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Goal Estimation of Explorers Based on their Behavior:
Toward Development of a Life-navigation System

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Given our goal, we would like to choose the best possible behavior among others to achieve the goal. It is, however, difficult to select the "best" behavior among all possible behaviors, since we may have some other options, of which we are not aware at the time of the decision. Furthermore, if we believe there is the best possible option on the list of options we can come up with, we may lose an incentive to further pursuit other behavior options. Then we may lose an opportunity to know the actually "best" behavior from the potential list of options that we can choose.

Accordingly, I am motivated to build an intelligent system that can give us a list with potentially better options, and support us to choose better behaviors to achieve our own goals. So, if it is difficult to aware of the best behavior option, I would like to people to present the better behaviors than what I thought. In order to give a "good" option, we need to know the criterion of behavioral goodness, which depends on one's goal of interest. Because, as mentioned above, the one himself/herself often cannot verbalize his/her goal, it is difficult for such a person to explicitly indicate his/her own goal to a system. Therefore, this research aims to construct a system that suggests a list of effective behaviors for a goal by estimating the latent goal from one's behavioral history.

2. Research content

We consider the behavioral history, which is the chained dependence of behavior, situation and decision making, as this dependence reflect the latent goal underlying a series of chosen behaviors. These processes, a series of decision making under uncertain situation, could be formulated as a Markov decision process as general. Therefore, the purpose of this research is to estimate one's goal underlying in the given behavior history that is generated by a Markov decision processes (MDPs).

We used the Wikispeedia dataset (West, Pineau& Precup, 2009) as a prototype of such MDPs. Wikispeedia was a task in which each participant started from the given article (start article) on Wikipedia, and was asked to move to a given destination article (target article) by choosing a hyperlink at each article. The participant was asked to move to a given target article by using hyperlinks.

There are two reasons to use the Wikispeedia dataset. First, the dataset reflects a series of behavior, that is supposed to be a result of Markov decision process. Second, the participant in the Wikispeedia had a general semantic knowledge, which is not sufficient to optimally solve the task. From an analysis of the Wikispeedia dataset, we would like to specify the features of the exploration behavior with incomplete knowledge, and reveal a mechanism of goal estimation.

3. Result

In this research, we examined the accuracy of estimation as to whether the article that an explore transitioned at a certain time is goal or not. And we examined the possibility of specifying goal article by features of explore article transition. For explaining explore behavior reflecting person's prior knowledge, we examined three elements as show. First, the shortest-path-length that shows the least steps from an article to goal article by hyperlinks on Wikipedia. Second, the degree when each article is regarded as vertex of the graph. Third, the PageRank corresponding to the stationary probability of staying in an article when transitioning the existing options in each article with uniform probability.

As results, it was shown three tendencies. First, the minimum transition steps among an article at a certain point and the goal article is reduced or maintained at about 81% during the entire trial. Second, the degree increases immediately after start articles and decreases before goal articles. Third, the PageRank is the highest in articles immediately after start articles, and then decrease. Then we conducted regression analysis as follows to investigate prediction accuracy of goal articles with shortest-path-length and PageRank as indicators of explore behavior.

First, we conducted a regression analysis on the terminal article to determine whether the article is a

target article. As a result of the analysis, the correct answer rate of target article discrimination remained only from 52.7% to 57.6%, slightly exceeding the chance level of 50%, but it can not be said that the accuracy is good. However, when we compare SPL comparison with PageRank at this time, we found that each element has information on discrimination, since the weight increases near the terminal article when it is a regression coefficient.

Second, we conducted a regression analysis to pinpoint estimating of target articles. As a result of the analysis, the correct answer rate of goal article estimation was 3.6% (chance level 0.03%). The rate was not high precision but exceeds chance level.

Third, we conducted a regression analysis to narrow down target articles by ranking from those with high probability for estimating target articles. As a result of the analysis, the probability that the target article estimation was made by 500th was ranked at 40% while ranking up to 2500th.

4 . Conclusion

From the findings above, we conclude the three implications on the human exploratory behaviors below. First, a person tends to select the best behavior for the purpose, even though incomplete knowledge. Second, people have a tendency to keep a more options until some point near the goal. Third, a person tends to choose situation with many behavior choices for the first time. And since the correct answer rate of goal estimation exceeds the chance level by the regression analysis, it is found that these elements have information on goal estimation.