

RobotPerf

An Open-Source, Vendor-Agnostic, Benchmarking
Suite for Evaluating Robotics Computing System
Performance



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ACCELERATION
ROBOTICS



HARVARD
UNIVERSITY



Carnegie
Mellon
University



JOHANNES KEPLER
UNIVERSITÄT LINZ



Introduction

Motivation

Robotic Applications

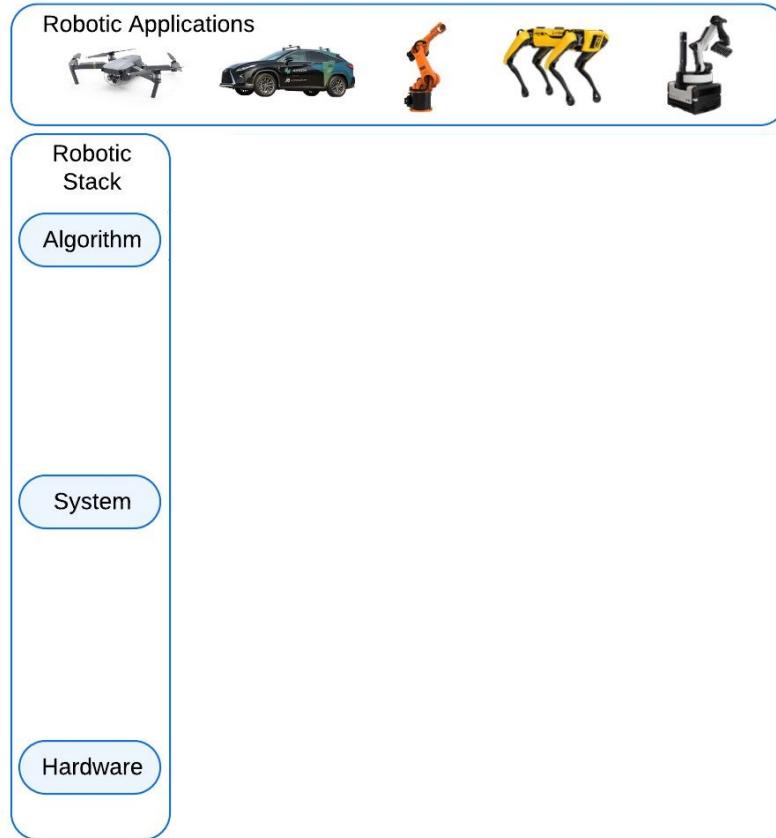


Real-Time
Systems

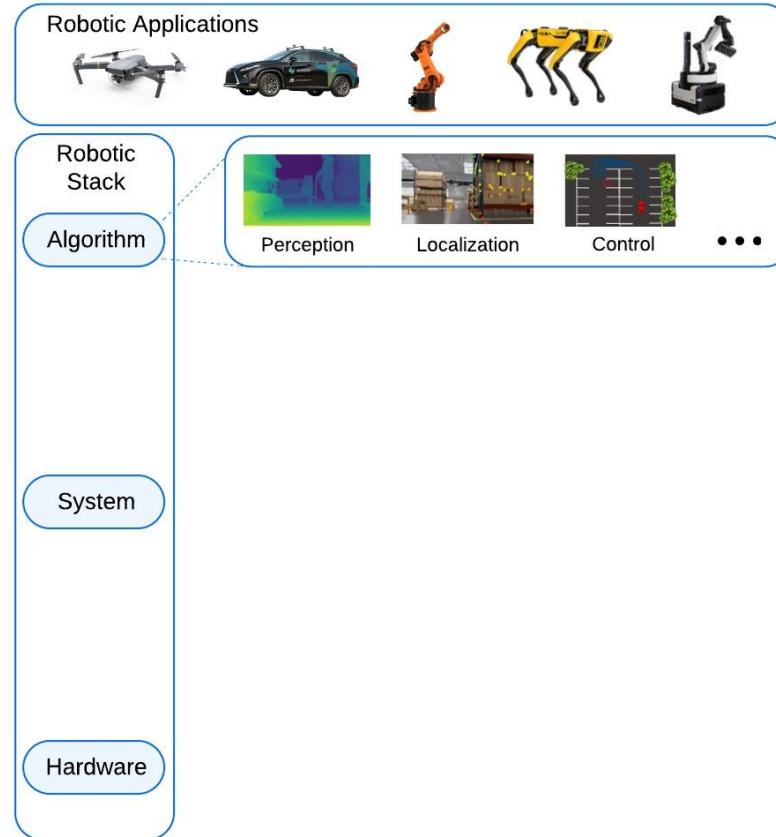
Moore's Law &
Dennard Scaling

Heterogeneous
Hardware

Overview



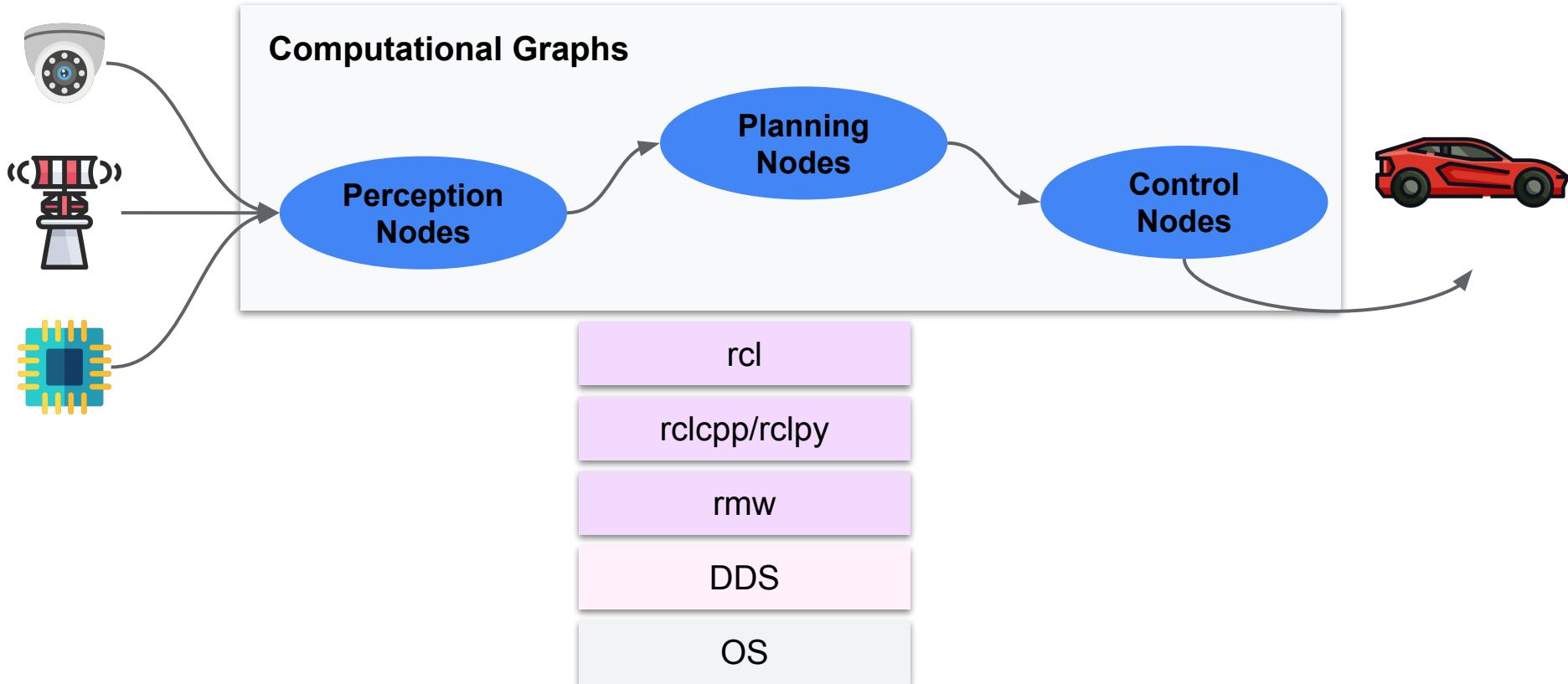
Overview



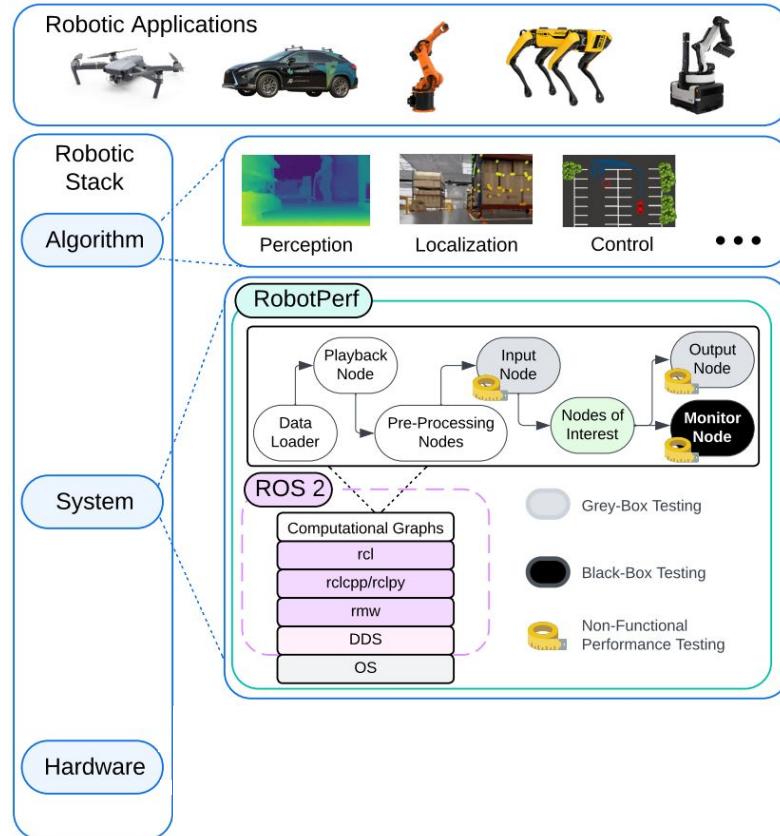
Overview



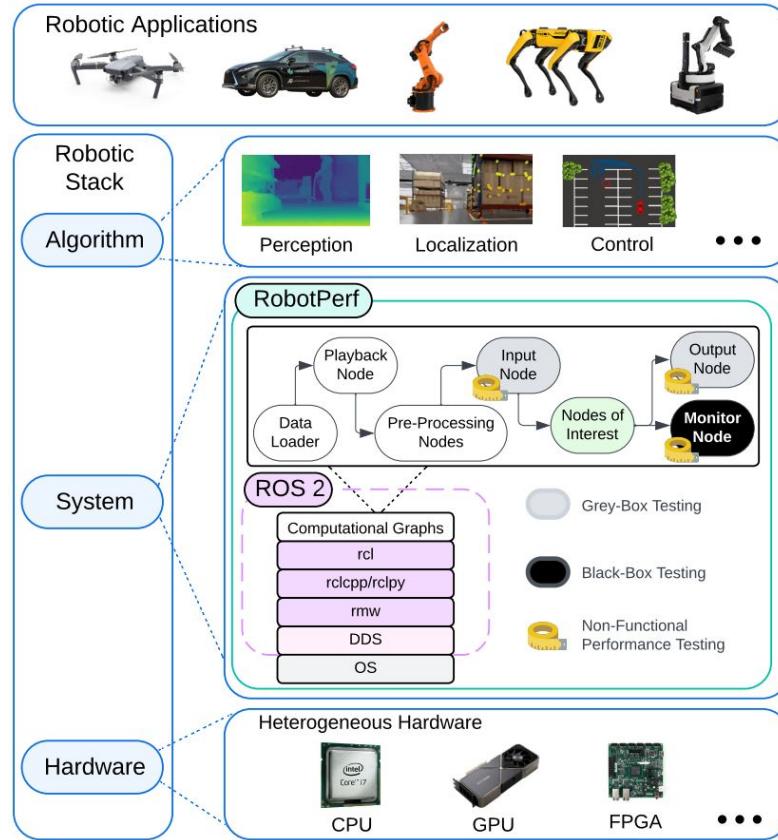
Background



Overview



Overview



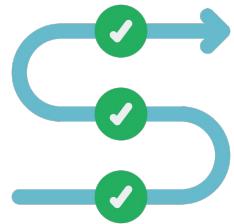
RobotPerf Principles

RobotPerf Principles

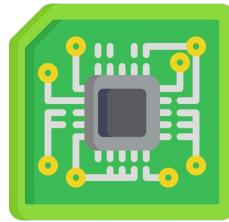
Non-Functional
Performance
Testing



Performance Testing Types



Functional



Non-Functional

RobotPerf Principles

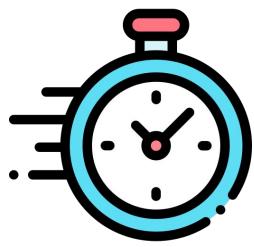
Non-Functional
Performance
Testing



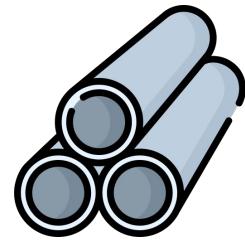
RobotPerf
Benchmarks

Real-Time
Metrics

Real-Time Metrics



Latency



Throughput



Power

RobotPerf Principles

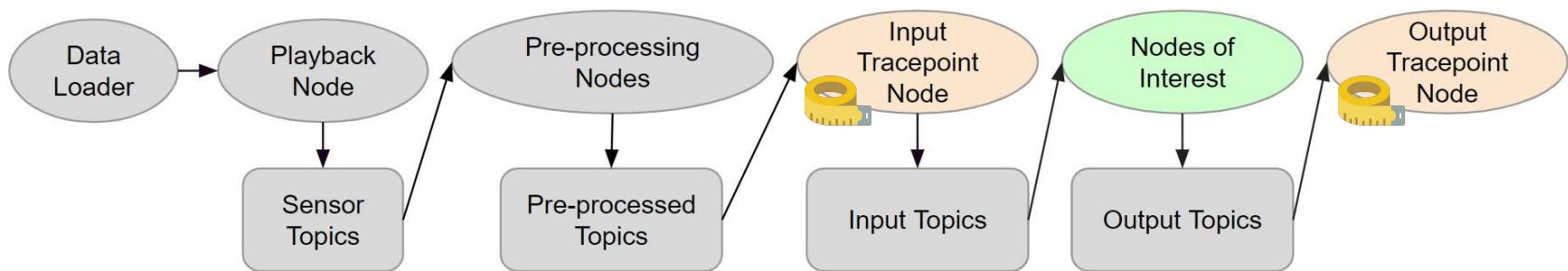
Non-Functional
Performance
Testing

Flexible
Methodology

Real-Time
Metrics

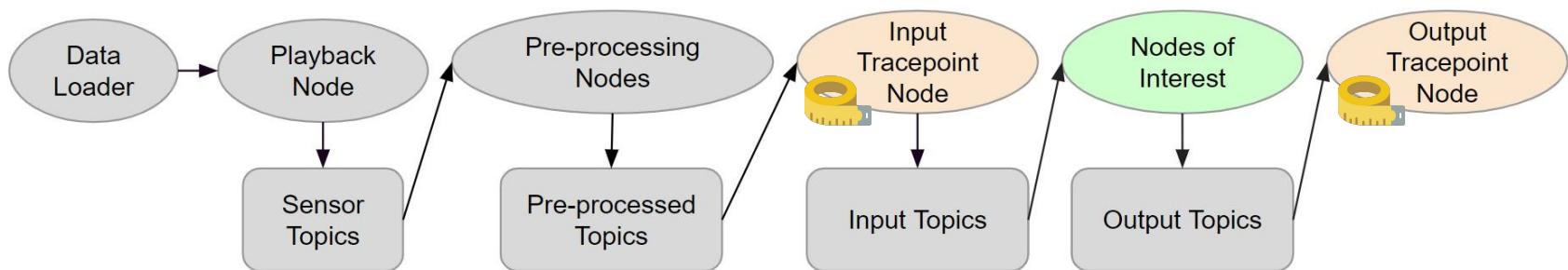


Methodology Types

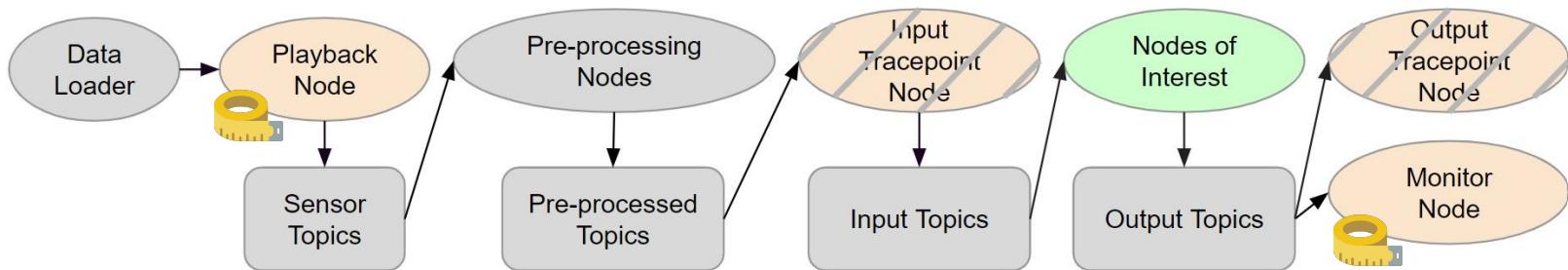


Grey Box Testing

Methodology Types

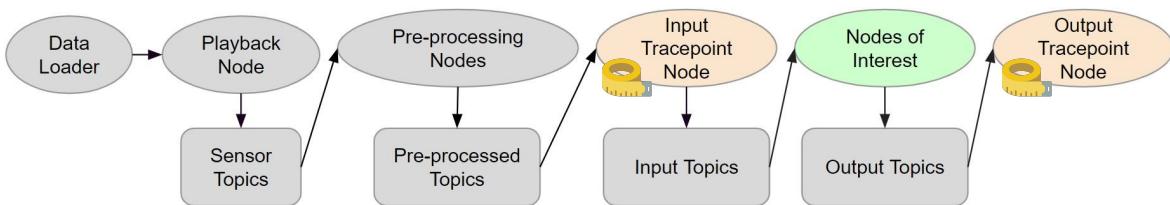


Grey Box Testing

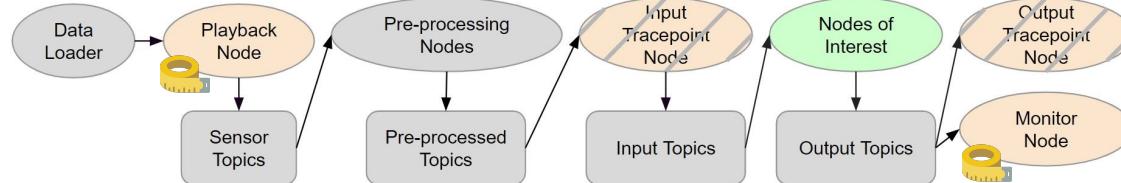


Black Box Testing

Methodology Types



Grey Box Testing



Black Box Testing

Tracing Granularity

Valid Tracer

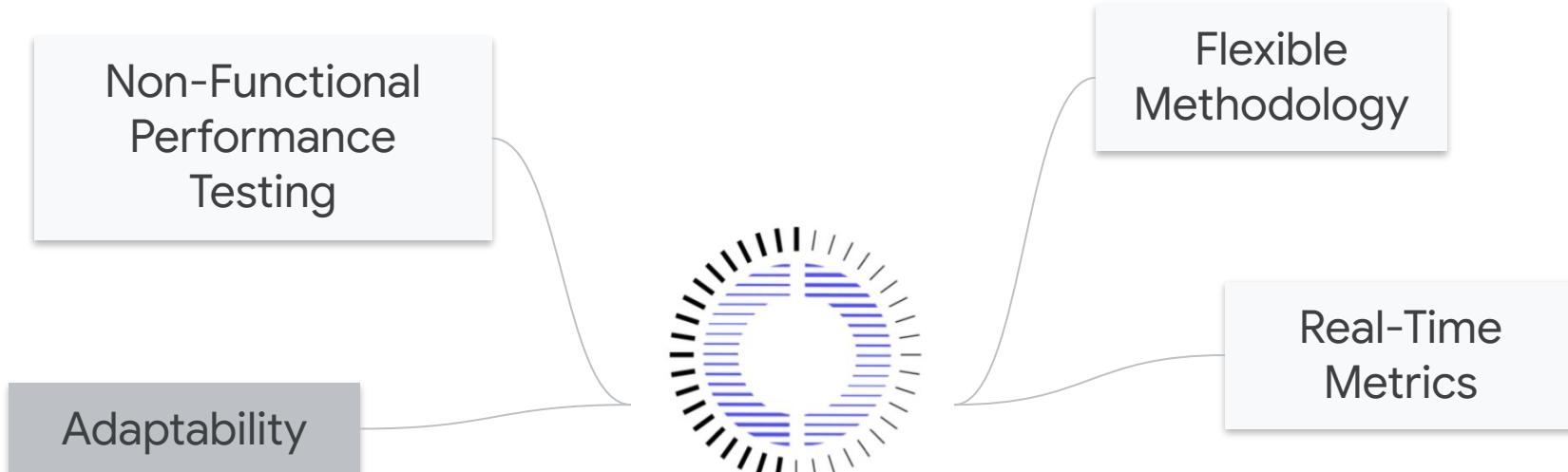
Event Types

Code Modification

Standard ROS 2 APIs

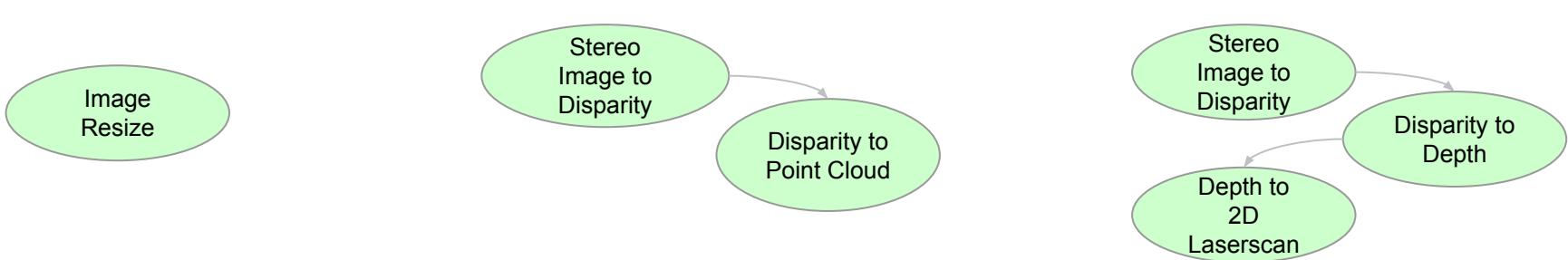
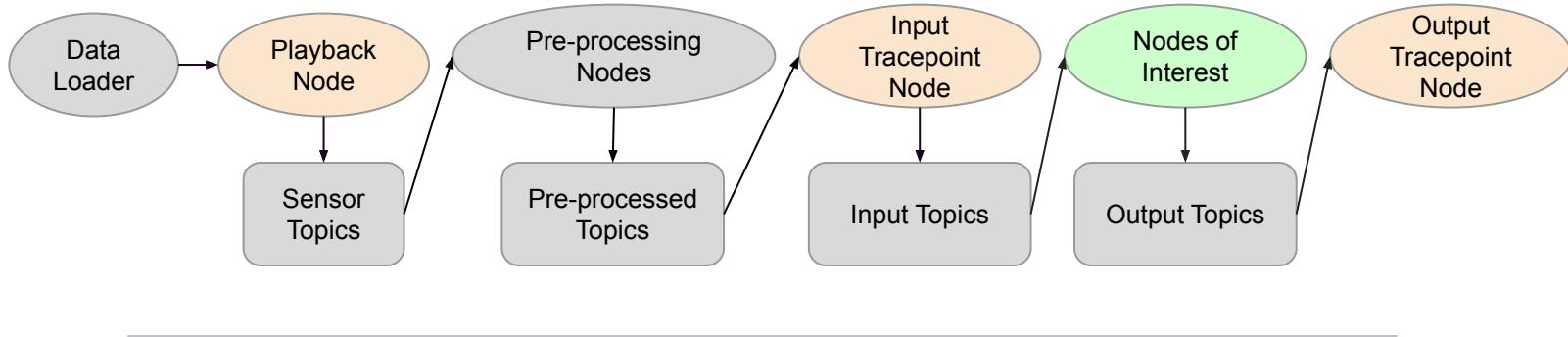
Post-Processing

RobotPerf Principles

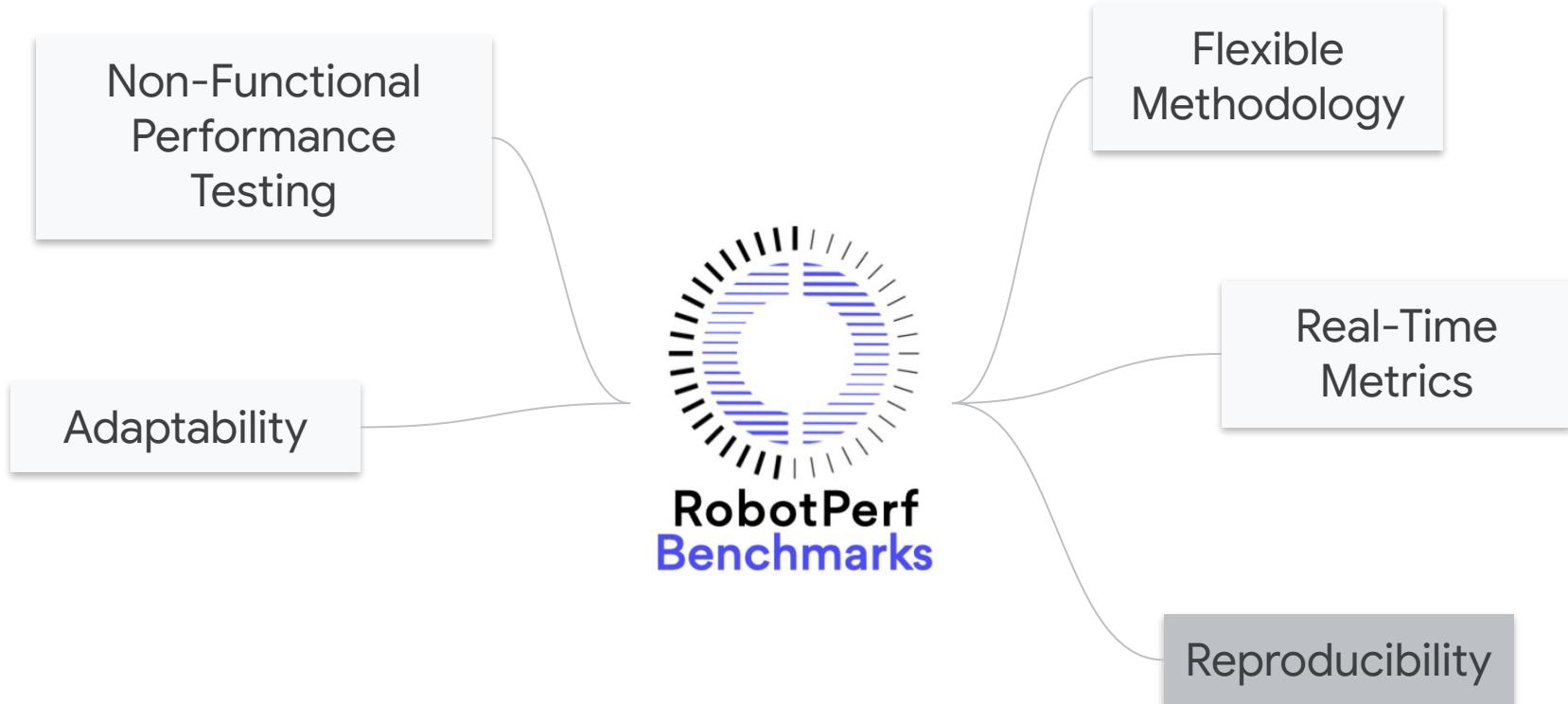


RobotPerf
Benchmarks

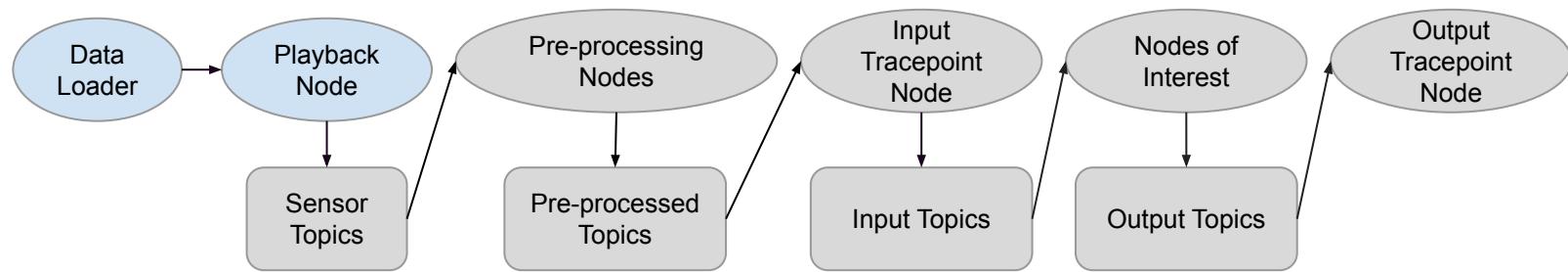
Adaptability



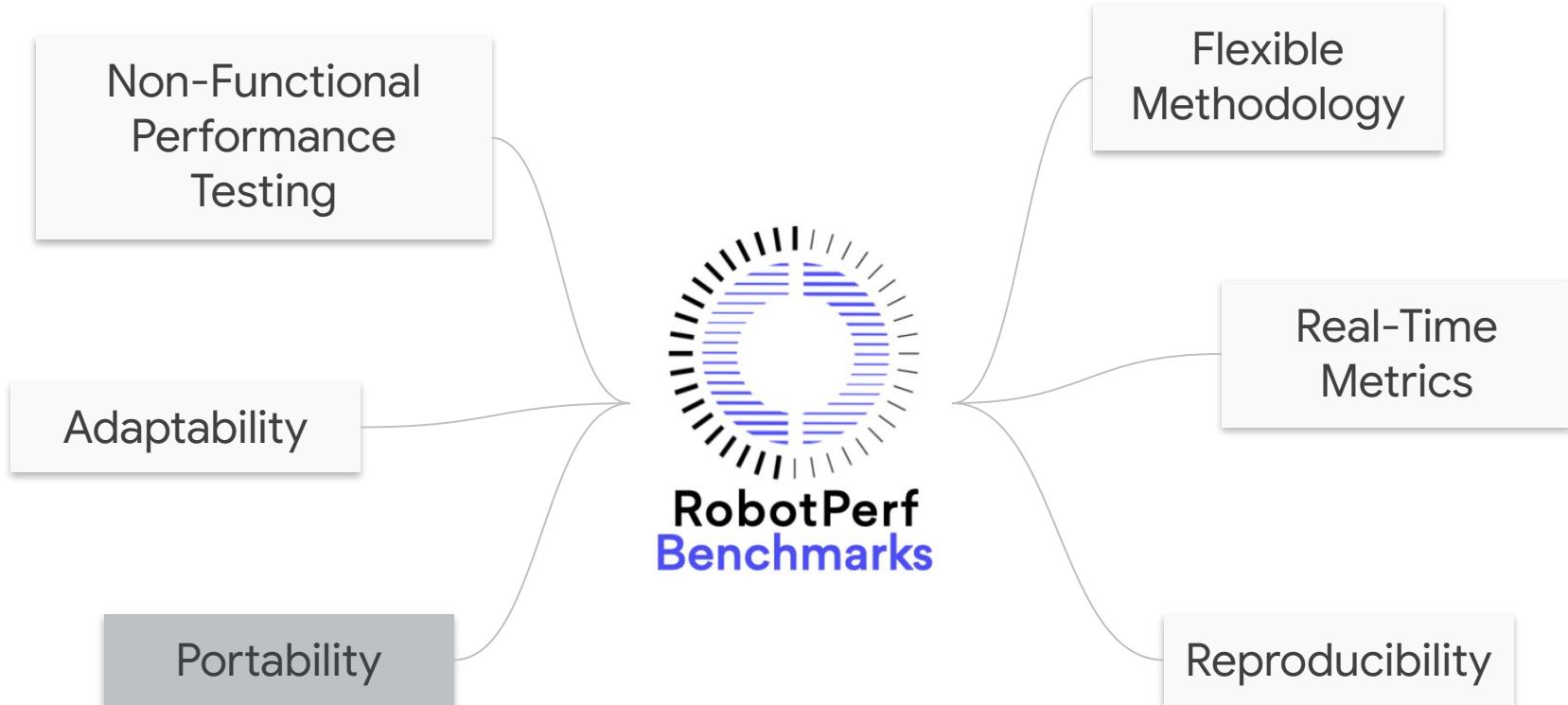
RobotPerf Principles



Reproducibility

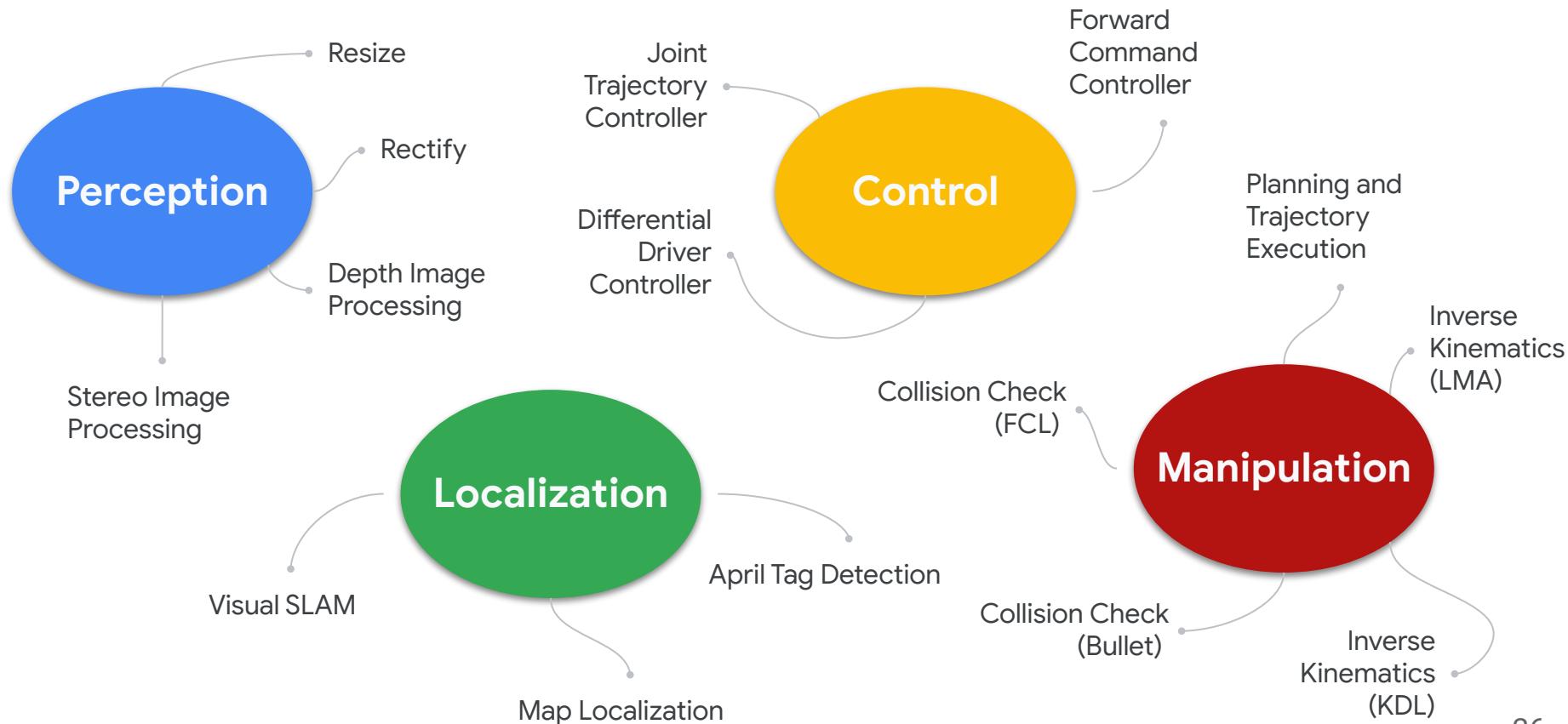


RobotPerf Principles



RobotPerf Results

Benchmarks



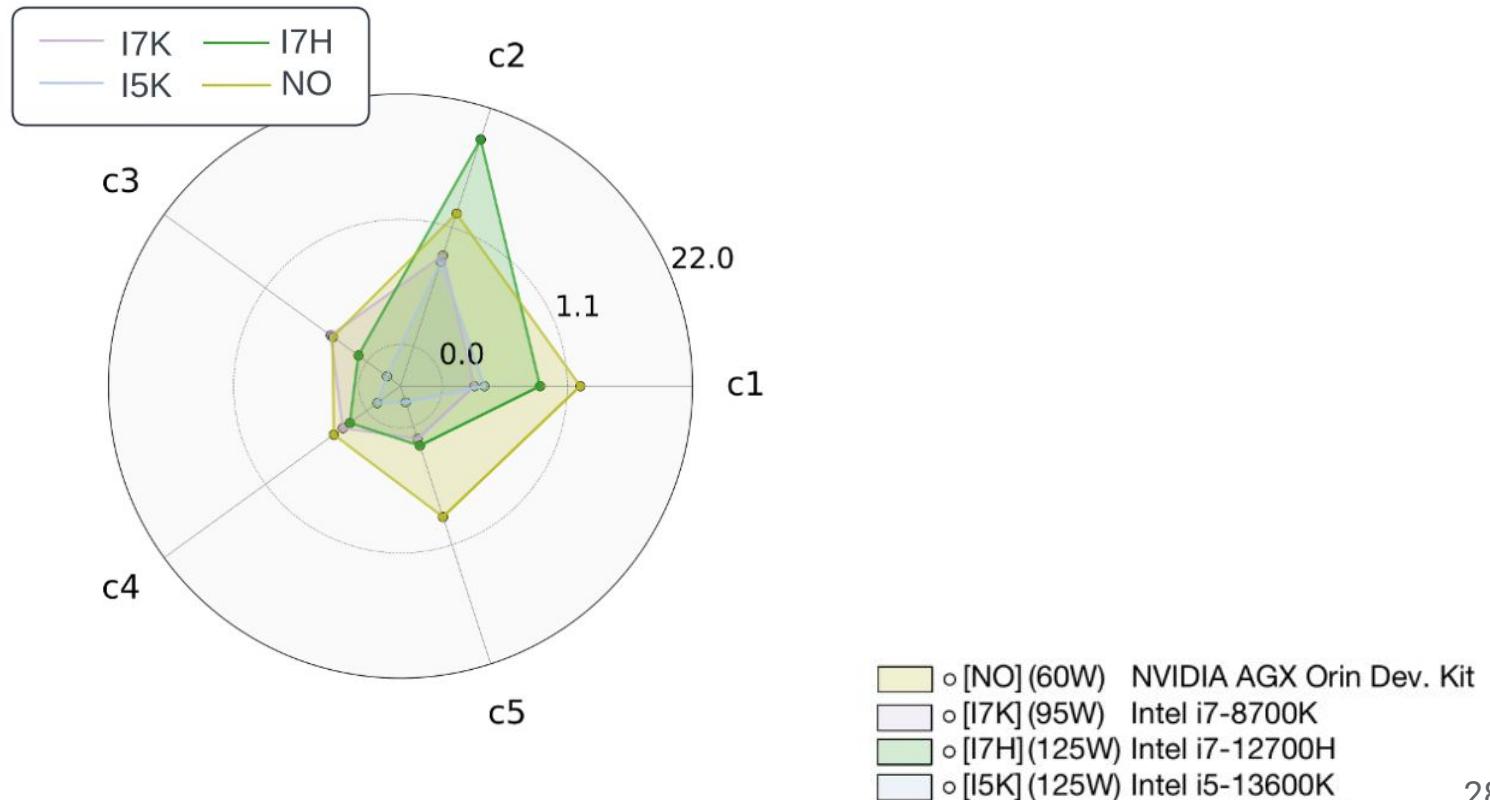
Takeaways

Quantitative Approach to
Hardware Selection

Representative Assessment of
Heterogeneous Hardware

Assessment of Acceleration
Benefits

Hardware Selection



Representative Assessment

- [15U] (15W) Intel i5-8250U
- [AR] (65W) AMD Ryzen 5 PRO 4650G
- [I7K] (95W) Intel i7-8700K
- [I7H] (125W) Intel i7-12700H
- [I5K] (125W) Intel i5-13600K
- [I9K] (125W) Intel i9-12900KF

General-Purpose Hardware

- [NN] (5W) NVIDIA Jetson Nano
- [QR] (5W) Qualcomm RB5 Robotics Kit
- [JX] (30W) Jetson AGX Xavier
- [NO] (60W) NVIDIA AGX Orin Dev. Kit
- [I7N] (295W) Intel i7-12700H + NVIDIA GeForce RTX 3060

Heterogeneous Hardware

- [KK] (15W) Kria KR260
- [KV] (36W) Kria KV260

Reconfigurable Hardware

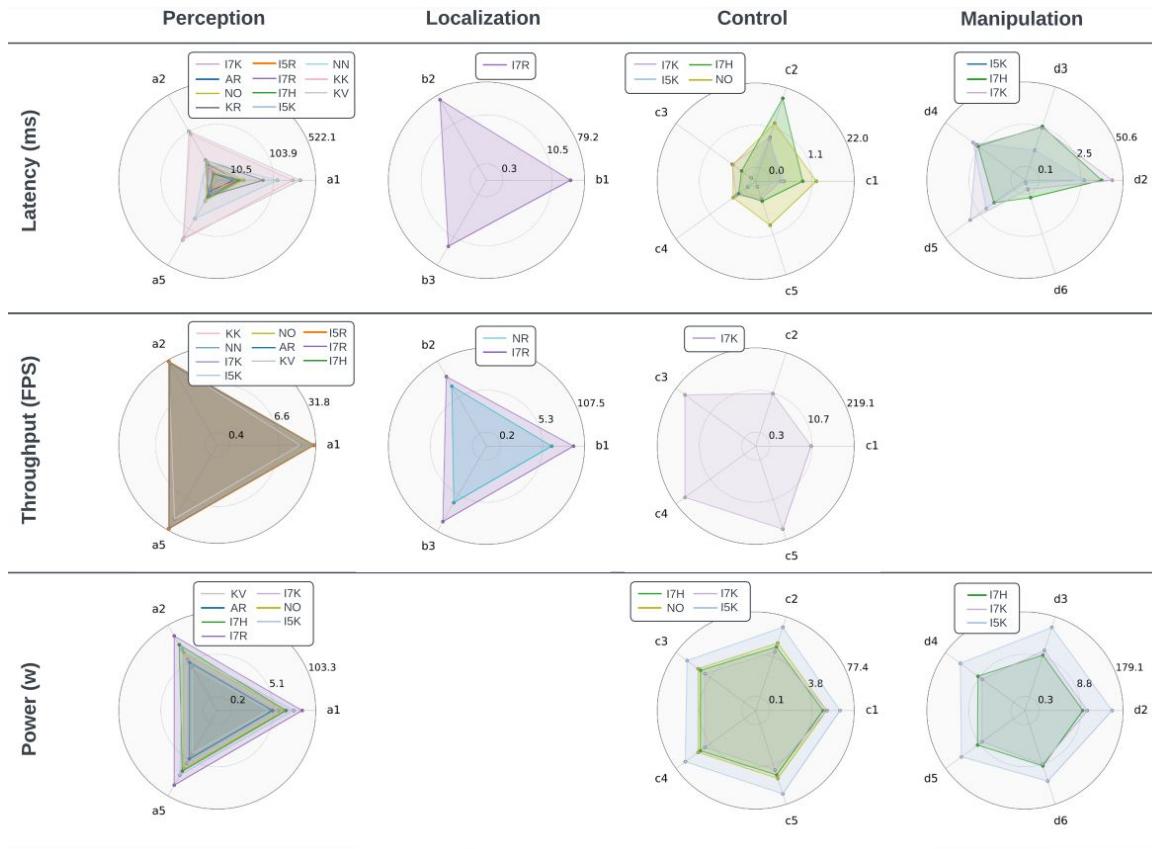
- [KR] (35W) Kria KR260 (ROBOTCORE® Perception)
- [NR] (80W) NVIDIA AGX Orin Dev. Kit (ROBOTCORE® Perception)
- [I7T] (145W) Intel i7-12700H (ROBOTCORE® Transforms)
- [I5R] (315W) Intel i5-13600K + NVIDIA GeForce RTX 3060 (ROBOTCORE® Perception)
- [I7R] (315W) Intel i7-12700H + NVIDIA GeForce RTX 3060 (ROBOTCORE® Perception)

Accelerator Hardware

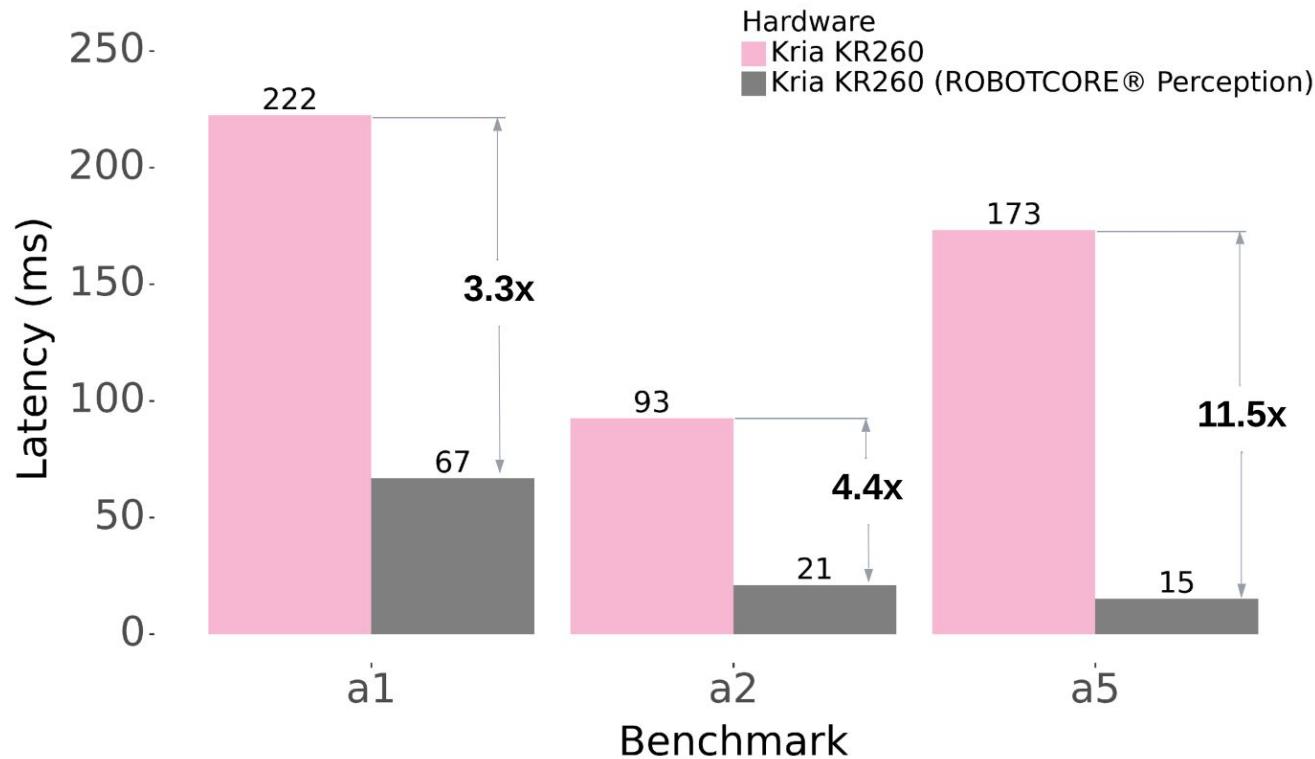
Grey Box

Black Box

Representative Assessment



Acceleration Benefits



Join the Community!





Thanks!

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