Disruptive technologies

- Small, fast memory + large, slower memory (RAM+SSD)
  - 1969
  - CDC 7600
  - Small core memory + word or block addressable large core memory
Disruptive Technologies

- Scalar & SIMD processor with equal high speed to same RAM
  - 1976
  - Cray-1
Disruptive technologies

- 3-D stacked memory
  - 1984
  - Cray-2
Disruptive technologies

- Liquid cooling
  - 1984
  - Cray-2
10,000 years of progress
Accelerators: 1984

DEC VAX 11/785
One to two 7.2 MHz processor
32-bit word

Floating Point Systems FPS-164
12 MFLOP/s
64-bit word
Accelerators: 2014

16 Sandy Bridge cores (2.2 GHz per core)
1 NVIDIA Kepler K20 (1.17 Teraflops)
1 INTEL Phi (1.2 Teraflops)
1984

- Fortran

2014

- Fortran, C, C++, Python
- CUDA, OpenCL, OpenACC
- Global arrays/shmem/PGAS
- OpenMP
- OpenMPI
Editorial comments

• Big increase in hardware performance

• Big decrease in hardware cost

• More software layers and programming complexity

• Now need to be even more cognizant of the underlying hardware layers

• Cars will drive themselves (with errors not allowed) before it gets easier to write HPC applications