



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

PhD Student: Marco Grazioso

Cycle: XXXVI

Training and Research Activities Report

Academic year: 2021-22 - PhD Year: Second

Marco Grazioso

Tutor: Prof. Francesco Cutugno

Co-Tutor: PhD. Valentina Russo

Date: October 31, 2022

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1. Information:

- **PhD student:**Marco Grazioso **PhD Cycle:** XXXVI
- **DR number:** DR995138
- **Date of birth:**26/11/1990
- **Master Science degree:** Computer Science **University:** University of Napoli “Federico II”
- **Scholarship type:** Funding company
- **Tutor:** Prof. Francesco Cutugno
- **Co-tutor:** Dr. Valentina Russo

2. Study and training activities:

Activity	Type ¹	Hours	Credits	Dates	Organizer	Certificate ²
Supporting code-related tasks via Deep-Learning	Seminar	1	0,2	11/11/2021	Antonio Mastropaolo	Y
Complexity And The City: Transitioning Towards The Smart Cities Of The Future	Seminar	1	0,2	23/11/2021	Professor Luis Bettencourt	N
Threat Hunting Use-Cases	Seminar	2	0,4	13/12/2021	Group-IB Vladimir Kurdin	Y
All roads lead to WebRTC: an introduction to Janus	Seminar	2	0,4	16/12/2021	Dr. Lorenzo Miniero	Y
Designing Quantum Algorithms	Seminar	2	0,4	16/12/2021	Prof. Michele Amoretti	Y
SOCIAL NETWORK DYNAMICS LEADING TO COMMUNITY FORMATION AND RESIDENTIAL SEGREGATION	Seminar	1,5	0,3	16/12/2021	Prof. Massimo Franceschetti	Y
CLIMATE MEETS COMPLEXITY: EXPLORING PREDICTABILITY OF EXTREME CLIMATE EVENTS VIA A COMPLEX NETWORK APPROACH	Seminar	1,5	0,3	13/01/2022	Jürgen Kurths	Y

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yTorsional instability in suspension bridges: a new mathematical explanation of the Tacoma Narrows Bridge collapse	Seminar	1	0,2	14/01/2022	Filippo Gazzola	Y
seminario: The learning landscape in deep neural networks and its exploitation by learning algorithms	Seminar	2	0,4	21/01/2022	Riccardo Zecchina	Y
Space Weather: Science or Application?	Seminar	1,5	0,3	27/01/2022	Lucilla Alfonsi	Y
Systems biology as a compass to understand tumor-immune interactions in humans	Seminar	1	0,2	02/02/2022	Davide Bedognetti	Y
The quest of quantum advantage with a photonics platform	Seminar	1	0,2	03/02/2022	Fabio Sciarrino	Y
COMPRENDERE I "MALEDETTI" ESPRESSIVI	Seminar	1	0,2	23/02/2022	Filippo Domaneschi	Y
Project Vāc: Can a Text-to-Speech Engine Generate Human Sentiments?	Seminar	1	0,2	28/02/2022	Prof. Vijay K. Gurbani	Y
Bench to Bytes to Bedside: Converting genomic data into healthcare tools	Seminar	1	0,2	04/03/2022	Serena Nik-Zainal	N
Artificial visual intelligence: Perceptual commonsense for human-centred cognitive technologies	Seminar	1	0,2	16/03/2022	Prof. Mehul Bhatt	N
From basic principles in spintronics to some recent developments toward spin-orbitronics	Seminar	1	0,2	31/03/2022	Vincent Cros	N
La struttura 3D del genoma e il suo ruolo in salute e malattia	Seminar	1,5	0,3	31/03/2022	PROF. MARIO NICODEMI	N
Toward a political philosophy of AI	Seminar	2	0,4	11/04/2022	Prof. Mark Coeckelber	Y

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An Introduction to Deep Learning for Natural Language Processing	Seminar	1	0,2	13/04/2022	Dr. Marco Valentino	Y
Explainable Natural Language Inference	Seminar	1,5	0,3	13/04/2022	Dr. Marco Valentino	Y
"Probing and infusing biomedical knowledge for pre-trained language models"	Seminar	2	0,4	07/06/2022	Dr. Zaiqiao Meng	Y
Lezioni di Linguistica Computazionale 2022	Courses	15	3	08 - 10 /06/2022	AILC	Y
Corso Accademia e imprenditorialità	Courses	27	4		Prof. Pierluigi Rippa	Y
Neural networks and deep learning	Courses	65	10		Prof. Giorgio C. Buttazzo	Y

- 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	7,1	1,9	7,1	0	9
Bimonth 2	7	2	7	0	9
Bimonth 3	9,2	1,8	9,2	0	11
Bimonth 4	5	0,4	5	0	8,4
Bimonth 5	6	0	6	0	10
Bimonth 6	2,6	0	2,6	0	12,6
Total	36,9	17	6,1	0	60
Expected	30 - 70	10 - 30	80 - 140	0 - 4.8	

3. Research activity:

During the current year, I deeply investigated the domain of task-oriented dialogue systems by studying state-of-the-art methodology to solve problems like intent recognition, intent disambiguation, entity recognition, slot filling and dialogue management strategies. My research has been applied in the development of graph-based task-oriented dialogue system architecture being domain adaptable, customizable and able to communicate with external API. The dialogue flow has been developed by following a theoretical framework of dialogue issues and, thus, providing an architectural solution to these issues.

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On one hand, transformer-based models have been applied to extract information from the utterances, on the other hand, such information is analyzed through a probabilistic framework based on bayesian networks to solve ambiguous situations, identify intent switching and handle failed slots validation.

In the architecture developed so far, in the second half of the year, I focused my attention on the Dialogue State Tracking (DST) task which consists of recovering from previous exchanges information useful to accomplish the current task. During my research, I found out that most of the approaches leverage transformer architecture by passing as input to the model the dialogue history (past utterances) plus the current utterance and doing joint intent recognition and slot-filling. This kind of approaches represents the dialogue state as a set of slot-value pairs losing other contextual and conversational information. Following more recent studies, the idea of using structured knowledge and more flexible state representation in order to capture the dialogue complexity seems to be promising. Given that, I directed my studies to the development of a graph-based representation of the dialogue state in order to connect entities occurred during the exchange to the domain knowledge base, also represented as a graph, and increase the DST module capabilities of modelling contextual and conversational behaviours.

4. Research products:

Origlia, A., Grazioso, M., Chiacchio, M. L., & Cutugno, F. (2022). 3D Avatars and Semantic Models Annotations for Introductory Cultural Heritage Presentations. In Proceedings of the 2022 AVI-CH Workshop on Advanced Visual Interfaces for Cultural Heritage. CEUR-WS. org.

Russo, V., Mancini, A., Grazioso, M., & Di Bratto, M. (2022). Graph-based representations of clarification strategies supporting automatic dialogue management. *IJCoL. Italian Journal of Computational Linguistics*, 8(8-1).

D'ASARO, F. A., Raggioli, L., Malek, S., Grazioso, M., & Rossi, S. (2022). An Application of a Runtime Epistemic Probabilistic Event Calculus to Decision-making in e-Health Systems. *Theory and Practice of Logic Programming*, 1-24.

Campi, M., Cera, V., Cutugno, F., di Luggo, A., Giulierini, P., Grazioso, M., ... & Palomba, D. Virtual Canova: a Digital Exhibition Across MANN and Hermitage Museums.

Developed a ChatBot prototype, presented at the SMAU fairs, Milan 11th to 12th October 2022

5. Conferences and seminars attended

Poster presented at Lectures on Computational Linguistics, Napoli 8-10 giugno 2022

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AIxIA 2021, 20th International Conference, Italian Association for Artificial Intelligence, November 29-30, December 1 - 3, 2021, online event

ACL 2022, 60th international meeting, Dublin, 22 – 27 May 2022

6. Periods abroad and/or in international research institutions

7. Tutorship

8. Plan for year three

During my third year, I'm going to implement a dialogue state tracking module to be applied and tested in the already developed chatbot prototype, in order to collect data and validate the research assumptions.

I plan to stay in Edinburgh for a research period. Here I'm going to start a collaboration with a research group from Heriot-Watt university and apply my research in the field of human-robot interaction by tracking dialogues and activities to build a graph-based state representation and improve the robot's next action selection model. The current state representation will be enriched with a second information level by representing also complex activities composed of chains of tasks. Each user may have different task chains for the same complex activity. By doing that we will add knowledge about the user into the representation which will be used to provide a personalized dialogue flow based on the users' preferences.

Finally, I will spend my last year in making experiments and collecting data to confirm or reject the research assumptions, and writing the thesis.