

PySchedCL: A Framework for Automatically Exploiting Concurrency in Heterogeneous Data-Parallel Applications

M.Tech Project - II Thesis report submitted to

Indian Institute of Technology Kharagpur

in fulfilment for the award of the degree of

Dual Degree (B.Tech + M.Tech)

in

Computer Science and Engineering

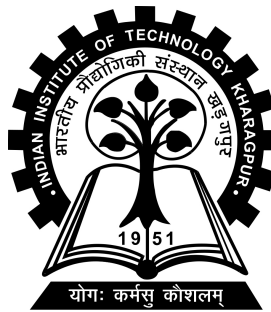
by

Siddharth Singh

(15CS30032)

Under the supervision of

Professor Soumyajit Dey



Department of Computer Science and Engineering

Indian Institute of Technology Kharagpur

Spring Semester, 2019-20

June 2, 2020

DECLARATION

I certify that

- (a) The work contained in this report has been done by me under the guidance of my supervisor.
- (b) The work has not been submitted to any other Institute for any degree or diploma.
- (c) I have conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.
- (d) Whenever I have used materials (data, theoretical analysis, figures, and text) from other sources, I have given due credit to them by citing them in the text of the thesis and giving their details in the references. Further, I have taken permission from the copyright owners of the sources, whenever necessary.

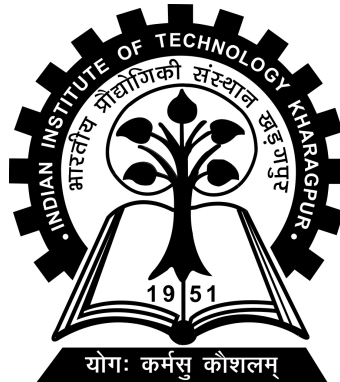
Date: June 2, 2020

Place: Kharagpur

(Siddharth Singh)

(15CS30032)

DEPARTMENT OF COMPUTER SCIENCE AND
ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
KHARAGPUR - 721302, INDIA



CERTIFICATE

This is to certify that the project report entitled “PySchedCL: A Framework for Automatically Exploiting Concurrency in Heterogeneous Data-Parallel Applications” submitted by Siddharth Singh (Roll No. 15CS30032) to Indian Institute of Technology Kharagpur towards partial fulfilment of requirements for the award of degree of Dual Degree (B.Tech + M.Tech) in Computer Science and Engineering is a record of bona fide work carried out by him under my supervision and guidance during Spring Semester, 2019-20.

Date: June 2, 2020

Place: Kharagpur

Professor Soumyajit Dey
Department of Computer Science and
Engineering
Indian Institute of Technology Kharagpur
Kharagpur - 721302, India

Abstract

Name of the student: **Siddharth Singh**

Roll No: **15CS30032**

Degree for which submitted: **Dual Degree (B.Tech + M.Tech)**

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Thesis title: **PySchedCL: A Framework for Automatically Exploiting
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In the past decade, high performance compute capabilities exhibited by heterogeneous GPGPU platforms have led to the popularity of data parallel programming languages such as CUDA and OpenCL. Such languages, however, involve a steep learning curve as well as developing an extensive understanding of the underlying architecture of the compute devices in heterogeneous platforms. This has led to the emergence of several High Performance Computing frameworks which provide high-level abstractions for easing the development of data-parallel applications on heterogeneous platforms. However, the scheduling decisions undertaken by such frameworks do not sufficiently exploit the concurrency inherent in a data parallel application to its full potential. We propose a framework called *PySchedCL*, whose design philosophy is along similar lines as that of other HPC frameworks, with a specific focus on exploring fine-grained concurrency aware scheduling decisions that completely harness the power of heterogeneous CPU/GPU architectures. We showcase the efficacy of such scheduling decisions over popular dynamic scheduling

schemes by conducting extensive experimental evaluations for a Machine Learning based inferencing application. We also experiment with automated coarse-grained scheduling algorithm that rely on Machine learning to schedule heterogenous applications.

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Chapter 1

Introduction

1.1 Introduction

Appendix A

Appendix A

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Bibliography