ISAHP 1999, Kobe Japan, August 12-14, 1999

KNOWLEDGE ACQUISITION FROM MULTIPLE PARTICIPANTS USING AHP AND DECISION TREES

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Abstract: This paper proposes a method (1) to elicit decision knowledge from multiple participants or decision makers, and (2) to formalize them into decision rules by integrating different viewpoints using AHP. The proposed method is validated by the cases of (1) the judgement about a movie story and (2) knowledge acquisition on the task of elevator malfunction diagnostics.

1 Background

We have been developing several knowledge-based systems or expert systems [Terano 1996] and have met difficulties (1) to articulate human expertise of the problem task-domains from tacit dimensions, (2) to formalize them into consistent knowledge bases, and (3) to refine and maintain them to adopt new problem solving situations.

This paper focuses on the first problem: how to support multiple human experts or decision makers to develop decision rules with various categories when they are discussing in order to formalize their knowledge into proper knowledge-bases. The basic idea comes from a simple generate-and-test method: first, for a given set of word hierarchy in the problem domain, randomly generate rules using the words, then evaluate the importance of each word using AHP.

2 Outline of the Proposed Method

To address the problems, we deal with multiple viewpoints of multiple decision makers in order to articulate the tacit knowledge. To obtain it, we develop the following procedure: (1) multiple participants interactively select good decision rules from randomly generated ones with given category information, (2) they evaluate the importance of the categories in the rules via AHP, then determine which categories should appear in the rules, and (3) through the discussion among multiple decision makers, they formulate the knowledge into proper decision rules.

To develop the procedure, we assume that words appeared in decision rules have been classifies beforehand into proper categories fit for the problem task domain. We further assume that each category coincides with the evaluation item in the hierarchical structure used by AHP. These assumptions are natural when we will develop knowledge-based systems.

The procedure consists of the following steps. In the step (2), decision makers carry out interactive sessions, and in the step (5), they discuss to tune up the difference of multiple participantsh.

(1)Generate random decision rules by computers, or write down such rules that decision makers consider good ones to make decisions.
(2)Among the generated rules in the above step, select rules which the decision makers consider appropriate based on their own might-be-subjective judgements.

(3)Measure relative ratio of word categories appeared in the rules.
(4)Evaluate the importance of the word categories by AHP.
(5)Compare the results of (3) and (4), then evaluate the importance of the rules in order to reveal the decision makers' respective view points on the problem.
(6)Determine the decision rules for the given problem.

3 Experiments

To validate the effectiveness of the proposed method, we have carried out two practical experiments: (1) the judgement about a movie story and (2) knowledge acquisition on the task of elevator malfunction diagnostics.

In the first experiment, twenty subjects have been required to formalize the decision rules to predict the ending of a sample movie based on the intermediate observation on the movie. The judgements based on rule selection and AHP made by each subject are coincide with each other. Then, to assimilate the difference of the judgements among groups with two or three subjects, they have been required to make discussions based on the individual judgements, proper set of rules have been obtained.

In the second experiment, two domain experts on elevator diagnosis domains have been selected as subjects. They have been required to improve the knowledge base on the elevator malfunction diagnosis using the proposed method. To develop the original knowledge base, it took 140 man-month efforts. On the other hand, applying the proposed method, they have found new important decision rules after the discussion. The rules found are the supplementary ones of each expertise.

The experiments are not huge ones, however, the results suggest the effectiveness of the proposed method that the procedure is useful to make clear some tacit dimensions of decision knowledge of humans which are hard to formulate.

4 Concluding Remarks

This paper has addressed knowledge acquisition problems from multiple human experts or decision makers and has proposed a generate-and-test type procedure, which consists of random generation of decision rules and evaluation of them by AHP. The method is unique in the following points: (1) each decision maker can recognize his or her own tacit knowledge based on the viewpoint on the problem by AHP, and (2) through the discussion among multiple participants, we can formulate appropriate set of decision rules for the problem solving. Future work includes to extend the proposed method toward group discussion and/or creative thinking support systems.

References

[Terano 1996] Terano, T., Ishino, Y.: Knowledge Acquisition from Questionnaire Data Using Simulated Breeding and Inductive Learning Methods. Expert System with Applics., Vol. 11, No. 4, 507-518, 1996.