



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee^{PhD}
information technology
electrical engineering



Luca Giamattei

Causal Reasoning for Software Testing

Tutor: Roberto Pietrantuono

Cycle: XXXVII

Year: Second

My background

- MSc degree in Computer Engineering
- Research group: DEpendable and Secure Software Engineering and Real-Time Systems (DESSERT – Proff. Russo, Cotroneo, Cinque – www.dessert.unina.it)
- PhD start date: 1st November 2021
- Fellowship: Unina

Summary of study activities

	Courses	Seminars	Research	Tutorship
First Year	29	1,1	28,3	1,6
Second Year	4	4,3	50	1,6
Total	33	5,4	78,3	3,2
Expected	30-60	10-20	40-80	0-3,2

- **Courses:**

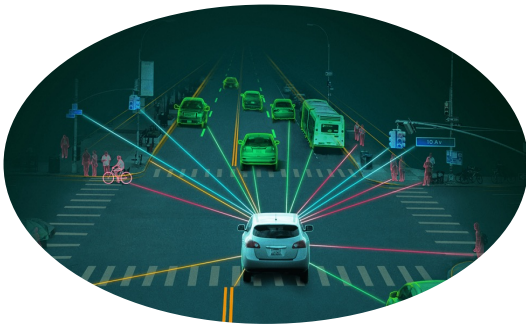
- IoT Data Analysis (PhD course), Prof. Raffaele Della Corte

- **Conferences attended:**

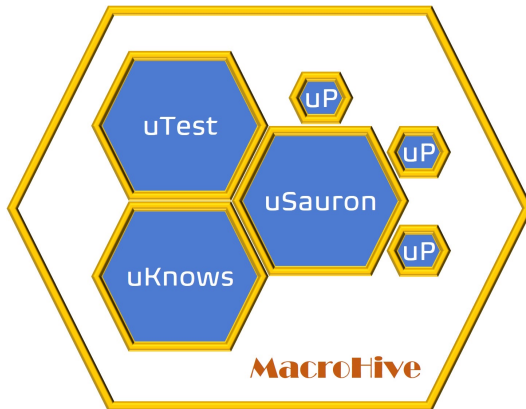
- 22nd IEEE International Conference on Software Quality, Reliability and Security (QRS), Guangzhou, China, 2022 (online)
- 45th IEEE/ACM International Conference on Software Engineering (ICSE), Melbourne, Australia, 2023
- 34th IEEE International Symposium on Software Reliability Engineering (ISSRE), Florence, Italy, 2023

Research field of interest: Software Testing

Research topics:



- Testing of Autonomous Driving Systems



- Testing of Microservices Architectures
 - Product:
MacroHive, a prototype for automated grey-box MSA testing and Root Cause Analysis

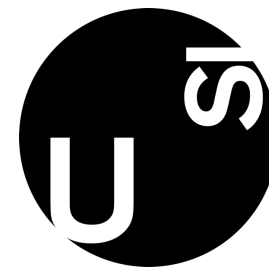
Research activity: Overview

- **Problem:**
 - Testing activities are costly and time-consuming
 - Automatic testing still a major challenge in many contexts
- **Goal:**
 - Shift “from fitting to understanding”*: go beyond limits of state-of-the-art Machine Learning-based testing techniques
- **Proposal:**
 - Development of automatic Reasoning-Based testing techniques aiming to:
 - Reduce cost
 - Increase effectiveness
 - Increase explainability
- **Methodology:**
 - Causal Reasoning
 - *Causal Discovery* and/or domain knowledge to extract a causal model
 - *Causal Inference* to estimate the causal effect of one or more variables (treatment) over a certain outcome of interest

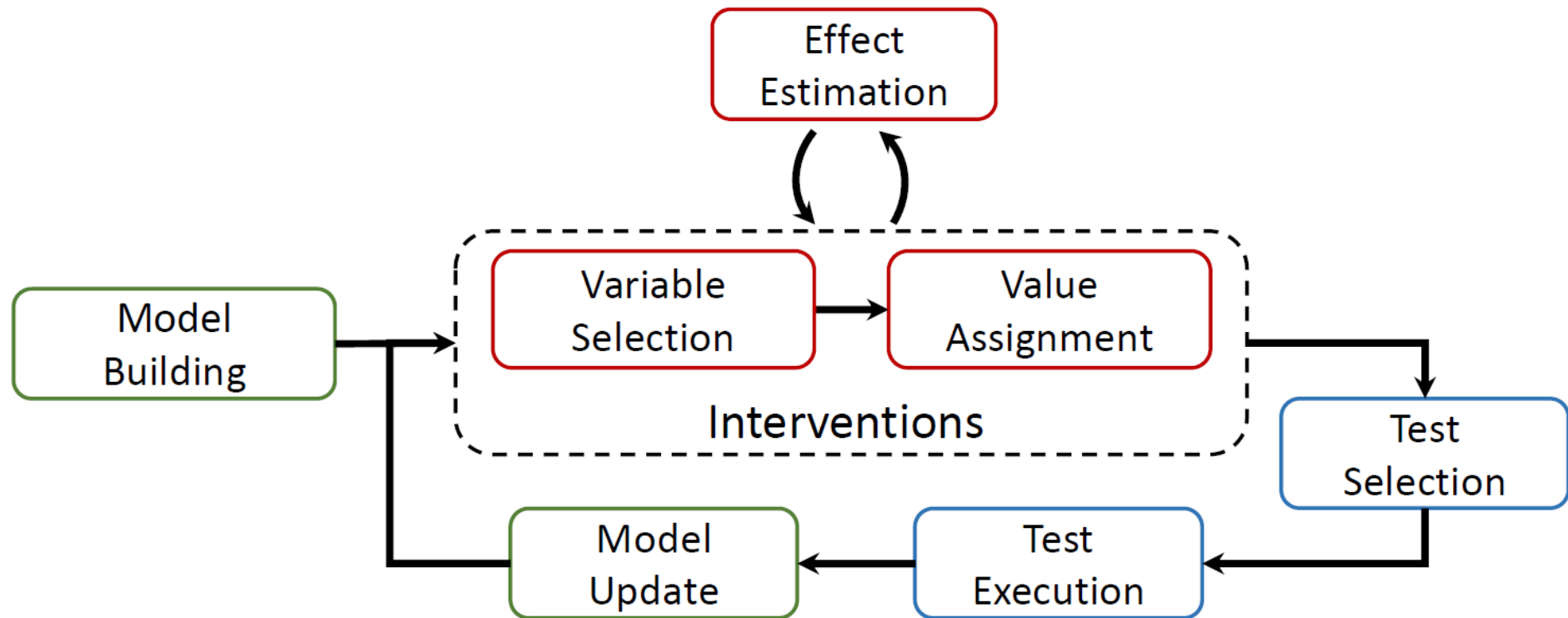
* J. Pearl and D. Mackenzie. 2018. The Book of Why: The New Science of Cause and Effect (1st ed.). Basic Books, Inc., USA

Testing Autonomous Driving Systems

- Automated online testing of Autonomous Driving Systems (ADS)
- Activities:
 - Development of reasoning-based techniques to effectively and efficiently expose safety violations in simulation
 - Research on Causal Reinforcement Learning
- 3 months spent in “Università della Svizzera Italiana”, under the supervision of Prof. Paolo Tonella

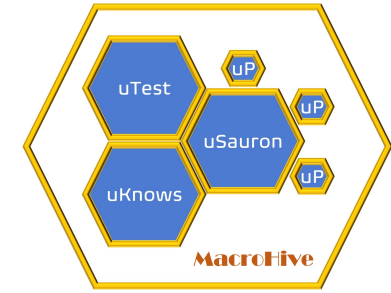


Reasoning-Based Software Testing





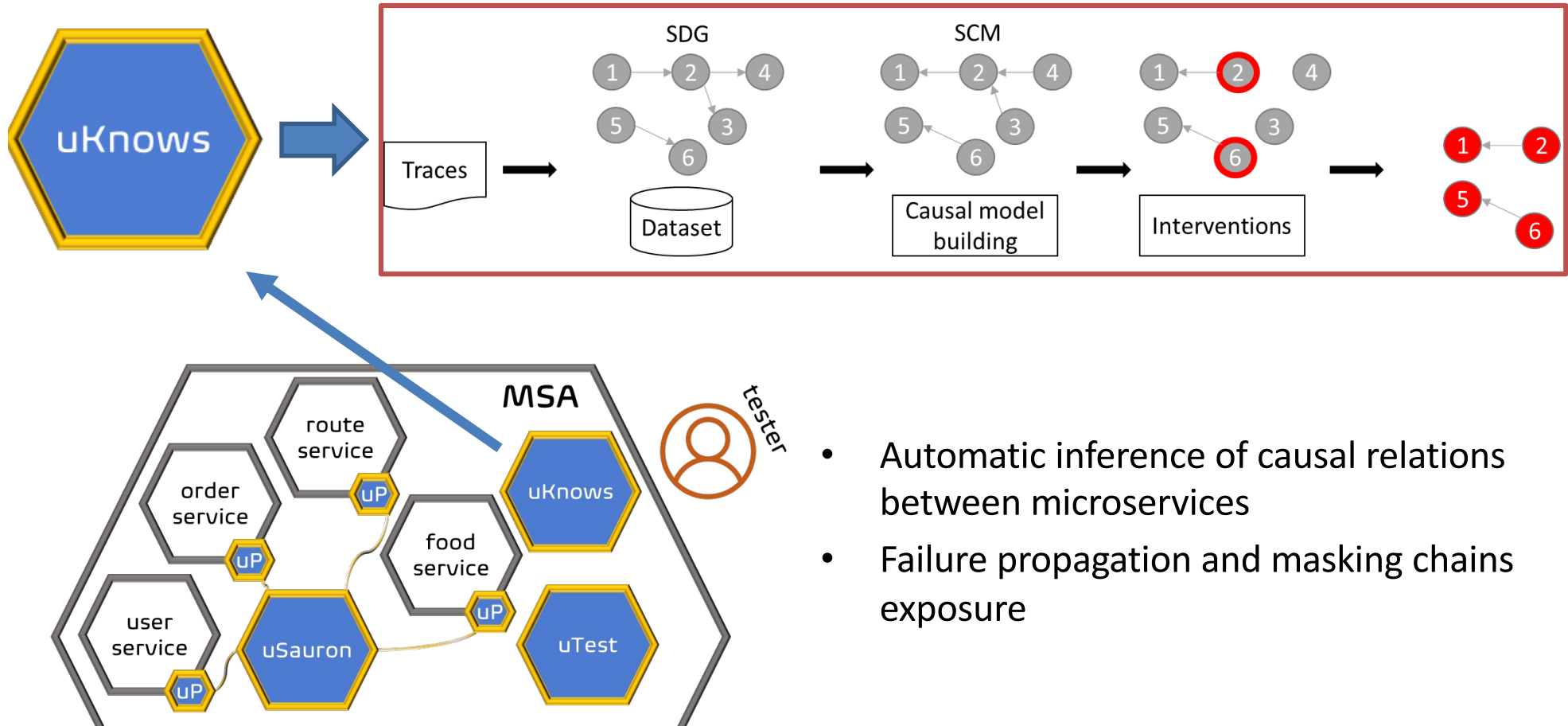
Testing Microservices



- Automated testing and monitoring of Microservices Architectures
- Activities:
 - Development of reasoning-based techniques for automated exposure of failure propagation and masking chains
 - Survey on microservices monitoring tools
 - Research on energy consumption in microservices architectures
- EU Marie Marie Skłodowska-Curie uDevOps (PI: Roberto Pietrantuono) – www.udevops.eu
- 5 (not consecutive) months spent in “Panel Sistemas Informaticos” (Madrid), a Spanish IT company
- 2 months to spend in “Silensec” (Cyprus)



Causality in MSA Testing



- Automatic inference of causal relations between microservices
- Failure propagation and masking chains exposure

Products

[P1]	L. Giamattei, A. Guerriero, R.Pietrantuono, S.Russo, <i>Automated Grey-box Testing of Microservice Architectures</i> , IEEE International Conference on Software Quality, Reliability, and Security (QRS) , Guangzhou, December 2022
[P2]	L. Giamattei, R. Pietrantuono, S. Russo, <i>Reasoning-Based Software Testing</i> , IEEE/ACM International Conference on Software Engineering: New Ideas and Emerging Results (ICSE-NIER) , Melbourne, May 2023
[P3]	L. Giamattei, A. Guerriero, R.Pietrantuono, S.Russo, <i>Automated functional and robustness testing of microservice architectures</i> , Journal of Systems and Software (JSS)
[P4]	M. Dinga, I. Malavolta, L. Giamattei, A. Guerriero, R. Pietrantuono, <i>An Empirical Evaluation of the Energy and Performance Overhead of Monitoring Tools on Docker-based Systems</i> , 21st International Conference on Service-Oriented Computing (ICSOC) , Rome, November 2023
[P5]	L. Giamattei, A. Guerriero, R.Pietrantuono, S.Russo, <i>Causality-driven Testing of Autonomous Driving Systems</i> , ACM Transactions on Software Engineering and Methodology (TOSEM) , <i>2nd round of revision</i>
[P6]	L. Giamattei, A. Guerriero, R. Pietrantuono, S. Russo, I. Malavolta, T. Islam, M. Dînga, A. Koziolok, S. Singh, M. Armbruster, J. M. Gutiérrez Martínez, S. Álvaro Caro, D. Rodríguez García, S. Weber, J. Henss, <i>Monitoring Tools for DevOps and Microservices: a Systematic Study</i> , Journal of Systems and Software (JSS) , <i>2nd round of revision</i>
[P3_A]	MacroHive, uDEVOPS2020/MacroHive (github.com)