




**Hyperthreading and
"Almost Amdahl"**



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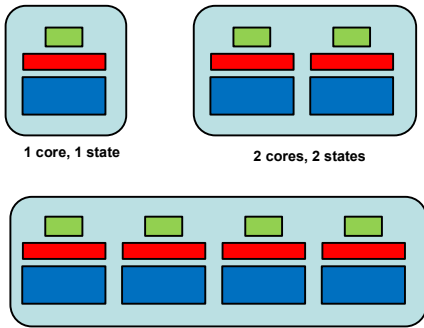


hyperthreading.and.almostamdahl.pptx


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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



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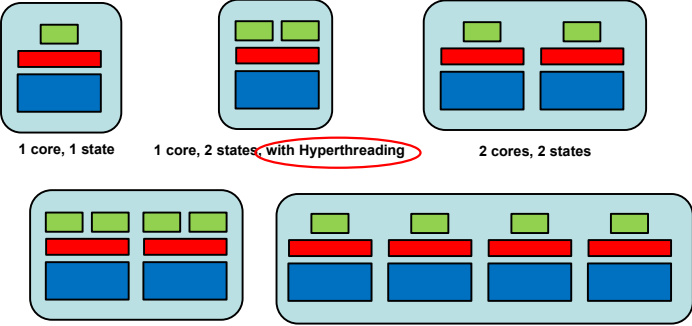
- State
- Registers
- Program Counter
- Stack Pointer



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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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- State
- Core
- Cache



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What is Hyperthreading and what can it Do?

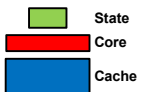
Hyperthreading is when a CPU chip has more states than cores.

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 **(1-H)ⁿ**. The capacity actually in use would then be **1-(1-H)ⁿ**. If one thread can only keep the CPU H% busy, then the speed-up is potentially:

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



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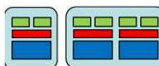
- State
- Core
- Cache



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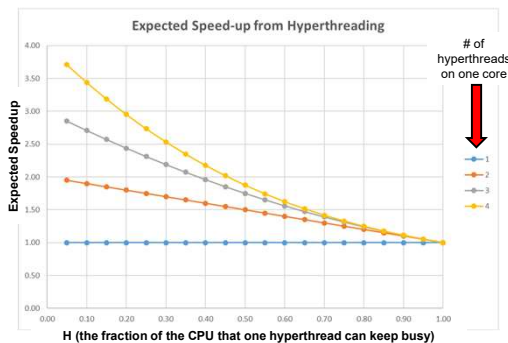
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What is Hyperthreading and what can it Do?



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

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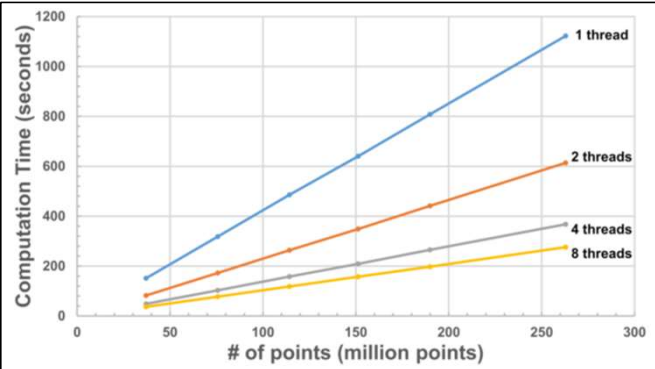




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A Lidar Application: Four Cores with Two Hyperthreads per Core



Source: Erzhuo Che

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



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