CIDSE Invited Talk with Kohei Suenaga

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Automated Proof Synthesis for Propositional Logic with Deep Neural Networks

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2:00 PM

BYENG 210

Abstract:

This work explores the application of deep learning, a machine learning technique that uses deep neural networks (DNN) in its core, to an automated theorem proving (ATP) problem. To this end, we construct a statistical model that quantifies the likelihood that a proof is indeed a correct one of a given proposition. Based on this model, we give a proof-synthesis procedure that searches for a proof in the order of the likelihood. This procedure uses an estimator of the likelihood of an inference rule being applied at each step of a proof. As an implementation of the estimator, we propose a proposition-to-proof architecture, which is a DNN tailored to the automated proof synthesis problem. To empirically demonstrate its usefulness, we apply our model to synthesize proofs of propositional logic. We train the proposition-to-proof model using a training dataset of proposition-proof pairs. The evaluation against a benchmark set shows the very high accuracy and an improvement to the recent work of neural proof synthesis.

BIO:

Kohei Suenaga received a Ph.D. in Information Science and Technology from the University of Tokyo in 2008. He was a JSPS research fellow, a researcher in IBM Research Tokyo, a postdoctoral researcher at Lisbon University, an assistant professor in Hakubi Center for Advanced Research in Kyoto University. He joined the Graduate School of Informatics, Kyoto University in 2013 as an associate professor. He is now at ASU as a visiting scholar (until March 2020). He is interested in (1) formal verification of software and hybrid systems and (2) verification and testing of/for machine learning systems. He led a JST PRESTO project “Formal methods for hybrid systems based on the theory of nonstandard programming languages” (2015--2018) and JSPS Grant-in-Aid for Scientific Research project “Formal verification of hybrid systems based on infinitesimal programming”. He established the foundation and the implementation of nonstandard programming languages, which is a programming language extended with a constant that denotes an infinitesimal number; this language is used to model and verify hybrid systems. He is also interested in implementing research via industrial collaboration; he has collaborated with TOYOTA (2014-2016) and is working as a scientific advisor in four startup companies (PatentField Ltd., LegalForce Inc., DaiLambda, Inc., and SenseTime Japan Ltd.).

Hosted by: Georgios Fainekos

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