



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

PhD Student: Gaetano Perrone

XXXIV Cycle
Training and Research Activities Report – Third Year

Tutor: Simon Pietro Romano



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

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1 Information

My name is Gaetano Perrone. I obtained Master Degree in Computer Engineering at the University Federico II in July 2017. I am completing my PhD in Information Technology and Electrical Engineering without fundings. I am a co-founder and employee in SecSI (Security Solutions for Innovation), an innovative cybersecurity startup founded on 29/07/2019. At SecSI, we believe that security testing needs to be done offensively.

Our company strictly lies with the University. Our mission is the technology transfer to companies that need to solve challenging cybersecurity problems. My research is mainly focused on the Network Security field, in three main research areas: modelling attacker's knowledge, increasing the automation of offensive security and creating innovative solutions to design and implement cyber ranges. My tutor is Professor Simon Pietro Romano.

2 Study and Training Activities

During my third year of the PhD, I have mainly actualized my research works and produced several papers. My course of study focused on side research projects followed to learn the knowledge of mathematical skills. I have mainly followed seminars at Scuola Superiore Meridionale, the international school of higher education and research. To improve my understanding of state-of-art market solutions, I have attended Palo Alto seminar courses on Prisma SASE solution, an innovative platform that is focused on cloud security. The seminar helped me understand the current challenges in the cloud security domain, which can address our further security research works.

Year	Lecture/Activity	Type	Credits	Certification
3	Quasar as Standard Candles	Seminar	0.3	x
3	Network Systems, Kuramoto Oscillators, and Synchronous Power Flow	Seminar	0.4	x
3	Force and Visual Control for Safe Human–Robot Interaction	Seminar	0.4	x
3	Beyond Einstein Gravity: Dark Energy and Dark Matter as Curvature Effects	Seminar	0.3	x
3	Advances in Machine Learning for Modelling and Understanding the Earth Sciences	Seminar	0.3	x
3	Age, morbidity, or something else? A residual approach using microdata to measure the impact of technological progress on health care expenditure	Seminar	0.2	x
3	Palo Alto Networks Prisma Access	Seminar	3.2	x

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	Credits year 1							Credits year 2							Credits year 3							Total	Check				
	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4			5	6	Summary	
Modules	18	1,4	1,2	6	0,4	9,6	18,6	9		3		3,6	6		12,6	0									0	31,2	30-70
Seminars	13	0	0			0	5	6							0		1,4	0,3					3,4	5,1	10,1	10-30	
Research	34	6	6	6	6	5	7,4	36,4	42						47,4									54,9	138,7	80-140	
	65	7,4	7,2	12	6,4	5	22	60	57	0	3	0	0	6	0	60	0	1,4	0,3	0	0	0	3,4	60	180	180	

3 Research Activity

The main area of my research is Network Security.

I continued my research on the topics of the second year:

- The application of Artificial Intelligence to develop an intelligent agent able to use hacking techniques to detect web application vulnerabilities;
- The application of virtualization techniques to create network security scenarios for educational purposes;
- The realization of knowledge models to describe the attacker actions;

As an extension of the second year of research, we extended the “Hacking Goal” classification approach we developed in previous years. We show that it is possible to model the attacker’s behaviour with knowledge graphs. We develop a model that maps the OWASP methodology to conduct Web Application Penetration Testing activities into a Knowledge Graph.

This year, we extended our work in the cyber-range domain by modelling an on-demand deployment and orchestration architecture of Cyber Ranges in the Cloud environment. We define a cyber-range model composed of “Micro Range” and “Macro Range”. This model shows how it is possible to deploy Docker Security Playground (an innovative project developed by me to emulate network security scenarios) as a micro-range environment. We create an advanced architecture in the AWS cloud platform.

My research is conducted in collaboration with Francesco Caturano. We have created a working group focused on the network security field called SecSI.

4 Products

4.1 Publications

Published Papers

- *F.Caturano, G.Perrone, S.P. Romano, Hacking Goals: a goal-centric attack classification framework, , published to 28th 32th IFIP International Conference on Testing Software and System IEEE (ICTSS 2020)*
- *F.Caturano, G.Perrone, S.P. Romano, Capturing flags in a dynamically deployed microservices-based heterogeneous environment, 13th IEEE Principles, Systems and Applications of IP Telecommunications (IPTComm2020)*
- *F.Caturano, G.Perrone, S.P.Romano, “Discovering reflected Cross-Site Scripting vulnerabilities using a Multiobjective Reinforcement Learning environment”, submitted to Computers & Security (2020)*

- *A.P. Luise, G.Perrone, C.Perrotta, S.P.Romano, “On-demand deployment and orchestration of Cyber Ranges in the cloud”, CEUR Workshop Proceedings 2021*

Submitted Papers

- *D.Antonelli, R. Cascella, G. Perrone, S.P. Romano, A. Schiano, Leveraging AI to optimize website structure discovery during Penetration Testing, IEEE Transactions on Network and Service Management*

In Preparation

- *C.Brandi, F.Caturano, G.Perrone, S.P.Romano Generic Testing to find injection vulnerabilities in Web Applications*
- *F. Caturano E. De Martino G.Perrone S.P.Romano, Leveraging Knowledge Graphs to model Attackers' Behaviors*
- *F. Caturano A. Ferraiuolo M. Perna G. Perrone S.P.Romano, Recheck Through Ansible: a declarative-based approach to vulnerability fix validation*

4.2 Patents

We registered “Docker Security Playground” (<https://github.com/giper45/DockerSecurityPlayground>) to SIAE (Società Italiana degli Autori ed Editori) in date 10/06/2020. It is the software that allowed us to convert SecSI in an **innovative start-up** on 10/11/2020.

5 Conferences and Seminars

- *IFIP International Conference on Testing Software and Systems*
- *ITASEC Workshop 2020*