UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DOTTORATO DI RICERCA / PhD PROGRAM IN
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

Activities and Publications Report

PhD Student: Antonia Affinito

Student ID: DR993885

PhD Cycle: XXXV
PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 01/11/2019
PhD program student's end date: 31/01/2023

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PhD scholarship funding entity:
Università "Federico II"

General information

Antonia Affinito received in year 2018 the Master Science degree in Computer Engineering from the University of Napoli Federico II. She attended a curriculum in Networking Engineering within the PhD program in Information Technology and Electrical Engineering. She received a grant from Università Federico II.

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1	"Intelligenza Artificiale ed etica: La ricerca in IA alla prova delle sfide etiche"	Ad hoc course	1,6	Prof. Prevete	ITEE
1	"Safety Critical Systems for Railway Traffic Management"	Ad hoc course	3,3	Mario Barbareschi, RFI	ITEE
1	"Scientific Programming and Visualization with Python"	Ad hoc course	2	Prof. Alessio Botta	DIST
1	"Innovation Management, entrepreneurship and intellectual property"	Ad hoc course	5	Prof. Pierluigi Rippa (University of Naples Federico II)	ITEE
1	"Virtualization technologies and their applications"	Ah hoc course	4	Prof. Domenico Cotroneo, Luigi de Simone	ITEE
1	"Big Data Analytics and Business Intelligence"	MSc Course	6	Prof. Vincenzo Moscato	University of Naples Federico II
1	"Machine Learning"	Ad hoc course	4	Prof. Carlo Sansone	ITEE-ICTH
1	"Intelligenza Artificiale"	MSc Course	6	Prof. Flora Amato	University of Naples Federico II
2	"Data Management"	MSc Course	6	Prof. Flora Amato	University of Naples Federico II

Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
2st	SSIE 2021 – IEEE Italy Section Summer School. Machine Learning Theory	remote	5	12-16/07/2021	University of Padova, Italy
3st	"TMA PhD School 2022"	Enschede, the Netherlands	2	27-28/06/2022	University of Twente, the Netherlands

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1st	"Introduction to CERN and wakefield measurements at CLEAR"	0.4	Prof. Arpaia, Gilardi	DIETI,	ITEE
1st	"Blockchain for beginners"	0.6	Andrea Varriale, Valerio Gallitto		ITEE
1st	"Deep Learning Onramp"	0.4	Stefano Marrore	DIETI	ITEE
1st	"Marked point processes for object detection and tracking in high resolution images: application to remote sensing data"	0.2	Josiane Zerubia	INRIA, Université Côte d'Azur.	ITEE
1st	"Lo spazio cibernetico come dominio bellico"	0.4	Gian Piero Siroli	Università di Bologna	ITEE
1st	"Cybersecurity and fuzzing for robots, blockchain, and more"	0.2	Antonio Ken Iannillo	Universitè du Luxembourg	ITEE
1st	"Elettromagnetismo e salute"	0.2	Rita Massa	UNINA	UNINA
1st	"Computational Biology: Large scale data analysis to understand the molecular bases of human diseases"	0.2	Michele Ceccarelli	DIETI	ITEE
1st	"How to Get Published with IEEE"	0.4	Eszter Lukacs	IEEE	ITEE
1st	"Large Scale Training of Deep Neural Networks"	0.4	Giuseppe Fiamenti	NVIDIA	ITEE
1st	"Design e Nuove tecnologie. Possibili scenari per fronteggiare l'emergenza"	0.2	Amleto Picerno Ceraso	Part of Innovation Village 2020	UNINA
1st	"Access the eLearning library on IEEE Xplore"	0.2	Eszter Lukacs	IEEE	ITEE
1st	"Health 4.0 – La rapidità della medicina e la velocità del cambiamento del nostro mondo organizzato da Università degli studi di Napoli Federico II"	0.4	Paolo Netti	Part of Innovation Village 2020	UNINA
1st	"Planning 5G under EMF constraints: challenges and opportunities"	0.4	Luca Chiaraviglio	University of Rome Tor Vergata	ITEE
1st	"Virtual Seminars on	0.8	J. Wenger, C.	Institute Fresnel,	

	Sensing"			Rockstuhl, L. Baldassarre, M. Fleischer	France; Karlsruher Institut fur Technologie, Germany; Sapienza University of Rome; Universitat Tubingen, Germany	
1st	"La programmazione europea e la ricercar. Nuovi scenari della programmazione europea dopo il 2020 – La gestione di un progetto di ricerca"	0.4	Filippo Ammirati	Part of Innovation Village 2020	UNINA
1st	"Joint Design of Optics and Post-Processing Algorithms Based on Deep Learning for Generating Advanced Imaging Features"	0.4	Raja Giryes; Laura Waller; Michael Unser; Katie Bouman; Yoram Bresler; Orazio Gallo; Saiprasad Ravishankar	Tel Aviv University; UC Berkeley; EPFL; Caltech; UIUC; Nvidia; Michigan State University	IEEE SPS
1st	"Exploring Autonomy Robotic Flexible Endoscopy"	0.4	Pietro Valdastri		UNINA
2nd	"AI4NETS-AI/ML for data communication Networks-Tutorial"	0.8	Marco Mellia	Politecnico di Torino	External Institutions – Polito
2nd	"Robot Manipulation and Control"	0.5	Bruno Siciliano	DIETI	ITEE
2nd	"Telemedicina in Italia: casi di successo"	0.3	Giovanni d'Addio	-	UNINA
2nd	"Digital Project Management: practices, processes, techniques, tools and scientific approach"	0.4	Dario Carotenuto	-	UNINA
2nd	"L'esperienza del Progetto di tele-riabilitazione NEUROREAB"	0.3	Ing. F. Furno, Ing. L. Romanelli	Project Management Institute	
2nd	"#andratuttobene: Images, Texts, Emojis and Geodata in a Sentiment Analysis Pipeline"	0.3	Prof. Serena Pelosi	University of Salerno	UNINA
2nd	"Telemedicina, e-health e mobile health si può davvero usare il digitale nel	0.3	Dott.ssa Simonetta Scalvini	-	UNINA

	perocrso assistenziale?"				
2nd	"Patent Searching Best Pratices with IEEE Xplore"	0.2	Eszter Lukacs	IEEE	ITEE
2nd	"At the Nexus of Big Data, Machine Intelligence, and Human cognition"	0.2	Prof. George S. Djorgovski	California Institute of Technology	UNINA
2nd	"From Photometric Redshifts to Improved Weather Forecasts: an interdisciplinary view on machine learning"	0.2	Kai Polsterer	Heidelberg Institute for Theoretical Studies - HITS	UNINA
2nd	"Cybercrime and e-evidence: the criminal justice responde"	0.2	Matteo Lucchetti	PhD Programme Manager Cybercrime – Council of Europe	UNINA
2nd	"Machine Learning: Causality lost in translation"	0.3	Edwin Valentijn	University of Groningen The Netherlands	UNINA
2nd	"Approaches to Graph Machine Learning"	0.2	Miroslav Cepek	Oracle Labs	UNINA
2nd	"Visual Interaction and Communication in Data Science"	0.4	Marco Quartulli	Vicomtech (Spagna)	UNINA
2nd	Rodo Ludens: A game design taxonomy for human-robot interaction"	0.2	John Edison Munoz Cardona	University of Waterloo, Canada	ITEE
2nd	"Ethics of qualifitication"	0.4			UNINA
2nd	"End-to-end optimization of augmented experience servies over cloud-integrated 5G networks"	0.8	Dr. Jaime Llorca	New York University	DIETI
3rd	PhD & PDEng Day	0.25	Jamie Hyneman, Michelle Ekkelkamp, Connie Clare	University of Twente, Expat Center East Netherlands, 4TU.ResearchData	University of Twente, Enschede, the Netherlands
3rd	From Cyber Situational wareness to Adaptive Cyber Defense: Leveling the Cyber Playing Field	0.4	Massimiliano Albanese	George Mason University	

Research activities

Antonia Affinito focused on the research regarding the analysis of emerging network anomalies and large-scale phenomena. The first activities involved a detailed review of the scientific literature in this field, enhancing the existing knowledge base. This preliminary study helped

shaping possible gaps in the state of the art, leading to the formulation of possible research questions and, subsequently, a research proposal.

The experimental activities involved designing, developing and testing big data algorithms for detecting network scanning activities in real high-speed network traffic traces. The results reveal that these algorithms can easily achieve higher performance than other ground truths, which are based on much more complex algorithms.

The second part of the experimental activities focused on the study of the Domain Name System (DNS) and its features, with the goal of identifying malicious domain names. The inspection of the security level and performance of Internet Service Providers (ISP) and public DNS resolvers reveals that it is not needed to trade off security against performance. The analysis of domain name lifetimes, instead, highlight the existence of malicious name registration campaigns and that some domains are subjected to take down efforts after appearing on a blocklist.

Tutoring and supplementary teaching activities
Fondamenti di Informatica A-CIR; November – December 2021

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1st	31,9	6,6	36,1	0
2nd	11	6,8	43,5	6
3rd	0	2,65	61	0

Iter formativo	corsi / scuole	seminari	attività ricerca	tutorato / did. int.
1 anno	min 20 - max 40	min 5 - max 10	min 10 - max 35	min 0 – max 1.6
2 anno	min 10 - max 20	min 5 - max 10	min 30 - max 45	min 0 – max 1.6
3 anno	min 0 - max 10	min 0 - max 10	min 40 - max 60	min 0 – max 1.6
TOTALE	min 30 – max 70	min 10 – max 30	min 80 – max 140	min 0 – max 4.8

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
1st-2nd	University of Twente, Enschede, the	Roland van Rijswijk-Deij, full Professor	14/04/2021-12/04/2022	Research on Domain Name System features, with a focus on domain name lifetimes. Exploration the longitudinal changes in the

Netherlands			infrastructure used by Russian sites – notably DNS, hosting, and TLD certificate issuance – before and after the invasion of Ukraine. Experiments on malicious domain name takeover reactiveness.

PhD Thesis

In the PhD Thesis, Antonia Affinito focused on the research regarding the analysis of emerging network anomalies and large-scale phenomena.

Nowadays, the growth in the number of network devices has been of many advantages to society, automating a substantial number of processes, and enhancing communications and quality of life.

However, with the advent of emerging devices and the advancements in Internet technology, large-scale phenomena, both real-life events (e.g, COVID-19) and cybersecurity threats, are increasingly reflected over the Internet.

Prior to initiating a malicious activity, cybercriminals usually scan a network to discover active and vulnerable network devices. This is also the approach adopted by botnets, recent cybersecurity threats. These infrastructures more and more use the Domain Name System (DNS) as a tool for their operations.

In line with this trend, this thesis first addresses the problem of detecting port and net scan activities in high-speed networks using Big Data techniques to cope with the increased volume of data to be processed.

After that, it deals with analysing and detecting Mirai botnet scans. Scrutinizing its signature over a six-year period from real Internet traffic reveals the evolution of such a botnet and its variants.

It then concentrates on DNS as a possible observation lens for these activities. It, therefore, focuses on how Internet Service Providers and public DNS resolvers protect users accessing these unreliable domains.

Then it focuses on analysing the domain name lifetimes, showing how domain names are subject to takedown efforts after appearing in the blocklists.

Finally, two case studies are reported on how DNS data can be used to analyse prominent and global real-life events. Specifically, this thesis covers the effect of COVID-19 on network utilization, providing insights into the use of Internet applications related to several categories. In addition, the impact of the conflict on Russian domain infrastructure is presented, investigating its changes before and after the invasion of Ukraine.

Publications

Research results appear in *5* contributions to international conferences.

List of scientific publications

International conference papers

A. Affinito, A. Botta, L. Gallo, M. Garofalo, G. Ventre,

Spark-based port and net scan detection,

Proceedings of the 35th Annual ACM Symposium on Applied computing (SAC '20),

Virtual Conference, March 2020, pp. 1172-1179, Association for Computing Machinery (ACM), https://doi.org/10.1145/3341105.3373970

A. Affinito, A. Botta, G. Ventre,

The impact of covid on network utilization: an analysis on domain popularity,

IEEE International Workshop on Computer-Aided Modeling, Analysis, and Design of Communication Links and Networks, CAMAD,

Virtual Conference, Sept 2020, pp. 1-6, IEEE, DOI: 10.1109/CAMAD50429.2020.9209302

A. Affinito, A. Botta, G. Ventre,

Local and Public DNS Resolvers: do you trade off performance against security?,

IFIP Networking Conference,

Catania, Italy, June 2022, pp. 1-9, IEEE, doi:10.23919/IFIPNetworking55013.2022.9829756

A. Affinito, R. Sommese, G. Akiwate, S. Savage, K. Claffy, G. M. Voelker, A. Botta, M. Jonker,

Domain Name Lifetimes: Baseline and Threats,

Proceedings on the 6th edition of the Network Traffic Measurement and Analysis Conference (TMA Conference)
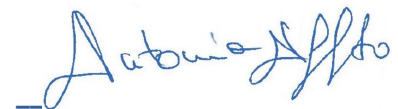
Enschede, the Netherlands, June 2022 ,IFIP

M. Jonker, G. Akiwate, A. Affinito, KC Claffy, A. Botta, G. M. Voelker, R. van Rijswijk-Deij, S. Savage,

Where .Ru? Assessing the Impact of Conflict on Russian Domain Infrastructure,

Proceedings of the 22nd ACM Internet Measurement Conference,

Nice, France, October 2022, pp. 159-165, Association for Computing Machinery, doi: 10.1145/3517745.3561423

Awards and Prizes
- Receipt of the travel grant at ACM CoNEXT 2022
- Receipt of the travel grant at ACM IMC 2022
- Receipt of the travel grant at TMA PhD school 2022

Date 13/01/2023

PhD student signature _

Supervisor signature _____