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A SURVEY ON TEAM SELECTION IN GAME OF BASEBALL USING MACHINE LEARNING

1. Aamir Maqbool Najar, 2. Rajesh Kumar Kashwan Research Scholar:- Shri Khushal Das University

Email-Id:- aamirdxd@gmail.com

Abstract

When deciding commands, baseball coaches observe the current situation from various viewpoints, think of various criteria, and select commands/eliminate inappropriate commands. Whether they can arrive at the appropriate commands depends on the range of viewpoints and the number of criteria and commands that they consider. Usually, this process of deciding commands cannot be evaluated, since it is done in the mind and is not observed. The objective of this research is to develop a system by which a baseball coach's ability to decide on an appropriate command is improved by providing an environment for externalizing the decision process. In addition, a function for comparing the represented decision process with that of others is provided in order to allow the baseball coach to notice other effective decision processes previously unconsidered.

Keywords: Decision ability development, baseball command, externalization

1. Introduction

When deciding commands, baseball coaches observe the current situation from various viewpoints, think of various criteria, and select commands/eliminate inappropriate commands. Whether they can arrive at the appropriate commands depends on the range of viewpoints and the number of criteria and commands that they consider. This command decision process is a subjective and implicit activity, so it is usually evaluated indirectly by the result of the team's play. The decision process by which the command is derived is not analyzed and evaluated. In addition, even if the decision process can be described, there is no correct decision process for each situation because the results of the decision may vary because of several factors. The objective of this research is to develop a decision ability development support system for the baseball coach. To support decision-making, many decision support systems have been proposed. These systems provided organized information that helps users make decisions easily. However, the decisionabilities are not fostered. For the purpose of improving decision ability, the decision process should berepresented and evaluated.

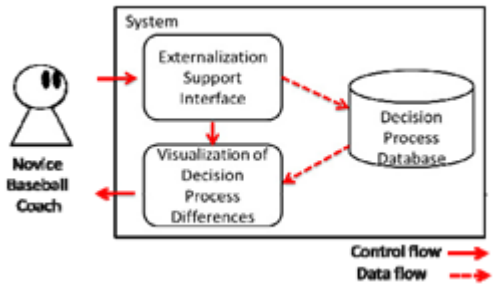

Figure-1:- Framework of System

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There are various studies aimed at visualizing information that is usually unobservable. For instance, Tateiwa et al. proposed a computer network learning support system by showing the flow of the packets visually. Packet flow is determined systematically by the network system, so the system simply showed the determined flow visually. On the contrary, the decision process of a baseball command has not been formulated. To develop a baseball command decision ability support system, the decision process should be investigated and steps in the decision process need to be determined.

Knowledge is sometimes represented as a concept map. This method is effective for representing static relations among objects, but it is not appropriate for showing the dynamical change of the objects. Also, Ogawa et al. proposed a learning activity for medical staff to create an ontology that would encourage sharing of common information about patients. This ontology also focused on arranging concepts with hierarchical relations. Our research analyzes steps that consist of the baseball command decisionprocess and develops a system by which baseball coaches can externalize their command decision processes easily. By describing the decision process, baseball coaches are able to recognize their decision processes objectively and notice the inappropriateness of their decision processes, especially whether they behavedstereotypically.

Sometimes baseball coaches are not able to recognize the insufficiency of their decision processes even if they can observe them. There were some expert systems whose targets were sports decision- making, these systems predicted better decisions for the situations based on the statistical data. However, the coaches' decision abilities are not improved if they are only shown what choice would have been better. To grasp the insufficiency of their decision abilities, it helps for coaches to compare their decisionprocesses with those of others, which can highlight the existence of different viewpoints, criteria, and candidates. Therefore, we also develop a function for comparing the decision processes with those of others and visualizing their differences so as to allow baseball coaches to notice their inappropriateness positively.

2. Framework of Decision Ability Development Support System

Figure 1 illustrates the framework of the decision ability development support system. It consists of two Mechanisms: an externalization support interface and a visualization module of decision process differences. In the externalization support interface, a function that helps novice baseball coaches to externalize their own Decision processes is provided as an interface. The function is carefully designed based on the analysis of the decision process of novice baseball coaches, who are usually not aware of their decision process. Therefore, this interface plays the role of not only externalization support, but also

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reflection support of their decision Processes. Typically, a decision process is not externalized, but even if it is, novice baseball coaches still have difficulty noticing insufficiency or inappropriateness of their decision processes.

In addition, there are no correct decision processes. Novice baseball coaches learn of their insufficiency by observing the decision processes of others. The visualization module of decision process differences analyzes the differences between two decision processes, that of the novice baseball coach and one stored in the decision processdatabase. In this research, the method of selecting another decision process for comparison is not focused on. Currently, only one decision process of an expert baseball coach is stored in the database.

3. Command Decision Process Model of Baseball Coach

A preliminary experiment was conducted in order to determine the command decision model of thebaseball Coach. In it, three examinees who belong to a baseball team were asked to determine the next play for the batter as a command under a given situation: "No out, runner on first, 8th inning, even scores, and a homerun batter". Also, they were asked to write down what they thought about in the command decision process in anatural Language form.

Table 1 shows an example answer.

First, the examinee considered the situation, such as "no out, Runner on first", and then judged the situation based on the coaching policy of safely getting the runner to Second base. Thus, he removed the command "hit right" from the candidates. Second, he also checked the Situation, such as "9th inning and the same score", and decided he would try to get only one run. Then, the Command "long hit" was eliminated from the candidates. This way of thinking is repeated until one candidate is Selected, such as "hit-and-run" in this example. Based on such analysis for the results of the other two Examinees, it is revealed that the command decision process consists of three steps: 1. Selection ofviewpoints In the situation, 2. Determination of judging policy, which decides the way to evaluate the selected viewpoint, And 3. Elimination of candidates. These steps are repeated until one candidate is left. Figure 2 represents the Decision process model of the baseball coach. The externalization support interface provides the input Environment by which novice baseball coaches can express their command decision process based onthis model.

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Table 1:- Answer of one examinee

1.	Since there are no outs and a runner first, we would like to get the runner o second base safely.Therefore, hit right is not approved.
2.	Since it is the 9th inning and the scores are the same, we only need 1 run. Therefore, long hitting isunnecessary.
3.	Since the batter is not a fast runner, base stealing is eliminated.
4.	Position of the field players of the other team is close in. A bunt cannot succeed.
5.	Since the next batter is not very good, hit-and-run is the best decision in this situation.

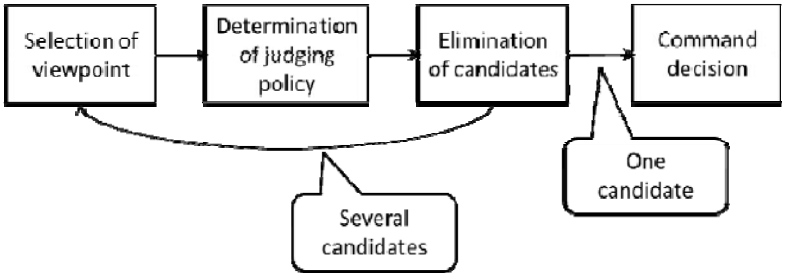

Figure 2:- Decision process model of Baseball Coach

4. Visualization Policy of Decision Process Differences

In the decision process model, baseball coaches should use three different judging factors: to decide policy based on the viewpoint, to eliminate candidates according to the policy, and to select viewpoints for judging Current candidates. These judging factors can be decided independently of each other. Thus, in our system, Differences of decision processes between a novice baseball coach's decision process and that of the expert are Shown according to the individual judging factors.

Steps in the two decision processes that reflect the differences of judging factors can be detected by Comparing sets of two steps in the decision process. If two steps in both decision processes are thesame and their next steps are different, they may be generated based on different judging factors. For example, if both decision processes focus on "no outs and runner on second" as the viewpoint, and one decision process considers "moving the runner to third" and the other "getting one run" as policies, these decision processes may be established by different deciding policies based on the viewpoint. Table 2 shows the algorithm for finding steps from the expert's decision process (current_step_of_other) that are generated by different judging factors such as input step of the novice baseball coach (current_step_of_user).

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Table 2: Algorithm for extracting different steps from the other's decision process

```
int extract_difference(int current_step_of_user){
    current_step_of_other = first step of other decision
    process;while (current_step_of_other != null){
      if(current_step_of_user == current_step_of_other){
        if(current_step_of_user + 1 != current_step_of_other + 1){
          return current_step_of_other  + 1;
        }
      }
    }
}
```

5.Evaluation

We have evaluated the usability and effectiveness of our prototype system. Eleven baseball players (examinees) were asked to use the system as baseball coaches. All examinees were more than 20 years old, male, and members of an amateur baseball team. First, examinees were asked to represent their decision processes using the system. Table 4 shows the situation presented to the examinees. After the commands were decided, Examinees were asked to answer the questionnaire to evaluate the usability of the externalization support Interface. Then, they were asked to compare their decision processes with the one that was already prepared in Tatsuhiko Matsumoto and Tomoko Kojiri / Procedia Computer Science 22 (2013) 653 – 661 the decision process database as an expert's decision process. Examinees were asked to note the differences they found from the comparison.

Table 4:- Given Situation.

[Inning]	bottom of sixth
[Score]	1-1
[Out count]	0
[Runner]	1st (who can run 50 m in 7.0 seconds)
[Batter]	batting average 0.256, good at bunting
[Next batter]	batting average 0.301, long hitter
[Pitcher]	good control, slow speed
[Fielding]	close-in infield
[Catcher]	good shoulder
[Field size]	large

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Table 5 shows the questionnaire results. Examinees were asked to select a number from 1 to 4, 4 being the best evaluation and 1 the worst. Table 6 shows the reasons for the answers. Based on the answers for item 1, Our interface is useful in expressing the decision process. In addition, according to the reasons, the decision process model is regarded as valid since our interface provided enough buttons, and the order of displaying the buttons was useful. Furthermore, based on answers for item 2, the way of visualizing the decision process was appropriate because of the color differences of the viewpoint, policy and candidate. However, as is pointed out, the design of the interface could be improved so as to observe the whole decision process easily.

Table 5:- Questionnaire result of externalization interface.

Item		1	2	3	4
1.	Were you able to express your decision process easily?	1	1	8	1
2.	Was the represented decision process easy to see?	1	2	1	7

Table 6: Reasons for questionnaire answers in Table 5

Item	Reason (who answered 1 or 2)	Reason (who answered 3 or 4)
1	• I would like to see an example of using theinterface. • I would like to select several viewpoints at a time. However, this system only allows me to select one viewpoint at a time.	• Provided buttons help me in representingthe decision process smoothly. • Enough buttons are provided to representthe decision process. • Since buttons emerge one-by-one, it is easier to represent the decision process.
2	• Scroll bar should be prepared to view thewhole decision process. • It is difficult to grasp candidates that arenot eliminated from the visualized decision process.	• Because of the color differences in thedecision process, it is easy to grasp.

Table 7 shows the descriptions of what examinees acquired from the visualization of decision process differences. The descriptions were arranged according to the judging factors. In this experiment, only one difference is extracted as the judging factor of selecting viewpoints for judging current candidates. Therefore, only one description could be acquired. For all judging factors, most examinees could notice the differences of their decision processes and those of others successfully. Overall, some examinees could evaluate the qualities of their decision processes and find out their insufficiencies. Therefore, our system gave examinees thechance to consider the quality of their decision processes.

Table 7:- Description about what examinees noticed by visualization.

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Judging factors	Description
To select viewpoints forjudging current candidates	☐ Since the order of selecting viewpoints is different, important viewpointsseem different according to the examinees.
To decide policy based onthe viewpoint	☐ Policies of others seem to have high risk. ☐ Policies of others care about a wide range of viewpoints. • I think the typical command in this situation is bunt. However, I havenoticed that the good command cannot be a bunt when the batter has a good batting rate.
To eliminate candidatesaccording to the policy	☐ I selected the candidates that follow the stereotype. ☐ I focused on only the current batter, but others also considered followingbatters.

Table 8 represents the questionnaire result regarding the visualization module, where 1 is the worst answer and 4 is the best. Most examinees answered that it was easier to find differences in the decision processes by the yellow squares. One of the examinees who answered 1 insisted that the differences of candidates were hard to understand. Currently, eliminated candidates are shown by red squares. However, the System detects the differences by candidates that are not eliminated. Therefore, we should revise theway of representing candidates, not to show the eliminated one but to show the current candidates.

Table 8:- Questionnaire result of visualization module.

Item	1	2	3	4
Were you able to see the differences between your decisionprocess and the other decision process?	3	0	6	3

6. Conclusion

In this paper, the system for supporting baseball command decision ability has been proposed. To evaluate the Command decision process, the process is modeled and an interface that supports baseball coaches in externalizing their own decision processes along the model was provided. In addition, a function for comparing the represented process with those of others was developed in order to allow baseball coaches to notice unexpected viewpoints and policies. Based on the experimental result, the baseball command decision model was proved to be valid, and the activity of representing the decision process was effective for examinees to reflect on their own decision processes. In addition, the different judging factors were noticed by comparing the decision processes of others.

Current experiments were performed only by amateur baseball players. To ensure the effectiveness of our system, it should be evaluated by

expert baseball coaches. In addition, the current system holds only one decision process in the decision process database. Therefore, the system could give only one type of judging factor. We need to gather various decision processes and develop a mechanism that selects the appropriate one from the database that is worth comparing.

Our decision process model represents what examinees thought in making the decision. However, the intention in making such decisions is not represented. In comparing decision processes, knowingintentions helps examinees evaluate the validity of the other decision process. Thus, we will update the decision process model so as to represent the reason for selecting each viewpoint, policy, and candidate.

This research focused on the decision process of the baseball coach. This framework can be applied to different activities, e.g. a doctor's decisions on medical treatment, if the decision process model for the target Activity is established. Therefore, we will find a different activity that our framework can be applied to and evaluate whether it can be effective in a general decision process activity.

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