Rethinking RAM: Testing alternative models of computation

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Abstract

This is where the abstract will briefly summarize how great our project is. After all, we discovered that the VAT/RAM model is superior to the RAM/VAT model of computation.

Keywords RAM Model, computational models, benchmarks, algorithms

1 Introduction

We solved the problem of demonstrating whether the Virtual Address Translation (VAT) model of computation–presented by Jurkiewicz and Mehlhorn–is a better model than the Random Access Machine (RAM) model for analyzing the performace of algorithms when implemented on modern computing hardware.

The novel contribution includes not only the benchmarking of these procedures, but also the comparative analysis of the two models.

This work could be very significant if VAT is indeed superior to RAM. We would be the first to independently verify this and we would be contributing some of the first analysis of common, reference algorithms.

2 Motivation

Analysis of algorithms on abstract machines serves as a crucial element of computer science, which allows incredible increases in the speed and utility of computer programs. Until now, computer scientists have used the RAM and the EM models to perform algorithmic analysis accurately. But Jurkiewicz and Mehlhorn observe discrepancies with some experimental findings and attempt to push forward the VAT model to account for these discrepancies.

Before algorithm analysts shift to this new model, they must carefully verify its claims and correctness, it's utility. This is where Jurkiewicz and Mehlhorn's contribution falls short. Their paper does mention that experimental findings tally with the theoretical predictions of the new VAT model, but it does not clearly represent these findings. Additionally the number of test cases is limited. So before scientists readily accept this new model for theoretically analyzing the running time of algorithms the test set must be broadened to verify and compare the experimental results with the model's predictions.

If it can be verifed by experimental comparison that the new VAT model is more accurate, then this will serve as an incentive to researchers to use the proposed model for more accurate estimations of running time of algorithms. More accurate algorithm analysis will help maintain the pace of innovation enjoyed by computer science for a generation.

3 Previous Work

It is evident that most papers on algorithms tend to ignore the cost of virtual address translation, though researchers recognize these costs. This is because of the model that researchers follow, and that is the classic RAM model without virtual memory. Papers like "The cost of virtualization" by Ulrich Drepper and other materials like "AMD64 Architecture Programmer's Manual Vol 2" describe the implementation of virtual memory and its associated costs during translation; but no study has tried to develop a model that considers these costs for algorithmic analysis prior to the recently proposed VAT model.

Keeping this trend in mind, it is not surprising that there has been little related work that carefully verifies the experimental results and strengthens the new model that accounts for these costs. Our contribution, experimentally examining and comparing the proposed model to the older model, will fill this gap.

4 Methods

Here we describe in excruciating detail what we did.

4.1 Implementations

We took a set of standard reference algorithms including permute, and heapsort. We turned them into C procedures. We ran each one a dozen times on each of a wide variety of sizes of inputs. On each run, we timed the execution. We then took those running times and figured their growth rates. This gives us real world running times.

4.2 VAT Model Analysis

We learned how to use the VAT model. We overview how to do that here, but point you to the J&M article to explain it. We used the VAT model to analyze our set of algorithms.

5 Results

We need actual results to write this section, but it will be divided into three subsections.

5.1 Benchmarks

This subsection will have some text explaining several charts that show empirically discovered running times of our various procedures.

5.2 RAM

This subsection will be fairly brief, with a table listing the runtimes every one 'knows' these reference algorithms have.

5.3 VAT

This subsection will have a little more to it than the RAM section. There will be a table telling about the calculated running times of our algorithms. There might also be some text describing some of the difficulties or nuances of doing the analyses with the new model.

6 Discussion

This is where we discuss results.

6.1 RAM vs Reality

Here is where we will compare the benchmark results with the standard runtimes. This will need a table to compare the two algorithm-by-algorithm.

6.2 VAT vs Reality

Here is where we will compare the benchmark results with the new model's runtimes. This will need a table to compare the two algorithm-by-algorithm.

6.3 VAT vs RAM

The big finale, old vs new, here is where we will declare a winner between RAM and VAT. This will likewise need a table. Really all three tables could be combined into one good chart for the whole section.

7 Future Work

There still remains work to be done making our mathematical models better reflect reality.

8 Conclusions

We did the experiment, because reasons. We found a result, and thought it was pretty nifty.

9 References

The final paper will include our references duly cited using Bibtex. I have to remember how to compile them properly. But from our proposal

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Appendix

We will include an Appendix for our source code and data. We might include our efforts at employing VAT analysis. For now, all our materials can be found online at:

https://github.com/dslachut/adv-algo-project