Hyperthreading and "Almost Amdahl"

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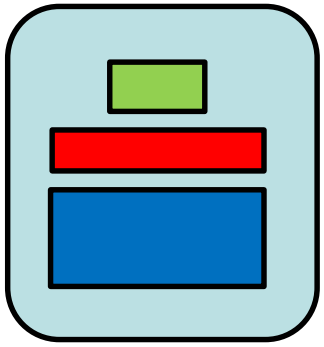
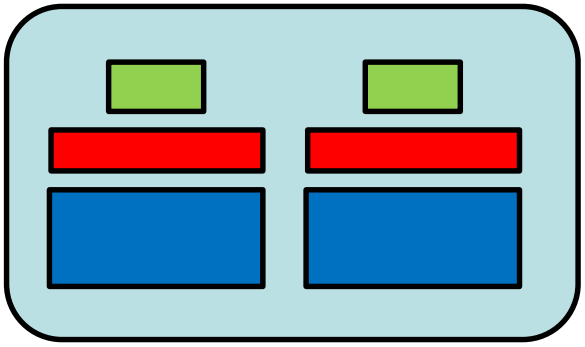
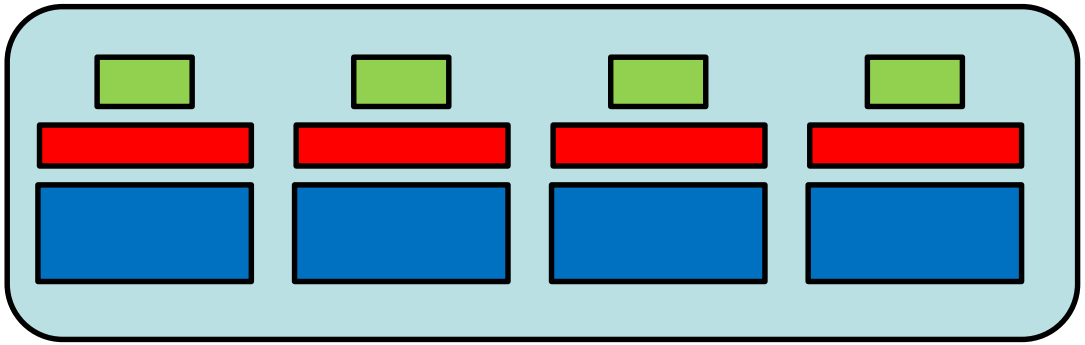
Each of the Multiple Cores keeps its own State



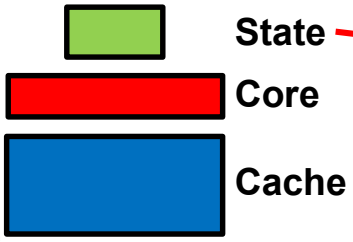
1 core, 1 state



2 cores, 2 states

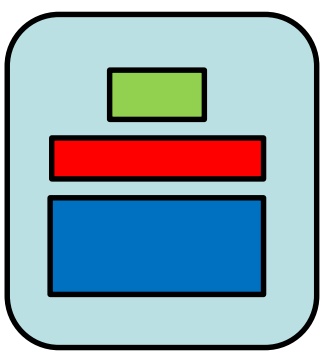


4 cores, 4 states

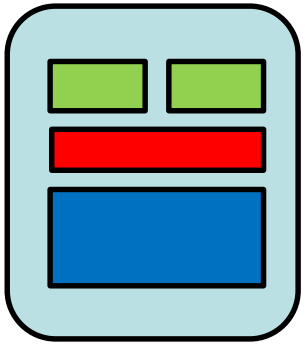


- Registers
- Program Counter
- Stack Pointer

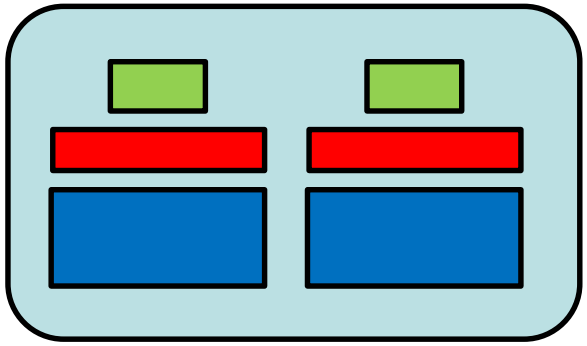
So, if that's what Multicore is about, what is *Hyperthreading*?



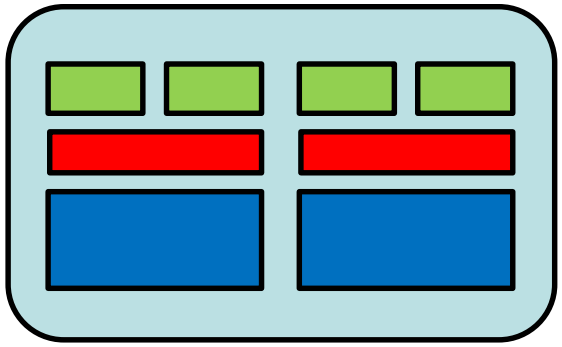
1 core, 1 state



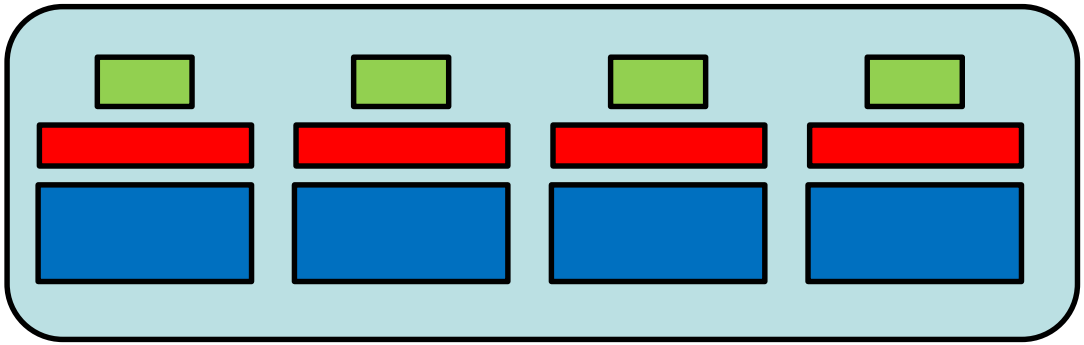
1 core, 2 states, with Hyperthreading



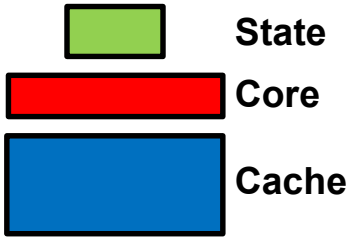
2 cores, 2 states



2 cores, 4 states, with Hyperthreading



4 cores, 4 states



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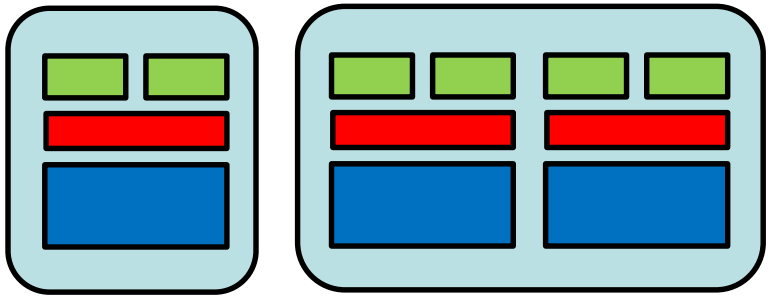
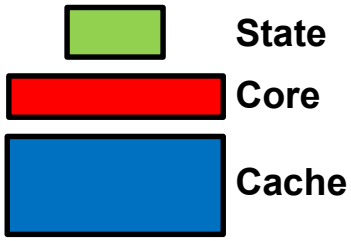
What is Hyperthreading and what can it Do?





Hyperthreading is when a CPU chip has more states than cores.

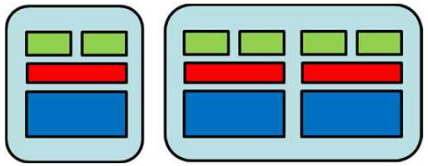
In this case, if one thread of execution blocks (waiting for a memory fetch, for instance), then the other thread can resume execution with its state.

If we let **H** be the fraction of a CPU's capacity that one hyperthread can keep busy, then the remaining unused capacity is (1-H). If another hyperthread can keep H% of that capacity busy, then that leaves (1-H)*(1-H) remaining unused capacity and so on.

If we have **n** hyperthreads, then the final remaining unused capacity is $\mathbf{(1-H)^n}$. The capacity actually in use would then be $\mathbf{1-(1-H)^n}$. If one thread can only keep the CPU H% busy, then the speed-up is potentially:

$$SU = \frac{1-(1-H)^n}{H}$$

What is Hyperthreading and what can it Do?



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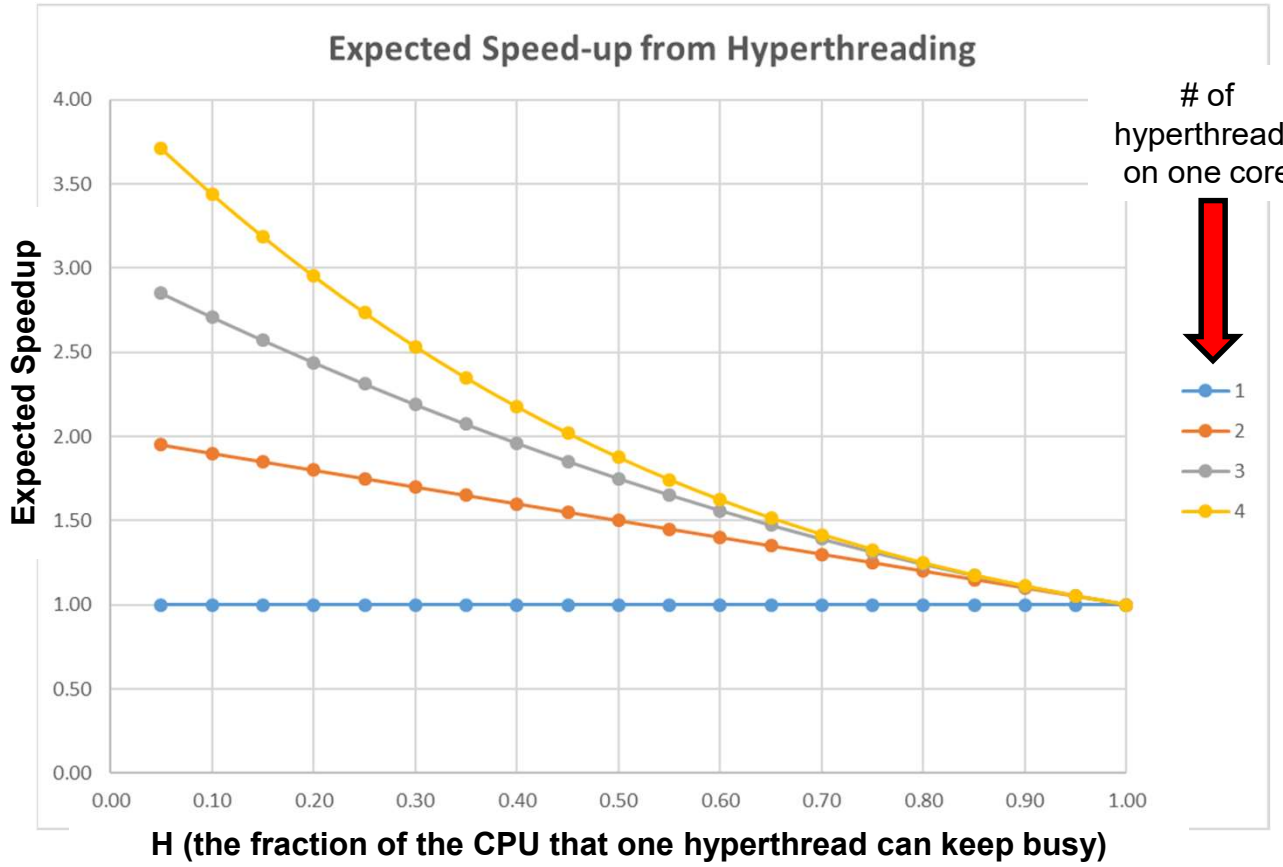

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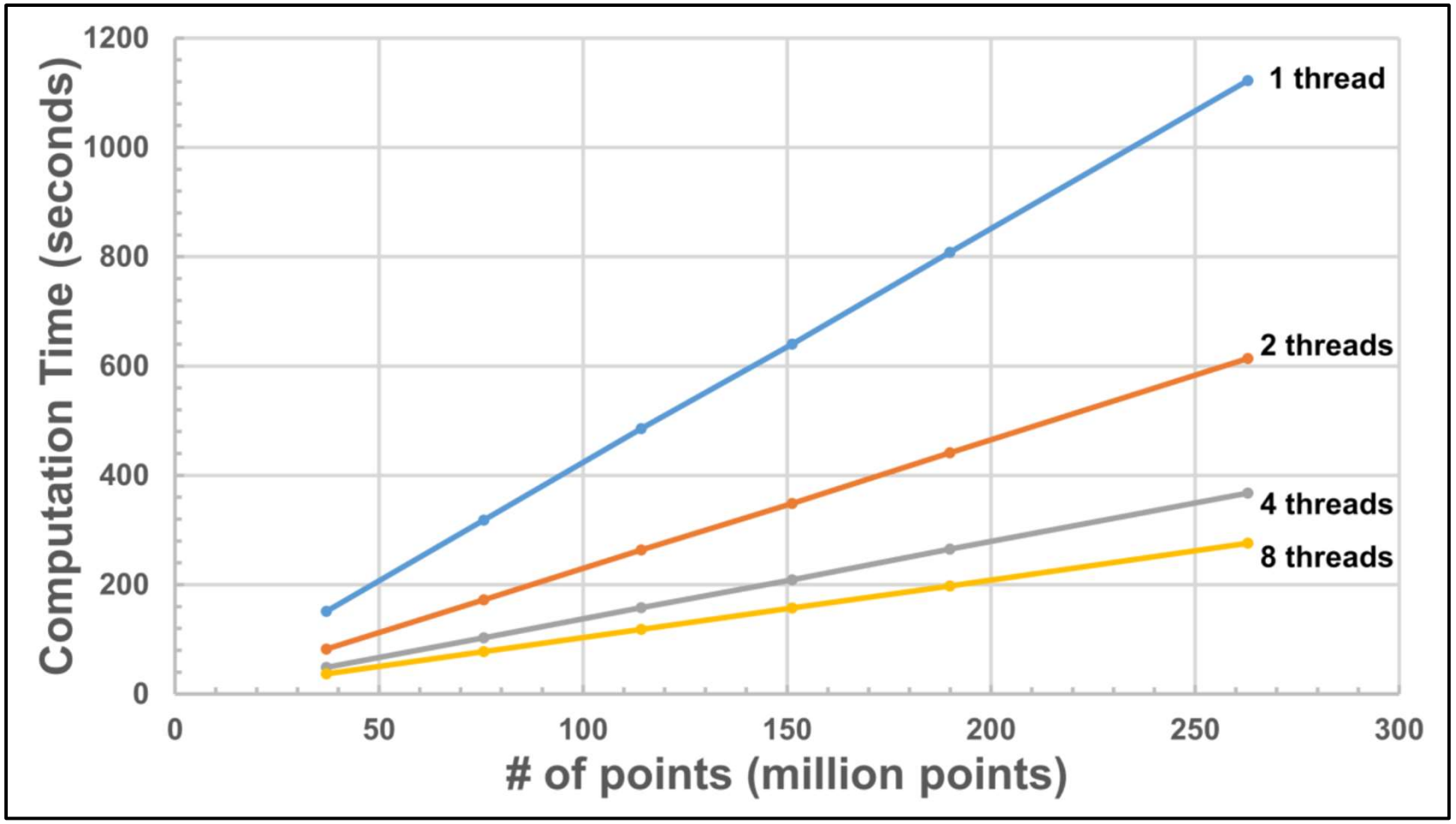
William Leslie

A Lidar Application:
Four Cores with Two Hyperthreads per Core



Source: Erzhuo Che

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Note that this is upside-down from our usual convention. Sorry. I got this from someone else.