



**Data
Schools**

Computational Infrastructures an overview

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Training Goals

Learn the concept of

1. Local vs Distributed
2. Examples of
 - High Performance Computing (HPC)
 - High Throughput Computing (HTC)
 - Cloud

Local vs Distributed Computing

The science computing is becoming complex

- Monte Carlo, image analysis, genetic algorithm, simulation...

It will take a year (CPU time) to get the results on your laptop, but your paper is due in a week.

What do you do?

You have the following options:

- Wait until the calculation is done
- Use a distributed computing environment to speedup



Distributed computing environment

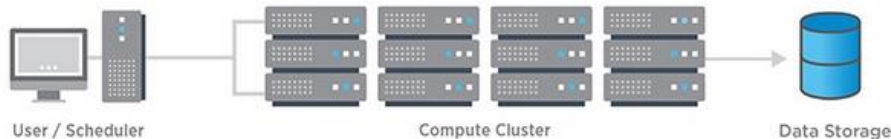
Distributed computing is a field of [computer science](#) that studies distributed systems. A *distributed system* is a system whose components are located on different [networked computers](#), which communicate and coordinate their actions by [passing messages](#) to one another.

- High Performance Computing (HPC)
- High Throughput Computing (HTC)
- Cloud

High Performance Computing

High Performance Computing (HPC) is the ability to process data and perform complex calculations at high speeds

- Fast access to network/disk/memory
 - Limited resources
- Needs
 - A highly parallel program or
 - Port your code to a special environment
 - Request and wait for an allocation



High Throughput Computing

- Instead of the fastest computer, lots of individual “**commodity**” computers
 - May not be fastest network/disk/memory, but you can access a lot of them
 - Job can be broken down into separate, independent pieces
 - If I give you more computers, you run more jobs
 - You care more about total quantity of results than instantaneous speed of computation

Grid Computing

- Provisioning and use of *massively distributed and federated resources* routinely happens since several years.
- An example of great success in the scientific world is given by **Grid Computing**.
- On the right:
 - Real-time situation of computation and data transfer for the physics experiments running at the CERN Large Hadron Collider (LHC).



Cloud computing

What is Cloud Computing?

Cloud Computing is also a utility service - giving you access to technology resources managed by experts and available on-demand.



You simply access these services over the internet, with no up-front costs and you pay only for the resources you use.



Source: bit.ly/2Z4kHNG

In a nutshell, Cloud Computing deals with:

- 1 Supplying
- 2 information and communication technologies
- 3 as a service

US National Institute of Standards and Technology (NIST) bit.ly/2YOop2X

Characteristics

- **Self-service, on-demand**

- A consumer can unilaterally provision computing capabilities as needed automatically without requiring human interaction with each service provider.

- **Network-based access**

- Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms

- **Resource pooling**

- The customer has no control or knowledge over the details of the provided resources, that are managed by the Cloud provider

- **Elasticity**

- Capabilities can be elastically provisioned and released to scale rapidly commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited

- **Pay-per-use**

- The customer pay only for what he/she used.

Information and Material

- <https://opensciencegrid.org/dosar/DataTrieste2019/Materials/>
- <https://github.com/CODATA-RDA-DataScienceSchools/Materials/tree/master/docs/DataSanJose2019/CI>
- Alessandro Costantini – alessandro.costantini@cnaif.infn.it



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