PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Iliana Mineva Petrova

Training and Research Activities Report – First Year

Tutor: Piero Andrea Bonatti

1.   Information

My name is Iliana Mineva Petrova.

I am a PhD Student in Information Technology and Electrical Engineering, XXIX Cycle, Università degli Studi di Napoli Federico II.

I have been granted a three-year fellowship sponsored by Università degli studi di Napoli Federico II.

I work under the supervision of Prof. Dr. Piero Andrea Bonatti.

2.   Study and Training activities

A. Courses

"EuroProgettazione", ad hoc module, held by Dr. Gianpaolo Varchetta, 3 CFU

"IBM-Bluemix Corso tecnico sulla nuova piattaforma di sviluppo in Cloud (PaaS)", 3 CFU

"Machine Learning e applicazioni mod A: Machine learning applicato all'information retrieval", module from Ms.Sc., held by Prof. Anna Corazza, 6 CFU

"Three core issues for the Internet: things, security and economics", occasionally provided ad hoc module, held by Prof. Henning Schulzrinne, 2 CFU

"Statistica e applicazioni", ad hoc module, held by Prof. Antonio D'Ambrosio, Pasquale Erto, Biagio Palumbo, Roberta Siciliano, Amalia Vanacore, preliminary test on probability and inference passed on 7 Jenuary 2015, final examination expected to take place in march.

B. Seminars

"Fractional Programming for Energy Efficiency in Wireless Networks: Part 1, Theory", Dr. Ing. Alessio Zappone, 15 September 2014

"Fractional Programming for Energy Efficiency in Wireless Networks: Part 2,

Theory", Dr. Ing. Alessio Zappone, 22 September 2014

"Nano-carbon based components and materials for high frequency electronic",
Prof. Giovanni Miano, Sergey Maksimenko, Alexander Lobko,   6 October 2014

Developmental Robotics: From Babies to Robots, Prof. Angelo Cangelosi, 10 October 2014
"Quantum teleportation", Prof. Giovanni Miano, 23 October 2014

"Reliability and Availability Modeling in Practice", Prof. Kishor S.Trivedi, 5 November 2014

"Capacity Planning for Infrastracture-as-a-Service Cloud", Prof. Kishor S.Trivedi, 7
November 2014

"Heterogeneities in temporal networks emerging from adaptive social interactions", Prof.
Takaaki Aoki, 14 November 2014

"Methods and tools for smart device integration and simulation", Prof. Franco Fummi, 20
November 2014

"UML Profiles for the specification of non functional properties of
software systems", Prof. Simona Bernardi, 26 November 2014

"Site Reliability Engineering at Google", Dr. Marco Papa Manzillo, 27 November 2014

"Verification of Mobile Agents in Partially Known Environments", Dr. S. Rubin, 27 November
2014

"Applications for software development: types, interactions and continuousintegration",
Prof. Antonio Almazán, 16 January 2015

"Risk management meets model checking: fault tree analysis and model-based testing via
games", Prof. Mariëlle Stoelinga, 20 January 2015

C. External courses

First EATCS Young Researchers School on Automata, Logic and Games
July 27 – August 1, Telč, Czech Republic, 3 CFU

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D. Summary of training activities for the first year

Student: Iliana Mineva Petrova   **Tutor: Piero Andrea Bonatti**   **Cycle XXIX**
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	Credits year 1								Credits year 2								Credits year 3									
	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Total	Check
Modules	20			3		6	8	17	13							0	0							0	17	30-70
Seminars	5				2 2/5	2 9/10	1 7/10	7	5							0	0							0	7	10-30
Research	35	10	10	7	7	2	3	39	42							0	60							0	39	80-140
	60	10	10	10	9,4	10,9	12,7	63	60	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	63	180

Year	Lecture/Activity	Type	Credits	Certification	Notes
1	First EATCS Young	International Summe	3	x	
1	Fractional Programm	Seminar	2/5	x	
1	Fractional Programm	Seminar	2/5	x	
1	Nano-carbon based	Seminar	4/5	x	
1	Developmental Rob	Seminar	2/5	x	
1	Quantum teleportati	Seminar	2/5	x	
1	EuroProgettazione	Ad hoc module	3	x	
1	IBM-Bluemix Corso	Ad hoc module	3	x	
1	Reliability and Availa	Seminar	3/5	x	
1	Capacity Planning f	Seminar	2/5	x	
1	Heterogeneities in t	Seminar	1/5	x	
1	Methods and tools f	Seminar	2/5	x	
1	UML Profiles for the	Seminar	1/2	x	
1	Site Reliability Engi	Seminar	2/5	x	
1	Verification of Mobil	Seminar	2/5	x	
1	Machine Learning e	MS Module	6	x	
1	Three core issues fo	Ad hoc Module	2	x	
1	Applications for soft	Seminar	2/5	x	
1	Risk management n	Seminar	2/5	x	
1	Workshop "Efficient	Seminar	9/10	x	

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3.   Research activity

Design, implementation and optimization of non-standard reasoning services

Nowadays, within the field of knowledge representation there is the increasingly growing need to extend the ontology languages and reasoning engines with non-standard characteristics. Example of concrete application contexts include *(i)* extension of description logics (DLs) with nonmonotonic inferences and *(ii)* framework extensions with confidentiality constraints. In all these cases the available classic tools are just not sufficient to provide the required non-standard reasoning services. A considerable additional effort reveals mandatory in order to provide practical support of these kind of applications. As a consequence my research activity is currently focused on the design, implementation and optimization of the above mentioned frameworks. We adopt a suitable, easy to grasp, representation of the new constructs introduced by the specific context (non monotonic axioms in *(i)* and background metarules in *(ii)*). Due to the large size of ontologies that both applications need to deal with, general purpose optimization techniques such as incremental reasoning and suitably adapted module extraction proves to improve performance drastically. Effective conjunctive query answering techniques are as well required for the efficient implementation of the second framework. When it comes to a standard reasoning tasks these applications rely on publicly available classical reasoners.

As far as it concerns context *(i),* my working group contribute to the practical support of nonmonotonic inferences in description logics by introducing a new semantics expressly designed to model priority-based overriding. This formalism makes it possible to design knowledge bases by describing prototypical instances whose general properties can be refined later, by adding suitable exceptions. The new family of nonmonotonic DLs is called $DL^{N.}$ Automated reasoning in the new logic is carried out by means of polinomial reduction to classical description logics. The first experimental scalability tests on a semi-naive implementation (cf. [2], relying only on the optimization techniques of the underlying classical reasoner), called NMReasoner, revealed promising. The result graphs showed that DIs cause an approximately linear increase in reasoning time. As no "real" nonmonotonic DL knowledge bases currently exist, the available implementations of nonmonotonic DLs can only handle knowledge bases with moderate size. Our scalability tests have been carried out on synthetic test cases, that have been automatically generated in a principled way. The test case generator should be considered as a contribution, as well. Its output has been analyzed in depth to verify that the synthetic ontologies it constructs and their classification are not trivial.
Recently we introduced optimization techniques ([3]) based on module extraction and optimistic computation techniques for reasoning in DL^{N}. Such optimizations have been integrated in NMReasoner and validated experimentally on large synthetic KBs with more than 30K axioms. The experimental results show speedups of at least 1 order of magnitude (and up to approximately 780 times faster in some cases).

Semantic Web techniques make possible to exploit various sources of background knowledge and metaknowledge to reconstruct the hidden part of the knowledge base. The main contribution to the area of knowledge base confidentiality of my work group consists in the introduction of a knowledge base confidentiality model based on a fully generic formalization of the user's background knowledge, and *(ii)* the definition of a method for computing secure knowledge views that generalizes some previous approaches. In order to compute secure views in practice we adopt a safe, generic method for approximating background knowledge, together with a specific rule-based language for expressing metaknowledge. We further provide a prototypical implementation of the new framework (cf. [1]) that include a standard as well as a novel optimized rule evaluation. Sperimental analysis show that the generation of secure views for medium sized ontologies may take several minutes. It's worth to note that secure views can be constructed off-line, so that no overhead is placed on user queries.

Future work include identification, implementation and experimental analysis of new optimization techniques. Furthermore we hypothesize the realization of an inference engine that allows incremental retraction.

Cooperations

Currently I am working in collaboration with with Prof. Dr. Piero A. Bonatti, Prof. Dr. Marco Faella and Dr. Luigi Sauro, members of the Department of Electrical Engineering and Information Technologies.

4. Products

A. Conference papers

[1] "A mechanism for ontology confidentiality", P. A. Bonatti, I. M. Petrova and L. Sauro, Proceedings of the 29th Italian Conference on Computational Logic, volume 1195 of CEUR-WS.org

B. International journal papers

[2] "A new semantics for overriding in description logics", P.A. Bonatti, M. Faella, I. M. Petrova and L. Sauro. Artificial Intelligence Journal, 222:1–48, 2015.
Available online: http://www.sciencedirect.com/science/article/pii/S0004370215000028

C. Papers submitted to international conferences

[3] "Optimizing the Computation of Overriding in Description Logics", P. A. Bonatti, I. M. Petrova and L. Sauro, submitted to the KR track of the conference IJCAI 2015.

5.   Conferences and Seminars

A. Conferences

I participated in the 29th Italian Conference on Computational Logic (CILC 2014), held in Torino, Italy from June 16th to June 18st, 2014. In that place I have made a presentation of the paper "A mechanism for ontology confidentiality", joint work with Piero . Andrea Bonatti and Luigi Sauro.

B. Workshop

Final Workshop PON RECAS, Napoli, 16 Dicembre 2014.

Workshop "Efficient service distribution in next generation cloud networks", held by Dr. J. Llorca, Prof. S. P. Romano, P.Festa, S.Avallone, R.Canonico, G. Di Stasi, A. Tulino, 10 February 2015.

6.   Activity abroad

7.   Tutorship

I am teaching assistent for the courses of Web Technologies and Programming Languages I, both courses of the Bachelor's degree in Computer science, Department of Electrical Engineering and Information Technologies, Università degli Studi di Napoli Federico II.