

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

PhD Student: Alessandro Mauro

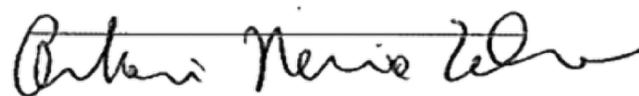
Cycle: XXXIX

Training and Research Activities Report

Year: First



Tutor: Prof. Antonia Maria Tulino



Co-Tutor: Prof. Jaime Llorca

Date: October 31, 2024

Training and Research Activities Report

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Author: Alessandro Mauro

1. Information:

- **PhD student:** Alessandro Mauro
- **DR number:** DR997205
- **Date of birth:** 23/09/1998
- **Master Science degree:** Computer Science **University:** UNINA
- **Doctoral Cycle:** XXXIX
- **Scholarship type:** *PNRR*
- **Tutor:** Prof. Antonia Maria Tulino
- **Co-tutor:** Prof. Jaime Llorca

2. Study and training activities:

Activity	Type ¹	Hours	Credits	Dates	Organizer	Certificate ²
Energy-Efficient Data Science	Seminar	1	0.2	13/12/2023	Prof. Elio Masciari	Y
Robotics meets AI & 5g: Il futuro è adesso	Seminar	2	0.4	14/12/2023	Prof. Paolo Massarotti	Y
Hominis	Seminar	1	1	21/02/2024	Prof. Carlo Sansone, eng. Stefano Marrone	Y
STRATEGIC ORIENTATION FOR STEM RESEARCH & WRITING	Ad hoc course	24	5	07/12/2023 to 23/02/2024	Adriana D'Auria	Y
IoT Data Analysis	Ad hoc course	12	4	08/02/2024 to 1/03/2024	Prof. Raffaele Della Corte	Y
IEEE Authorship and Open Access Symposium Tips and Best Practices to Get Published from IEEE Editors	Seminar	2	0.4	07/05/2024	Rachel Berrington Director, IEEE	Y
Rewire the brain: The potential of Neuroplasticity	Seminar	2	0.4	09/05/2024	Prof. Antonia Maria Tulino	Y
Perché digital in un mondo che sembra già Estensivamente digitale e perché trasformare	Seminar	4	0.8	10/05/2024	Prof. Antonia Maria Tulino	Y

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IA e 5G: Tecnologie Abilitanti per la Manutenzione Predittiva	Seminar	1	0.2	10/05/2024	Prof. Antonia Maria Tulino	Y
Regolazione in tema di intelligenza artificiale alla luce dell'AI Act	Seminar	5	1	13/05/2024	Prof. Antonia Maria Tulino	Y
Intelligenza Artificiale e regole del mercato	Seminar	2	0.4	14/05/2024	Prof. Antonia Maria Tulino	Y
Verso una gestione smart della risorsa idrica con il supporto della digital innovation	Seminar	1	0.2	14/05/2024	Prof. Antonia Maria Tulino	Y
Sustainable IT: Strategies and Best Practices for a Green Engineering Future	Seminar	5	1	27/05/2024	Prof. Antonia Maria Tulino	Y
Generative AI for software engineering: strategies, impacts and practical applications	Seminar	5	1	29/05/2024	Prof. Antonia Maria Tulino	Y
Research & Innovation	Seminar	2	0.4	10/06/2024	Prof. Antonia Maria Tulino	Y
Using Deep Learning properly	Ad hoc course	12	4	23-25-30/01/2024 01-06-08/02/2024	Dr. Andrea Apicella	Y
Topological Signal Processing and Learning	Seminar	1	0.2	17/07/2024	Prof. Antonia Maria Tulino	Y
Learning in nonstationary environments	Seminar	2	0.4	15/10/2024	Prof. Carlo Sansone	Y
Information Theory	MSc Course	48	6	12/09/2024	Prof. Antonia Maria Tulino	Y
Elaborazione dei segnali digitali	MSc Course	24	3	16/10/2024	Prof. Antonia Maria Tulino	Y

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- 1) Courses, Seminar, Doctoral School, Research, Tutorship
- 2) Choose: Y or N

2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1		0.6	7		7.6
Bimonth 2	5	1	7		13
Bimonth 3	4		7		11
Bimonth 4		5.8	7		12.8
Bimonth 5	4	0.2	3.5		7.7
Bimonth 6	9	0.4	3.5		12.9
Total	22	8	35		65
Expected (1st year)	20 - 40	5 - 10	10 - 35	0 - 1.6	

3. Research activity:

During my first year, my primary research focus was on E2E service optimization within programmable networks. Specifically, building on the work conducted in the "RESTART - RESearch and innovation on future Telecommunications systems and networks, to make Italy more smART" Spoke 4 project—which funded my Ph.D. fellowship—I studied techniques and methodologies for Long-Mid Term Optimization for E2E Service Orchestration across the Cloud-Edge Continuum. This entails optimizing the delivery of Next-Generation (NextG) services across distributed cloud and edge computing resources in programmable networks. After an in-depth preliminary review of the state-of-the-art, I began developing IDAGO (Information-Aware DAG Orchestration), a multi-criteria approximation algorithm for solving the class of unsplittable multicast Cloud-Network-Flow (CNFlow) problems in polynomial time. This work culminated in the submission of a journal paper titled “End-to-End Orchestration of NextG Media Services over the Distributed Compute Continuum” to IEEE Transactions on Mobile Computing. The work was also presented at the WP5 SUPER project update meeting and showcased as a poster during the RESTART Plenary Dissemination Workshop in Catania on July 4-5, 2024.

Over the subsequent months, my research advanced on three fronts. First, I focused on practical extensions to the IDAGO algorithm. These extensions generated solutions that effectively prevent constraint violations in real-world scenarios, with additional simulations demonstrating the algorithm's benefits and highlighting the role of edge and access resources in delivering next-generation media services efficiently. This resulted in the submission of a conference paper, “Efficient Orchestration of Extended Reality Services in Distributed Edge-Cloud Computing Networks,” to the IEEE International Conference on Communications (ICC). On a second front, I start working on combining IDAGO for long-term placement, routing, and initial resource allocation, with an RL-based algorithm for dynamic resource autoscaling. On the third front, I started collaboration with Meetecho and NXW to integrate IDAGO in the SUPER orchestrator and use it for the orchestration of Meetecho’s real-time stream-processing services, providing a JSON-based interface as a starting point for such integration.

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4. Research products:

4.1. Journal Papers

- **Mauro, A., Tulino, A. M., & Llorca, J. (2024).** *End-to-End Orchestration of NextG Media Services over the Distributed Compute Continuum.* **IEEE Transactions on Mobile Computing.** Status: Under Review. arXiv preprint arXiv:2407.08710

4.2. Conferences Papers

- **Mauro, A., Tulino, A. M., & Llorca, J. (2024).** *Efficient Orchestration of Extended Reality Services in Distributed Edge-Cloud Computing Networks.* **IEEE International Conference on Communications (ICC).** Status: Under Review.

5. Conferences and seminars attended

- *RESTART Plenary Dissemination Workshop, Poster Presentation, Catania 4-5 July 2024.*
- *Dissemination Workshop on Programmable Networks Organized by SUPER Project (RESTART), Bologna 10 September 2024.*

6. Activity abroad:

During my first PhD year I did not spend any time abroad.

7. Tutorship

None