

# Introduction to High-Performance Computing

Thursday, 13 March 2025 12:05 (55 minutes)

- 1 History of HPC
  - 1.1 The Early Days: 1960s
  - 1.2 Vector Processors and the Rise of Cray: 1970s-1980s
  - 1.3 Parallel Processing: 1990s
  - 1.4 The Advent of Clustering: Late 1990s and 2000s
  - 1.5 Petaflops and Beyond: 2010s
  - 1.6 Exascale Computing: The Next Frontier
  - 1.7 Moore's Law
  - 1.8 AI and HPC
- 2 General Concepts of High Performance Computing (HPC)
  - 2.1 Definition of HPC
  - 2.2 Importance of HPC
  - 2.3 Components of an HPC System
  - 2.4 Parallel Computing
    - 2.4.1 Instructions
    - 2.4.2 CPUs, Cores and Threads
    - 2.4.3 Threads: Software vs Hardware
    - 2.4.4 Tasks, Threads, and Cores
  - 2.5 CPUs, GPUs and Nodes
    - 2.5.1 Sample Slurm Script
  - 2.6 Types of Parallel Computing
- 3 Scaling
  - 3.1 Why Parallelization Matters
  - 3.2 Scalability in HPC systems
  - 3.3 Speedup
  - 3.4 Parallelization Efficiency
  - 3.5 Scaling Tests
  - 3.6 Strong Scaling
  - 3.7 Amdahl's Law
  - 3.8 Weak Scaling
  - 3.9 Gustafson's Law
  - 3.10 Performance Metrics in HPC
- 4 Programming Models in HPC
  - 4.1 OpenMP (Open Multi-Processing)
  - 4.2 MPI (Message Passing Interface)
  - 4.3 GPUs (Graphics Processing Units)
  - 4.4 CUDA (Compute Unified Device Architecture)
- 5 State of the art machines
  - 5.1 The Top 500 list
  - 5.1.1 Exponential Growth
  - 5.2 Top 8 European Supercomputers
  - 5.3 ARIS - HPC Infrastructure in Greece
  - 5.4 Daedalus - EuroHPC supercomputer in Greece
- 6 Apply for Access at EuroHPC JU
  - 6.1 EuroHPC JU Benchmark Access
  - 6.2 EuroHPC JU Development Access
  - 6.3 EuroHPC JU Regular Access
  - 6.4 EuroHPC JU Extreme Access
  - 6.5 EuroHPC JU Access Call for AI and Data-Intensive Applications
  - 6.6 Frequently Asked Questions (FAQ)

- 6.7 Indicative Application
- 6.7.1 The project
- 6.7.2 Research Fields
- 6.7.3 Societal impact
- 6.7.4 CPU Partition
- 6.7.5 Input / Ouput
- 6.7.6 GPU Partition
- 6.7.7 Code Details
- 6.7.8 Scalability & Performance
- 6.7.9 Optimization
- 6.7.10 Performance
- 6.7.11 Data Consent
- 6.8 Resources

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