ECE574: Embedded Systems – Homework #2

Supercomputer Paper Reading

Due: 26 January 2017, 3:30pm

Read the following three papers and answer the questions.

1.   How the World's Most Powerful Supercomputer Inched Toward the Exascale, IEEE Spectrum, 20 Jul 2016.

http://spectrum.ieee.org/computing/hardware/how- the- worlds- most- powerful- supercomputer- inched- toward- the- exascale

(a)   Name one way the computer's design saved on power.

It uses lightweight approach that use microprocessors that are slower but cooler. It uses DDR3, an older, slower memory, to save on power. Its architecture also uses small amounts of local memory near each core instead of a more traditional memory hierarchy. That is making the ratio of the floating-point operations for every byte of main memory accessed. This architecture design cuts down on a big expense in a supercomputer's power budget.

(b)   What percentage of theoretical peak does it reach on Linpack? On HPCG?

It reaches 74% on Linpack and 0.3% on HPCG.

(c)   When does the US plan on having an Exaflop machine?

US is targeting the early 2020s.

2.   Next-Generation Supercomputers, IEEE Spectrum, 26 Jan 2011

http://spectrum.ieee.org/computing/hardware/nextgeneration- supercomputers

(a) Is the limiting power factor (in pico-Joules per operation) the actual floating point instruction, or something else?

No, the actual floating point instruction is not limiting power factor, it is a small limit compare with the energy needed to shuffle the data around. Memory technologies requires emerge to have greater densities at the same or lower power.

(b) Typically, around what percentage of a supercomputer's theoretical peak performance is actually achieved?

5 to 10 percent.

(c) Did we make DARPAs goal of an Exaflop by 2015?

No we did not.

3. How To Kill A Supercomputer: Dirty Power, Cosmic Rays, and Bad Solder, IEEE Spectrum, 23 Feb 2016

http://spectrum.ieee.org/computing/hardware/how- to- kill- a- supercomputer- dirty- power- cosmic- rays- and- bad- solder

(a) What year does this article predict an exascale computer will be ready?

By 2023, exascale are predicted to arrive in the USA.

(b) How often were ECC memory errors happening on the Jaguar super computer?

350 times per minute.

(c) What was causing the LLNL Bluegene computer to crash?

Radioactive lead in the solder was found to be causing bad data in the L1 cache, a chunk of very fast memory meant to hold frequently accessed data.

(d) Why might powering off unused chips or parts of chips be bad?

Studies done at the University of Michigan in 2009 found that constant power cycling reduced a chip's typical lifetime up to 25 percent. Power cycling has a secondary effect on resilience because it causes voltage fluctuations throughout the system. Too large of a voltage fluctuation can cause circuits to switch on or off spontaneously inside a computer.