

CLASSIFYING LOCATIONS BY IDENTIFYING STATION SPECIFIC PATTERNS

BACKGROUND

- The Train Unit Shunting Problem- create feasible schedules considering multiple constraints
- Local search algorithms[1] and Deep Reinforcement Learning[2]

OBJECTIVES

- Identify patterns in train shunting data across various stations
- Use patterns to differentiate between locations automatically
- Identified patterns should be instrumental in improving the algorithms or identifying best-practices and better layouts

METHODOLOGY

- Train data provided by ProRail across seven locations
- Aggregated data structure supporting filtering
- Feature categorisation for statistical analysis:
 - Single train paths
 - Whole solutions
- Classification algorithms
 - K-means clustering with PCA for visual verification
 - Random Forest Classifier with feature importance analysis

EXPERIMENTS

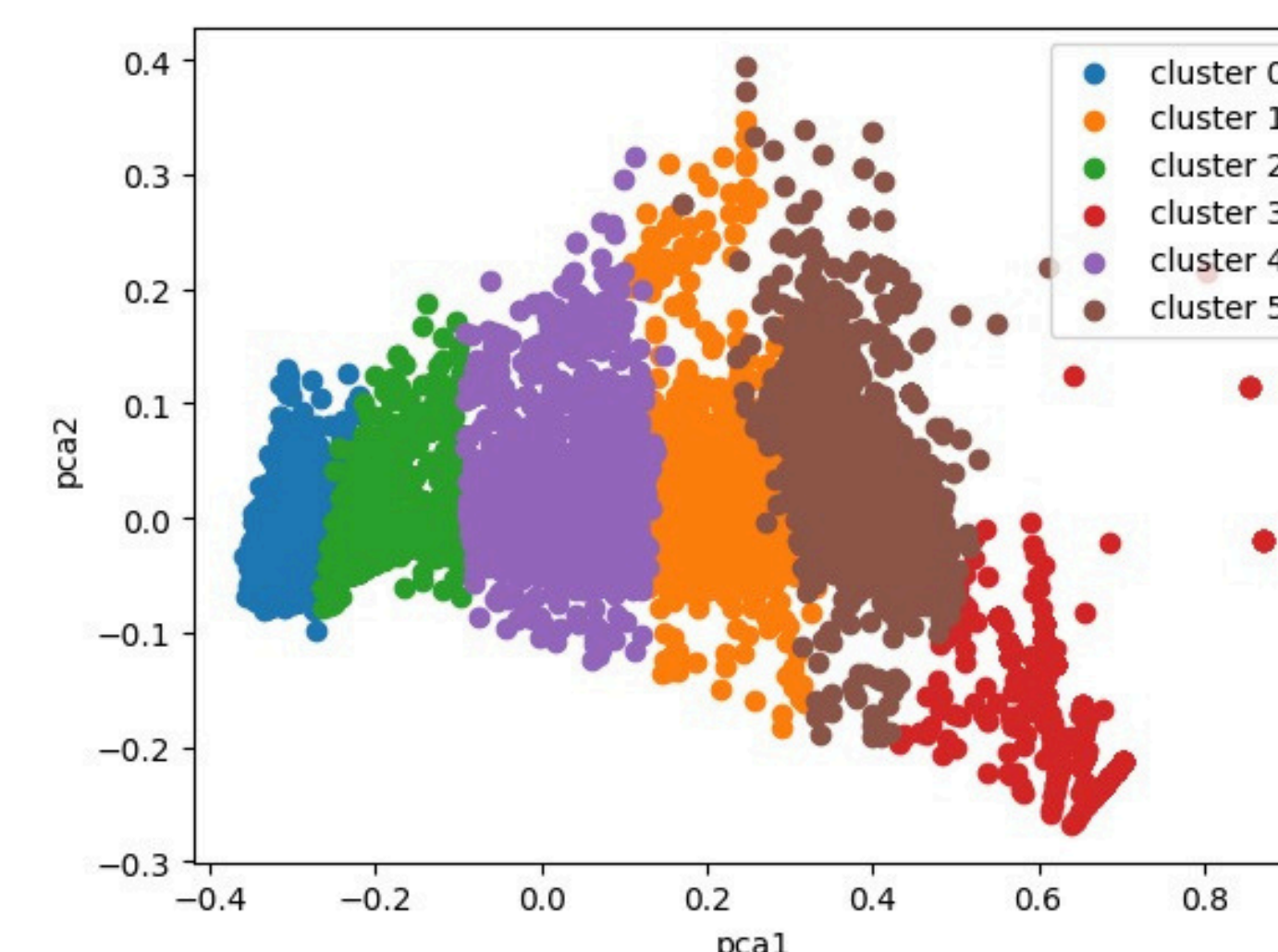


Figure 1: Clustering after performing K-means

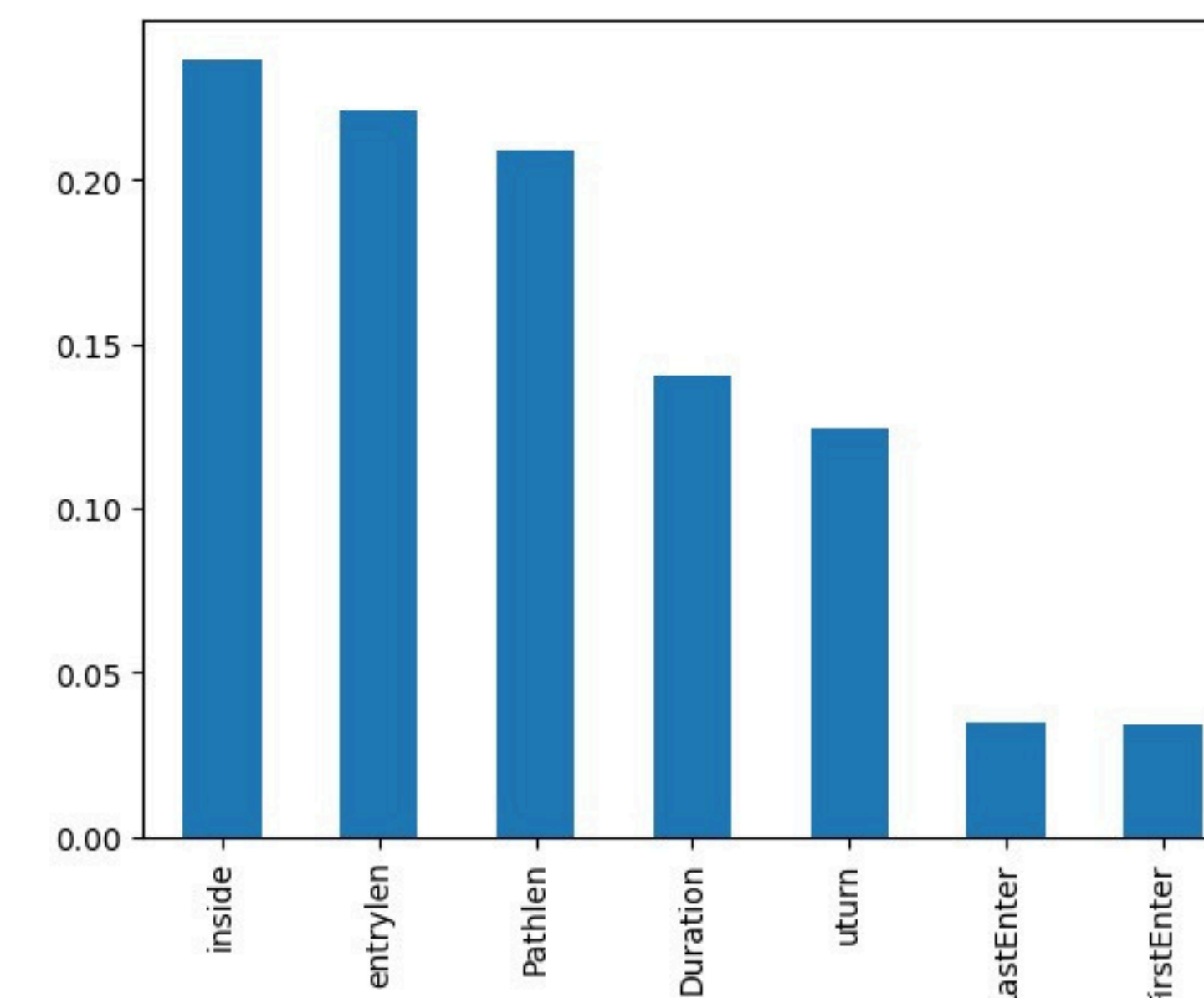


Figure 3: Feature importance provided by RFC

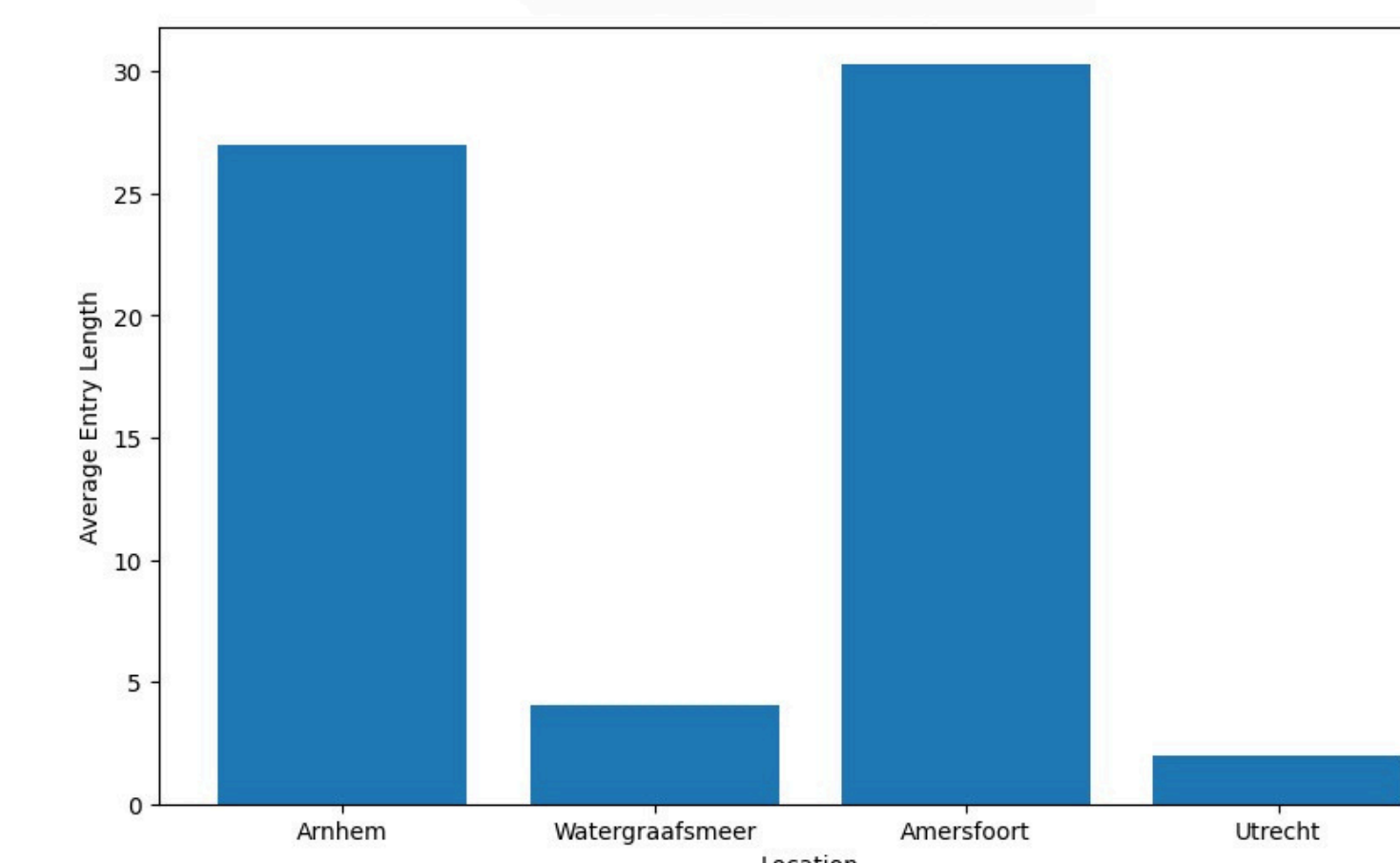


Figure 2: Comparison between the entry paths across similarly sized locations

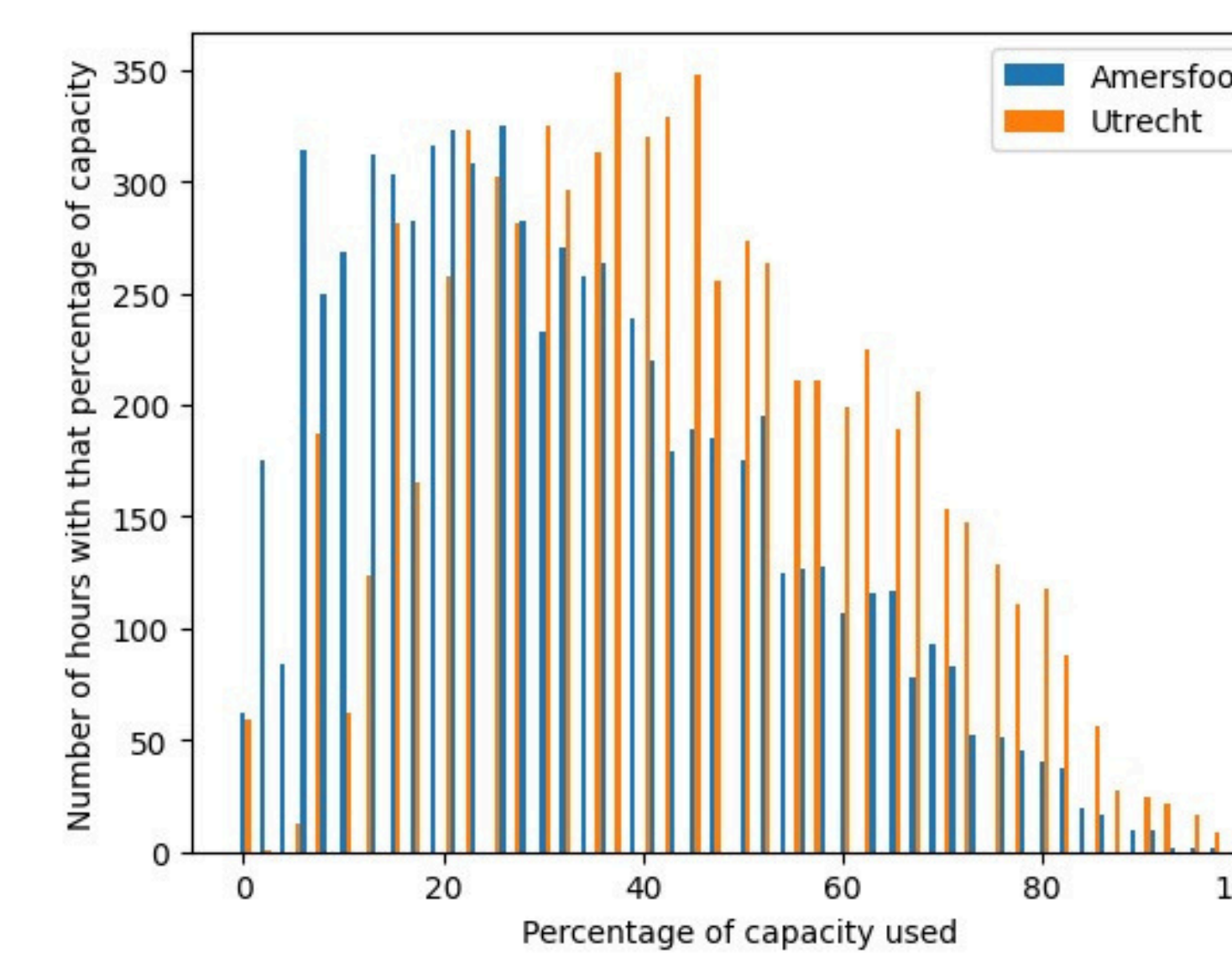


Figure 4: Comparison between the usage of the capacity in Amersfoort and Utrecht

FINDINGS

- Path lengths vary across locations
- Some locations operate closer to their full capacity than others
- Similar patterns prove consistency in scheduling
- Layout differences (such as FILO setups) have minimal effect on scheduling

- Single Train Paths Classification
 - K- means clustering achieved 66% accuracy
 - RFC improved to 86%
 - Path lengths influence the classification the most
- Whole Solutions Classification
 - Train movements over 24hrs
 - RFC yielded 87% accuracy, identifying capacity utilisation as a significant determinant

CONCLUSION

- Identified consistent train position data patterns across multiple locations
- Unique patterns can classify locations, aiding in data interpretation
- Potential to enhance scheduling by guiding heuristic adjustments
- Insights into infrastructure
- Expansion to international contexts could uncover country-specific railway practices

REFERENCES

[1]Roel van den Broek, Han Hoogeveen, Marjan van den Akker, and Bob Huisman. A local search algorithm for train unit shunting with service scheduling. *Transportation Science*, 2022.

[2]Evertjan Peer et al. "Shunting Trains with Deep Reinforcement Learning". In: 2018 IEEE International Conference on Systems, Man, and Cybernetics (SMC). 2018, pp. 3063-3068. DOI: 10.1109/SMC.2018.00520.

