

# Analyzing Methods for the Phase Ordering Problem

## Task Description

The problem of ordering optimizations (so-called “phases”) during the compilation of a program, known as the Phase Ordering Problem, is a problem that is known to be NP-hard. The idea of this thesis is to conduct a literature research on promising methods that find a “good” solution for the problem. The following aspects should be analyzed:

- Which kinds of methods are there?
- Which factors are important to determine the best order of optimizations?
  - How important are they?
  - Is there any evaluation?
  - Do some factors appear more often in various methods than others?
- Is there any kind of classification involved in the method to solve the problem?

## Overview of the Tasks

- Literature research on the Phase Ordering Problem
- Classification of already existing methods
- Analysis of the important factors to solve the problem

## Prerequisites

- Basic knowledge on how a compiler works
- Basic knowledge in AI methods (helpful, not necessary)

## Get in Touch

In case you are interested, please send an e-mail (German or English) with your motivation and which prerequisites you fulfill to [michelle.to@nm.ifi.lmu.de](mailto:michelle.to@nm.ifi.lmu.de). Please do not send long e-mails generated by a large language model; a short e-mail is enough.

## Administrative Information

**Aufgabensteller:** Prof. Dr. D. Kranzlmüller

**Art der Abschlussarbeit:** Bachelorarbeit

**Bearbeitungsdauer:** gemäß Studienordnung

**Anzahl Bearbeiter\*innen:** 1

**Betreuer\*innen:** Xiao-Ting Michelle To

## References

- [1] Mohammed Almakki, Ayman Izzeldin, Qijing Huang, Ameer Haj Ali, and Chris Cummins. Autophase v2: Towards function level phase ordering optimization. In *Machine Learning for Computer Architecture and Systems 2022*, 2022.
- [2] Amir H Ashouri, Andrea Bignoli, Gianluca Palermo, Cristina Silvano, Sameer Kulkarni, and John Cavazos. Micomp: Mitigating the compiler phase-ordering problem using optimization sub-sequences and machine learning. *ACM Transactions on Architecture and Code Optimization (TACO)*, 14(3):1–28, 2017.
- [3] Ameer Haj-Ali, Qijing (Jenny) Huang, John Xiang, William Moses, Krste Asanovic, John Wawrzynek, and Ion Stoica. Autophase: Juggling hls phase orderings in random forests with deep reinforcement learning. In I. Dhillon, D. Papailiopoulos, and V. Sze, editors, *Proceedings of Machine Learning and Systems*, volume 2, pages 70–81, 2020.
- [4] Sameer Kulkarni and John Cavazos. Mitigating the compiler optimization phase-ordering problem using machine learning. In *Proceedings of the ACM international conference on Object oriented programming systems languages and applications*, pages 147–162, 2012.