Model-Based Generation of Linear Algebra Software

Variants Analysis of Linear Algebra Algorithms in the Presence of Performance Variations

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1. Background

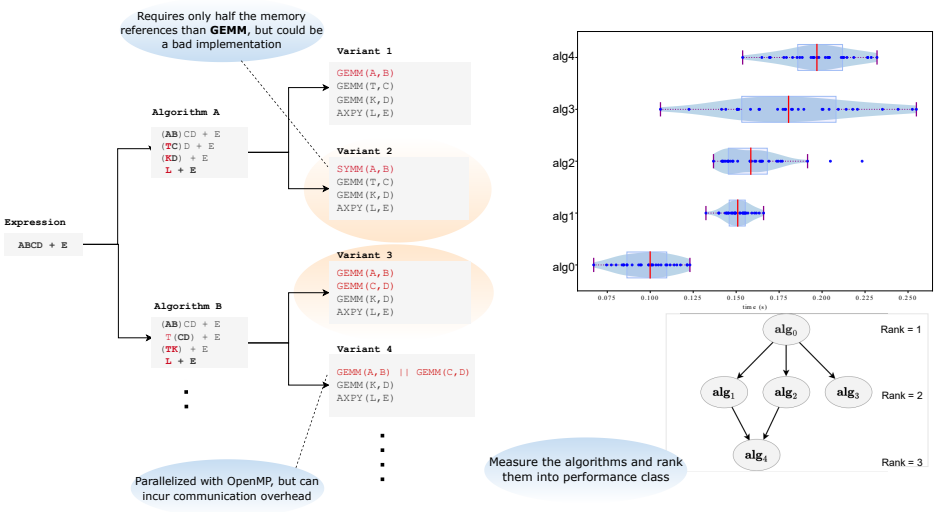
Motivation

- A mathematical expression can be computed in many alternative ways, which although equivalent from a mathematical perspective, differ in terms of performance.
- Popular computing systems such as Matlab, TensorFlow, PyTorch, etc. often choose the sub-optimal variant [1].

Objective

- Data-driven performance analysis of variant implementations and aid in selecting a fast variant.

2. Same expression, but many variants with different performance



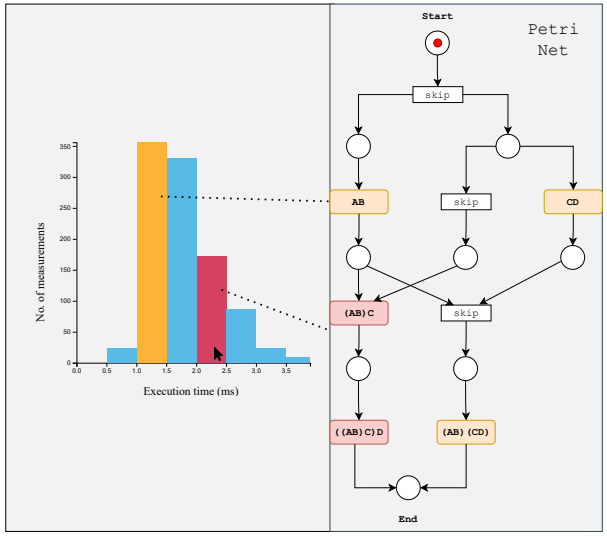
Parenthesization and Kernel choices results in different implementations of a Matrix chain.

3. Deliverables

The increasing complexity of computing systems induces variations in performance measurements. In this work, we develop methods to analyze the variants in the presence of performance variations.

- Methodologies to rank the variants into performance class, while making as little measurements as possible [2].
- Explain the performance variations in terms building block kernels using Decision Trees.
- Model the workflow though the kernels for each performance class using Petri Nets [3].

4.Visual Analytics and Identifying bottlenecks



Process model of the variants ((AB)C)D and (AB)(CD)

[1] **A. Sankaran**, NA. Alashti, C.Psarras and P. Bientinesi, *"Benchmarking the Linear Algebra Awareness of TensorFlow and PyTorch."*, IPDPS: iWAPT 2022.
[2] **A. Sankaran** and P. Bientinesi, *A Test for FLOPs as a Discriminant for Linear Algebra Algorithms*, IEEE SBAC-PAD 2022
[3] Van Der Aalst, Wil. *Process mining: data science in action. Vol. 2.* Heidelberg: Springer, 2016: Ch. 7