Scalable Metagraph Algorithms for Network Security

University of Adelaide

NICOLAS BAUDIN
INTERNSHIPS IN AUSTRALIA INITIATIVE

Name of the hosting institution in Australia	University of Adelaide
Name of the host laboratory / research team	School of Computer Science
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Internship offer

Topic of the internship (title)	Scalable Metagraph Algorithms for Network Security			
Proposed dates of the internship	Start	05/07/2021	End	03/01/2022

Scientific and academic objectives of the internship:

Configuration of network devices is one of the most complex network management tasks, and in particular when it comes to security. Configuration complexity in this domain leads to human error, which is often only uncovered when it is too late: after a successful attack.

There has been significant on work languages and tools for resolving policy conflicts in software defined networks and refining these down to device level configurations. However, an important question remains: How do we verify that conflict free policies are secure? We have developed a provable network security configuration (PNS) capability that models network policies in a metagraph (a special type of directed hypergraph) and automatically analyses and generates provably secure network configuration code. Our PNS capability employs the rich formal foundations provided by the metagraph algebra to analyse useful network-policy properties such as redundancy and inconsistency.

Our current Metagraph library – the MGtoolkit - was written in Python and that performance is an issue. We will investigate methods to make our metagraph algorithms scalable for large network in this project. There are two directions that we will explore. We could speed it up by (a) porting it to C++ and/or (b) improving the complexity of the algorithms. Also, if we do (a) well, we can generate bindings for Python and other languages easily. Option (b) is the long-term direction of the research. Metagraphs have applications beyond network security, for example in business decision processes, privacy policies, etc. The improved algorithms will also improve metagraph applications in these domains.

Industrial partner

Name	Defence Science and Technology Group
Role of the industrial partner in the internship project	Industry mentor
Main contact	Peyam Pourbeik
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Expected profile of applicant

Level of study	PhD
Discipline	Computer Science
Prerequisite knowledge, qualities and skills	Interested in graph algorithms
Other specific eligibility criteria	English language competency