METAHEURISTIC ALGORITHMS FOR TRANSIT NETWORK DESIGN
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INTRODUCTION
- Public transportation is a crucial part in developing sustainable transportation in urban areas.
- Without a good public transportation system, private vehicle ownership increases, which lead to many problems: traffic congestion, air pollution, energy exploitation. [1]
- Planning and designing efficient public transportation is essential.

TRANSIT NETWORK DESIGN
As the first activity in transportation planning process, network design may be considered as the most crucial and important stage, with aims to designate a set of routes in a specific area which is determined by a sequence of transit points [4, 5].

INPUT
- Demand data
- Supply data
- Route performance indicators

OUTPUT
- Route changes
- New routes
- Operating strategies

Fig. 3. US’ road network (as background) [9]
Fig. 4. Binary codes (as background) [7]
Fig. 5. Topographic map of the London Underground (as background) [8]

PROBLEM FORMULATION
- **Road network:** G=(N, A)
  - N: set of nodes (potential bus stops, e.g. inter-sections, zone centroids);
  - A: set of links (street segments)
- **Origin–destination matrix:** D
  - D = {dᵢⱼ | i, j ∈ [1, 2, ..., |N|]}, dᵢⱼ is # of trips between node i and node j
- **Travel time matrix:** TR
  - TR = {trᵢⱼ | i, j ∈ [1, 2, ..., |N|]}, trᵢⱼ is in-vehicle travel time between node i and node j
- **Objective:** find a set of routes R such that “total travel time of all passengers in the network” is minimized.

PROCEDURE
- **Representation:** each individual is a set of paths
- **Initialization:** each route is the shortest path based on the travel time
- **Mutation:** small modification vs big modification
- **Selection:** select individuals based on fitness
- **Crossover:** swap the routes of the two parents

METAHEURISTIC APPROACH

- **Heuristic**
  - A trial-and-error based method that often involves random choices
- **Metaheuristic**
  - Combines heuristics into a framework to explore a solution space in attempts to find global optimum solutions

In some complex optimization problems where the best solution is considered computationally expensive, a heuristic and a metaheuristic offer ways of searching “the sufficiently good solution” by sacrificing optimality, completeness, accuracy, or precision for speed [9].

REFERENCE