Automatic Fact Extraction from Open-Ended Geometry Questions

Ishadi Jayasinghe

188090K

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Department of Computer Science & Engineering

University of Moratuwa

Sri Lanka

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DECLARATION

I, Ishadi Jayasinghe, declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of Supervisor: Dr. Surangika Ranathunga

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ABSTRACT

Semantic parsing of geometry problems is the first step towards automated geometry problem solvers. Existing systems for this task heavily depend on language-specific NLP tools and use hard-coded parsing rules. Moreover, these systems produce a static set of facts and record low precision scores. In this study, we present the two-step memory network, a novel neural network architecture for deep semantic parsing of GWPs. Our model is language independent and optimized for low-resource domains. Without using any language-specific NLP tool, our system performs as good as existing systems. We also introduce on-demand fact extraction, where a solver can query the model about entities during the solving stage. This is impossible for existing systems; the set of extracted facts with these systems are static after the parsing stage. This feature alleviates the problem of having an imperfect recall.

We also investigate data augmentation techniques for low resource domains to alleviate the difficulties in applying deep learning techniques in the domain above. We also introduce an enhanced metric for evaluating language generative models alleviating the the limitations of exiting metrics. Analysing the results, we come up with a ranking of models on their suitability to be used o low resource domains

Keywords: Semantic Parsing; Deep Learning; Memory Networks; Generative Adversarial Networks; Temperature Sweep

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LIST OF ABBREVIATIONS

NLP	Natural Language Processing
GWP	Geometry Word Problem
MCQ	Multiple Choice Question
NLG	Natural Language Generative
DNN	Deep Neural Network
GAN	Generative Adversarial Net
CNN	Convolutional Neural Network
RNN	Recurrent Neural Networks
LSTM	Long Short Term Memory
GRU	Gated Recurrent Unit
DBN	Deep Belief Net
DAE	Denoising Autoencoder
VAE	Variational Autoencoder
MLE	Maximum Likelihood Estimate
RL	Reinforcement Learning
FC	Focus Controlling
PE	Position Encoding

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