Research Article

Clustering for Recommendation of Further Studies for Lectures at Politeknik Negeri Media Kreatif, Indonesia

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Abstract.
Professionally, lecturers must continue to develop themselves in their field of expertise and regularly update their knowledge and skills, in order to provide teaching that is up-to-date and relevant to the changing times. To improve the quality of lecturers, one of the strategies is to enhance their academic qualifications. In this regard, lecturers who meet the qualifications can pursue further studies at the doctoral level.

The recommending authorities can consider various factors when evaluating the performance quality of a lecturer, including age, work experience, academic achievements and performance, specialization, lecturer-to-student ratio, availability and readiness of substitute lecturers, as well as the reputation and status of the university where the lecturer applies and is accepted.

In this research, the clustering of lecturer performance data is done using the K-Means method to address the aforementioned issues. This allows for faster determination of recommendations as the process is automated. The analysis and evaluation of the clustering results are conducted by determining the quality of the clustering using the Silhouette Coefficient method.

This research has successfully applied the K-Means Clustering method, providing 3 clusters of recommendations for further studies for Polimedia lecturers. The testing of this system using the Silhouette Coefficient obtained an average value of 0.78, indicating that the clustering results are in good condition.

Keywords: K-Means, evaluating, results

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1. Introduction

Lecturers play a crucial role in implementing the national education system by teaching, transforming, developing, and disseminating knowledge, technology, and the arts through education, research, and community service, as stated in Article 1, paragraph 2 of Law No. 14 of 2005 on Teachers and Lecturers. As professionals, lecturers are

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also responsible for elevating the dignity of their profession and advancing knowledge, technology, and the arts to improve the quality of national education [11].

Professionalism in education also encompasses responsibility towards students, educational institutions, and society. A professional lecturer must be capable of delivering quality instruction, providing guidance and support to students, and upholding ethics and integrity in their duties. Furthermore, a professional lecturer must continually self-improve in their field of expertise and periodically update their knowledge and skills, ensuring they can provide the most current and relevant instruction in line with the times' developments [11].

For the purpose of improving the quality of lecturers, one of the methods is to enhance their academic qualifications, especially for lecturers who already meet the qualifications. Consequently, recommending authorities can consider factors that influence the assessment of a lecturer's performance, such as age, work experience, academic achievements, specialization, the lecturer-to-student ratio, the availability and readiness of substitute lecturers, as well as the reputation and status of the university where the lecturer applies or is accepted. All these factors will be compiled in a database called the lecturer data. These factors will be treated as variables in a program, which will be grouped using the K-Means clustering method to obtain the best clusters for further consideration by recommending authorities in making recommendations for further studies. Many clustering methods have been developed for use in recommendation systems, such as K-Means, Hierarchical, ROCK, and various other methods [5].

Based on the above issues, to facilitate the recommendation process, an application has been created that can automatically group lecturer data, thereby reducing the time required to make recommendations for further studies for lecturers pursuing higher education.

2. Material and Methods

The experimental research in this case is focused on the application of the K-Means method to perform clustering of faculty data. A literature review was conducted to gather information from printed and electronic sources, such as books and modules, which can support the theories used as the basis for this research. The research was conducted using an experimental method, with the aim of testing the influence of specific treatments on other variables that can be controlled [12].

The collected data will undergo data analysis using predefined methods. The analysis method to be used may vary depending on the research objectives, the type of data

Table 1: Lecturer Data.

No.	Name	Age	Masa Kerja	Pengalaman	Kinerja	Spesifikasi	Rasio	Dosen Pengganti	Reputasi dan Status PT Tujuan
1	Ahmad Irfan A	39	4	Cukup	Baik	Sesuai	Cukup	Tersedia	Sangat Baik
2.	Fitriani Halik	27	2	Cukup Berpengalaman	Baik	kurang sesuai	Tidak Cukup	Tidak Tersedia	Baik
3.	Junaedi	36	5	Cukup Berpengalaman	Sangat Baik	kurang sesuai	Tidak Cukup	Tidak Tersedia	Baik
4.	Arysespajayadi	32	1	Cukup Berpengalaman	Baik	sesuai	Cukup	Tersedia	Sangat Baik
5.	H. Suardi	61	33	Sangat Berpengalaman	Sangat Baik	kurang sesuai	Tidak Cukup	Tidak Tersedia	Baik
6.	Moh Djazman Addin	51	17	Berpengalaman	Baik	sesuai	Cukup	Tersedia	Sangat Baik
7.	Elok Faiqoh	29	4	Cukup Berpengalaman	Mencukupi	kurang sesuai	Tidak Cukup	Tidak Tersedia	Baik
8.	Besse Irna Tawaddud	34	4	Cukup Berpengalaman	Mencukupi	sesuai	Cukup	Tersedia	Sangat Baik
9.	Fadly Shabir	35	1	Cukup Berpengalaman	Baik	sesuai	Cukup	Tersedia	Sangat Baik
10.	Fitriani Halik	27	2	Cukup Berpengalaman	Baik	kurang sesuai	Tidak Cukup	Tidak Tersedia	Baik
...									
...									
137.	Sofi Andriyanti, S.Pd., M.Sn.	33	4	Cukup Berpengalaman	Baik	Sesuai	Cukup	Tersedia	Sangat Baik

collected, and other relevant factors, such as data normalization to support more accurate clustering results.

After data analysis is performed, the research results need to be interpreted and analyzed to obtain accurate and relevant conclusions related to the research problem. At this point, the data is ready to be processed into the K-Means clustering algorithm. This stage will be carried out by the research team leader and members with the achievement indicator being that the clustering of candidate faculty members for further study recommendations is of good quality.

Clustering data with the K-Means method is often performed using a 5-step algorithm as follows [8].

Determination of the number of clusters.

Data will be randomly allocated into clusters.

Calculation of centroids for the data within each cluster.

Allocation of data to the nearest centroid/average.

Return to step three, which is to calculate centroids, if there is still data cluster movement in the previous clustering results, or if the centroid values exceed the

predetermined maximum value, or if the objective function being used still exceeds the threshold value. The measurement of data distance to the cluster center is done using Euclidean distance, thus obtaining the shortest distance between two points. The application flow design is depicted as shown in Figure 1. The Euclidean distance equation between two points ⬚⬚ and ⬚⬚ in p dimensions is as follows [2]:

$$d\left(x_j, c_j\right) = \sqrt{\sum_{j=1}^{n} (x_j - c_j)^2}$$

Where :

d : distance

n : number of objects

j : (ranging from 1 to n)

x_j : feature of object j with respect to x

c_j : centroid of feature j
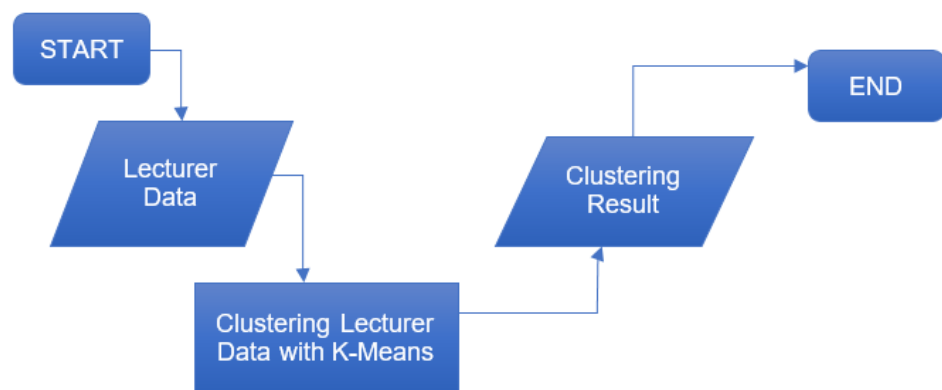
Figure 1: K-Means Flow Diagram.

3. Result and Discussion

The lecture data displayed in Table 1 were processed using the K-Means algorithm, resulting lecturer clusters. Three clusters were obtained and labeled as follows: less recommended, recommended, and highly recommended. Out of the 139 lecturers, 90 were clustered as less recommended, 28 as recommended, and 21 as highly recommended for further study. These cluster results can be used by policymakers to provide further study recommendations to lecturer at Politeknik Negeri

Media Kreatif. These cluster results shown in Figure 2.

Figure 2: K-Means Lecturer Data Cluster.

The obtained cluster results were then tested using the Silhouette Coefficient method, which yielded a value of 0.78. This test result indicates that the clustering results are in good condition since it is above the standard threshold of 0.6 for cluster testing using the K-Means method. Visualisation of lecturer clusters result in scatter graphic and shilouette score shown in Figure 3.
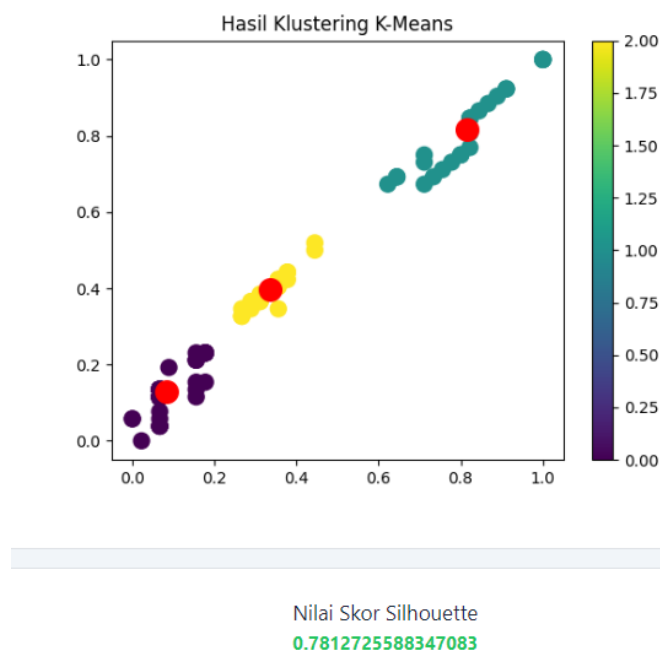

Figure 3: K-Means Lecturer Data Cluster Validation.

4. Conclusion

This research has successfully applied the K-Means clustering method, providing 3 clusters of study recommendations for faculty members at Polimedia. The system's trial results, using the Silhouette Coefficient, obtained an average value of 0.78, indicating that the clustering results are in good condition.

Furthermore, for the development of this research and to achieve even better results, future research will apply various other methods and make changes to variables.

Acknowledgements

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