Innovating for
EXASCALE visions and
PETASCALE production with
TERASCALE technologies

High Performance Computing

The Future of HPC

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Dr. David S Scott

- PhD in Numerical Analysis (Berkeley, 1978)
- Oak Ridge National Lab
- University of Texas at Austin
- Joined Intel Scientific Computers in 1985
- Helped deliver ASCI Red, the first Teraflop machine in 1996
- Three years in Singapore (2003-2006)
- Two years in Hong Kong (2011-2013)
- Recently moved back to Oregon

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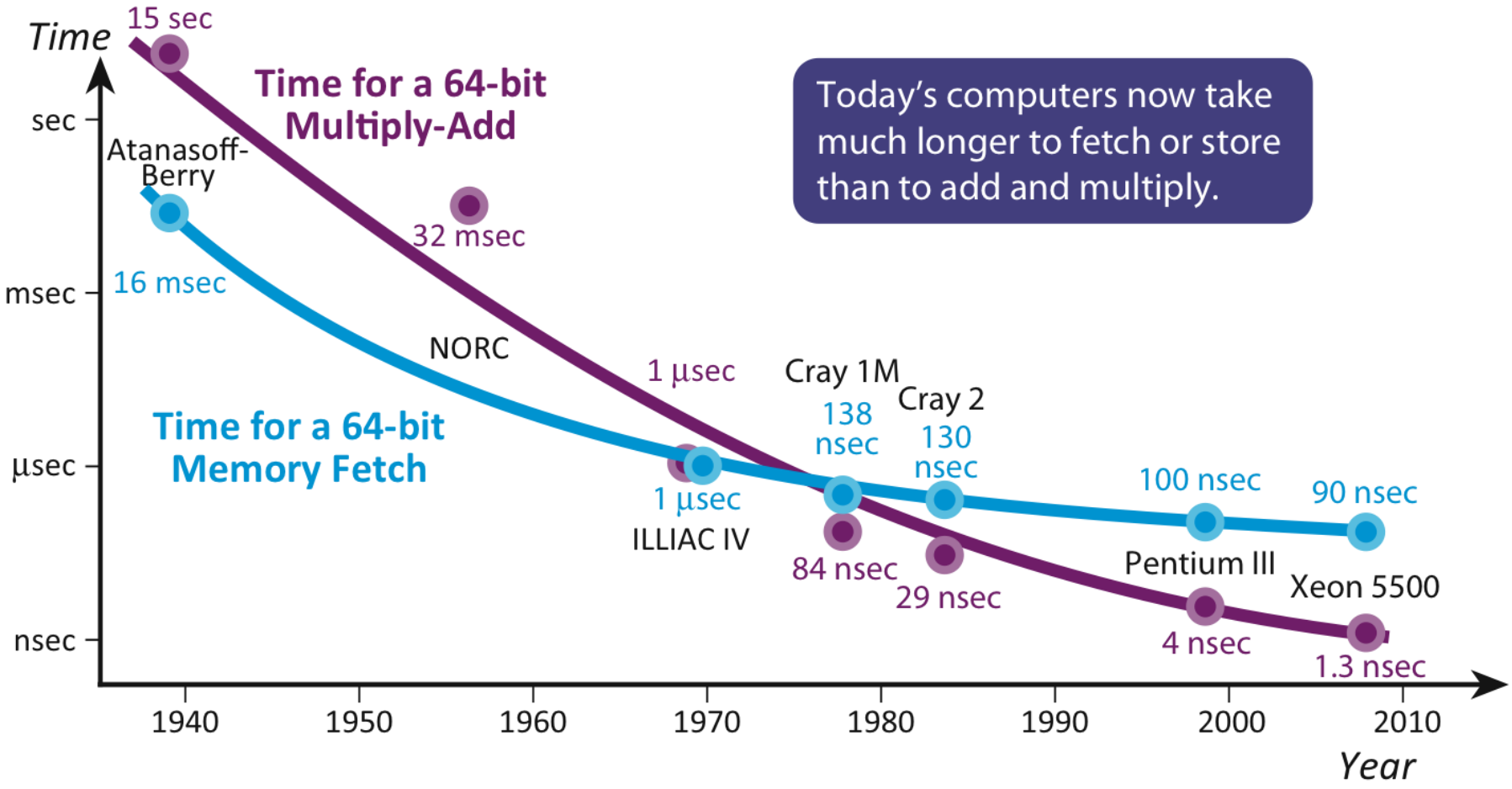
Serial Algorithms

- For most of a century, numerical analysts have looked at algorithms with two goals in mind:
- The algorithm should be stable, that is rounding errors should not stop the computer from getting the right answer (if there is one)
- The algorithm should be efficient, defined as minimizing the number of flops--wrong

Flops are “free”, data motion is expensive

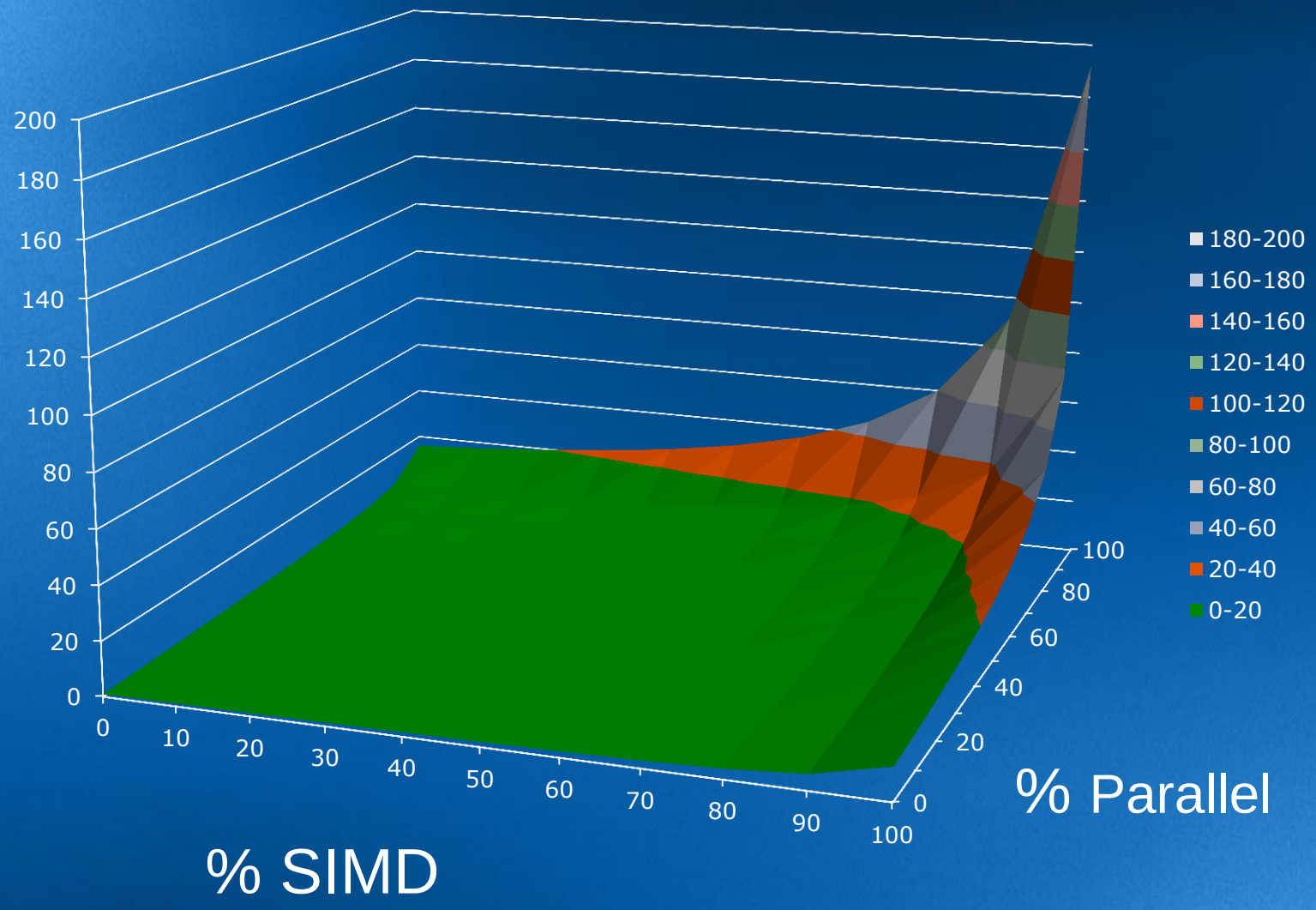


High Performance

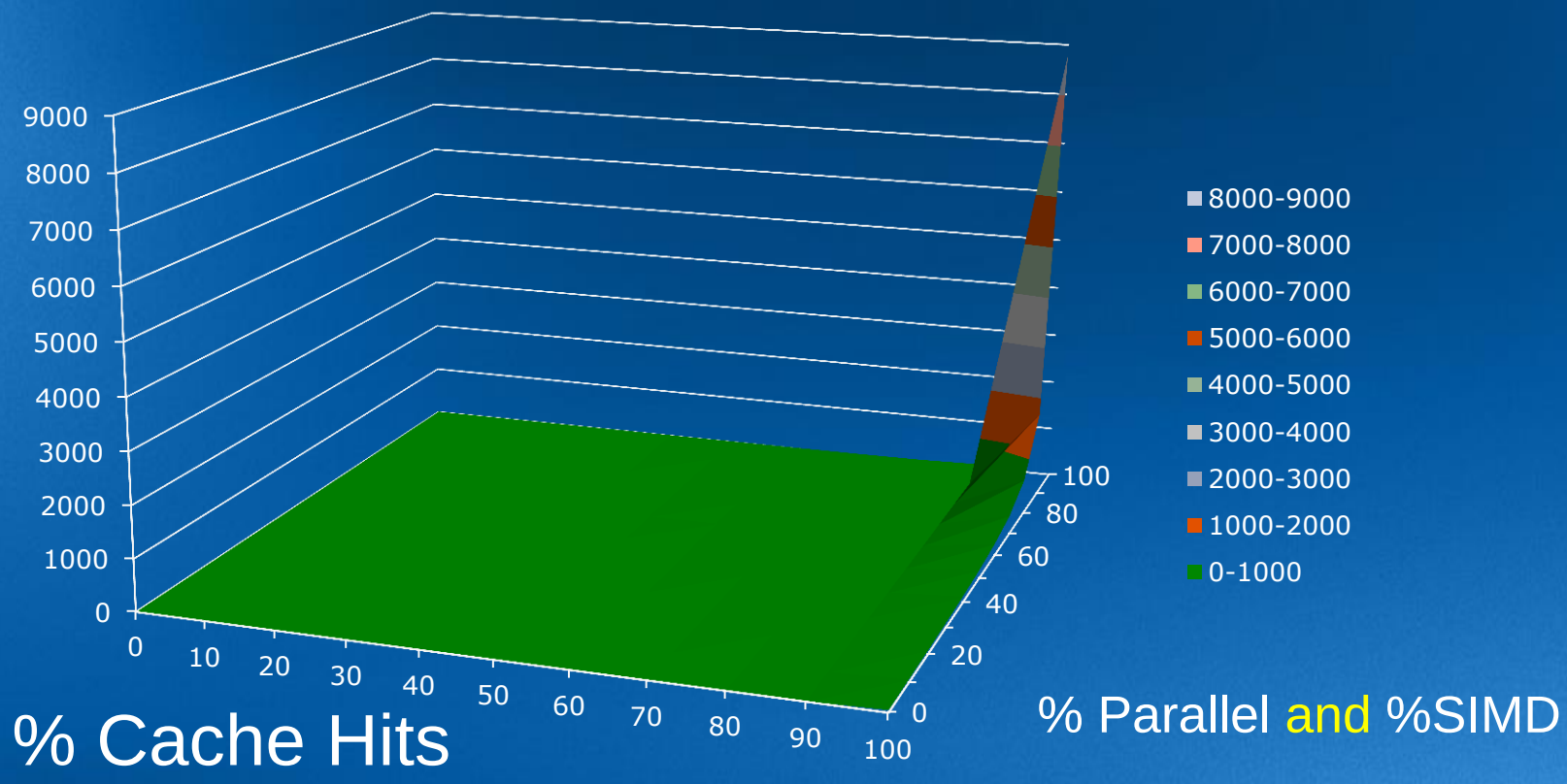
What does your code need to run fast on all modern computers?

1. Vectorization (SIMD)
2. Parallelism (including load balancing)
3. Compute Intensity (hit the cache)

SIMD and Parallel (E5v2)



SIMD & Parallel vs Cache HIts (E5v2)



HPC Algorithms

- Most HPC algorithms were developed before parallel computing
- Parallelism was retrofitted
- The industry needs to re-architect algorithms and codes

- Huge amount of work to be done