**Abstract:**

This paper discusses the implementation of evolutionary algorithm (EA) for optimising the travelling thief problem (TTP). The Traveling Thief Problem (TTP) is an extension of the classical Traveling Salesman Problem (TSP) that incorporates elements of the Knapsack Problem (KP). The Traveling Thief Problem (TTP) poses a challenging combinatorial optimization task. In this study, we research into the application of four different optimisation algorithms- Ant Colony Optimization (ACO), Non-dominated Sorting Genetic Algorithm II (NSGA-II), Greedy algorithm, and Particle Swarm Optimization (PCO). During our research we leverage existing research papers to analyse and compare the algorithms' performances in solving the TTP.

By reviewing a diverse set of research papers, we extract insights into the strengths and weaknesses of each algorithm with respect to solution quality, convergence speed, and robustness across various TTP instances. During our research, we identified NSGA-II as the algorithm exhibiting consistent superiority in terms of solution quality, convergence speed, and robustness across diverse TTP instances. Subsequently, we adopted NSGA-II to address the optimization challenge of the nine experiments. The results of these experiments provide valuable insights into NSGA-II's efficacy in solving the TTP across different scenarios and highlights practical implications in using NSGA-II for complex combinatorial optimisation challenges. By utilizing NSGA-II to successfully solve nine experiments, our study underscores its reliability and effectiveness in addressing the intricacies of the Traveling Thief Problem.

**Introduction**

Over the past 50 years, researchers from diverse fields, including applied mathematics, operations research, meta-heuristics, and artificial intelligence, have extensively studied a multitude of optimization problems. Most of these problems fall under the class of NP-hard, implying that finding optimal solutions for "large" instances becomes computationally intractable. This category encompasses renowned challenges like the Traveling Salesman Problem (TSP), the Knapsack Problem (KP), the Vehicle Routing Problem (VRP), the Multiprocessor Task Scheduling Problem and many others. These problems often represent real-world industrial environments and as such, solving them optimally holds significant value.

The Traveling Thief Problem (TTP) emerges as a captivating extension of the classic Traveling Salesman Problem (TSP) by incorporating elements of the Knapsack Problem (KP). In the TTP, a cunning thief embarks on a journey through a network of cities, seeking to pilfer valuable items from each location. The thief's objective is to maximize the overall worth of stolen goods while navigating the delicate trade-off between maximizing the value of loot and minimizing the travel time. This optimization challenge presents a formidable combinatorial problem due to the inherent interdependence between the routing and packing decisions.