Open Street Routing Machine: an introduction

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Outline

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Seminar outline

1. 06/16: 路线规划的开源软件及应用（第一部分：软件介绍）
2. 06/23: 路线规划的开源软件及应用（第二部分：实践操作）
3. 06/30: 城市设施选址问题（第一部分：模型介绍）
4. 07/07: 城市设施选址问题（第二部分：开源软件）
5. 07/14: 城市设施选址问题（第三部分：案例分析）
6. 07/21: 选址-路线规划问题：无人机基站选址的案例

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Using a paper map for routing?

Questions on routing

- Have you used routing software (e.g. Baidu Map, Gaode Map)?
- Are these software free?
- What are the problems of these software?

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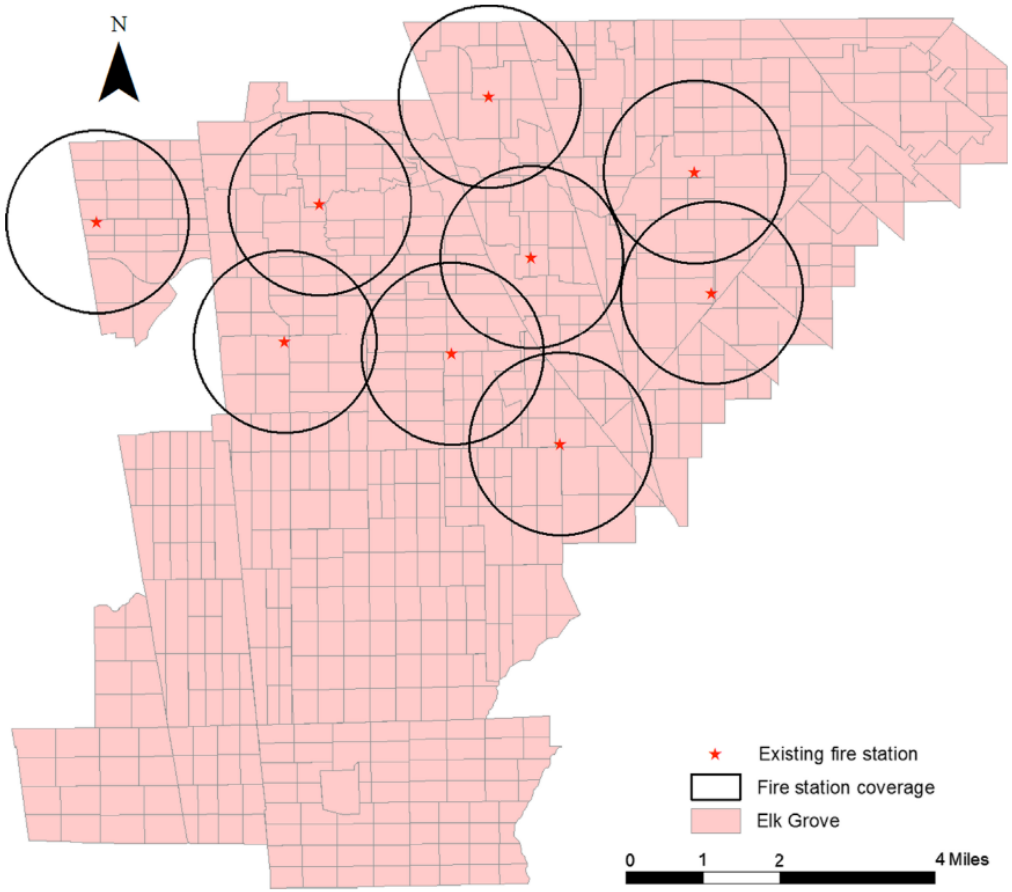
Open Street Routing Machine

- An open-source modern C++ routing engine for shortest paths in road networks
- An open-source alternative to Google Map, Gaode Map (Amap), Baidu Map, et al.
- The network data is based on OpenStreetMap.
- The server can be deployed in an off-line environment without Internet
- Supporting driving, bike, foot (but not public transport)

Why we need OSRM (given that Google/Gaode/Baidu Maps are free and fast)?

- **Not free for large-scale queries**: when you have millions of queries (0.04 USD per query)
- **Not secure for high-security projects**: you need to visit Internet; anyone may be forbidden to use these APIs (up to company decisions)
- **Not customisable** (if you want to change the road network or simulate the effect of new infrastructures)

Why we need road network distance (many geography/transport papers using Euclidean distance)



Why we need road network distance (many geography/transport papers using Euclidean distance)

- Is Euclidean distance always a good approximation? (Multiple mode; infrastructure; et al.)
- The distance or duration is likely to differ across travel modes (driving, cycle, walking)
- What if you want to simulate/predict the influence of a new road on travel times? (You can't use Euclidean distance in this case)

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Functions of OSRM

1. Nearest - Snaps coordinates to the street network and returns the nearest matches
2. Route - Finds the fastest route between coordinates
3. Table - Computes the duration or distances of the fastest route between all pairs of supplied coordinates
4. Match - Snaps noisy GPS traces to the road network in the most plausible way
5. Trip - Solves the Traveling Salesman Problem using a greedy heuristic
6. Tile - Generates Mapbox Vector Tiles with internal routing metadata

Example of map matching

What you need to deploy and use OSRM

1. OSRM backend: based on Docker (cross-platform, but Linux is recommended)
2. OSRM frontend: I haven't used it before
3. (We will practice with OSRM in the next seminar)

Examples: Uber using OSRM

1. Uber using OSRM to compute ETA
2. In Uber's early days, we used a combination of routing engines to produce an ETA. (We didn't have in-app navigation at this point, so we only used it for the ETA and map matching to display vehicle locations.)
3. `https://eng.uber.com/engineering-routing-engine/`

Examples: using OSRM to predict trip fare

1. Kaggle competition of NYC taxi fare prediction
2. Intuition: using the driving distance predicted by OSRM will increase the model accuracy, better than Haversine distance
3. Result: adding this trip distance to the data led to 300/1500 on the leaderboard
4. `www.thinkdatascience.com/post/2020-03-03-osrm/osrm/`

Using OSRM in your projects

1. Pre-processing noisy GPS data
2. Travel mode choice: predicting the travel time/distance of different modes
3. Cycling route choice: simulate the influence of planned cycle infrastructure

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Summary

1. OSRM is an open source routing software with multiple functions of routing/map matching.
2. It has the potential for many projects.
3. In the next seminar, we will practice with OSRM using Python.

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