****GROUP Cluster 555****

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### ****Problem Defination: Identify abnormal driving behavior using spatio and temporal analysis****

### ****Task Done in This Week:****

This week, we focused on exploring different machine learning algorithms to identify abnormal driving behavior using **spatio-temporal data** (location + time). Since driving patterns change over time, we looked into **time-series clustering methods** that can help group similar driving behaviors without needing labeled data.

One of the key algorithms we examined was **K-Shape Clustering**. This method groups driving behaviors based on the overall shape of their patterns over time. Unlike traditional clustering methods, K-Shape uses **Shape-Based Distance (SBD)** to compare time-series data, making it more effective for identifying different driving styles like aggressive or distracted driving. Research has shown that K-Shape is highly accurate and efficient for time-series clustering, making it a strong candidate for our project.

Another algorithm we looked into was **Time-Series K-Medoids**, which is similar to K-Shape but more robust to outliers. Instead of calculating an "average" pattern for each cluster, K-Medoids picks actual examples from the dataset as cluster centers. This makes it especially useful for real-world driving data, which often contains unexpected variations.

**We have found and understood the following papers to identify the driving methods:**

1. Y. Feng, Q. Ye, F. Adan, L. Marques and P. Angeloudis, "Driving Style Classification Using Deep Temporal Clustering with Enhanced Explainability," 2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC), Bilbao, Spain, 2023, pp. 4040-4045, doi: 10.1109/ITSC57777.2023.10421826.
2. Du X, Kang X, Gao Y and Wang X (2024) Driving behavior characterization and traffic emission analysis considering the vehicle trajectory. Front. Psychol. 14:1341611. doi: 10.3389/fpsyg.2023.1341611
3. D. I. Tselentis and E. Papadimitriou, "Driver Profile and Driving Pattern Recognition for Road Safety Assessment: Main Challenges and Future Directions," in IEEE Open Journal of Intelligent Transportation Systems, vol. 4, pp. 83-100, 2023, doi: 10.1109/OJITS.2023.3237177.
4. X. Wang, R. Song, J. Xiao, T. Li and X. Li, "Accelerating k-Shape Time Series Clustering Algorithm Using GPU," in IEEE Transactions on Parallel and Distributed Systems, vol. 34, no. 10, pp. 2718-2734, Oct. 2023, doi: 10.1109/TPDS.2023.3298148.
5. Wang, S., Jia, R., Zhang, L. (2023). Multivariate Sequence Clustering for Driving Preference Classification Based on Wide-Range Trajectory Data. In: Bie, Y., Gao, K., Howlett, R.J., Jain, L.C. (eds) Smart Transportation Systems 2023. KES-STS 2023. Smart Innovation, Systems and Technologies, vol 356. Springer, Singapore. https://doi-org.ahdunielib.remotexs.in/10.1007/978-981-99-3284-9\_5
6. J. Paparrizos and L. Gravano, *k-Shape: Efficient and Accurate Clustering of Time Series*. 2015, pp. 1855–1870. doi: 10.1145/2723372.2737793.

**Tasks Planned for Next Week:**

* Obtain a readily available spatiotemporal dataset on driving.
* Acquire the dataset provided by Yagnik Sir or pick a relevant dataset from the identified research in the literature survey.
* Perform exploratory data analysis (EDA) to learn about the dataset properties and structure.
* Revisit and critically assess the research papers chosen in order to better appreciate their approaches.
* Analyze and determine the best-suited algorithm or collection of algorithms to achieve the project objectives.