




PhD in Information Technology and Electrical Engineering
Università degli Studi di Napoli Federico II

PhD Student: Franca Rocco di Torrepadula

Cycle: XXXVII

Training and Research Activities Report

Year: First



Tutor: prof. Nicola Mazzocca



Co-Tutor: prof. Sergio Di Martino

Date: October 28, 2022

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle:
XXXVII

Author:
Franca Rocco di Torrepadula

1. Information:

- **PhD student:** Franca Rocco di Torrepadula
- **DR number:** DR995856
- **Date of birth:** 26/06/1998
- **Master Science degree:** Computer Engineering
University: Università degli Studi di Napoli Federico II
- **Doctoral Cycle:** XXXVII
- **Scholarship type:** UNINA
- **Tutor:** Prof. Nicola Mazzocca
- **Co-tutor:** Prof. Sergio Di Martino

2. Study and training activities:

Activity	Type ¹	Hou rs	Credits	Dates	Organizer	Certificate ²
Cyber security in Akka Technologies.	Seminar	2	0.4	03/11/21	Prof. D. Cotroneo, Prof. S. P. Romano (DIETI)	Y
Threat Hunting Essentials.	Seminar	2	0.4	03/12/21	Prof. D. Cotroneo (DIETI)	Y
Threat Hunting Use-Cases.	Seminar	2	0.4	13/12/21	Prof. D. Cotroneo (DIETI)	Y
Neural Networks and Deep Learning	Course	95	9	01-05/22	Prof. G. Buttazzo (SSSA)	N
The learning landscape in deep neural networks and its exploitation by learning algorithms	Seminar	1	0.2	21/01/22	Prof. R. Zecchina.	Y
Virtualization technologies and their applications	Course	20	5	17/01/22-18/02/22	Dr. Luigi De Simone (DIETI)	Y
IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE	Seminar	1.5	0.3	30/03/22	IEEE	Y
Ciberconflitti e minacce per la pace e la stabilità internazionale. Riflessioni sulla guerra	Seminar	2	0.4	05/04/22	Prof. S. P. Romano. Prof. Tamburri ni	Y

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in Ucraina e oltre.						
Explainable Natural Language Inference.	Seminar	1.5	0.3	13/04/22	Dr. M. Valentino	Y
An Introduction to Deep Learning for Natural Language Processing	Seminar	1	0.2	13/04/22	Dr. M. Valentino	Y
Statistical data analysis for science and engineering research	Course	16	4	22/03/22-07/04/22	Prof. R. Pietrantuono (DIETI)	Y
Big Data Architecture and Analytics	Course	20	5	06/04/22-11/05/22	Prof. G. Sperli (DIETI)	
Data Week 2022	Seminar	7	1.4	08/06/22	Big Data Value Association and the EUHubs4 Data project	Y
Imprenditorialità Accademica	Course	16	4	26/05/22 - 14/06/22	Prof. P. Rippa	Y
Risk Assessment	Course	48	6	03-06/22	Prof. A. De Benedictis (DIETI)	Y
Software Products Management and Evolution	Course	48	6	03-06/22	Prof. S. Di Martino (DIETI)	Y
Workshop Nazionale per il Trasferimento Tecnologico e l'Alta Formazione	Research	11.5	2.3	16-17/06/22	Laboratorio Embedded Systems & Smart Manufacturing	Y
Privacy-preserving machine learning	Seminar	2	0.4	14/10/22	Prof. S. P. Romano	Y
15th International Conference on the Quality of Information and Communications Technology	Seminar	15	3	12-14/09/22		Y

1) Courses, Seminar, Doctoral School, Research, Tutorship

2) Choose: Y or N

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2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1		1.2	6		7.2
Bimonth 2		0.2	7		7.2
Bimonth 3	5	1.2	5	0.4	11.6
Bimonth 4	4	1.4	6		11.4
Bimonth 5	10		2		12
Bimonth 6	6	3.4	2		11.4
Total	25	7.4	28	0.4	60.8
Expected	30 - 70	10 - 30	80 - 140	0 - 4.8	

3. Research activity:

The main topic of my research activity concerns the definition and the application of intelligent systems to smart cities, with the aim of mitigating the challenges posed by the current tendency towards urbanization. More in detail, during this first year, my research activity mainly focused on public transportation systems, where the demand of commuters is often higher than transport supply. This leads to inadequate quality of service, causing, among others, stress, anxiety, and loss of productivity for passengers.

The definition of *Intelligent Public Transportation Systems (IPTS)* is becoming a widely recognized strategy to mitigate these problems, by applying ICTs (Information and Communication Technologies) to the public transportation field. The general goal is to exploit the available and often limited public transport resources in a smarter, more effective and even proactive way. In this context, the role of the Internet of Things (IoT) and the artificial intelligence (AI) techniques is crucial. The former empowers the collection and the transmission of big amount of data, and the latter allows the extraction of new useful information, on top of which it is possible to develop a number of transport-related use cases.

I started my research from the *Bus Passenger Load (BPL) Prediction* problem, that was of special interest for the *Hitachi Rail* company. BPL prediction aims at exploiting data acquired through IoT devices to predict future in-vehicle crowding. Since data were characterized by non-negligible noise (probably due to sensor misreadings), I proposed the application of a smoothing step, preliminary to the time series prediction one, in order to obtain great level of accuracy, even with noisy data.

BPL prediction can be seen as a service of a more complex system, which manages the entire public transportation system of a smart city, namely a real IPTS. However, practitioners willing to develop a new IPTS may run into a number of technical challenges, such as dealing with a multitude of spatio-temporal data acquired by heterogeneous IoT devices. The definition of reference architectures is a strategy well-known in other domains, to facilitate the design of complex systems, and to improve their interoperability. Unfortunately, from an analysis of the state of the art, I found a lack of domain-specific reference architectures for IPTS. To fill this gap, starting from the identification of a set of requirements specific for IPTS, I proposed a reference architecture intended as a collection of software components and their connections, meant to comply the identified requirement. I also described a catalogue of potential technologies for the implementation of the proposal.

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Finally, during the last two bimesters of this year I started studying the deployment of neural networks (NNs) directly at the edge, in order to reduce network bandwidth, latency, and computational costs. The problem here is that NNs, and in particular deep NNs (DNNs), demand high computational volume and large storage requirements, while edge and embedded devices are typically characterized by limited resources, in terms of both computation and storage capability. To reduce network size and computational costs, many efforts are being made on the definition model compression techniques. Among these, I am currently focusing on network quantization and knowledge distillation.

4. Research products:

Amato, F., Di Martino, S., Mazzocca, N., Nardone, D., Rocco di Torrepadula, F., & Sannino, P. *Bus Passenger Load Prediction: Challenges from an Industrial Experience*. International Symposium on Web and Wireless Geographical Information Systems. W2GIS. Published. 2022.

Cilardo, A., Maisto, V., Mazzocca, N., & Rocco di Torrepadula, F. *A Proposal for FPGA-Accelerated Deep Learning Ensembles in MPSoC Platforms Applied to Malware Detection*. International Conference on the Quality of Information and Communications Technology. QUATIC. Published. 2022

Di Martino, S., Mazzocca, Rocco di Torrepadula, F., & Sannino, P. *A Reference Architecture for Data-Driven Intelligent Public Transportation Systems*. IEEE Transactions on Intelligent Transportation Systems. IEEE T-ITS. Submitted.

Starace L. L. L., Rocco Di Torrepadula, F., Di Martino, S., & Mazzocca, N. *How many taxis do we need to crowd-sense historical cities?* Journal of Advanced Transportation. JAT. Submitted (Under the second round of review).

5. Conferences and seminars attended

International Symposium on Web and Wireless Geographical Information Systems. W2GIS. Online. 28-29/04/2022. I presented the paper “Bus Passenger Load Prediction: Challenges from an Industrial Experience”.

Workshop Nazionale per il Trasferimento Tecnologico e l'Alta Formazione. Verona. 16-17/06/2022. I presented a poster.

International Conference on the Quality of Information and Communications Technology. QUATIC. Talavera de la Reina. 12-14/09/2022.

6. Activity abroad:

None

7. Tutorship

“Computer System Design” course: support and tutorship on Motorola 6800 programming and

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simulation on ASIM/ASIM Tool 22/03/2022 (3 hours); MIPS programming and simulation 29/03/2022 (3 hours); Intel 6821 peripheral driving programming 07/04/2022 (2 hours); Mutual exclusion in assembly 26/04/2022 (2 hours). Total 10 hours.