Distributed embedded incremental reasoning for Web of Things

PhD position, LIRIS

Keywords

Web of things, Semantic Web, Reasoning, Embedded, Distributed, Edge computing

Context

This PhD position is in the context of the CosWot project ("Constrained Semantic Web of Things"), a project funded by the French National Research Agency. CoSWoT will consider semantic web technologies for the Web of things (WoT). The objectives are to propose a distributed WoT-enabled software architecture embedded on constrained devices with two main characteristics: 1) it will use ontologies to declaratively specify the application logic of devices and the semantics of the exchanged messages; 2) it will add reasoning functionalities to devices, so as to distribute processing tasks among them. Doing so, the development of applications including devices of the WoT will be highly simplified: our platform will enable the development and execution of intelligent and decentralised smart WoT applications despite the heterogeneity of devices.

The main objectives of this PhD is to provide contributions to distributed and embedded reasoning on the Web of Things.

Research Lab

The PhD student will be a member of the LIRIS Laboratory in Lyon, France.
The PhD supervisor is Pr Frederique Laforest; the student will be co-supervised with Kamal Singh from Lab. Hubert Curien.

The LIRIS Lab. (https://liris.cnrs.fr/) is a joint research unit of CNRS (UMR 5205), INSA Lyon, Université Claude Bernard Lyon 1, Université Lumière Lyon 2 and Ecole Centrale de Lyon. Its main scientific research area is computer science and, more generally, information technologies. More precisely, the PhD student will belong to the TWEAK team of LIRIS, with specialisation in Web and Semantic Web technologies, in particular WoT knowledge representation and distributed reasoning.

Lab. Hubert Curien (https://laboratoirehubertcurien.univ-st-etienne.fr/en/index.html) is a joint research unit of CNRS (UMR 5516), Université Jean Monnet in Saint-Etienne, and the Institut d'Optique Graduate

School, working on topics related to optics, photonics and microwave, computer science, telecom and image. The members from LaHC involved in the CoSWoT project include researchers of its team named as Knowledge Representation and Reasoning team. They are specialised in semantic data streams processing, efficient reasoning and web of things.

Objectives and expected contributions of the PhD

The objective of the PhD thesis is to design an efficient incremental embedded and distributed reasoner for the Web of Things (WoT). The idea is that the reasoner should be able to work on constrained and autonomous devices. The target architecture is based on edge main components, including sensors and actuators as well as gateways of various computing capabilities.

There are some existing works on reasoners such as [1-12]. However, they are not suitable for WoT and diversely constrained objects. As all devices are not capable of performing all reasoning tasks (some cannot even store enough data), the goal will be to design a distributed reasoner suitable for a set of constrained objects. We target a paradigm of edge intelligence where incremental reasoning concerns both sensor data streams and contextual data. As it is probable that all constrained objects will not be able to execute all reasoning tasks, distributing these tasks over a network of WoT nodes will also be necessary [8-9].

Program

M1 - M4: the PhD student is expected to study the state of the art to check the existing work on embedded reasoning and distributed reasoning.

M4 - M16: embedded reasoning on WoT. The objective is to design and develop an efficient incremental inference processor that can be executed on constrained and autonomous devices, while conforming to the standards of the Web and the Semantic Web. The diversity of objects may lead to profile-related reasoning competences.

M16 - M26: distributed reasoning in the edge. The objective is to define a method for the distribution of reasoning among the edge and devices, where each device collaboratively performs a part of the reasoning tasks.

M26 - M36: In the last year of the PhD thesis, the student will focus on experimentations and field experiments for the CoSWoT project and evaluation of the work proposed in the thesis. This time will also be dedicated to write the thesis manuscript and defend the PhD.

At each step of this program, collaboration with the CoSWoT project consortium will bring use cases and evaluation material, as well as other support like the software platform for communication between devices, interoperability knowledge graphs or use cases. Publications are also expected at each step.

Candidate Profile

M2 in computer science.
Skills in semantic web knowledge representation and reasoning are required.
Proficiency in the English language for speaking, writing and reading are necessary.
Experience in the Rust programming language is a plus.

French language skills are not a prerequisite. For non-French speakers, French lessons will be provided for free by INSA Lyon (French as a Foreign Language).
Depending on the candidate native language, French or English will be the working language.

Salary : around 1775€ net per month during 3 years

Expected starting date : Octobre 2020

Place of work

LIRIS, INSA Lyon
7 avenue Capelle, 69100 Villeurbanne - France
INSA Lyon (https://www.insa-lyon.fr/en/) is the largest engineering school in France. It is a renowned school with a very dynamic student community.

To apply

Candidates should send the following:
- A motivation letter
- A CV
- All documents attesting the required skills and knowledge
- Academic records and transcripts of Master
- Contact information of 2 professors who can provide recommendation on the candidate

The applications should be sent to frederique.laforest@liris.cnrs.fr

Application Deadline: 20/06/2020

References

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