ECE 571 – Advanced Microprocessor-Based Design Lecture 21

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Announcements

- HW#10 will be another reading

Project Stuff

- Status result/Literature search due on Tuesday

- Would like a brief update on how things are going.

- Do you need to borrow any hardware (only 1 spare wattsup-pro)

- Willing to volunteer for Tuesday rather than Thursday

- Literature search: 5 items for alone, 8 in group
  Prefer if academic, but some things those might not

exist so books, web-pages, blogs acceptable too.
If academic and can't find paper, if IEEE, ACM, etc you can log in on UMaine library website and download for free if on campus.

- Cite your references.

- You can fold this into your larger project writeup.

- It's OK if you find out someone else has done your exact project before. It's good to validate results.

Reading

A Validation of DRAM RAPL Power Measurements
by Desrochers, Paradis and Weaver

Digression on Academic Papers

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- Work I've been doing with some students.

- MEMSYS conference

- Haswell-EP server with 80GB RAM is 13W of power
  that's not even with all slots full
  428GFLOPS incidentally (2.1 GFLOPS/w)

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- Notes on the documentation. Intel tries, but their documentation can be a real pain sometimes, often conflicting and out of date. Also their teminology an be really confusing.

- Instrumenting the hardware
  P4 power connector
  ATX power measurement and previous students
  Hall effect sensors vs sense resistors

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- DIMM extender card
  PCIe extender cards
  small resistance. Instrumentation amplifier
  Data acquisition board.

- RAPL measured using perf tool

- Synchronizing the measurements. Hard at high
  frequencies.
  Other ways to do it? Use serial port and data acquisition

board

On green500 list/wattsup just use NTP to make sure within a second.

- RAPL overhead, only measure at 10Hz.
  Overhead of too many interrupts, writing to disk. Also power overhead.

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- Benchmark choice.
  idle

  stream

  BLAS: ATLAS, OpenBLAS, MLK

- GPU: OpenCL ray-tracer
  KSP

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- Results

- Figure 2: Idle. Is a system truly idle? It is measuring the perf counters and such.

- Figure 3: Stream benchmark. Package power reads a bit low. DRAM very close when busy, low when idle.

- Figure 4: HPL Atlas Bursty. Note that when LLC miss happens, CPU power goes down (CPI gets worse) but memory power goes up.

- Figure 5: HPL OpenBLAS

- Figure 6: HPL MKL

- Figure 7: Raytracer
  DRAM behavior not well captured

- Figure 8: KSP: more CPU as at least one CPU is running the physics engine. Again DRAM power not captured well.

- Table results. Why no FLOPS/w for stream? Do ratios hold up?

Easy Future Experiments

- Conduct same measurements on other Haswell machines (we have at least two others)

- See if the memory extender causes any slowdown/different RAPL results

- Get another memory extender and see how it works with two DIMMs

- Measure RAPL overhead, can we run at 1kHz if we read

MSR directly too a buffer w/o any other overhead? Still need a timer of some sort.

More Difficult Future Experiments

- Measure on server system (our SNB-EP is dead, and HSW-EP is DDR4 which requires two voltage planes and DDR4 extender)