Recommendation Systems for internship place using artificial intelligence based on competence

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Abstract. Internship program is important to be implemented as it can increase the competence of the university students. In fact, the program gives significant impact to the success of the students in industry. Students freely choose their suitable place for the internship because suitable place will make students feel motivated and as a result they will be more competent. Industrial internship program is learning at the relevant industry, aimed to increase the competence of the students by introducing them with real working condition. Students are still find difficulty in deciding the suitable place for internship because of their low confidence or competence with related issue. Now, students only need to fill the questionnaire and take the test. The data obtained from the test and questionnaires are then processed by using Artificial Neural Network (ANN), one of the Artificial Intelligence (AI) method. The result was that system can execute the process well and provide accurate recommendation for informatics students to determine suitable place for their internship program. Neural Network in the system is using the recurrent architecture to produce accurate optimal training.

1. Introduction

One of the noble services of the university to prepare students for the labor market competition is through the implementation of the internship program. Internship program is one of many ways to create competent students trough learning at the relevant industry [1]. Informatics management which belongs to Faculty of Engineering and Vocation requires students to take the internship program courses that worth 3 academic credits. The industrial experience is expected to increase the students’ competence and acknowledge the industry environment [2]. After taking the internship program students are becoming aware of the industrial environment and needs because the experience obtained from the relevant industry can increase the competence of the students [3]. The role of the stake holder is important to assist students to acquire the relevant skill needed by the industry. After finishing study, they can compete in the labor market. It is often found that students are offered to be employee at the company where they take the internship program.

Ministry of Manpower, M. Hanif Dhakiri in the 36th Dies Natalis of Universitas Islam Malang stated that University had a strategic role in the development of human resources because based on the data gathered by Central Bureau of Statistic in August 2016, the unemployment rate 7.03 million from...
The 14.57 million of educated unemployment [4]. The high rate unemployment is triggered by the availability of job opportunity and competence of the job seeker that mismatch the industry requirement. To fill in the gap between the competence of the students and the need of industry, university implements the internship program. At the end of the semester, students can apply for their internship place. However, students seem to choose their internship place randomly without considering their future carrier. Students must choose their internship place based on their competence because internship program is crucial factor in the development of students readiness to compete in labor market. If the students are competent and highly motivated, they will easy find job which in turn decreasing the unemployment rate. This shows the significance of making right decision in choosing the internship place. Right internship place will help students to increase their competence [5].

The objective of the present research was to provide internship placement information to the students based on their actual competence. The most important aspect was guiding the students to find suitable internship place so that they can improve their competence which would be beneficial for their future carrier. Competence students are those who have already fulfill all the aspects of knowledge, skill and value. All those aspects must be measurable so that they can be used in the system learning process. Learning method used in the present research was Artificial Intelligence in the form of Artificial Neural Network. Networking structure of the research was recurrent that has feedback connection from the previous input thus it can improve the JST performance. This structure makes the iteration and convergence faster [6]. After the learning process, the next step was testing. The testing process was expected to recognize data training well so that system could give good recommendation about internship placement information to the students based on their actual competence.

2. Methodology

2.1 Recommendation System

Recommendation system is information filtering system that possess ability to predict future outcome to increase the decision making quality. The key success of the system is its ability to represent the interest of current user. The system requires accurate model to have accurate and relevant recommendation from the prediction technique [7]. The research have been done in education field to produce recommendation system to provide students recommendation for suitable school program. The system used tree decision model with C4.5 algorithm, and the result is system can give recommendation with accuracy 83.33%, that's means system run as good [8]. Recommendation system is also widely applied in library [9]. Conducted research in developing recommendation system for borrowing book at East Java Library. The system helps visitor by providing recommendation of other book to borrow by looking at the previous book borrowed by visitors.

2.2 Competence

Competence is defined as having ability, capability, expertise, capacity, intelligence and proficiency [2]. (Rose, 2001 in [3]) stated that competence is the ability to perform task and role in integrating knowledge, skill, attitude, and personal value based on experience. Competence is formed by behaviours supported by knowledge, skill, and value closely related to the job responsibility. Therefore, competence becomes an indication of good human resources. Thus it can be said that students’ competence is knowledgeable and skilful expertise to consciously and responsibly perform certain task. Knowledgeable and skilful students are the product of qualified education and training. Vocational education must be designed, performed, and evaluated thoroughly (link) so that it can match the need of industry [10]. Research conducted in Hungary [11] that test the competence of the students who take the informatics education course and identify their personal need based on the demand of industrial need. The result of the research indicated that the students of informatics engineering show lack of social skill, activity and domination, these indicate that they are introvert and inactive, work individually and tend to avoid social interaction. The high score of those students were
2.3 Artificial Intelligence

Artificial intelligence is widely known in Indonesia and extensively discussed scientifically and non-scientifically. Artificial intelligence, can be classified into four categories, namely: [13] 1. Thinking Humanly (Cognitive approach) the approach has to be done in two different ways namely: introspection in which human try to understand their own thinking and psychological experiments. 2. Acting Humanly (Turing test approach) in 1950, Alan Turing conducted an experiment to test the computer ability to deceive interrogator through teletype (text based telecommunication). 3. Thinking Rationally (Logical reasoning approach) this approach has two main issues. First, it is not easy to create informal knowledge and state this knowledge into formal arrangement needed by logical notation and second, there are big difference between solving problem (principally) and solving problem (in real word). 4. Acting Rationally (Agent approach) the approach is creating logical inference which becomes part of the rational agent.

Then, the method used to recognize data for training was Artificial Neural Network. Artificial Neural Network is defined as processing information system which has characteristic identical to biological neural system [15]. Based on its architecture, neural network can be divided into two categories that are feed forward structure and recurrent (feedback) structure. In the present research, the recurrent structure was used as it could increases accuracy and accelerates the learning process [6]. Recurrent structure used was Elman Neural Network which is considered as partial recurrent network because it could only accommodate feed forward connection [15]. The properties of the recurrent type are complete and partial. A completely connected Network connection has no special input layer and each neuron has input between one and another. Meanwhile, a partially connected is identical to multilayer architecture. [14] Network architecture proposed by Jeffrey Elman is repeating structure which designed to study sequential pattern and varying time because in this way algorithm can recognize and predict value and event sequence which are being studied, as mentioned in figure 1.

![figure 1. Elman Recurrent Neural Network [14]](image-url)
2.4 Data Collection for Training And Testing
The data was gathered on the academic year of 2018/2019 with total 20 Sample Data. The students stated their field of interest that they want to learn during the internship program. The companies and offices for the internship program were divided into three place such as software house, multimedia production house and government or private institution office. Students who take part in an internship fill in the registration form. There are several requirements for joining an apprenticeship such program, students submitted their academic transcript. The values of students who can support competence like the value of a course such as algorithm programming, database programming, multimedia, networking or data communication. Because, all the data used in the training had to be measurable, the GPA was used for the knowledge and affective score was taken from the result of the questionnaire given to the students using inventory personal survey.

There were 11 variables used namely: algorithm programming, database programming, multimedia, networking or data communication, GPA, with six attitude values obtained using a questionnaire such as realistic, investigative, artistic, social, enterprising and conventional. Attitude and behaviour values are obtained by giving a questionnaire called Inventory Personal Survey to students who will take part in an internship. There are six elements that according to Holland can represent student competencies. Interests and abilities in field realistic, investigative, arts, social fields, entrepreneurial fields, and conventional fields related to working on structured tasks and rules. It was done to adjust the competence of the students with the graduate profile of informatics management, which are at field programmer, multimedia, networking technician and database administrator.

The data that has been collected will then be trained and tested. The percentage for the training data was 80% (16 data) and testing data was 20% (4 data). The training process was conducted with number of settings used as parameter such as target error, learning rate, number of neuron, number of hidden layer, and momentum. All of the setting had to be done through trial and error.

2.5 Data Normalization
After the data was collected then the normalization process was commenced. Sigmoid function was used in the present research as the back propagation algorithm. The function brought the input value with unlimited range into input value with limited range of 0-1. In order to put the range of output value into input range, the input data must be normalized into range of 0-1. There are lot of methods to normalize data that can be used, but in the present research the Min-Max normalization was used in the normalization process with rescaling data from one range to other range that was 0 - 1 utilizing the equation 1.

\[ s' = \frac{s - \min\{S_k\}}{\max\{S_k\} - \min\{S_k\}} \]

. . . . . (Equation 1)

2.6 Software Development
System developmental live Cycle (SDLC) was used with waterfall method. The steps were problem identification, data gathering, system analysis, coding, implementation, testing and evaluation. The problem identification was done by listing the need of the users related to the system being developed. In this step, the need of the users had to be stated clearly to solve the problem being faced, that was about providing recommendation of the suitable internship place for the students. After the process of defining problem and data gathering, the next steps was system analysis. The step was started by analysing input data, ongoing process, and expected result. In developing the current system, the data was taken from the data of the previous internship program which had already been filtrated. In the input process, there were three aspects used that represented the knowledge, skill, and value. Those three aspects had to be measurable; knowledge aspect can be acquired from the Grand Point Average and the skill aspect can be seen from the courses related to the Informatics Management graduate
profile that are programmer, multimedia, networking technician and data base administrator. The recommendation system layout can be seen on the figure 2.

![Elman architecture for recommendation system of internship place](image)

**Figure 2. Elman architecture for recommendation system of internship place**

| experiment | Learning Rate | Number of Neuron | Max Epoch | Accuracy |
|------------|---------------|------------------|-----------|----------|
| 1          | 0.025         | 10               | 1295      | 100%     |
| 2          | 0.025         | 10               | 1261      | 100%     |
| 3          | 0.05          | 10               | 582       | 100%     |
| 4          | 0.05          | 10               | 689       | 100%     |
| 5          | 0.05          | 15               | 567       | 100%     |
| 6          | 0.05          | 15               | 561       | 93.73%   |
| 7          | 0.075         | 15               | 416       | 100%     |
| 8          | 0.075         | 15               | 397       | 100%     |

### 3. Result and Discussion

The first training process was conducted with target error 0.001, 1 hidden layer, and momentum 0.85. In this process there were two experiments with different setting for learning rate and number of the neuron. The result of the experiment showed that 10 neurons and accelerated learning rate resulted in decreasing the number of epoch. When the numbers of neurons were 15 with learning rate 0.05, the number of epoch was decreasing and the accuracy was also decreasing. When the learning rate was raised to 0.075 the epoch was decreasing but the accuracy was increasing. The detail result can be seen...
Increasing the number of neurons to 15 resulted in better accuracy and quick learning process.

The second experiment was set on target error 0.0001, 1 hidden layer, and momentum 0.85, and 15 neurons with different learning rate setting. It was to find suitable setting for learning rate to have the best accuracy. The experiment showed that at learning rate 0.075, maximum accuracy and smallest epoch were reported. It can be said that the learning process was quick and the outcome was also good. In this case the high learning rate will not always produce maximum accuracy. The learning graphic for the second experiment can be seen on the figure 3.

After acquiring suitable setting for target error 0.0001, the third experiment was commenced with modification of the number of the neurons that were 15, 20, 25, and 30. The best result was gathered when the numbers of neurons were 15 and the numbers of epochs were 381, the result of the testing can be seen on figure 4. The forth experiment was conducted by modifying the number of hidden layers; the result was that three hidden layers with 15 neurons showed the best accuracy and the highest epoch.

4. Conclusion
The conclusion of the present research is that the recommendation system of internship place has been successfully developed. The data was gathered from the fifth semester informatics management students of the class 2016 in the academic year of 2018/2019. The recognition process can be executed well on learning rate 0.075, momentum 0.85, hidden layer 1 and target error 0.0001. The learning process showed small iteration, but the accuracy was 100%. It can be stated that all the training data can be recognized well. In the testing process, the system was tested with not training data. The testing showed that the accuracy level was 95% with only single data that cannot be recognized. The 95% level of accuracy is categorized excellent as system can recognized not training data which has not been tested before. Based on the result of the testing, system can recognized the training data and
testing data well. System can provide recommendation of the internship place such as software house, multimedia, networking, or administrational job for the new students who are going to take internship program and seek internship place that match their competency.

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