GUARANTEEING SERVICE LEVEL AGREEMENTS FOR TRIANGLE COUNTING VIA OBSERVATION-BASED ADMISSION CONTROL ALGORITHM

Weerakkody Arachchige Chinthaka Rukshan Weerakkody

(189356P)

Thesis submitted in partial fulfillment of the requirements for the degree
Master of Science in Computer Science

Department of Computer Science and Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

October 2022

DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: ……. Date:…….
Name: Chinthaka Weerakkody

The above candidate has carried out research for the Masters dissertation under my supervision.

Signature of the supervisor: ……. Date: ……..
Name: Prof. Sanath Jayasena

Signature of the supervisor: ……. Date: ……..
Name: Dr. Miyuru Dayarathna

ACKNOWLEDGEMENT

My sincere appreciation goes to my family for the continuous support and motivation given to manage my MSc research work. I also express my heartfelt gratitude to Prof. Sanath Jayasena and Dr. Miyuru Dayarathna, my supervisors, for the supervision and advice given throughout this research period. I'm eternally grateful for Prof. Toyotaro Suzumura for helping us by providing necessary remote servers for the project. I am also thankful to WSO2. Telco (Pvt) Ltd, Virtusa (Pvt) Ltd, Macrometa and WSO2 Lanka (Pvt) Ltd for providing support to complete this project.

ABSTRACT

Increasingly large graph processing applications adopt the approach of partitioning and then distributed processing. However, maintaining guaranteed Service Level Agreement (SLA) on distributed graph processing for concurrent query execution is challenging because graph processing by nature is an unbalanced problem. We investigate on maintaining predefined service level agreements for commonly found graph processing workload mixtures. We develop a Graph Query Scheduler Mechanism (GQSM) which maintains a guaranteed service level agreement in terms of overall latency.

The proposed GQSM model is implemented using the queueing theory. Main component of GQSM is a job scheduler which is responsible for listening to an incoming job queue and scheduling the jobs received. The proposed model has a calibration phase where the Service Level Agreement data, load average curve data, and maximum load average which can be handled by the hosts participating in the cluster without violating SLA is captured for the graphs in the system. After completing the calibration phase the job scheduler is capable of predicting the load average curve for the incoming job requests. The scheduler checks whether the maximum load average extracted from the predicted load average curve exceeds the load average threshold values captured in the calibration phase. Based on the result the job scheduler accepts or rejects the job requests received.

Results show that SLA is successfully maintained when the total number of users is less than 6 in a JasmineGraph cluster deployed in a single host. For distributed clusters the number of users can go up to 10 without violating SLA. The proposed model is scalable and it can be applied to a distributed environment as well.

As future work, the proposed model can be extended to work with less initial calibration steps and the scheduling algorithm can be improved with intelligent workload management among hosts for more efficient resource consumption.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
SLA	Service Level Agreement
CPU	Central Processing Unit
VM	Virtual Machine
HM	Host Machine
GPU	Graphics Processing Unit
GQSM	Graph Query Scheduling Mechanism
ESM	Elastic Switching Mechanism

LIST OF APPENDICES