

A Neural-Evolutionary Algorithm for Autonomous Transit Network Design

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Transit Network Design

Autonomous buses are coming...

But designing a transit network is hard!

- ▶ n nodes, m routes $\Rightarrow \binom{n!}{m}$ possible networks



An NP-complete problem!

State-of-the-art approaches use metaheuristics

- ▶ genetic algorithms, tabu search, simulated annealing

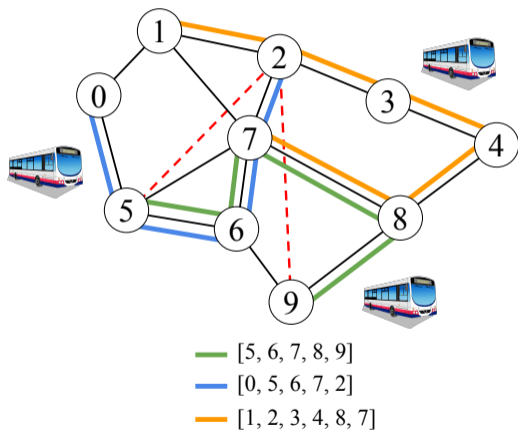
Metaheuristics succeed or fail on three factors [Fan and Mumford, 2010]:

1. The **representation** of the problem
2. The **initialization** procedure
3. The possible **neighbourhood moves**

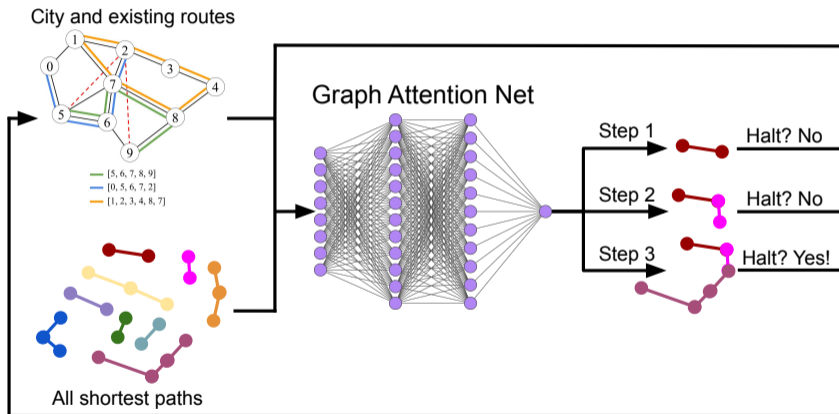
We address the **3rd** factor.

Representation

- ▶ City \mathcal{C} :
 - ▶ node set \mathcal{N} , with n nodes
 - ▶ street edge set \mathcal{E}_s
 - ▶ $n \times n$ demand matrix D
- ▶ Bus route: a path in \mathcal{C}
- ▶ Transit network \mathcal{R} : a set of routes
- ▶ **Goal:** minimize cost
$$C(\mathcal{C}, \mathcal{R}) = \alpha C_p + (1 - \alpha) C_o$$
 - ▶ C_p : passengers' cost
 - ▶ C_o : operator's cost

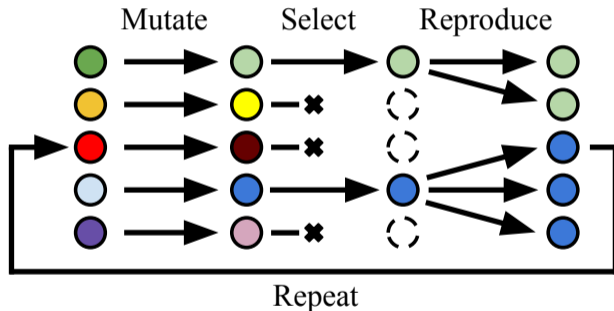


Graph-Attention-Net Policy



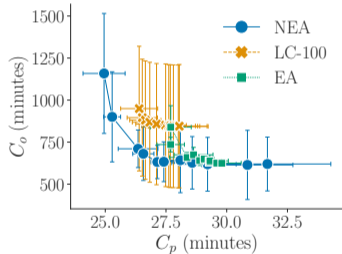
Evolutionary Algorithm

- ▶ Neural mutator: delete random route from \mathcal{R} , use π_θ to construct new route
- ▶ Use in evolutionary algorithm of [Nikolić and Teodorović, 2013]

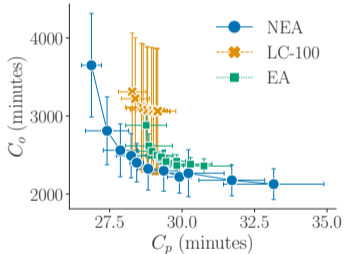


Results

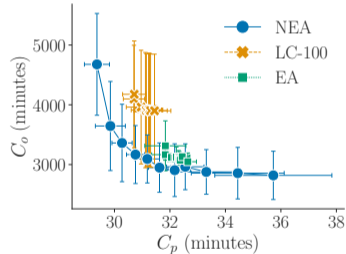
We evaluate on the Mumford benchmark cities [Mumford, 2013]



Mumford1



Mumford2



Mumford3

Thank you!

Sion driverless bus service to be expanded, 10 2017. Accessed: 2024-02-20.

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