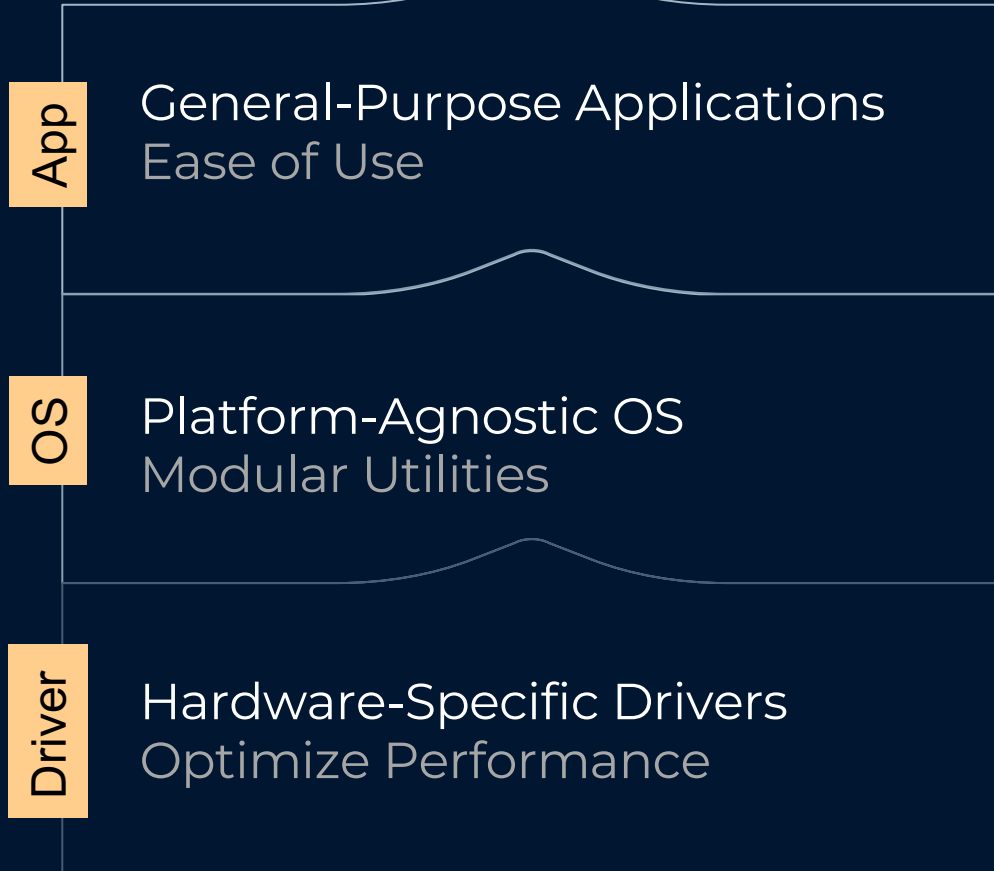
The Computing Stack

Digital AI

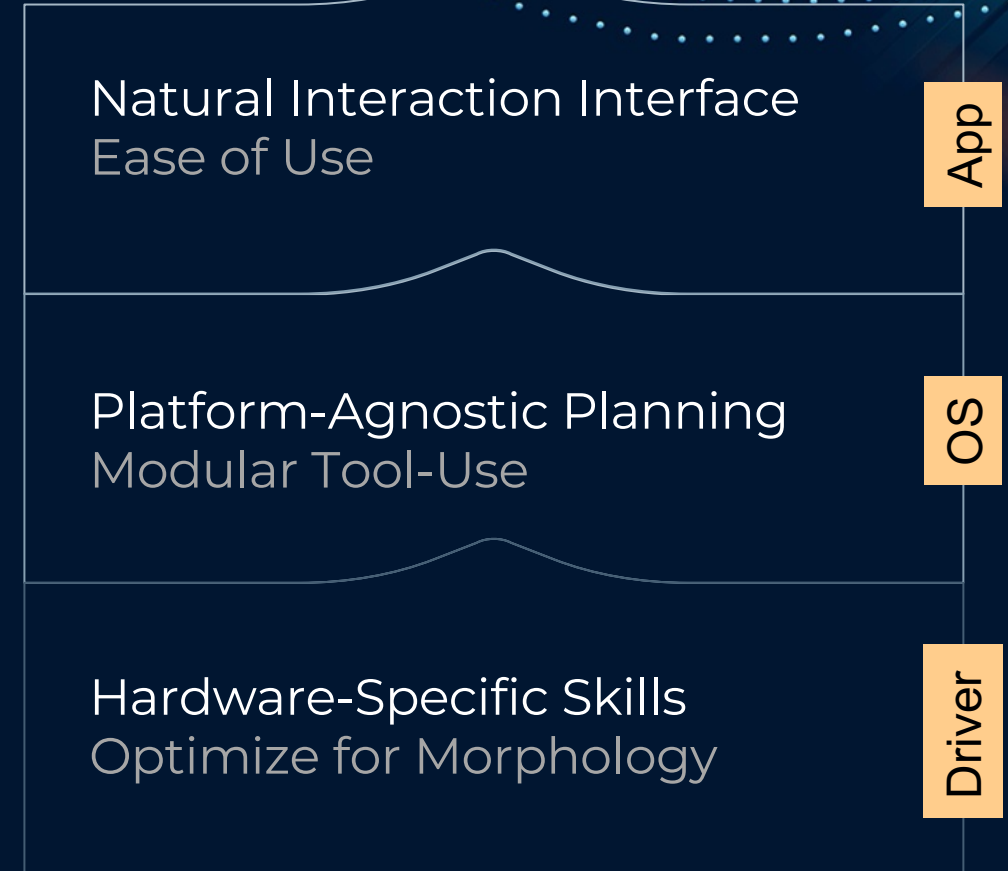


The Computing Stack

Digital AI



Physical AI



The Computing Stack

Physical AI



Natural Interaction Interface
Ease of Use

Platform-Agnostic Planning
Modular Tool-Use

Hardware-Specific Skills
Optimize for Morphology

App

OS

Driver

4. Data-First \Rightarrow Lack of Modularity

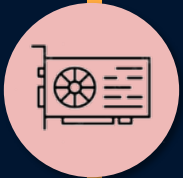
But Supervision is not _____

Scaling, generalizing, robust ...



Internet Data

Language, Image, Video
\$, Very Diverse



Synthetic Data

Simulation
\$\$, Engineered Designs



Real World Data

Teleoperation
\$\$\$\$, Limited Diversity



The revolution will not be supervised

– Alyosha Efros (circa 2018)

Data will solve Robotics?

Yes, data will take us very far!

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