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Subject :- HPC

### HPC Assignment No. :- 1

- \* Title :- Application Case Study of HPC.
- \* Aim :- Demonstration of an application case study of High Performance Computing.
- \* Objective :- To demonstrate case study of High - Performance Computing and its importance in real world.
- \* Theory :-
- \* Technical Concepts of HPC in smart city traffic management.
- \* The selected application utilizes HPC to predict and mitigate urban traffic congestion through high-speed, large-scale simulations. The technical framework involves :-

#### (1) Real-time data integration:-

HPC systems ingest massive stream of live data from GPS devices, road sensors, cameras & weather station to build a detailed digital twin of city mobility.

#### (2) Parallel Processing & Microscopic:-

Unlike standard PCs, HPC uses clusters of linked nodes & parallel CPU/GPU core to simulate the movement of millions of individual vehicles simultaneously.

#### (3) Dynamic Optimization:-

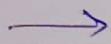
The system runs complex algorithms to generate congestion heatmaps and optimize signal timings in real-time, allowing for adaptive rerouting that can save billions of gallons of fuel compared to static systems.

#### (4) High-speed Decision Making:-

By processing data hundreds of times faster than a regular machine, HPC allows city planners to rerun simulations with fresh data instantly to respond to accidents or sudden weather changes.

\* PASSO-

- ① Write scope of High-Performance Computing in Medical Domain / or Agriculture Domain / or Weather forecasting.



Agriculture Domain:-

HPC is used for "Agricultural Forecasts" to provide accurate warnings regarding monsoon timing, size & soil moisture content, helping farmers optimize planting & irrigation.

- ② List top 5 supercomputers of the world with their specification from [www.top500.org](http://www.top500.org).



According to the 66th TOP500 list realised in November 2025, the leading systems are:-

① El Capitan

Country:- USA

Specifications:- 1.809 Exaflops/s;  
22,340,000 cores;  
AMD 4th Gen EPYC processors &  
AMD Instinct MI300A accelerators

② Frontier

Country:- USA

Specifications:- 1.353 Exaflops/s;  
9,066,176 cores.

HPE Cray EX architecture  
with 3rd Gen AMD EPYC  
CPUs & AMD Instinct 2.5D  
Accelerators.

③ Aurora

Country :- USA

Specifications :- 1.012 Exaflop/s;

9,264 nodes;

Intel Xeon CPU Max Series

& Intel Data centre GPU  
Max Series accelerators.

③ What is Quantum Computing & its relevance for HPC?

→ Quantum computing uses principles of quantum mechanics to perform computations in a fundamentally different way than classical computers, solving problems that are too complex or slow for current machines.

The future of HPC involves "accelerated R&D", where quantum processors act as specialized accelerators for classical supercomputers, handling specific tasks like complex chemical simulations or cryptography.