High Performance Computing (HPC) – Subject Overview and Resources

✅What is HPC?

High Performance Computing (HPC) refers to the use of supercomputers and parallel processing techniques
for solving complex computational problems. It involves using multiple processors and high-speed networks to
perform large-scale computations efficiently.
Some useful resources include:
- IBM: "What Is High-Performance Computing (HPC)?" — explains how clusters of many processors working in parallel solve very large problems.
(https://www.ibm.com/think/topics/hpc)
- Google Cloud: "What is high performance computing?" — includes how HPC connects compute, network & storage, and gives use-cases.
(https://cloud.google.com/discover/what-is-high-performance-computing)
- NVIDIA Glossary: describes HPC as the "art and science" of using cutting-edge systems for massive simulation and data tasks. (https://www.nvidia.com/en-us/glossary/high-performance-computing/)

⬚ Typical Syllabus / Subject Topics

Common topics found in university syllabi:
- Parallel computing concepts and architectures (shared-memory, distributed-memory, hybrid systems)
- Programming models: MPI, OpenMP, CUDA, OpenCL
- Performance measurement and optimization techniques
- Numerical and scientific computing (matrix operations, PDEs, iterative solvers)
- HPC software tools: Linux/Unix, cluster job submission, supercomputing environments
- HPC hardware: compute nodes, interconnects, storage systems
- Real-world applications: simulations, weather forecasting, AI/ML, data analysis
Example syllabi:
- "Intro to High-Performance Computing Systems" (University of Pittsburgh)
- "HPC for Engineers" (University of Texas)
- "CS402 High Performance Computing" (University of Warwick)

⬚ Good Courses & Learning Resources

- Coursera: Introduction to High-Performance and Parallel Computing
(https://www.coursera.org/learn/introduction-high-performance-computing)
- Carpentries Workshop: Introduction to HPC (https://carpentries-incubator.github.io/hpc-intro/)
- Georgia Tech: CSE 6220 – Intro to High-Performance Computing

(https://omscs.gatech.edu/cse-6220-intro-high-performance-computing)
- IBM HPC Overview (https://www.ibm.com/think/topics/hpc)

⬚ Study Approach

1. Understand HPC fundamentals (concepts, systems, software).
2. Learn basic parallel programming (MPI, OpenMP).
3. Study system architectures and performance tuning.
4. Complete an online HPC course (Coursera/Carpentries).
5. Get hands-on experience on a local or cloud-based cluster.
6. Apply knowledge to real-world problems and simulations.
7. Keep updated on emerging topics such as exascale systems and GPU computing.

⬚ Suggested Textbooks

- "Parallel Programming in C with MPI and OpenMP" by Quinn
- "Using OpenMP: Portable Shared Memory Parallel Programming" by Chapman et al.
- "Introduction to High Performance Computing for Scientists and Engineers" by Hager & Wellein
- "An Introduction to Parallel Programming" by Peter Pacheco