Presentation method of optimal avoiding way of failure prediction

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In this paper, we propose some methods for automatic generation and presentation of the optimal way to avoid from failure prediction.

The operation managers of large-scale information systems are confronted by two problems. The first is the expansion of scale of the system due to increasing the number of users and expanding data capacities. It is difficult to manage by increasing the number of building blocks per operation manager. The second is the increasing complexity of operational policies of the system due to growing demands of users and into difficulties in the required quality of services.

Under such circumstances, I have focused on the failure prediction technique, it is one of the approaches to maintain and improve the availability of information systems, but it depends on the skills and experiences of the operation managers. The operational environments that does not have experienced administrator are many exists in the world.

Therefore, I propose the methods for failure avoidance that can realize by the operation managers with no depends to skills and experiences.

I examined the multiple mechanisms to infer the fault workarounds from knowledge base, and conducted a preliminary experiment using the Expert System. Expert System can obtain the logically correct inference from the known facts and the knowledge base. In preliminary experiments acquired

the workarounds with enter the system configuration data, predictive failure information and operational rules to the Expert System. However, raises three issues are discussed with the results of the preliminary experiments. The first problem is the explosion of the number of rules. The second problem is about the consideration of evaluation barometers, e.g. expected time, monetary costs, and service level requirements. The third problem is the safety of the workarounds. In this research, I have proposed two methods for the solution of these three problems.

The first proposed method is Automated Rule Generation. This method is able to adapt to large-scale information systems by reducing the number of rules to be managed directly from the operation manager by increase level of abstraction of the operational rule descriptions. Operation manager is input to the proposed method to describe the basic rules at a higher level of abstraction that does not depend on the number of building blocks. The proposed method outputs refinement rules using Rule Refinement Algorithm that was devised. Rule Refinement Algorithm generates all combinations of building blocks based on the basic rules and system configuration information. At this time, most of the system configuration information is automatically collected. After all combinations have been generated by the algorithm, that to expand all of the new rules. Refinement rules that are generated by this method are excellent in safety, completeness and freshness.

The second proposed method is Optimum Workaround Presentation. Workarounds obtained from the inference system of the preliminary experiment had multiple problems that need to consideration of evaluation barometers and safety. The proposed method can solve them together by providing three steps. The first step is the selection, that gathers from the workarounds that can be avoided in the present condition. The second step is the evaluation that calculates evaluation scores for each workaround that selected in the first step. The last step is presentation. Ranked based on the score of each workarounds calculated in the second step, and finally presented to the operation manager.

These two proposed methods to solve the three problems raised in preliminary experiments. Based on this proposal, I have conducted experiments to investigate the characteristics of the proposed method.

In the evaluation experiment, I tried various inputs using a evaluation system that was implemented in Java SE 7 and Scala 2.9. The evaluation system is composed of four phases, the first is an implementation of Automated Rule Generation algorithm, the second is the integration of the workaround inference system that was created in the preliminary experiment, the 3rd is an implementation of Optimum Workaround Presentation algorithm, and Last is the test driver.

Number of building blocks of the information system was assumed up to 200 units, but some anomalistic input was assumed up to 1,000 units. The basic rules has prepared seven input patterns (independence five and simultaneous two) with different degrees of complexity. In addition, I ran the evaluation system using a personal computer for typical performance because there is no high-performance computer in the environments where expected.

The experimental results are summarized in terms of three points. The first point is about the effect of reducing the number of rules for writing by the operation managers. I examined the number of refinement rules generated by increasing to 100 the number of building blocks when a rule is entered all five. The percentage of reduction of the number of building blocks when 6 was 45.8%. On the other hand, the percentage reduction in the number of building blocks when 100 was over 99.9%. The second point is about the effect of Optimum Workaround Presentation algorithm. I made the same scaling as the first point again. When the number of building blocks is 100, 2,082 candidate workarounds are output from the inference engine, and number of candidate workarounds dropped in selection step of Optimum Workaround Presentation algorithm was 1026. The third point is about the performance of the evaluation system. I was raised to 200 for the number of building blocks with input to three patterns of the basic rules. The execution time was 4.3 seconds when the number of the building blocks of 100, and 313.6 seconds when the number of the building blocks of 200. Moreover, the most of the processing time was Automated Rule Generation algorithm. To investigate further, I have measured the execution time of each rule. As a result, it was discovered the relevance of the complexity of the rules and execution time.

I have discussed from three perspectives based on the results of the eval-

uation experiment. They are scalability of the information systems, complexity of the operational policies and dependency of experience and skills of operation managers.

The proposed methods can be easily realized from the failure avoidance of failure prediction technique. The operation managers can pick the buds of lowering the availability by using failure avoidance by the proposed methods. The avoided failure includes the possibility of failure of first, second, and more. Therefore, failure avoidance leads to great effect to improve the availability of the information systems. In addition, the proposed methods assume the environment in the absence of experienced operation managers. That can be applied to information systems in developing countries and/or organizations with the no experienced operation manager exist.