

Research Paper Summary: The Orienteering Problem

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Last Updated: 25 October 2025

1 Introduction to GTSP

Orienteering is a sport in which control points are established in an environment, and competitors using nothing but a compass and a map must navigate to as many control points as possible within the allotted time limit. To formalize this, given n nodes in a Euclidean plane with score $s(i) \geq 0$ [$s(1) = s(n) = 0$], we want to find a route through the nodes to maximize the score beginning at 1 and ending at n , taking no more than TMAX time. This is referred to as the generalized traveling salesman problem (GTSP). GTSP is NP hard, and the traveling salesman is considered a subset of this problem.

2 Common Heuristics

There are two general approaches to solve the GTSP, stochastic and deterministic.

2.1 Stochastic Algorithm

Stochastic algorithms generally rely on Monte Carlo techniques to build a large number of routes, and choosing the best one from this collection. The thought is this: if $A(j)$ is a measure of "desirability" for nodes j currently not on the route, then we say

$$A(j) = \frac{s(j)}{t(\text{last}, j)},$$

where $s(j)$ is the score associated with node j and $t(\text{last}, j)$ is the travel time from the last node to j . After choosing at most four values for $A(j)$, we normalize them, and a random number from 0 to 1 is generated to determine which j node is included. This is repeated until no additional nodes can be included in the route.

Deterministic Algorithm This approach creates routes using a variant of Wren-Holliday vehicle routing procedure. The environment is divided into sectors using concentric circles, and routes are built up from within sectors to save travel time.

3 Center of Gravity Heuristic

This new proposed heuristic has three core steps:

1. Route Construction Step
2. Route Improvement Step
3. Center of Gravity Step