

Static Analysis-Guided Automatic Source Code Summarization via Deep Learning

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the degree of

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under the supervision of Guandong Xu

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Certificate of Original Authorship

Required wording for the certificate of original authorship

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Wenhua Wang, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Software, Faculty of Engineering and Information Technology at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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LIST OF PUBLICATIONS

RELATED TO THE THESIS :

1. Wenhua Wang, Yuqun Zhang, Yulei Sui, Yao Wan, Zhou Zhao, Jian Wu, Philip Yu, and Guandong Xu. Reinforcement-Learning-Guided Source Code Summarization using Hierarchical Attention. IEEE Transaction on Software Engineering, 2021.
2. A Transformer-based Generative Adversarial Network Framework for Universal Code Summarization, submitted.
3. On Semantic-rich Code Summarization by Vital Code and Transformer-based Model, submitted.

ABSTRACT

Abstract. Code summarization provides the main aim described in natural language of the given function, it can benefit many tasks in software engineering. As far as I know, the existing research on comment generation can be summarized as the template based approaches, the information retrieval based approaches and the deep learning based approaches. Nowadays, based on the proposal and wide utilization of deep learning, the research of neural machine translation has been introduced to the research of code summarization. Based on my study, The existing deep learning based code summarization approaches mainly utilize the seq2seq model in which the encoder translates the source code into hidden representation of the program code and then the decoder decodes the representation into comment. However, due to the special grammar and syntax structure of programming languages and various shortcomings of different deep neural networks, the accuracy of existing code summarization approaches is not good enough. These approaches mainly suffer from three major drawbacks: a) they regard the source code as plain text directly, which neglecting the syntax structure of the source code that is quite important for the comprehension of source code; b) they only consider the generation of the code's intent, while ignore the information of parameters etc which is also quite important for the understanding and usage of the source code; c) their adopted CNN/RNN model usually cause long-distance dependency and excessive computation cost problem. Considering these limitations, the main research work of this thesis are as follows: (1) The first work proposes to adopt the hierarchical attention mechanism to enable the code summarization framework to translate three representations of source code to the hidden space and then it injects them into a deep reinforcement learning model to enhance the performance of code summarization. (2) While many existing approaches exploit inadequate power of statement-wise semantic contributions for augmenting their performance, the second work proposes the transformer-based generative adversarial network framework for universal code summarization which constructs a cross-language universal hierarchical semantic (UHS) model to classify statements according to their positions in the source code. (3) Considering that almost all approaches only consider to generate the general intent of the method without documenting their parameters, the third work proposes to generate both the method comment and the parameter comment to provide complete java documentation for the code snippets. Specifically, it designs a programming-analysis-based component to extract UseSet of parameter and the KeySet of the source code to obtain the main semantic information and discard the useless noise information and utilizes the copy-attention-integrated transformer based NMT

framework. Thought the completion of this thesis, I conduct a few of experiments, and the results of which prove that the proposed approaches can obtain better accuracy compared with the baseline approaches.

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