



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



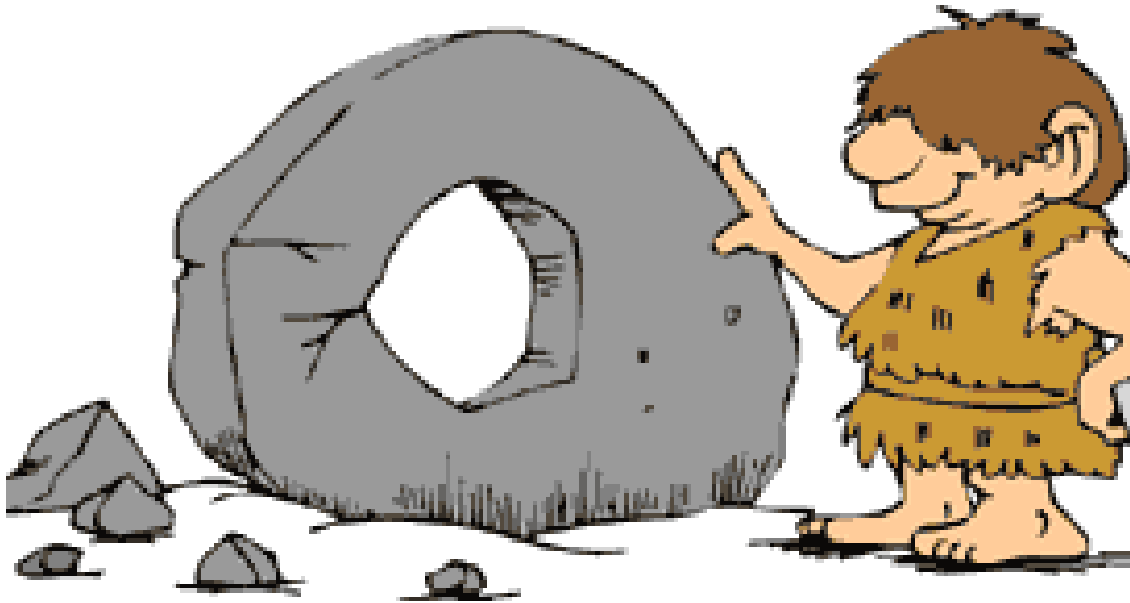
- Scalar & SIMD processor with equal high speed to same RAM'
 - 1976
 - Cray-1



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

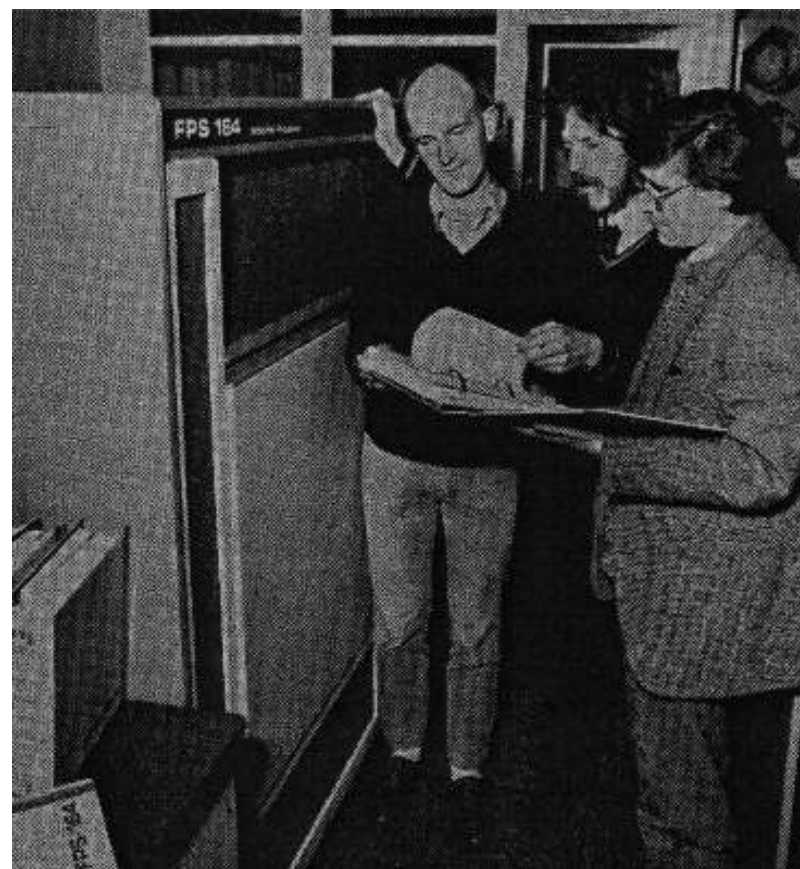


- Liquid cooling
 - 1984
 - Cray-2





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



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

- 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**