CS 395 D
SOFTWARE OPTIMIZATION

ASSIGNMENT 1
Winter 2014

Assigned: 1/11/2014
Due: 1/17/2014

This assignment can be submitted either in class or by email to jastratton@knox.edu

Part I: Performance Metrics and Analysis Exercises (4 points):

A) A datacenter administrator is concerned about ongoing power consumption of the big system, and wants to replace the current systems with a smaller number of faster systems. A vendor representative shows him a new system that finishes the same workload in half the time it took his current system to complete it. It is verified that, if adopted, the administrator would therefore need half as many machines to match current processing capacity. Is this enough to sign a deal and acquire the new system? If not, what was insufficient about the information given?

B) In the image processing example from class, we needed approximately 2 Bytes of memory traffic and one arithmetic operation to process each pixel. Suppose that you are a system builder, and can purchase processors and memory units specifically for this application. You can include up to 8 memory modules, each providing 40 GB/sec of bandwidth for $20, and can include a 2-core, 4-core, or 6-core processor, costing $50, $80, and $100, respectively, each delivering approximately 50 GOPS per core. Design a system with the highest possible performance, using the metric of pixels processed per second per dollar, assuming no overhead.

Part II: Performance Measurement writing assignment (20 points):

Performance measurements should have the same rigor and standards as scientific measurements of other physical phenomena, implying that results should be controlled to the extent possible, and published with enough information that the results can be compared and replicated. One of the biggest performance measurement organizations is the Standard Performance Evaluation Corporation. (Full disclosure, I am currently working with their high performance group to finalize a benchmark suite for GPU-accelerated applications.) The link below refers to the Run Rules for SPEC CPU 2006, and the benchmark workloads included in the suite. The Run Rules are the policies regarding how people should use the SPEC CPU benchmark suite, written because the benchmark suite is a product most strongly used by corporate advertising agencies, who may have little training on proper scientific procedures, and actually have an incentive to make their own systems look as good as possible. Write a short (1-2 page) analysis of these run rules, and analyze or critique them. Don’t worry about completely understanding every clause – many of these rules were written to prevent specific ways of cheating that you may not even be
aware of. A well-written response should cover at least some of these topics, in no particular order:

- What are some of the controlled experimental variables? What are the specific independent and dependent variables focused on in these run rules?
- Can you think of any uncontrolled variables, based on these run rules? How significant of an impact might those uncontrolled variables have on the results?
- What workload(s) have they chosen? What does the choice of benchmark programs say about what SPEC believes is a representative CPU workload? To what extent are these programs representative of your own computer usage?
- Why did SPEC have to make these rules so long, verbose, and precise? Pick at least one example rule or requirement, and explain why that requirement is necessary to avoid accidental or dishonest publication of misleading results. What would be the long-term consequences of misleading results being published?