Doctoral thesis referee report for Vlastimil Babak

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Professor Zdeněk Němeček
Faculty of Mathematics and Physics
Charles University in Prague
Ke Karlovu 3, 13 16 Praha 2

Referee report for the doctoral thesis “Improving Accuracy of Software Performance Models on Multicore Platforms with Shared Caches” by Mr. Vlastimil Babka.

Dear Professor Němeček,

I have read and considered the aforementioned doctoral thesis by Mr. Vlastimil Babka, and can state that this thesis demonstrates that he is deserving of a doctoral degree.

His thesis clearly shows that he is capable of accomplishing creative scientific work. The topic is non-trivial and of significant interest across all computer software and hardware fields. His work testifies to his ability to identify areas of importance, design and carry out experiments to investigate them, and analyze the outcomes to provide insight and create new knowledge. The results he presents in this thesis address several critical areas within the field of software systems modeling, and his work on cache sharing models is valuable across all areas of computer systems and software design.

In particular I would like to call attention to two products of his research that I find particularly compelling. These are his framework for producing randomized software systems for performance validation (chapter 8) and the development of an “emulator” for separating memory behavior from other program effects (chapter 13). Both of these show insight into the problems at hand and creativity in carrying out research. I trust he (and others) will make further use of these techniques in the future.

Additionally, his success in leveraging his earlier research throughout this thesis (in particular the validation framework from chapter 8 and the work on understanding the details of memory systems in chapter 10) bodes well for his future career. However, what most impressed me was the maturity he demonstrated in his investigation of his cache sharing model’s performance (chapter 13). Despite rather
disappointing initial results, he carefully investigated the impact of several variables on his model and managed to produce a research paper that provided insight and value, and was understandably awarded with a best student paper award.

However, there are several areas that I hope he will be able to clarify at his thesis defense, in particular:
- Chapter 8: I am concerned about how representative the validation framework is given that it is based on SPEC. This is discussed briefly as part of the future work section, but I would appreciate some insight into the differences between the generated applications and the typical references within the field.
- Chapter 9: I am interested to know if other simple models beyond the linear approximations used (such as polynomial or exponential) would have improved the results.
- Chapter 10: I would like to know what modifications would be require to collect similar data for newer generations of Intel CPUs with on-board memory controllers, and what performance counters would make this kind of study easier to accomplish.
- Chapter 13: I was struck by the explanation that the linear cluster of points in the lower left of Figure 4 is due to un-modeled effects of the cache replacement policy. I do not understand how this was determined or what could be done to improve the model to handle it.
- Chapter 13: I had a hard time evaluating the quality of the results presented in Figures 9 and 10. I appreciate the analysis in the related work section that states that it is difficult to compare against other work in the field, but I feel I am missing some perspective on how the accuracy/quality of this model compares to others.
- I would like to see a discussion of the relation of this work to understanding and optimizing the energy efficiency of software systems.

In conclusion, I would like to thank Mr. Babka for the pleasure of reading his thesis and wish him success in his future research career.

Sincerely,

David Black-Schaffer
Assistant Professor
Department of Information Technology
Uppsala University