



Shared Memory for Many-Core

A Hydrodynamics Case Study



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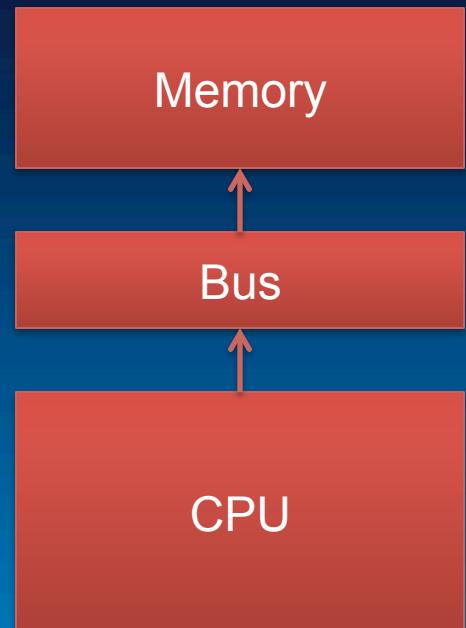
Overview

- A somewhat correct history of architectures
- The lookup table problem
- Programming models
- An argument for shared memory
- Measurements and results

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Architectures over time

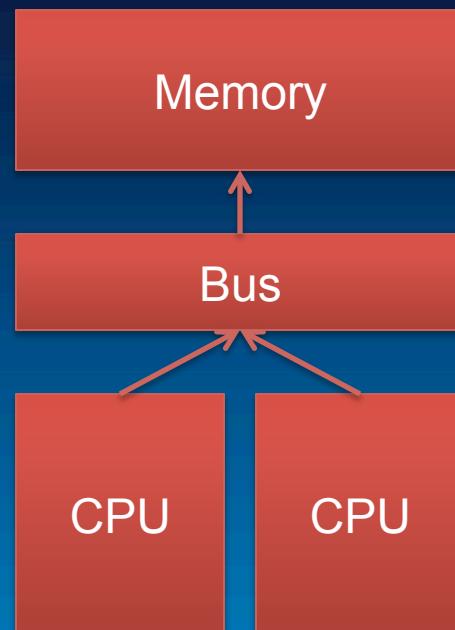
- 2000 – 2008: Pentium 4



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Architectures over time

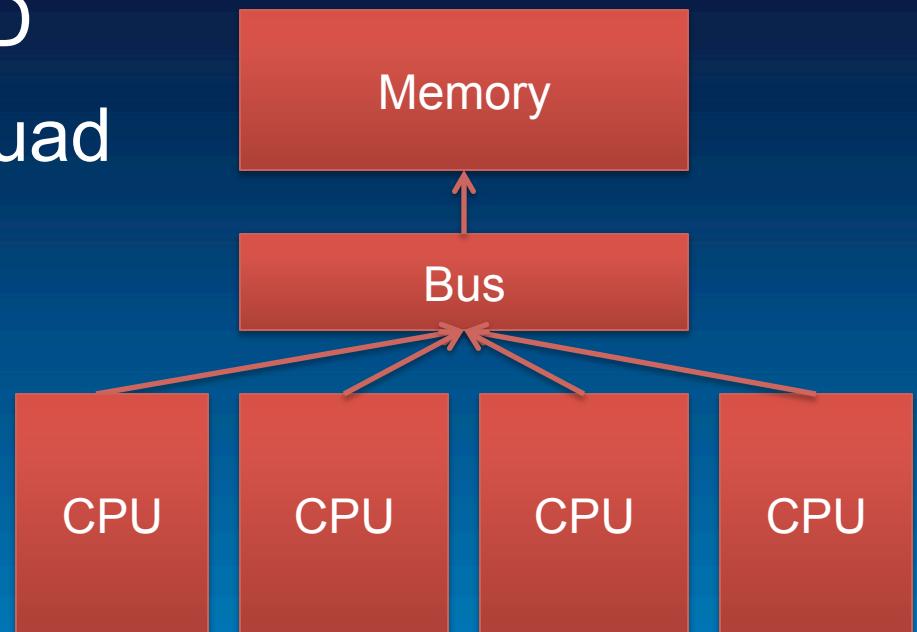
- 2000 – 2008: Pentium 4
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Architectures over time

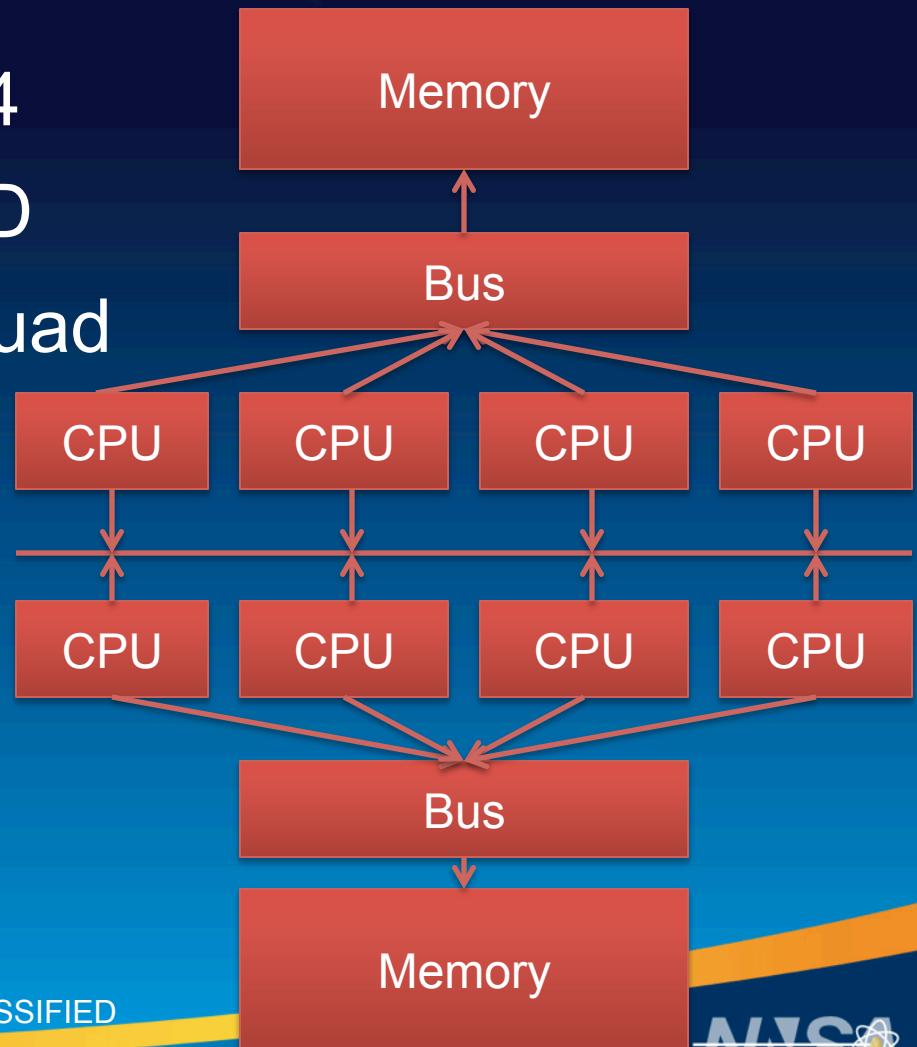
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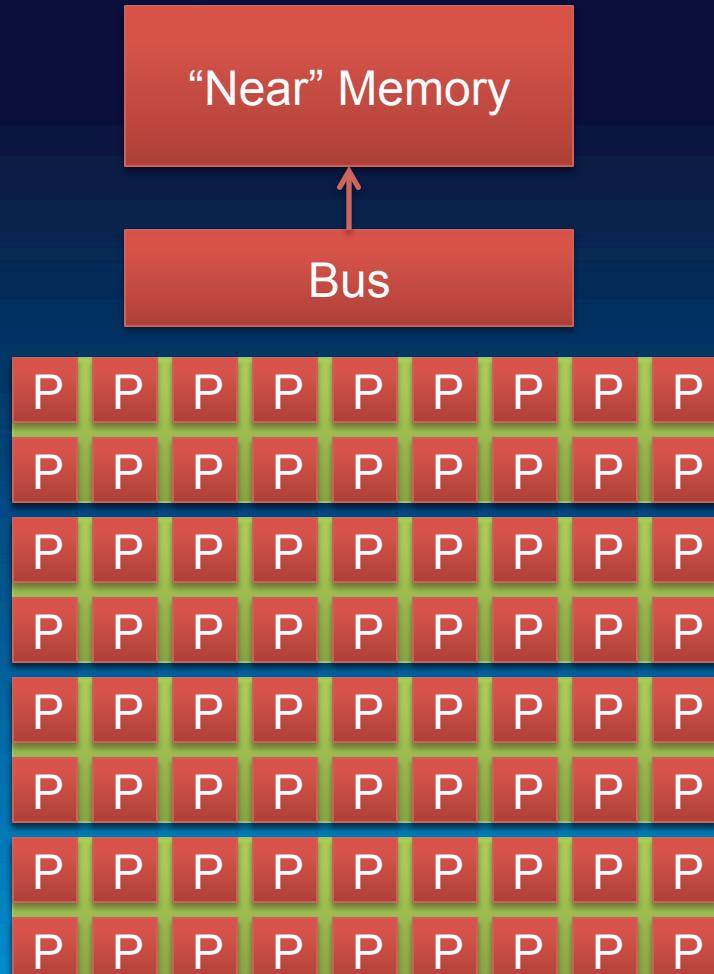
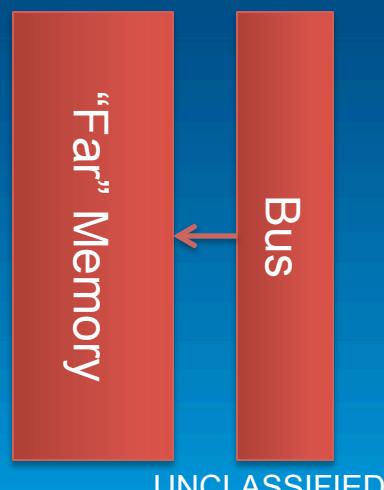
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Architectures over time

- 2000 – 2008: Pentium 4
- 2005 – 2008: Pentium D
- 2006 – 2008: Core 2 Quad
- 2010: Many Cores
- 2015+: KNL

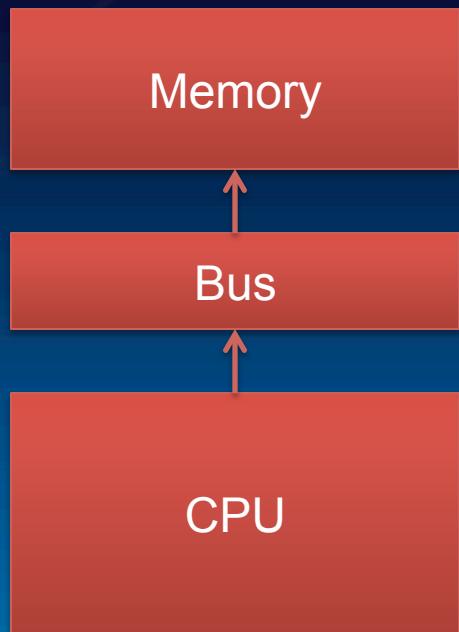


Lookup table problem



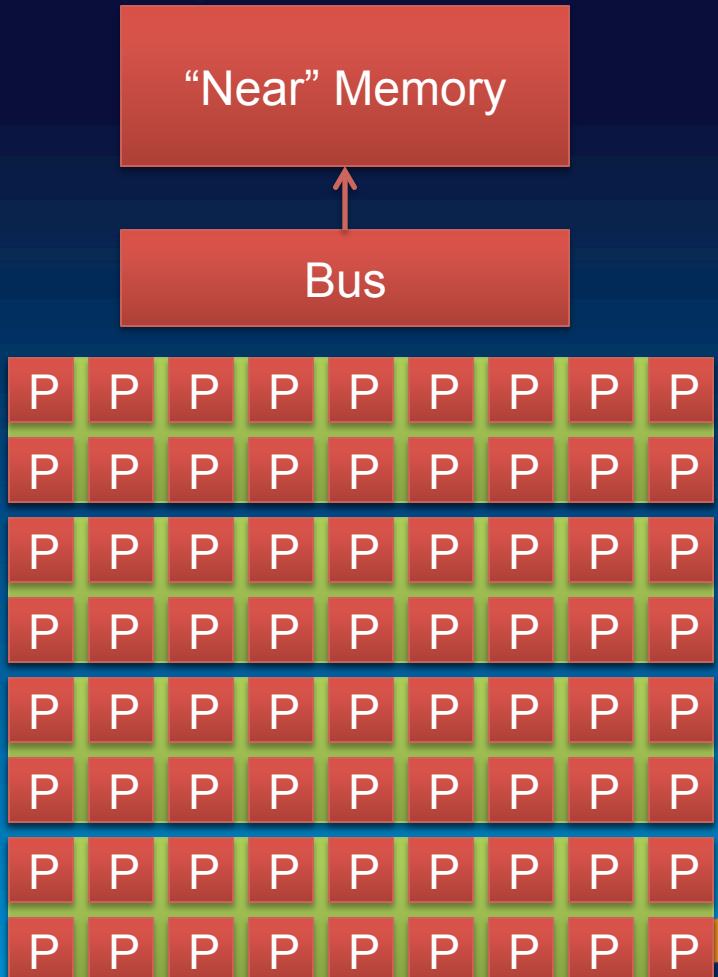
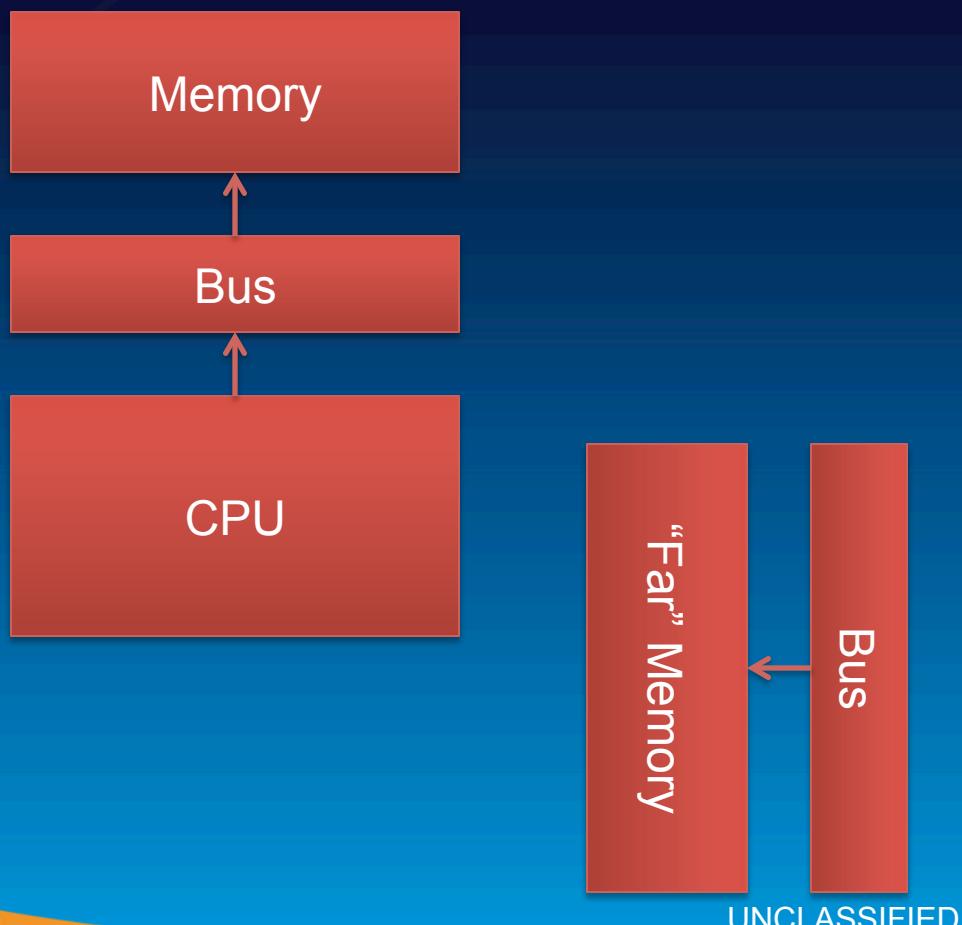
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Lookup table problem



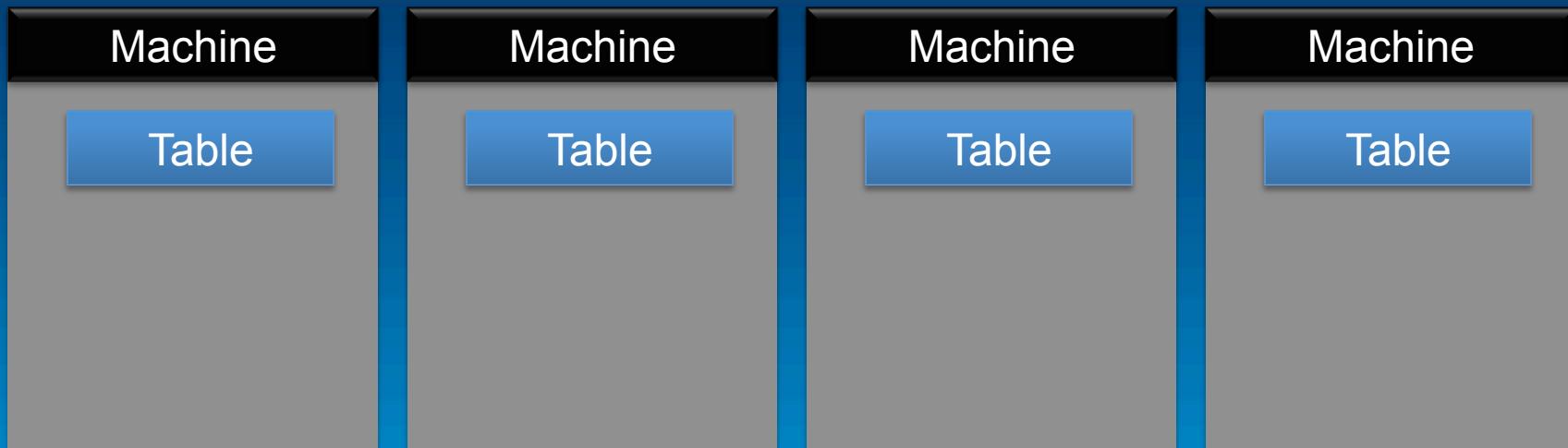
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Lookup table problem



Lookup table problem

- Large amounts of static data
- Read in at launch
- Needed throughout

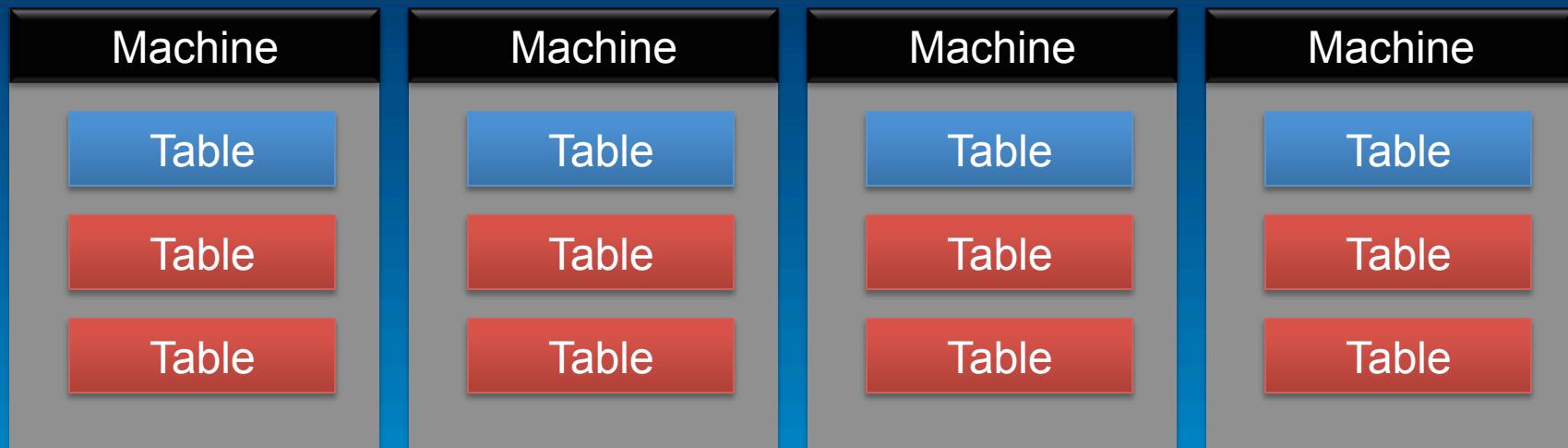


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Lookup table problem

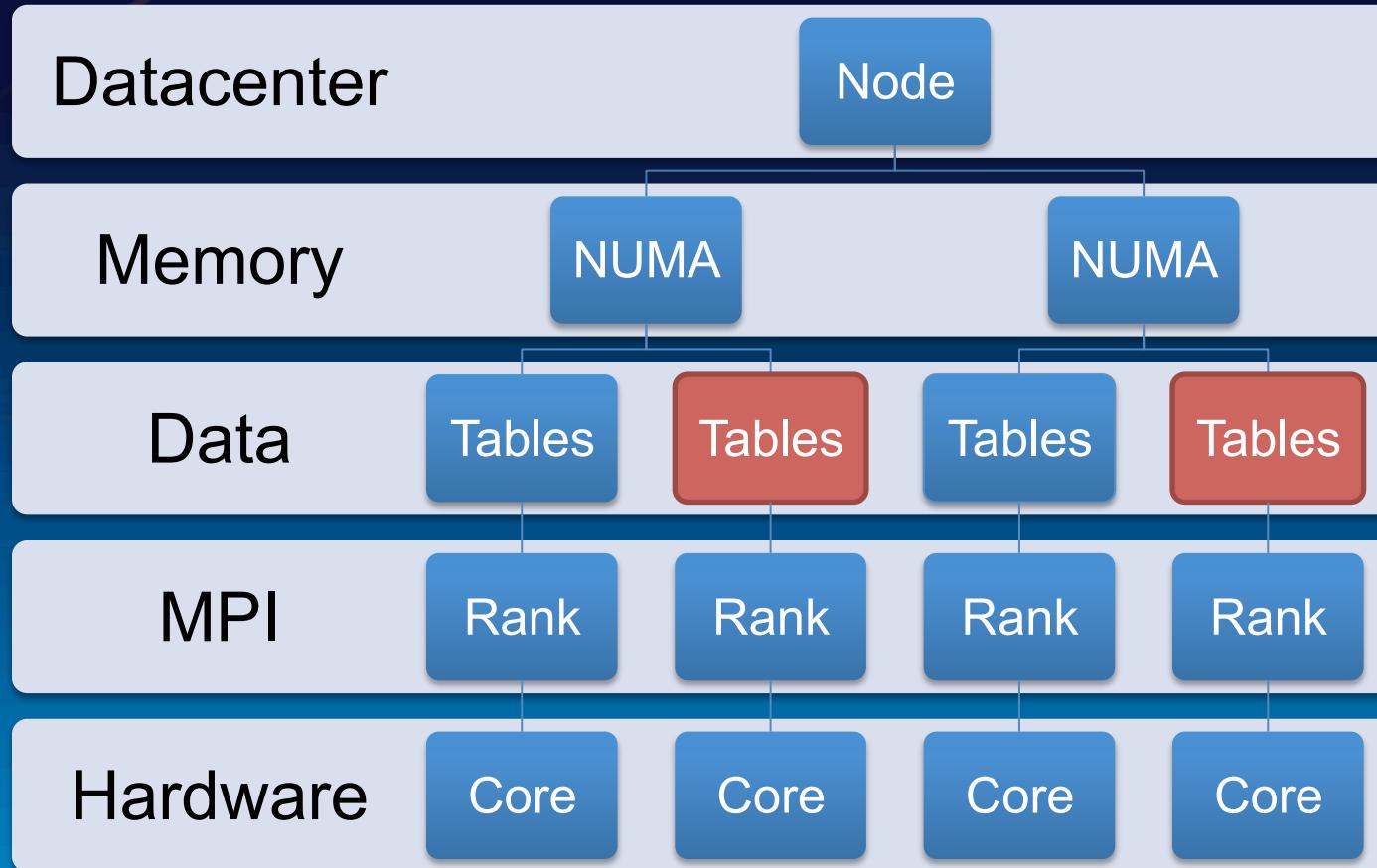
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MPI
EVERYWHERE!

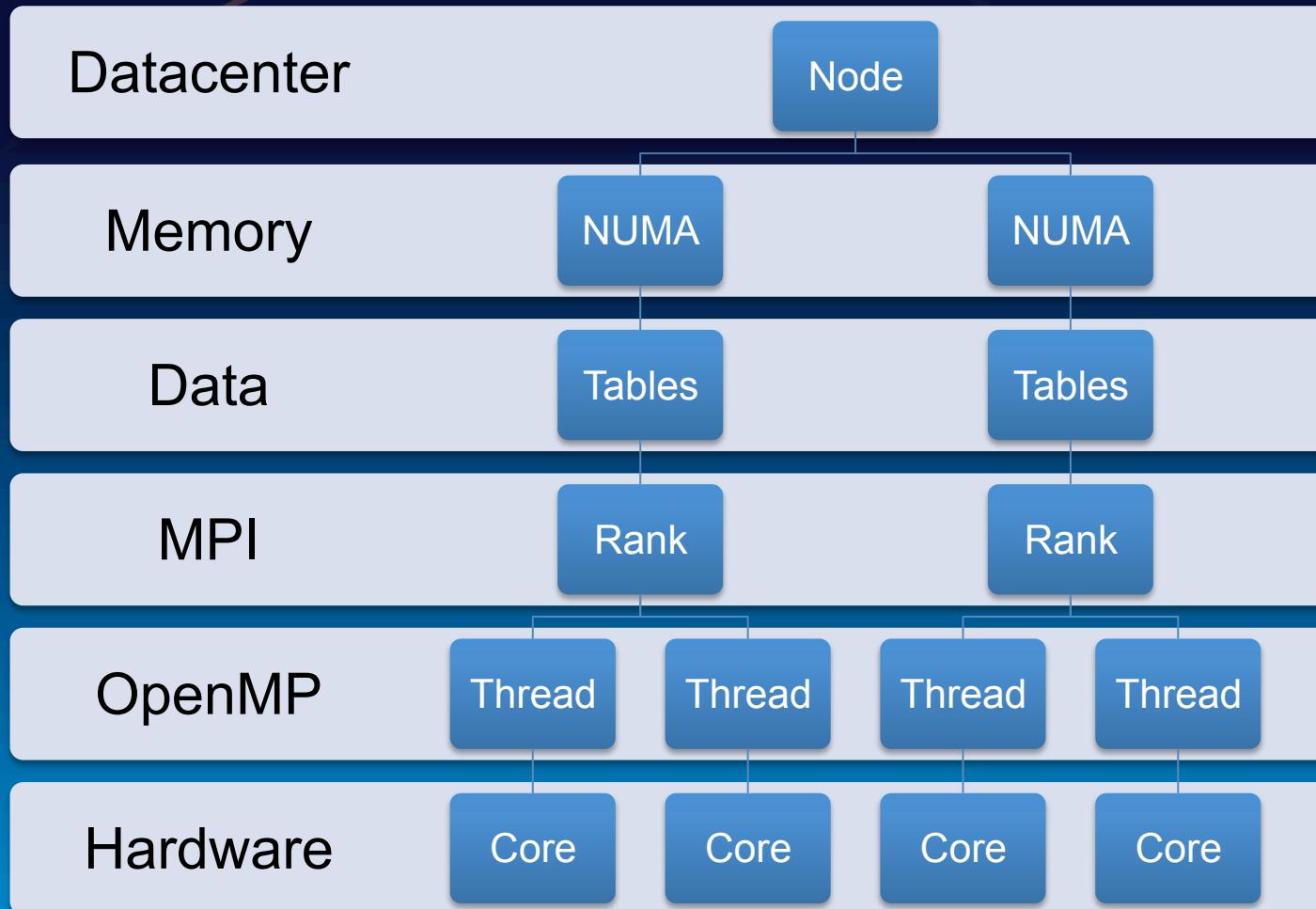


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MPI

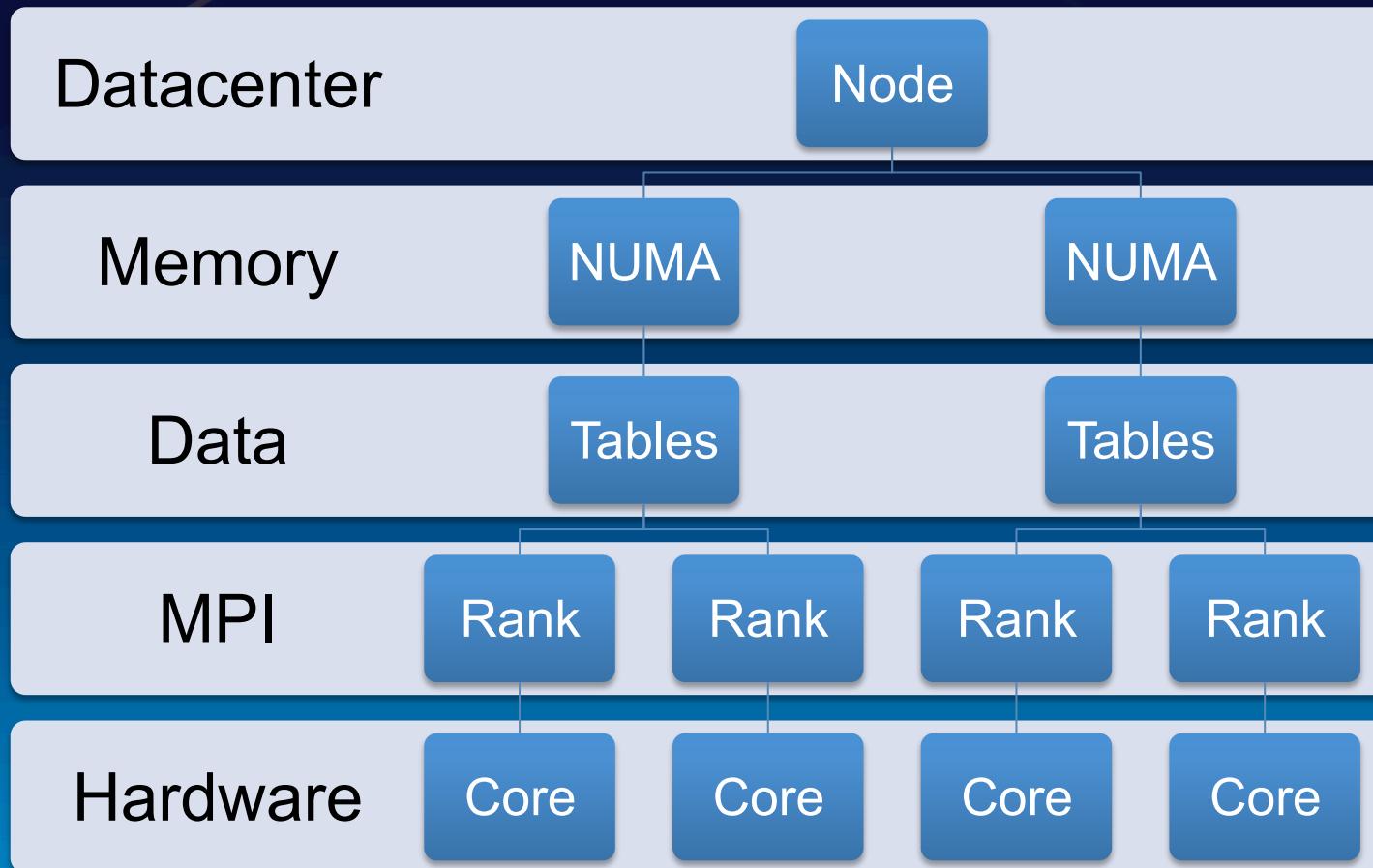


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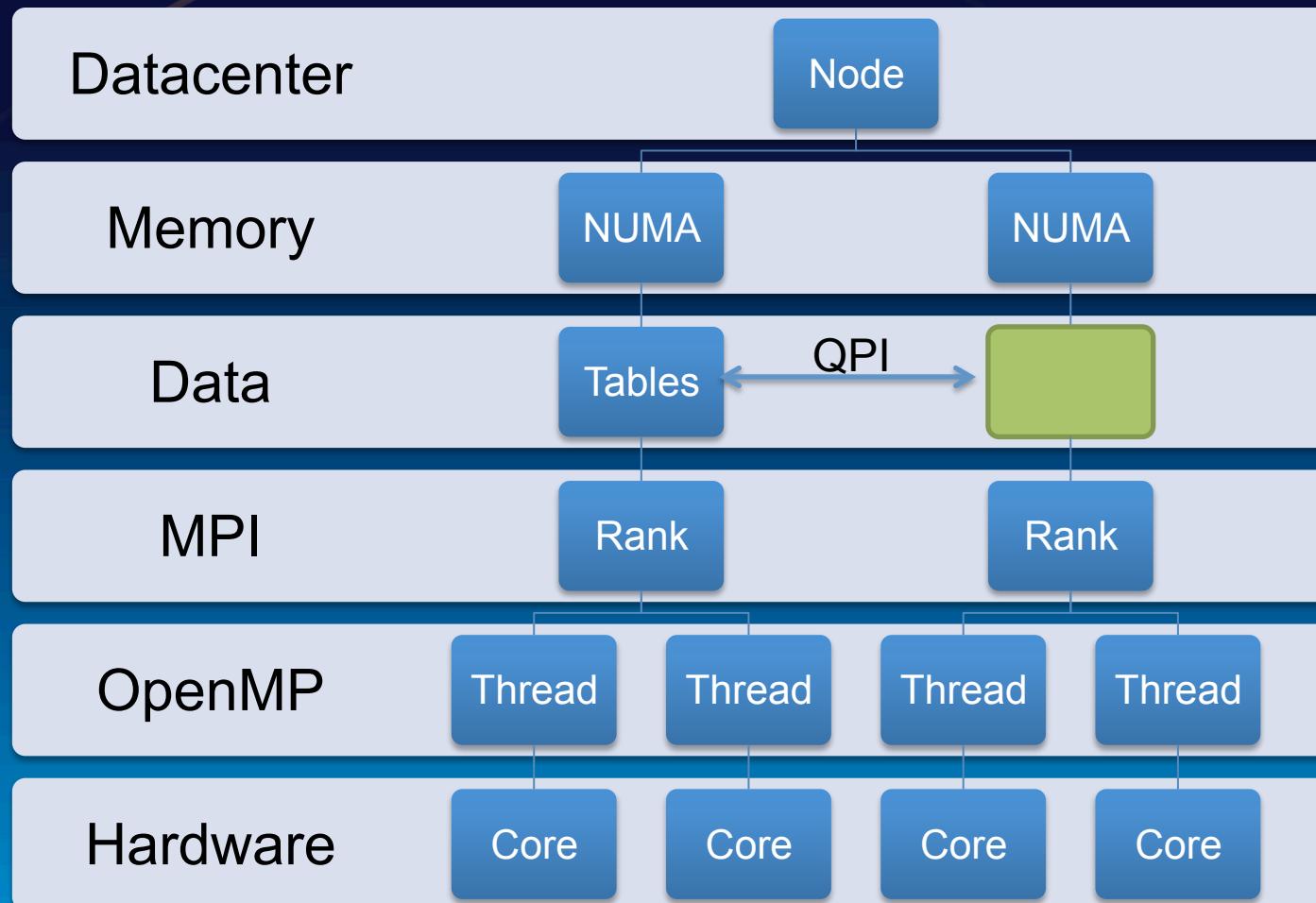
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Shared Memory



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MPI + X with Shared Memory



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Programming Models

	No sharing	Sharing
MPI	Data redundancy	Possible 0 redundancy
MPI + X	NUMA redundancy	Possible 0 redundancy

- For MPI everywhere codes...
 - Massive reduction in memory usage
- For MPI + X codes...
 - Ability to trade time for space

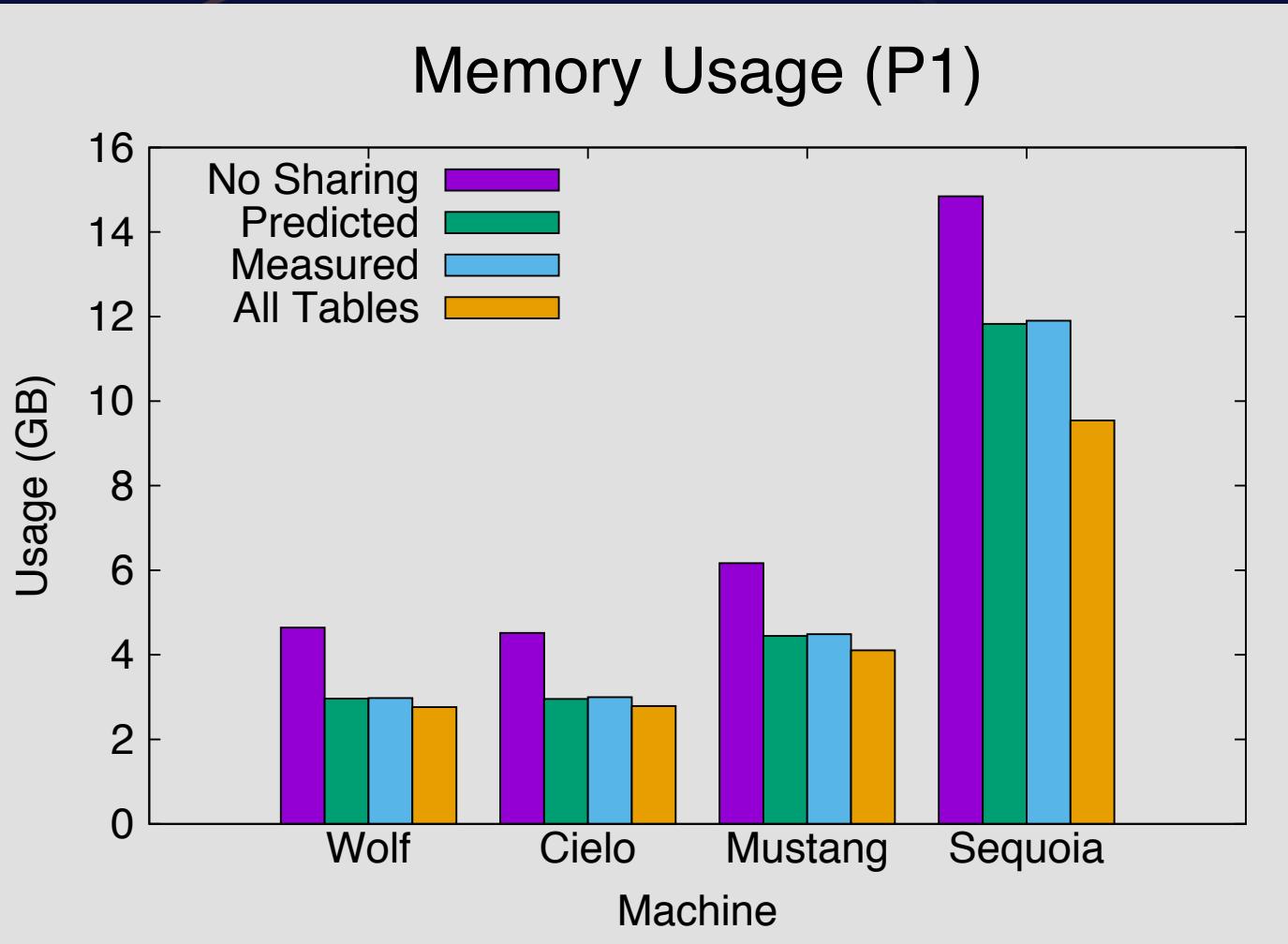
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Case study: radiation hydro

- Took a LANL radiation hydrodynamics code
- Added shared memory support
- Measured the results

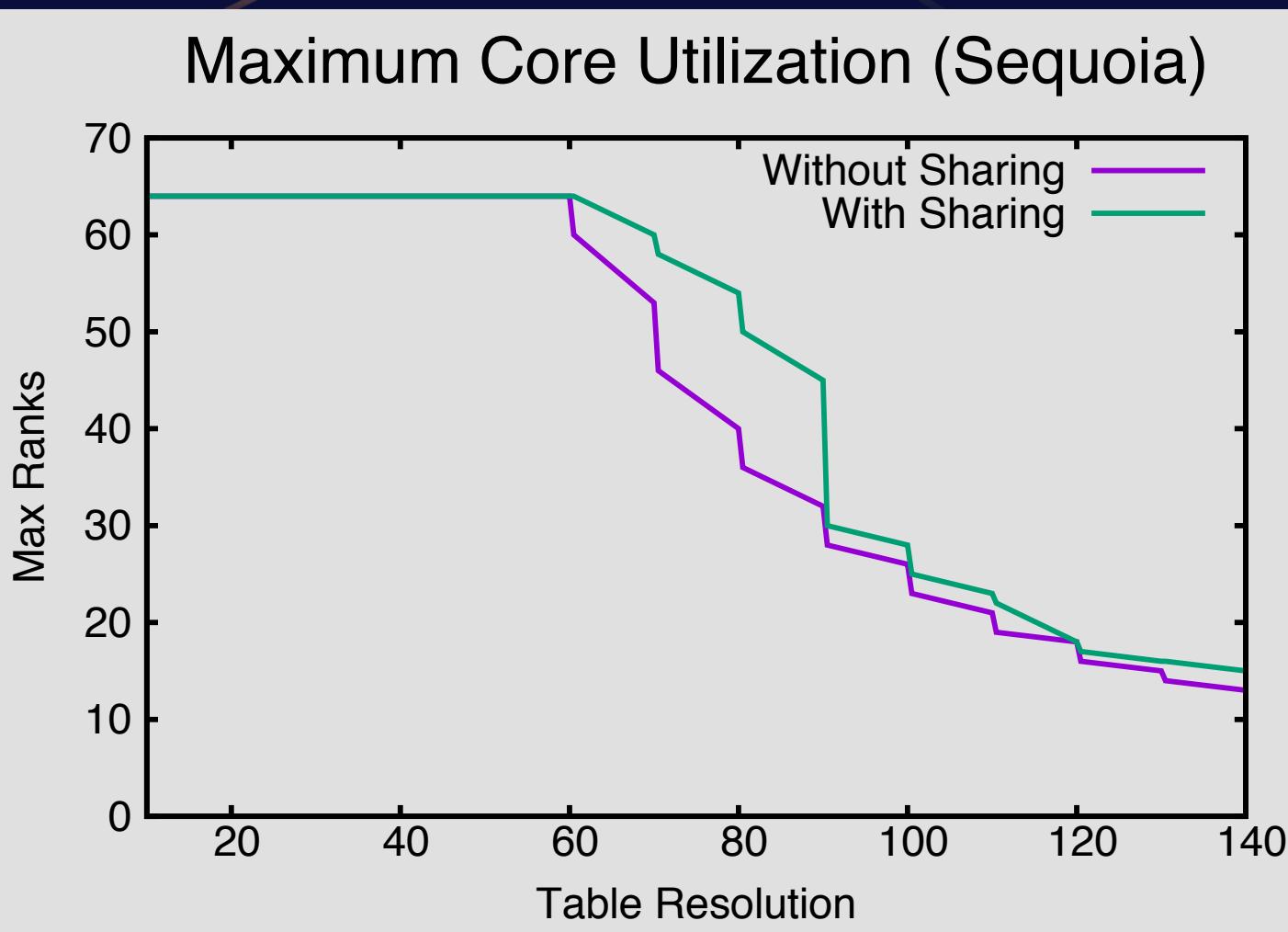
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Case study: radiation hydro



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Case study: radiation hydro



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Case study

- Shared memory isn't dead (yet)
- In the future...
 - Memory reductions = faster solution
 - Refactoring

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