



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Vincenzo Norman Vitale

XXXIV Cycle

Training and Research Activities Report – Third Year

Tutor: Professor Sergio Di Martino



Training and Research Activities Report – Third Year

PhD in Information Technology and Electrical Engineering – XXXIV Cycle

Vincenzo Norman Vitale

1. Information

PhD Candidate: Vincenzo Norman Vitale – Mat. DR993627

Date of Birth: 30/08/1989

Master Science Title: Master's degree in Computer Science (cum laude) 23/10/2018, Università degli Studi di Napoli "Federico II"

Master Thesis: A protocol for automatic collection of information to generate advanced reports in cultural heritage

Fellowship: "Industry 4.0: Storing, Retrieving and Mining sensor data for Predictive Maintenance" supported by AvioAero a GE Aviation Business

Tutor: Prof. Sergio Di Martino

Year: Third

Cycle: XXXIV

2. Study and Training activities

Lecture/Activity	Type	Hours	Credits	Dates	Organizer	Certificate
Robot Manipulation and Control	Seminar	2:30	0,5	17/11/2020	Università di Napoli Federico II	Yes
Picariello Lecture IV - #andràatuttobene: Images, Texts, Emojis & Geodata in a Sentiment Analysis Pipeline	Seminar	1:30	0,3	25/11/2020	Università di Napoli Federico II	Yes
Picariello Lecture V – At the Nexus of Big Data, Machine Intelligence, and Human Cognition	Seminar	1	0,2	02/12/2020	Università di Napoli Federico II	Yes
Scientific Colloquia at SSM: Network Systems, Kuramoto Oscillators, and Synchronous Power Flow	Seminar	1:30	0,3	03/12/2020	Università di Napoli Federico II	Yes
Picariello Lecture VI – Exploiting Deep Learning and Probabilistic Modeling for Behavior Analytics	Seminar	1	0,2	09/12/2020	Università di Napoli Federico II	Yes
Picariello Lecture VII – Data Driven Transformation in WINDTRE through Managers voice	Seminar	2	0,4	16/12/2020	Università di Napoli Federico II	Yes
Digital Forensics' methods,	Ad hoc		3	18/01/2020	Università di Napoli	Yes

Università degli Studi di Napoli Federico II

Training and Research Activities Report – Third Year

PhD in Information Technology and Electrical Engineering – XXXIV Cycle

Vincenzo Norman Vitale

practices, and tools	Module				Federico II	
Picariello Lecture IX - Cybercrime and e-evidence: the criminal justice response	Seminar	2	0,4	20/01/2021	IEEE - Live Training (CEU/PDH)	Yes
Picariello Lecture X – AI LEGAL: Artificial Intelligence for notary’s sector – a case study	Seminar	1	0,2	27/01/2021	Università di Napoli Federico II	Yes
Picariello Lecture XI – The era of Industry 4.0: new frontiers in business model innovation	Seminar	1	0,2	03/02/2021	Università di Napoli Federico II	Yes
Picariello Lecture XII – Machine learning: causality lost in translation	Seminar	1:30	0,3	10/02/2021	Università di Napoli Federico II	Yes
Picariello Lecture XIII – Approaches to Graph Machine Learning	Seminar	1	0,2	17/02/2021	Università di Napoli Federico II	Yes
Optimized Graph Representations for Right-Wing Reddit Community Using Graph Neural Networks	Seminar	1	0,2	30/04/2021	Università di Napoli Federico II	Yes
L’esposizione ai campi elettromagnetici generati dai sistemi 5G	Seminar	4	0,8	16/07/2021	Università di Napoli Federico II	Yes
Visualizing Discord Servers - definitely not a virtual conference video replay	Seminar	1	0,2	14/10/2021	Università della Svizzera Italiana (online)	No (self-certification)
Intelligenza artificiale e sistemi d’arma autonomi	Seminar	2	0,4	19/01/2022	Gruppo Interdisciplinare su Scienza, Tecnologia e Società (GI-STs) dell’Area della Ricerca di Pisa del CNR (online)	No (self-certification)

Training and Research Activities Report – Third Year

PhD in Information Technology and Electrical Engineering – XXXIV Cycle

Vincenzo Norman Vitale

	YR 1		YR 2		YR 3						Total	Check		
	Summary	Estimated	Summary	Estimated	Estimated	1	2	3	4	5			6	Summary
						bimonth	bimonth	bimonth	bimonth	bimonth	bimonth			
Modules	13,2	20	18,8	0	5	0	3	0	0	0	0	3	32,0	30-70
Seminars	2,4	10	2	6	6	1,9	1,3	0,2	0	0,8	0,6	4,8	4,4	10-30
Research	46	40	49	55	50	8	5,7	10	10	9,2	9,4	52	155,0	80-140
	61,6	70	69,8	60	61	9,8	10	10	10	10	10	60	191,4	180

3. Research Activity

The third year of research activities focused on studying the costs of existing data management architectures and the impact of hybrid Fog-Cloud architectures on costs and the diffusion of IoT and Big Data technologies. In addition, I focused on tools and metrics to evaluate and monitor costs in multi-layered architectures, with a particular focus on data-intensive tasks with (spatial) time-series.

3.1 Hybrid Data Management Architectures

To date, IoT (Internet of Things) sensor networks mainly rely on Cloud-based architectures for anything related to computation and storage. However, the increase in the number of IoT devices acquiring data, coupled with the ease with which it can now be accessed, highlighted the limitations of Cloud-centered architectures. As a result, new computational paradigms have been introduced to overcome these limitations, such as fog computing. During this year, my activity includes the study of hybrid architectures based on the Fog computing paradigm, with particular attention to its impact on data management.

I focused on the Smart Factories and Smart Cities architectures, as these are the most striking examples of geographically distributed sensor networks gathering highly heterogeneous data.

In particular, I focused on the use of median layers (between IoT and Cloud) both for computationally intensive and data-intensive tasks. What emerged was the intensive use of these intermediate levels for reducing latency times and saving resources on IoT / Mobile / Edge devices. An example is the Computational Offloading on Fog, which consists in entrusting (totally or partially) a computational task to

a Fog node. This practice also has two crucial effects: reducing network traffic and pressure on Cloud data centers. However, the intermediate layers are mainly used to support centralized databases on the Cloud, thus acting as cache memories to reduce delays.

However, one of the most limiting problems in the diffusion of IoT and Big Data technologies is the enormous costs of managing and manipulating data in existing data management architectures. To this end, I propose a management architecture in which the Fog takes a more active and targeted role in reducing costs on the Cloud. The proposed architecture combines the location-awareness of the Fog layer with the knowledge deriving from the structured (e.g., SQL) data requests flow to optimize the costs of the architecture by maximizing the use of resources in the Fog layer.

The undergraduate student Giuseppe Liccardi made his thesis in this context.

3.2 Benchmark and Simulation Tools

Before implementing any architecture, a solution architect needs to assess its impact on both performance and costs. To this end, standard benchmarks or simulation tools are prevalent solutions. My activity focused on the study of tools able to provide a cost evaluation for the performance of hybrid architectures based on Fog, particularly on their absence. Although there are many standard benchmarks for DBMS evaluation, none of them consider a Fog layer nor a massive (spatial) time series. Furthermore, those who consider the presence of massive temporal data focus on the evaluation and simulation of the ingestion flow only, treating very little (or not at all) the outgoing data flow, which, with the increasing ease of access to data, is revealing a problem in cost-effectiveness. On the other hand, the existing simulation tools that contemplate the presence of a Fog layer focus mainly on the simulation and evaluation of aspects related to computation. From the analysis of standard benchmarks, simulators, and related metrics, a lack of tools for evaluating cost efficiency in hybrid Fog-Cloud architectures for the management of massive quantities of data emerged.

4. Products

- “Benchmarking Management Techniques for Massive IIoT Time Series in a Fog Architecture” on “International Journal of Grid and Utility Computing.”

5. Conferences and Seminars

Conferences

Conferences	Place	Dates	Role

6. Activity abroad

7. Tutorship

During this third year I have been co-advisor for one undergraduate student and one master student:

- The master student Valerio Figliuolo is currently working on cost models for data management in hybrid Fog-Cloud Architectures.
- The under graduate student Giuseppe Liccardi made his thesis entitled “Gestione di dati spazio-temporali massivi in contesto ibrido Cloud-Fog”. **Graduated**