School of Electrical Engineering
Department of
Electrical Engineering-Systems

בית-הספר להנדסת חשמל
המחלקה להנדסת חשמל-מערכות

Iby and Aladar Fleischman
Faculty of Engineering
Tel Aviv University

הפקולטה להנדסה
ע"ש איבי ואלדר פליישמן
אוניברסיטת תל-אביב

October 27, 2019

Prof. Guy Even
email: guy@eng.tau.ac.il

Subject: Evaluation of Ph.D. Thesis of Mr. Maciej Pacut

Dear Scientific Council,

The thesis deals algorithmic problems that arise in modern networks, in particular, data centers.

Chapter 2 of the thesis deals with embedding problems. We a given a substrate (physical) network consisting of servers and routers. The servers have storage and computational capabilities. The routers support communication between the servers. The substrate network is supposed to host a virtual network that consists of data (partitioned into chunks) and computational elements (called nodes). In the embedding problem the task is to determine the physical location (i.e., servers) in which data chunks are stored and nodes are hosted. The goal is to find an embedding in which the virtual network performs its tasks quickly. This means that servers are not overloaded in terms of computation or storage. The thesis considers multiple variations of this problem depending on whether chunks can be duplicated, node locations are fixed, traffic between nodes is uniform, or there exist bandwidth limitations in the physical network.

Chapter 2 discusses several algorithmic approaches for tackling embedding problems that are based on flow, matchings, and dynamic programming. Other variations of the embedding problem are proven to NP-hard.

In Chapter 3, dynamic partitioning problems are investigated. Here, the algorithm has to maintain a balanced partitioning of the elements. Online requests for pairs arrive, and if the pair is not contained in the same part, then a penalty is incurred. The algorithm may swap pairs between parts at a cost. The goal is to find a swapping strategy that leads to minimum penalty. Deterministic online algorithms are presented and analyzed for this problem. This includes the natural case of a supporting matchings (namely, each part can contain two elements). The chapter presents a greedy algorithm, proves that its competitive ratio is 7. The chapter also presents a reduction to caching that implies a lower bound on the competitive ratio that equals the size of the cluster minus one.

In Chapter 4, an interesting variant of caching is presented. Here the data is hierarchical, and upon request of an elements, all its descendants must be present in the cache. An online algorithm is presented that employs resource augmentation. The main result is that the competitive ratio of the algorithm is h times the competitive ratio of a deterministic paging algorithm, where h denotes the height of the hierarchy.

School of Electrical Engineering
Department of
Electrical Engineering-Systems

Iby and Aladar Fleischman
Faculty of Engineering
Tel Aviv University

הפקולטה להנדסה
ע"ש איבי ואלדר פליישמן
אוניברסיטת תל-אביב

בית-הספר להנדסת חשמל
המחלקה להנדסת חשמל-מערכות

The thesis deals with the challenge of finding useful abstractions of problems that appear in practice. Formulations of such abstractions require combining practical knowledge with mathematical insight so that the abstractions capture the key components of the problems at hand.

The thesis contains new formulations of optimization problems, new algorithms and analyses of the performance of these algorithms. I conclude that this thesis meets all the requirements of a Ph.D. thesis.

Sincerely,

Guy Even

Guy Even

קריית האוניברסיטה, ת"ד 39040, תל אביב 6139001
Tel Aviv University, P.O.B 39040, Ramat Aviv, Tel Aviv, 6139001, Israel