vetmeduni

University of Veterinary Medicine, Vienna

AI-DRIVEN OPTIMIZATION OF VETERINARY CARE SERVICES

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Motivation

- Improvement /optimization of veterinary care services
  - In particular, with focus on Alpine countries and on livestock/cattle

- Solutions:
  - Assignment of a farm /several farms to the optimal veterinarian's practice / the respective optimal practices: R/Shiny application **vetfind**
  - Calculation of veterinary care regions: Assignment of subregions to the respective optimal practices: in R/Shiny application **vetcluster**

- Basis for calculation:
  - Road distance
  - Duration (results can differ from results for road distance)

Application vetfind

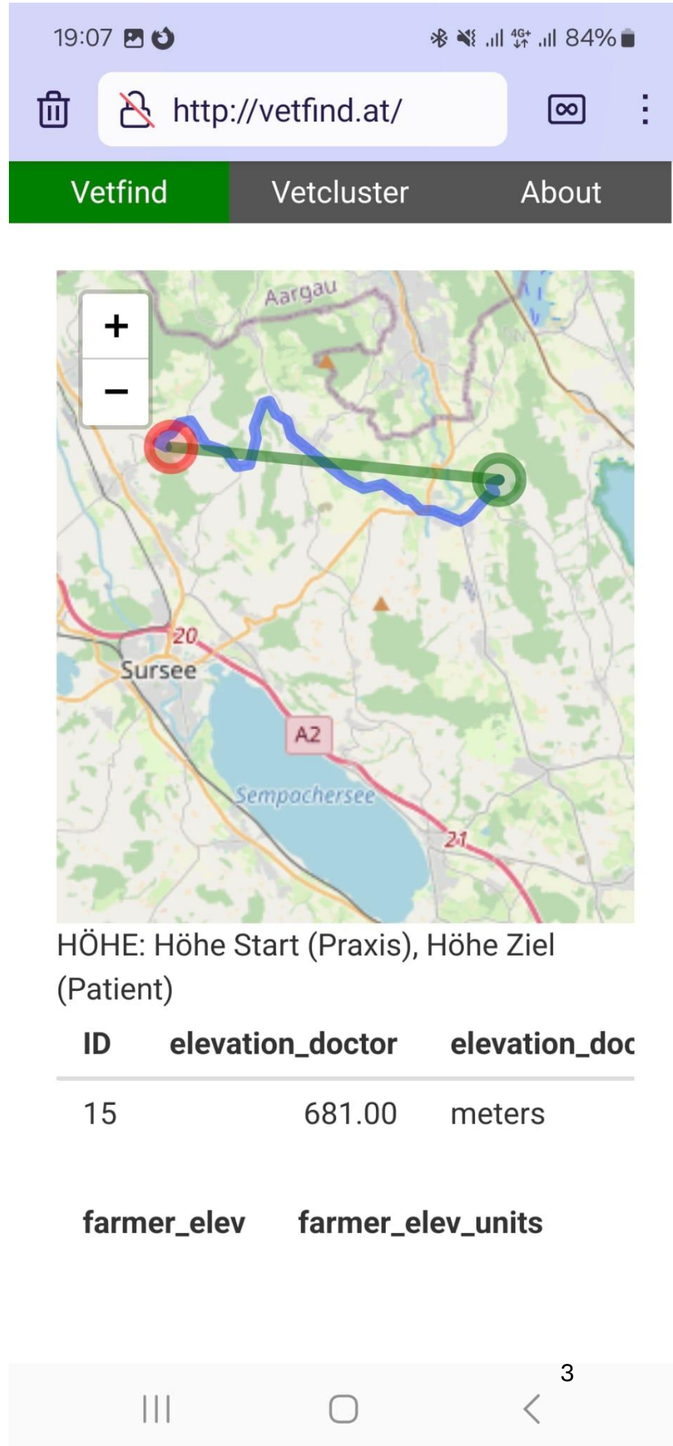
- Goal: find optimal available veterinarian's practice for a farm
- Output: practice ID, a map showing in particular the route, and further information

- Measure of optimality in current protoype(s):
  - Optimal available practice for a farm: minimal road distance

- Routing, road distances and road durations via OSRM:
  - R package osrm (interface between R and OSRM API)
  - osrm.profile=„car“

R shiny application, packages shiny, sp, sf, tidyverse, geosphere, osrm, leaflet, elevatr

Remark: practice and farm locations are random samples, names are placeholders

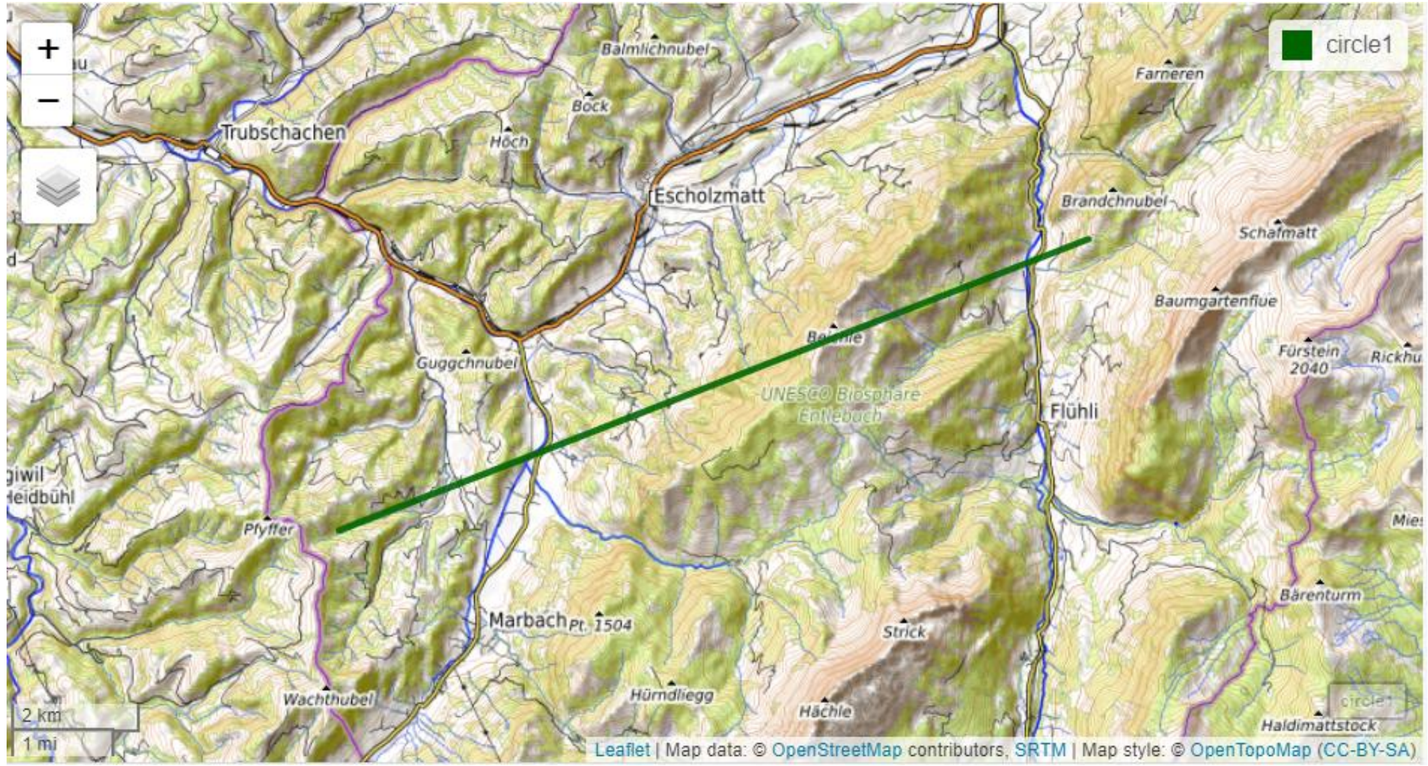


HÖHE: Höhe Start (Praxis), Höhe Ziel (Patient)

ID	elevation_doctor	elevation_doc
15	681.00	meters

farmer_elev	farmer_elev_units

Routing from optimal practice to farm: shortest path on Earth (topographic map)



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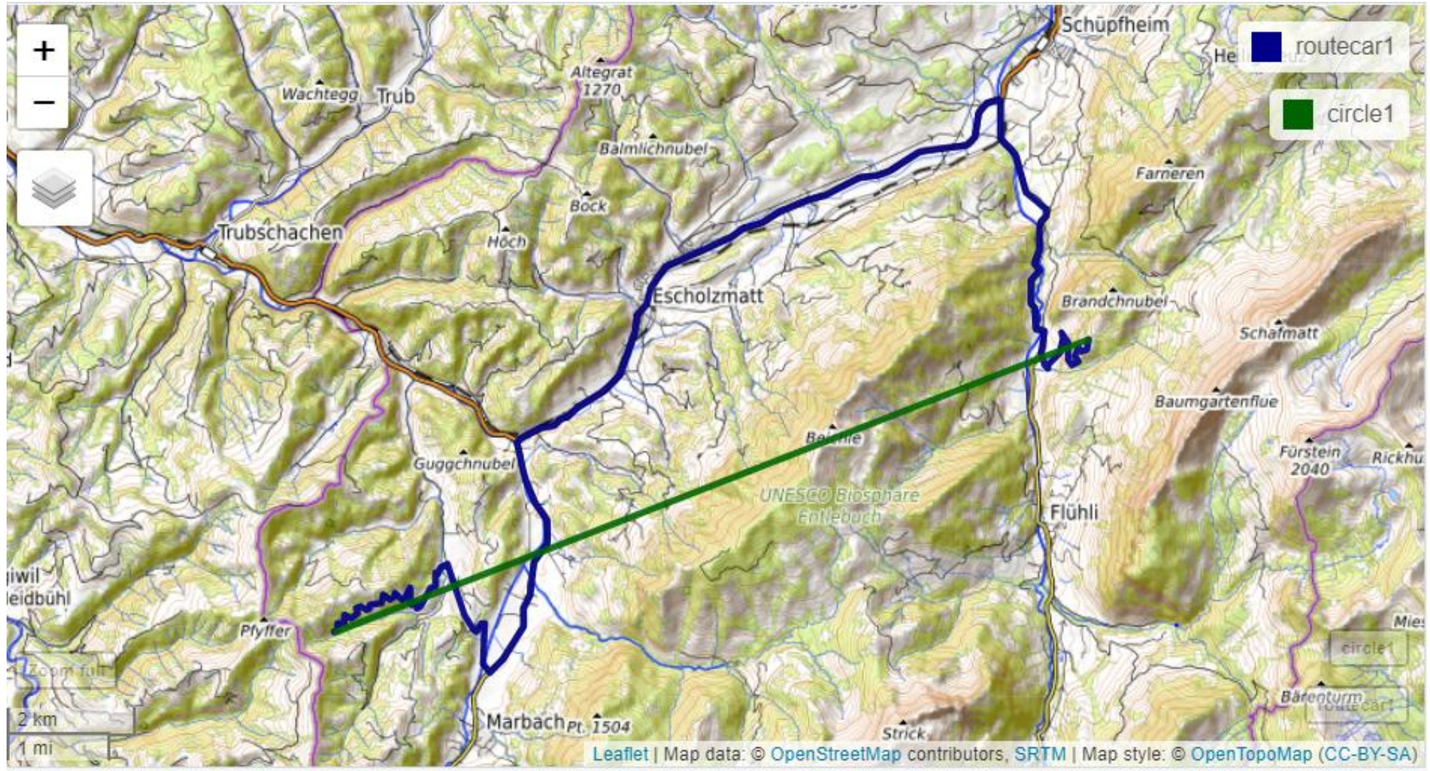
Routing: OSRM - http://project-osrm.org/

All locations are random samples

Routing from optimal practice to farm: shortest path on Earth with route on the road (topographic map)



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Graph theoretical modeling / graph clustering approach

All locations are random samples in this example.

- Weighted bipartite graph
- Graph clustering
- Example for 2 practices, 5 farms (R/igraph)

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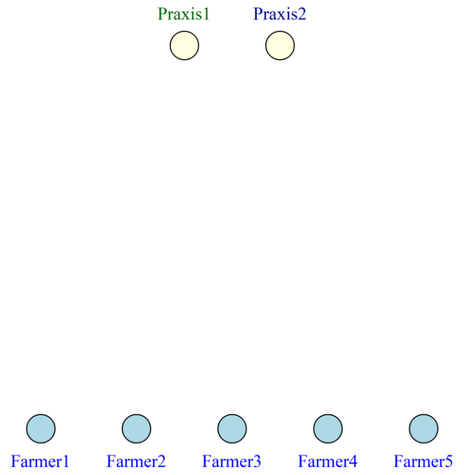

- Vertices representing practices
- Vertices representing farms

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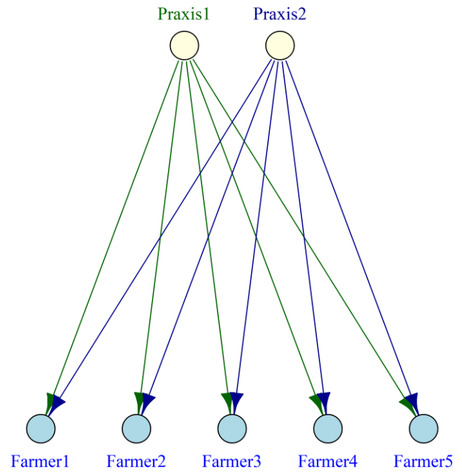
- Vertices representing practices
- Vertices representing farms
- Directed edges



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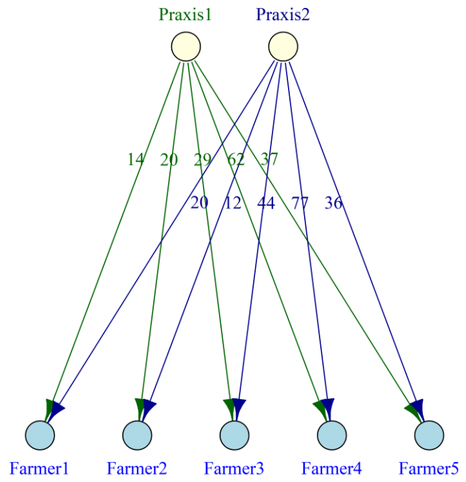
- Vertices representing practices
- Vertices representing farms
- Directed edges
- Weights on edges (here: road distance (osrm), km, rounded)



osrm copyright information for this example :

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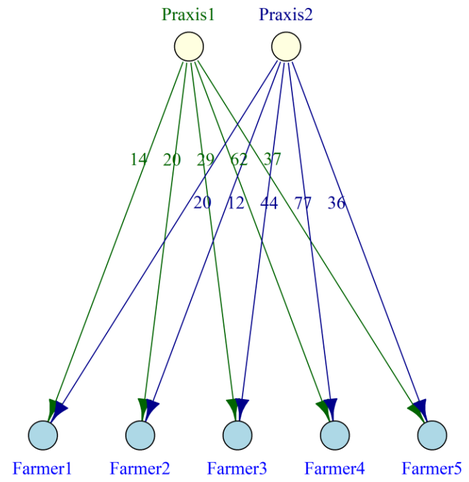
- Vertices representing practices
- Vertices representing farms
- Directed edges
- Weights on edges (here: road distance (osrm), km, rounded)
- Next step: For every farm vertex, keep only edge with minimal weight



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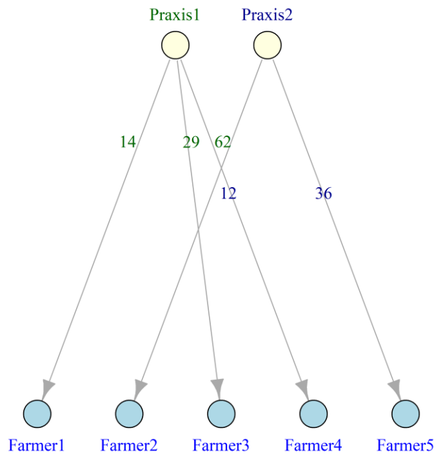

Result of assignment process:

- Practice 1 optimal for 3 farms
- Practice 2 optimal one for 2 farms

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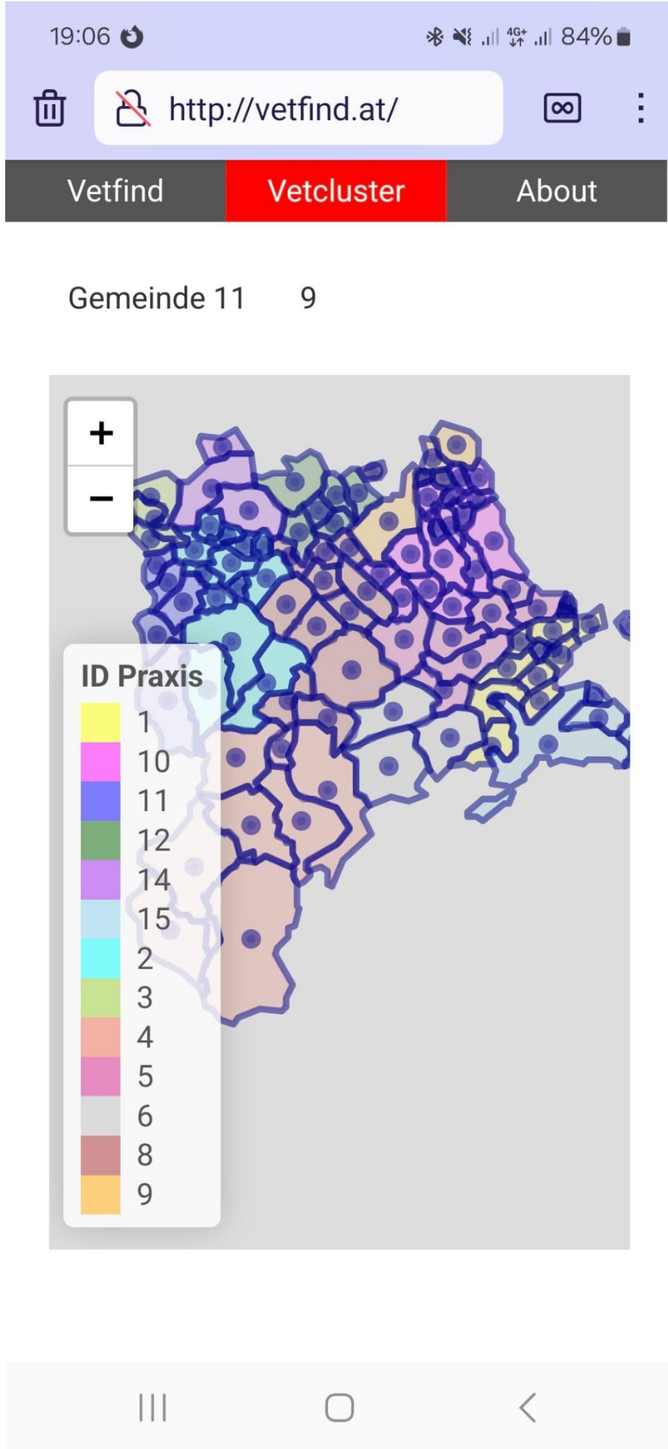
```

Application vetcluster

- Returns veterinary care regions (for a given region)
- Returns map showing veterinary care regions
- Returns ID of the calculated practice for the selected subregion

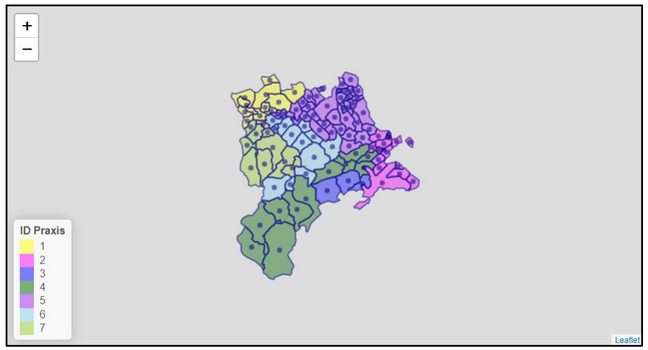
- Technical solution:
  - Calculation based on road-distance (one distinguished point for each subregion)
  - Find optimal practice for each point and assign subregions according to the assignments
  - R Shiny application: packages *shiny*, sp, *sf*, *tidyverse*, *osrm*, *leaflet*

Remark: practice locations are random samples, (sub-)region(s) and points should be viewed as placeholders, names are placeholders

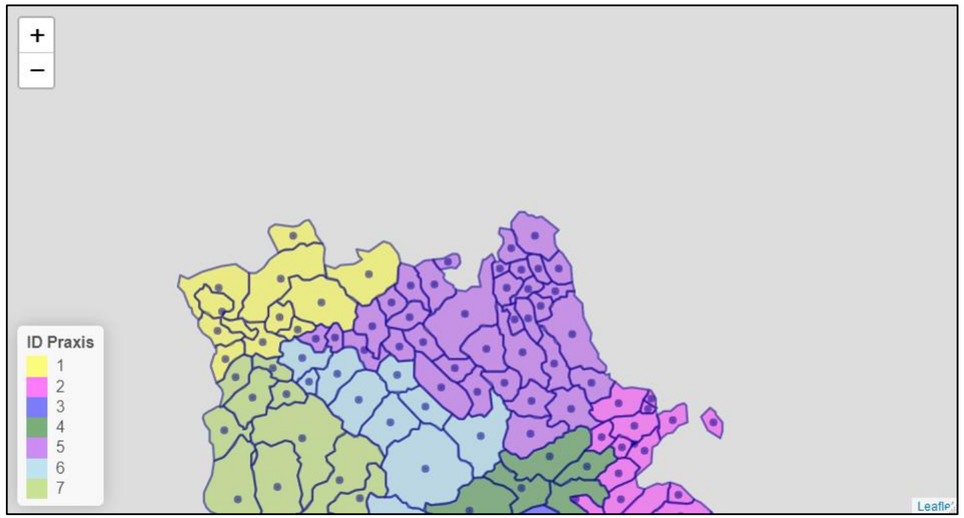


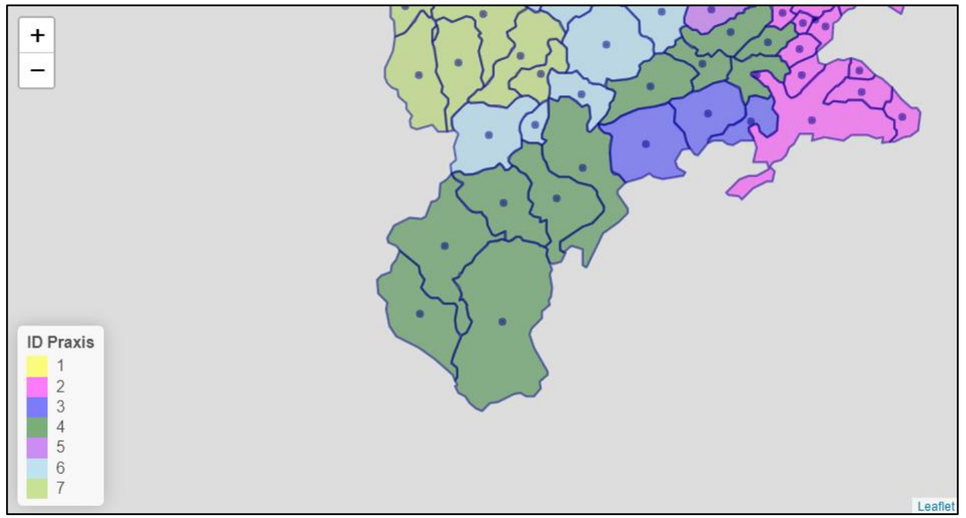
Illustration

Yellow region: services by **Praxis 1**



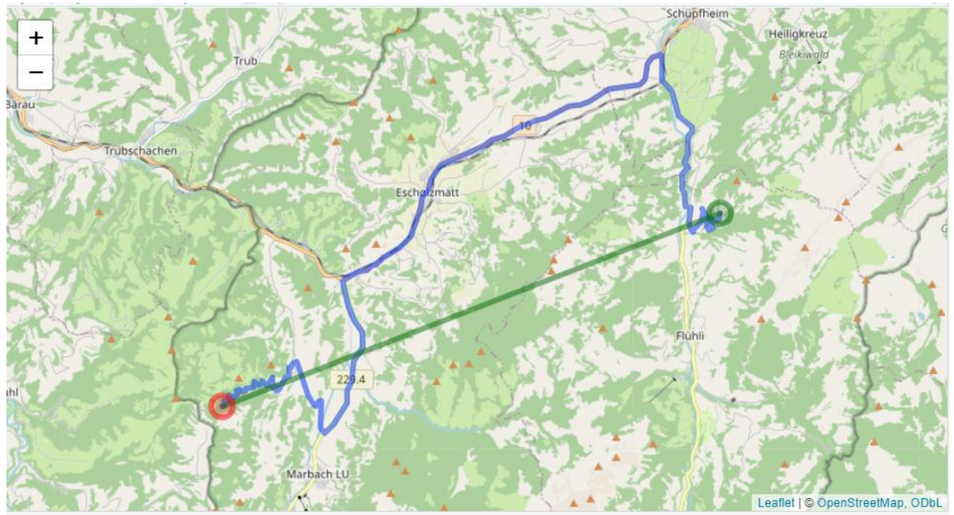
Green region: services by **Praxis 4**



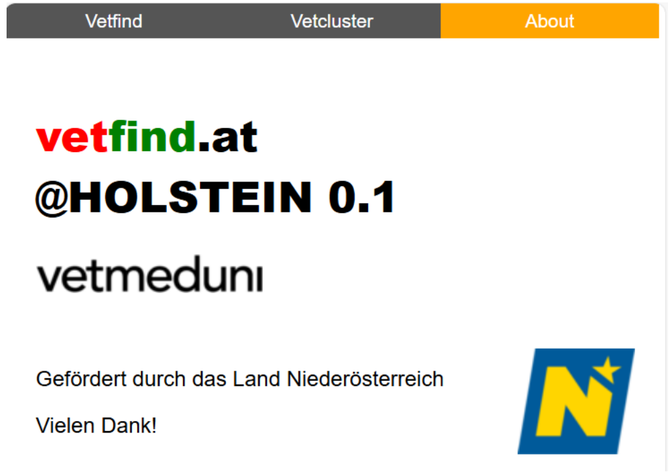


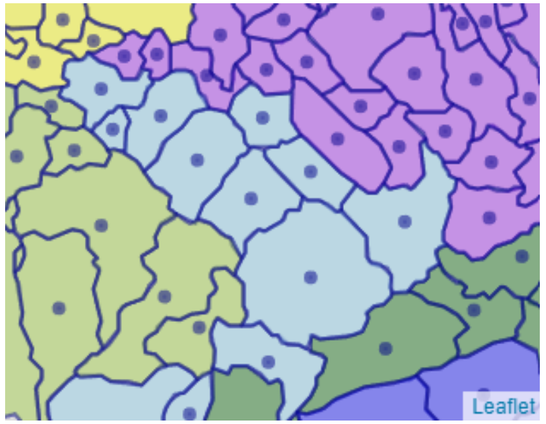
Future work

- Use patient's location as user input
- Use real data (placeholders for privacy and legal issues by now)
- Use real-time data (e.g., changing actual locations of the veterinarians, additional emergengies)
- Use more complex weight function (include, e.g., specialization of veterinarians, topographic data)



THANK YOU FOR YOUR ATTENTION!





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GEFÖRDERT IM RAHMEN DER FTI-STRATEGIE NIEDERÖSTERREICH 2027

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