Scuola Superiore di Catania

Corso Specialistico
Classe delle Scienze Sperimentali
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Cloud computing: sfide, opportunità e prospettive di ricerca

Cloud computing: challenges, opportunities, and research direction

The Cloud computing paradigm has revolutionised the computer science horizon during the past decade and has emerged as a backbone of modern economy by offering subscription-based services anytime, anywhere following a pay-as-you-go model.

The recent technological developments and paradigms such as serverless computing, Internet of Things, and processing at network edge are creating new opportunities for Cloud computing. However, they are also posing several new challenges and creating the need for new approaches and research strategies, as well as the re-evaluation of the models that were developed to address issues such as scalability, elasticity, reliability, security, sustainability, and application models. The course addresses them by identifying the major open challenges in Cloud computing, emerging trends, and impact areas.

It also discusses about some of the most recent and promising research directions within this context.

The course will be organized into the following modules:

- **From Cloud to Fog and Edge computing**. Fog computing, an extension of cloud computing services to the edge of the network to decrease latency and network congestion, is a relatively recent research trend. Although both cloud and fog offer similar resources and services, the latter is characterized by low latency with a wider spread and geographically distributed nodes to support mobility and real-time interaction. In this module, the fog/edge computing architecture and main features will be discussed together with its different services and applications.

- **Orchestration of computing resources in the Cloud computing continuum.** The intervention aims to deepen the organization and management of computing resources throughout the computing continuum consisting of the IoT, Edge / Fog and Cloud paradigms. Specifically, the theme of the orchestration of computing resources at the various technological levels and the related problems will be discussed in depth. The current state of the art will then be reviewed, and emerging software platforms and tools will also be presented.
- **Federated learning over the edge-cloud**. The increasing success of machine learning is amplifying the concerns regarding the access to data, which are the real fuel for the training of neural networks. Some information is hard to move because of its size and velocity, its privacy and security concerns or simply because it is a valuable industrial asset. Many data sets are naturally distributed over the internet and gathering in a single (virtual or physical) point is too difficult. An alternative is processing it in a distributed way adopting a federated learning approach. In the course, the basic concepts of distributed systems will be reviewed along with their modern technological epitomes, inter-alia, cloud, edge, fog, IoT. The underlying architectures for federated learning will be discussed together with their performance and accuracy.