

Bachelor's / Master's / Semester Project

Near data processing for self-driving cars

Self-driving cars generate **substantial data** through cameras, lidar, and various sensors. The data must be processed by computing units like CPUs and GPUs, leading to **significant data movement**. Such data movement can diminish both the **performance and lifespan** of these devices, as well as increase **power consumption**. Given that self-driving cars must adhere to **strict deadlines**, have **extended longevity** requirements, face **power constraints, and prioritize safety**, it becomes urgent to minimize these challenges. Therefore, we aim to implement near-data processing strategies to reduce the overhead associated with data movement.

Status of the project:

We have open-source code for the NVIDIA Jetson TX2 board, which is obsolete <https://github.com/duttresearchgroup/Chauffeur>. We need to run Chauffeur on a new board, such as Jetson Xavier NX, Jetson Orin AGX, or Jetson Orin Nano. Thus, we may need to modify the code and script to make it compatible with a new board. We have the author's support.

Tasks for this project:

1. Searching more related papers about this project (exploiting workload patterns of self-driving cars for PIM or storage-centric computing)
2. Run the benchmark suite on ARM or X86 platform (ARM)
3. Profile the workloads for DRAM and storage access patterns/features, data movement, and power consumption
4. Try to have some basic goals from the profiling data (have some hypotheses and the potential problems that we want to validate)
5. Collect motivational data based on goals and potential solutions. For example, data movement, power consumption, performance, and writes(lifetime)
6. Propose PIM or storage-centric-computing-based solutions to reduce data movement to improve performance and lifetime, or reduce power consumption
7. Explore the simulator for final evaluation (if there is no suitable simulator, we may design one)

We are looking for enthusiastic students who want to work hands-on on different software, hardware, and architecture projects for heterogeneous systems.

Requirements

- Outstanding programming skills (C/C++)
- Computer architecture background
- Interest in discovering why things do or do not work and solving problems
- Interest in making systems efficient and usable
- Strong work ethic

For the introduction of PIM or storage-centric (summary papers) please see:

- https://people.inf.ethz.ch/omutlu/pub/ProcessingDataWhereItMakesSense_micpro19-invited.pdf
- https://people.inf.ethz.ch/omutlu/pub/processing-in-memory_workload-driven-perspective_IBMjrd19.pdf

If you are interested, please email:

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