Computer System Architecture

First week's Report

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Benchmark programs

- FMM
- Ocean
- FFT
- Reason:
  These programs are relatively parallel and can be solved with greater efficient with multi-core processor

Parameters to consider

- Number of Cores (2^n)
- L1 cache size and associativity
- L2 cache size and associativity
- Hardware Cost

Conditions

- For the selected benchmark program, the core number has to be 2^n,then the viable option would be 2,4,8,16 core processor
- For optimum performance, both L1 and L2 cache should be integer multiple of the processor count
- From last experiment, higher associativity can have less access time but also result in higher energy consumption. Since the energy consumption is not considered in this exercise, associativity should be the value where access time reaches approximately the peak performance. [8, 16, 32, 64, 128 …]

Constrains

- Let x denotes number of processing cores, α denotes L1 cache size per core and β denotes L2 cache size per core:
- $\text{Total Hardware Cost} = x * 1 + x * {}^{\alpha}/_{2} + x * {}^{\beta}/_{32} \leq 128(BCE)$ where $x = 2, 4, 8, 16$
- $Freq = 1/Acc\_Time\ GHz$

Proposed options

Cores	L1 Cache (kB/core)	L2 Cache (kB/core)	BCE
2	32	1024	98
2	64	512	98
4	16	512	100
4	32	256	100
8	16	128	104
16	8	64	112

* Supplemental

- While we've selected 3 benchmark programs which core count has to be 2^n, all proposed options aren't able to fully utilize given hardware resources, if choose Raytrace, LU and Cholesky:

Cores	L1 Cache (kB/core)	L2 Cache (kB/core)	BCE
6	32	128	126

The option above can almost fully utilize hardware resource, and is worth give a shot if time is sufficient.