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学位論文の題目	A Study of Java Answer Code Validation Program and JavaScript Code Modification Problems (Java の解答コード検証プログラムと JavaScript のコード変更問題の研究)		
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学位論文内容の要旨			
<p>This thesis presents the answer code validation for code writing problem in Java with three features and code modification problems in JavaScript programming.</p> <p>As the first contribution of the thesis, I implement the <i>answer code validation program</i> to help teacher works in assigning a lot of CWP assignments to students in a Java programming course in a university or professional school. This program automatically tests and verifies all the source codes that are made to pass the tests in a test code, and reports the number of tests that each source code could pass with the CSV file. By looking at the summary of the test results of all the students, the teacher can easily grasp the progress of students and grade them.</p> <p>As the second contribution of the thesis, I propose the <i>intermediate state testing</i> in the <i>test code</i> for <i>fundamental algorithms</i> assignments. If a student implements a different logic or algorithm including the use of library, the conventional <i>test code</i> cannot find it. To improve problem-solving skills and develop strong foundations in algorithmic thinking, the <i>intermediate state testing</i> can check the randomly selected intermediate state of the important variables during the execution of the logic/algorithm.</p> <p>As the third contribution of the thesis, I implement the <i>test data generation algorithm</i>. The fixed test data in the test code may lead to the issue of cheating of students, where their answer source codes only output the data in the test code. The <i>test data generation algorithm</i> identifies the data type, randomly generates a new data with this data type, and replaces it for each test data in the test code, so that the source code can be tested with various input data in the test code.</p> <p>As the fourth contribution of the thesis, I implement the <i>naming rules checking function</i> in the <i>answer code validation program</i> for CWP in JPLAS for novice students, to master writing <i>readable codes</i> using proper names for variables, classes, and methods in <i>Java programming</i>. The <i>naming rules checking function</i> finds the naming errors in the source code. It is also implemented in the answer platform so that a student can write a code while checking the rules.</p> <p>As the fifth contribution of the thesis, I propose a <i>code modification problem (CMP)</i> as a new type of exercise problem in <i>JavaScript Programming Learning Assistant System (JSPLAS)</i>, to study <i>web client-side</i> and <i>server-side programming</i> using <i>JavaScript</i>. The goal of <i>CMP</i> is for the students to carefully read the source code and comprehend how to use the components and functions through modifying parameters, values, or messages.</p> <p>This thesis is organized as follows: Chapter 2 reviews the overview the web-based <i>Java Programming Learning Assistant System (JPLAS)</i>. Chapter 3 presents the answer code validation program in JPLAS. Chapter 4 presents the intermediate state testing for fundamental algorithms assignments. Chapter 5 presents the dynamic test data generation algorithm for test codes. Chapter 6 presents the naming rules checking function in code validation program. Chapter 7 proposes the code modification problem (CMP) for client-side programming using JavaScript in JSPLAS. Chapter 8 proposes the code modification problem (CMP) for server-side programming using JavaScript in JSPLAS. Chapter 9 presents previous works related to this thesis. Finally, Chapter 10 concludes this thesis with some future works.</p>			

## 論文審査結果の要旨

In this thesis, the applicant presented the studies of the answer code validation program for the code writing problem (CWP) in Java Programming Learning Assistant System (JPLAS) and the code modification problem (CMP) in JavaScript Programming Learning Assistant System (JSPLAS).

As the first contribution, she implemented the answer code validation program to help teacher works in assigning a lot of CWP assignments to students in a Java programming course in a university or professional school. This program automatically tests and verifies all the source codes that are made to pass the tests in a test code, and reports the number of tests that each source code could pass with the CSV file.

As the second contribution, she proposed the intermediate state testing in the test code for fundamental algorithms assignments. It aims to the case where a student implements a different logic or algorithm including the use of library, which the conventional test code cannot find.

As the third contribution, she implemented the test data generation algorithm. The fixed test data in the test code may lead to the issue where their answer source codes only output the data in the test code. It automatically identifies the data type, randomly generates a new data with this data type, and replaces it for each test data in the test code, so that the source code can be tested with various input data in the test code.

As the fourth contribution, she implemented the naming rules checking function in the answer code validation program for CWP in JPLAS for novice students, to master writing readable codes using proper names for variables, classes, and methods in Java programming. It finds the naming errors in the source code.

As the fifth contribution, she proposed a code modification problem (CMP) in JavaScript Programming Learning Assistant System (JSPLAS), to study web client-side and server-side programming using JavaScript. The CMP instance gives a source code using the functions to be studied and the screenshot of the web page generated by it. Then, it requests to modify the code to generate another web page given by the screenshot.

The applicant has published two journal papers and seven international conference papers to present the contributions.

From the overall evaluation of this thesis, the applicant has satisfied the qualification condition for the doctor degree in Engineering from the Graduate School of Natural Science and Technology at Okayama University.