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Editorial

Structure, Dynamics, and Applications of Complex Networks in Software Engineering

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Complex network analysis has been proved to be an effective tool to quantify the structural properties of different complex systems. Large-scale software projects are interesting examples of human-made complex systems, which can be analyzed using theories and tools in the field of complex networks [1, 2]. Generally, the complexity of these systems can be reflected both in their structure and in their development processes. Due to the wide adoption of open-source practices using online infrastructures, we can trace the software development process and the final software structure in an easy way. Thus, a large-scale dataset about software projects can be obtained, making an in-depth study of software projects possible. During the last decade, complex networks have been widely applied to analyze the topological structure and dynamics of software projects. Many shared physics-like laws of software projects have been revealed, such as *scale-free*, *small-world*, and *fractal properties*.

The objective of this special issue (SI) is to provide a comprehensive and latest collection of research works on the application of complex network theory and techniques to explore software projects. This SI receives 34 submissions in total, and after a fair and rigorous peer-review process, 13 of them are published, with the acceptance rate being roughly 38.2%. The 13 papers can be roughly categorized into three groups according to the topics that they focus on, i.e., object-oriented software systems, service-oriented software systems, and others.

1. Object-Oriented Software Systems

Five papers focus on the research topics in traditional object-oriented software systems, i.e., software metrics, bug report classification, software defect prediction, and bug triage. Li et al. [3] reviewed the interdisciplinary research work between the fields of complex networks and software engineering. These papers are published in the last seven years (2013 to 2019) and mainly focus on three different research directions, i.e., modeling, analysis, and applications of software networks. Gu et al. [4] analyzed the coupling between classes at different levels and used a set of bipartite software networks to represent them. Finally, they proposed metrics to characterize the coupling between classes. Guo et al. [5] proposed a novel approach to solve the bug report classification problem, which combines several imbalanced learning strategies and multiclass classification methods together. Shi et al. [6] proposed a novel software defect prediction model, which leverages a convolutional neural network to learn semantic features from the source code and applies network embedding to learn structural features from software networks at the class level. Ge et al. [7] proposed an improved bug triage approach for newly reported bugs, which removes the low-quality bug reports and considers the influence of the engagement of developers on their final ranking.

2. Service-Oriented Software Systems

Five papers focus on the research topics in service-oriented software systems, i.e., service clustering, service recommendation, service discovery, service selection, and service quality measurement. Zhou and Wang [8] proposed an approach to organize API services into different clusters. Their approach applies structural metrics built from service networks where APIs and Mashups are nodes, and their couplings are edges. Xiong et al. [9] applied NLP and graph embedding techniques to recommend APIs for Mashup developers. They extracted structural semantics from a two-mode graph of Mashups, APIs, and their relations. Sun et al. [10] proposed an improved web service discovery approach, which integrates labels of web services using a neural topic model as external semantics for these web services. Jiang et al. [11] proposed a novel API selection approach for Mashup development. Their approach extracted similarities from the profile of APIs and Mashups. Yang and Wang [12] proposed a hierarchical aggregation model to accurately aggregate the ratings of services.

3. Others

This SI also contains three papers which are not related to the topic of this SI, i.e., [13, 14], and [15]. These papers are handled by the editors from the editorial board of *Mathematical Problems in Engineering*.

Conflicts of Interest

The editors declare that there are no conflicts of interest regarding the publication of this SI.

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