Professorship of Business Analytics & Intelligent Systems
TUM School of Management
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Literature Review: Machine Learning-Based Approaches for Facility Location Problems

Facility Location Problems (FLP) aim to find the optimal placement of facilities with the objective of minimizing costs and improving service efficiency across various industries such as logistics, healthcare, and retail. Traditional methods, including linear programming and heuristic algorithms, have been used to address FLPs. However, the complexity of modern supply chains, characterized by dynamic customer demands and vast amounts of available data, has surpassed these conventional approaches. The emergence of machine learning (ML) offers promising frameworks with faster approximation of computationally expensive operations and learning from the experience when expert knowledge is insufficient.[1] Despite the growing number of studies, there is still a lack of a consolidated understanding of how ML models are utilized to solve FLPs.

Aims and scope of the thesis

This thesis focuses on conducting a thorough literature review of ML-based models utilized in solving FLPs. This review will systematically analyze existing studies to identify models, evaluate methodologies, and assess the effectiveness of ML approaches in this domain. This comprises the following research tasks:

- Classification of ML Models (i.e., supervised, unsupervised, reinforcement learning) used in FLP
- Exploring different industries and scenarios where ML has been implemented for FLP, such as urban planning, emergency services, and supply chain management
- Analyzing how specific ML techniques (e.g., neural networks, clustering algorithms, support vector machines) are adapted to the unique challenges of FLP
- Evaluating the performance of ML-based models against traditional optimization methods (exact and heuristic approaches) in terms of solution quality, computational efficiency, and scalability
- Identifying common obstacles in applying ML to FLPs, including data requirements, model interpretability, and integration with existing systems

Requirements

This thesis targets students of the Bachelor in Management and Technology. Knowledge of optimization and machine learning is advantageous. The thesis should be written in English.

Related Research

- Rolf, B., Beier, A., Jackson, I., Müller, M., Reggelin, T., Stuckenschmidt, H., & Lang, S. (2024). A review on unsupervised learning algorithms and applications in supply chain management. *International Journal of Production Research*, 1–51. https://doi.org/10.1080/00207543.2024.2390968
- Zhang, S., Yang, Y., Tong, H., & Yao, X. (2024). Learning-based problem reduction for large-scale uncapacitated facility location problems. *2024 IEEE Congress on Evolutionary Computation (CEC)*, 1–8. https://doi.org/10.1109/CEC60901.2024.10611785
- Turkoglu, D. C., & Genevois, M. E. (2020). A comparative survey of service facility location problems. *Annals of Operations Research*, *292*, 399–468. https://doi.org/10.1007/s10479-019-03385-x
- More, S. K., Gupta, L. R., Gehlot, A., K, S., Al-Hilali, A. A., & Alazzam, M. B. (2023). Exploring the effectiveness of machine learning in facility location problems. *2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)*, 154–158. https://doi.org/10.1109/ICACITE57410.2023.10182954
- Wu, T., Huang, L., Liang, Z., Zhang, X., & Zhang, C. (2022). A supervised learning-driven heuristic for solving the facility location and production planning problem. *European Journal of Operational Research*, *301*, 785–796. https://doi.org/10.1016/j.ejor.2021.11.020

Begin: as soon as possible

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Application: See https://www.ot.mgt.tum.de/osm/education/bachelor-thesis/

[1] Bengio, Y., Lodi, A., & Prouvost, A. (2021). Machine learning for combinatorial optimization: A methodological tour d'horizon. *European Journal of Operational Research*, *290*, 405–421. https://doi.org/10.1016/j.ejor.2020.07.063