Talk title:
Element Correction Problems for Code Reading Study of Novice Students in Java Programming Learning Assistant System

Abstract:
The object-oriented programming language Java has been extensively used in industries and educated in schools due to the portability, reliability, and flexibility. To assist Java programming educations, we have developed a Java Programming Learning Assistant System (JPLAS) and applied it to university students in Japan, Myanmar, and Indonesia.

JPLAS provides several types of programming exercise problems to cover various learning stages. Among them, the element fill-in-blank problem (EFP), the code completion problem (CCP), the element fixing problem (EXP), and the code fixing problem (CXP) have been designed as introductory ones for novice students to learn Java grammar and basic programming skills through code reading. In their instance, a source code containing incorrect elements is given to students who are requested to correct them. The answers are automatically marked through string matching with the registered correct ones.

The difference among the four problems is, for each incorrect element, whether an incorrect word is shown or not, and whether the respective input form is prepared or not, in the answer interface of JPLAS. An EFP instance requests filling in the blank elements with the respective input forms. A CCP instance requests filling in them without the forms. An EXP instance requests fixing the incorrect elements with the respective input forms. A CXP instance requests fixing them without the forms.

To help generating a new instance, a graph-based blank element selection algorithm has been proposed to select as many incorrect elements as possible from a source code, such that any of them has the grammatically correct and unique answer. In addition, for EXP and CXP, an error generation algorithm has been proposed to find an incorrect word for each incorrect element.

To investigate the difficulty levels of these problems, their instances are generated using the algorithms and assigned to novice students in Japan and Myanmar. Then, the average and the standard deviation of the correct solution rates among the students are compared. The results show that the difficulty level for the students increases by the order of EXP, CXP, EFP, and CCP.