

**Postman Problems: New Variants and their Solution by exact and heuristic
Approaches
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Arc-routing problems consist of determining a least cost traversal of some arcs or edges of a graph, subject to side constraints. Applications can be found in garbage collection, mail delivery, and the maintenance of the transportation infrastructure, such as street sweeping, salt gritting, and snow plowing. Postman problems are arc-routing problems where only a single person or vehicle has to be routed. They are named “postman problems” because of their high relevance in the context of designing cost-efficient delivery routes in postal applications. Starting with a short review of classical postman problems and their solution, we will discuss new variants identified being important in letter mail distribution. The discussed extensions include the option to have alternative service modes (including “zigzag deliveries”), turn and street crossing restrictions, and cluster constraints. The proposed solution approaches span a wide range of methods, from exact matching and cutting-plane/branch-and-cut algorithms to transformations of the postman problems into TSP. For the latter approach, non-standard local-search algorithms were developed because known exact TSP algorithms failed due to the high degeneracy of the transformed TSP instances. Extensive computational experiments show that the new solution method consistently outperforms standard TSP heuristics on real-world instances taken from a study performed in collaboration with Deutsche Post World Net.