

# 1. Popis projektu

Aplikácia by mala pomôcť šoférom alebo ľuďom, ktorí si potrebujú načerpať palivo a nevedia, kde presne sa nachádza. Keďže dáta z druhého datasetu sú z Ameriky, budem sa zameriavať v projekte na štát Colorado.

Celá aplikácia sa skladá z troch častí a to databáza, kde mám uložené dva zdroje dát, ktoré som spomínal vyššie. Potom backend(FLASK), ktorý prijíma požiadavky z frontendu a zároveň spracováva a vytvára dopyty na databázu. Následne všetko konvertuje do formátu GEOJSON a odosiela na frontend. Frontend(MAPBOX-GL) spracováva a zobrazuje informácie cez formát geojson, filtruje a posiela requesty na backend.

Celkovo som pracoval s dátami na Mapboxe ako s klastrami, takže sa zobrazujú niektoré stanice až po priblížení. Na mape je pohyblivý bod, pomocou ktorého sa dajú vykonávať scenáre. Vytvoril som aj heatmapu, ktorá znázorňuje hustotu benziniek na mape. Ikony na mape sú rozdelené podľa toho aké palivo je možné načerpať, teda palivo z ropy alebo na elektické palivo.

Najdôležitejšie scenáre:

- Nájsť najbližších 10 benziniek
- Benzíny v okruhu 5 km
- Filtrovanie podľa elektrickej benzinky a elektrického paliva
- heatmapa benziniek
- zobrazenie počtu benziniek a elektrických čerpacích staníc

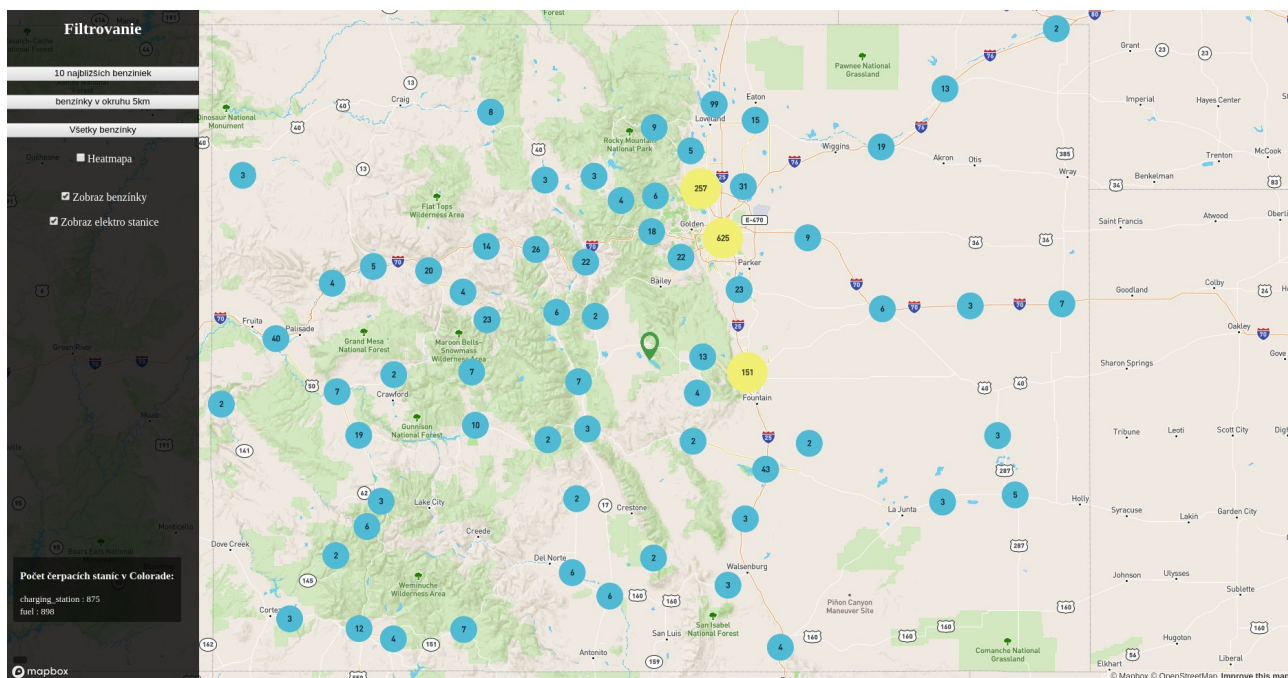
**Zdroj dát:** Openstreetmap.com, API na tankovacie

stanice: <https://developer.nrel.gov/docs/transportation/alt-fuel-stations-v1/>

**Použité technológie:** POSTGIS, PYTHON, MAPBOX-GL

## 2. Frontend

Ako frontend som použil Mapbox-GL, ktorý je novšia verzia mapboxjs. Aplikácia zobrazuje benzíny a elektro stanice na mape, ktoré sa zobrazujú v klastroch. Na frontende je možné filtrovanie dát, ktoré sa odosielajú na backend pomocou rôznych requestov. Na frontende je možné zobrazovať všetky scenáre popísané vyššie. Treba mať spustený plugin CORS, ktorý povoľuje Access-Control-Allow-Origin.



Obr. 1: Ukážka systému

## 2. Backend

Ako backend som použil Flask, čo je pythonovský framework na routovanie. Tu som písal všetky query potrebné na databázu. Celkovo je práca s týmto frameworkom jednoduchá. Napríklad v porovnaní so SpringBootom od javy.

```
cursor.execute("""SELECT amenity, ST_X(way), ST_Y(way) FROM planet_osm_point
WHERE amenity = 'fuel' OR amenity = 'charging_station'
UNION
SELECT amenity, ST_X(geo), ST_Y(geo) from stations;""")

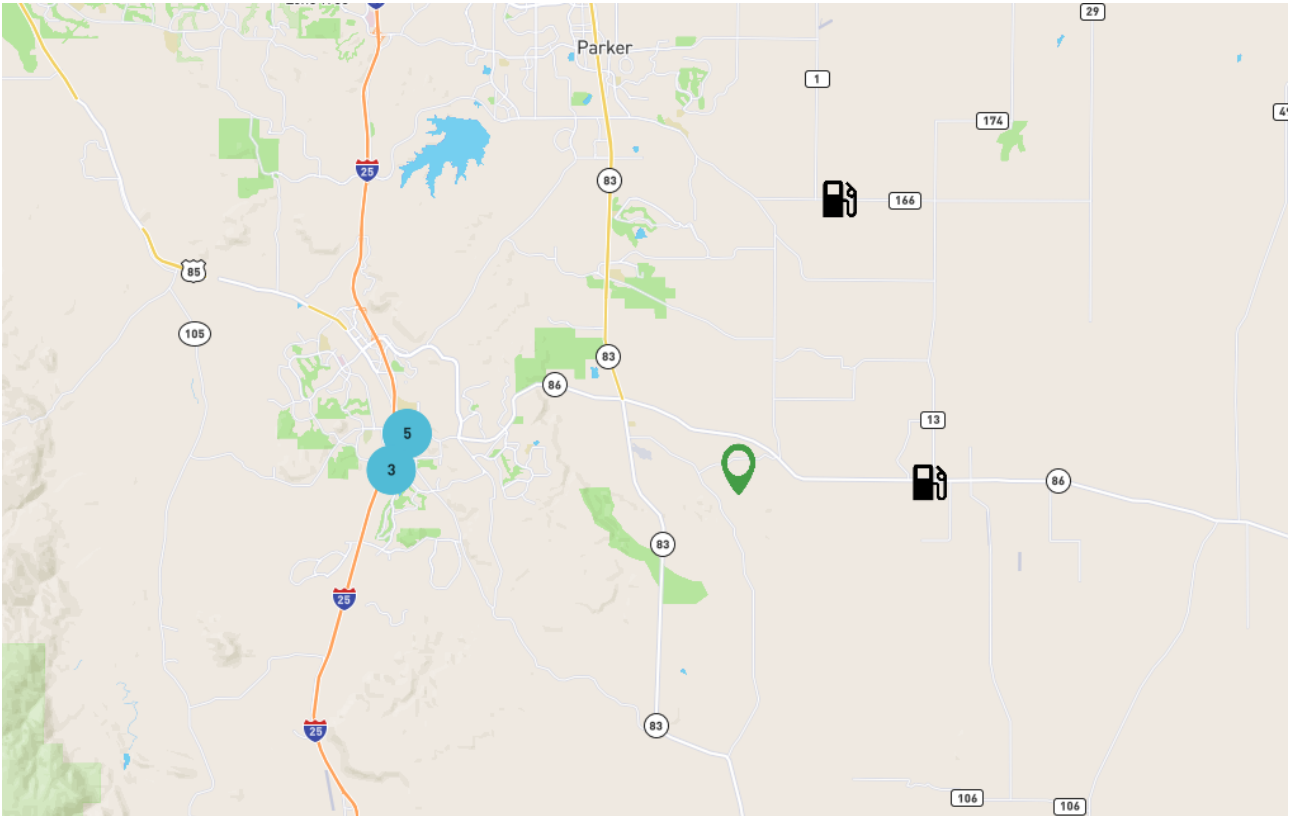
records = cursor.fetchall()
```

Obr 2: Ukážka selectu na BE

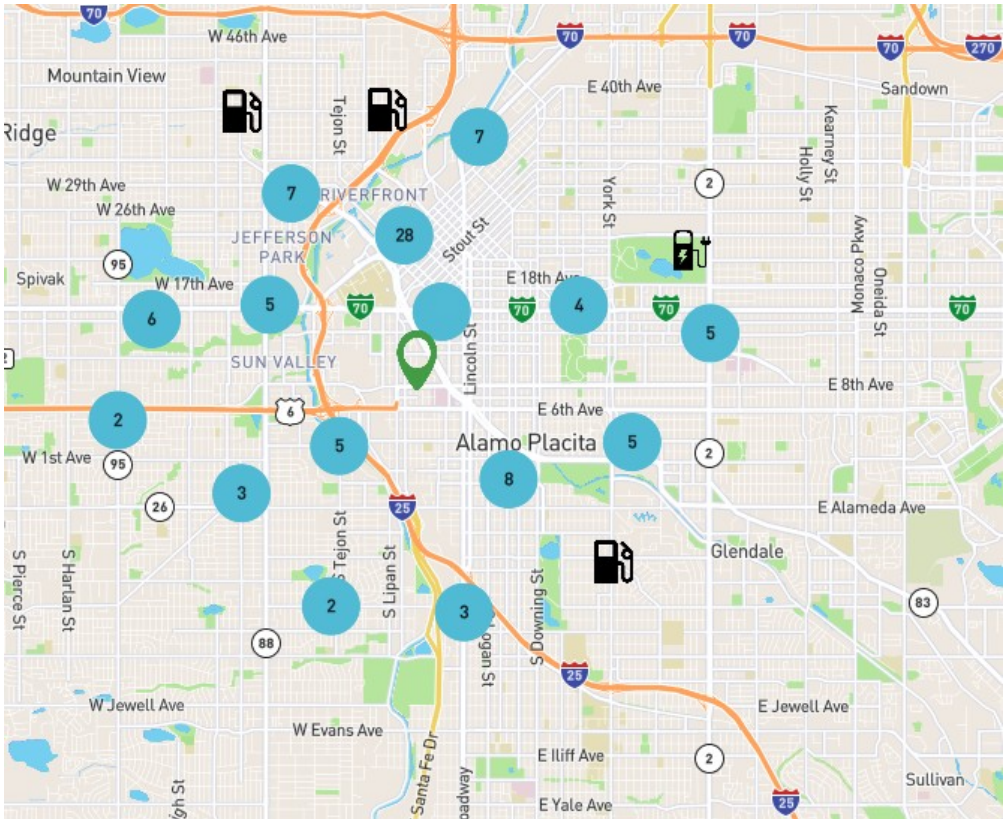
## 3. Ukážka scenárov

Na mape je možné hýbať pohyblivým bodom a tým meniť súradnice zadávania pri rôznych scenároch. K scenárom vždy pridávam query.

Nájdienie najbliŹších 10 benziniiek:



Nájdienie benzíniek v okruhu 5km:





A map of Colorado showing the distribution of red squirrels. The state is outlined in red, and numerous red dots indicate squirrel locations. Major cities like Denver, Fort Collins, and Colorado Springs are labeled. National forests and grasslands are also marked.

The map displays the proposed light rail line in orange, starting from the airport and heading west through Thornton, Federal Heights, and Westminster towards downtown Denver. The line follows major corridors like I-25 and I-76. Key locations and landmarks include Thornton, Federal Heights, Westminster, and parts of Denver. The map also shows major highways (I-25, I-76, I-70, I-495, I-270, I-225, I-224, I-222, I-220, I-218, I-216, I-214, I-212, I-210, I-208, I-206, I-204, I-202, I-200, I-198, I-196, I-194, I-192, I-190, I-188, I-186, I-184, I-182, I-180, I-178, I-176, I-174, I-172, I-170, I-168, I-166, I-164, I-162, I-160, I-158, I-156, I-154, I-152, I-150, I-148, I-146, I-144, I-142, I-140, I-138, I-136, I-134, I-132, I-130, I-128, I-126, I-124, I-122, I-120, I-118, I-116, I-114, I-112, I-110, I-108, I-106, I-104, I-102, I-100, I-98, I-96, I-94, I-92, I-90, I-88, I-86, I-84, I-82, I-80, I-78, I-76, I-74, I-72, I-70, I-68, I-66, I-64, I-62, I-60, I-58, I-56, I-54, I-52, I-50, I-48, I-46, I-44, I-42, I-40, I-38, I-36, I-34, I-32, I-30, I-28, I-26, I-24, I-22, I-20, I-18, I-16, I-14, I-12, I-10, I-8, I-6, I-4, I-2, I-0) and local streets (W 104th Ave, W 100th Pl, W 99th Ave, W 98th Ave, W 97th Ave, W 96th Ave, W 95th Ave, W 94th Ave, W 93rd Ave, W 92nd Ave, W 91st Ave, W 90th Ave, W 89th Way, W 88th Ave, W 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Zobrazenie počtu benzínok a elektrických čerpacích staníc:



#### 4. Ukážka scenárov

Na optimalizáciu query som použil indexovanie na základe parametru amenity. Čo mi v každom scenári zrýchlilo query v prepočte cca o 500 percent. V screenshots som vždy skopíroval výsledok pred použitím indexu a po použití indexu. Vytvorenie indexu:

```
create index index_planet_osm_point_on_amenity on planet_osm_point(amenity);
```

Všetky výsledky:

```
GroupAggregate (cost=13777.21..13778.57 rows=68 width=64)
GroupAggregate (cost=2640.09..2641.45 rows=68 width=64)
SELECT amenity, SUM(amenityCount) FROM (SELECT amenity, COUNT(amenity) as amenityCount FROM planet_osm_point
WHERE amenity = 'fuel' OR amenity = 'charging_station'
GROUP BY amenity
UNION
SELECT amenity, COUNT(amenity) as amenityCount from stations
GROUP BY amenity) AS subquery
GROUP BY amenity;
```

Nájdenie benzínok v okruhu 15 000 km:

```
Sort (cost=24765.69..24767.07 rows=551 width=56)
Sort (cost=2768.66..2770.04 rows=551 width=56)
SELECT * FROM (SELECT amenity, ST_X(way), ST_Y(way), 111.045 * DEGREES(ACOS(COS(RADIANS(39.05066563434664))
* COS(RADIANS(ST_Y(way)))
* COS(RADIANS(ST_X(way)) - RADIANS(-105.67662502733549))
+ SIN(RADIANS(39.05066563434664))
* SIN(RADIANS(ST_Y(way)))))) AS distance_in_km FROM planet_osm_point
WHERE amenity = 'fuel' OR amenity = 'charging_station'
UNION
SELECT amenity, ST_X(geo), ST_Y(geo), 111.045 * DEGREES(ACOS(COS(RADIANS(39.05066563434664))
* COS(RADIANS(ST_Y(geo)))
* COS(RADIANS(ST_X(geo)) - RADIANS(-105.67662502733549))
+ SIN(RADIANS(39.05066563434664))
* SIN(RADIANS(ST_Y(geo)))))) AS distance_in_km FROM stations
ORDER BY distance_in_km ASC) AS subquery
WHERE distance_in_km <= 15000;
```

## Najbližších 10 benziniek:

```
Limit (cost=13983.84..13983.86 rows=10 width=56)
Limit (cost=2790.71..2790.74 rows=10 width=56)
SELECT amenity, ST_X(way), ST_Y(way), 111.045 * DEGREES(ACOS(COS(RADIANS(39.04))
    * COS(RADIANS(ST_Y(way)))
    * COS(RADIANS(ST_X(way)) - RADIANS(-105.558522))
    + SIN(RADIANS(39.04))
    * SIN(RADIANS(ST_Y(way)))))
AS distance_in_km
FROM planet_osm_point
WHERE amenity = 'fuel' OR amenity = 'charging_station'
UNION
SELECT amenity, ST_X(geo), ST_Y(geo), 111.045 * DEGREES(ACOS(COS(RADIANS(39.04))
    * COS(RADIANS(ST_Y(geo)))
    * COS(RADIANS(ST_X(geo)) - RADIANS(-105.558522))
    + SIN(RADIANS(39.04))
    * SIN(RADIANS(ST_Y(geo)))))
AS distance_in_km
FROM stations
ORDER BY distance_in_km ASC
LIMIT 10;
```

## Zobrazenie počtu benziniek a elektrických čerpacích staníc(agregačná funkcia):

```
GroupAggregate (cost=13777.21..13778.57 rows=68 width=64)
GroupAggregate (cost=2640.09..2641.45 rows=68 width=64)
SELECT amenity, SUM(amenityCount) FROM(SELECT amenity, COUNT(amenity) as amenityCount FROM planet_osm_point
    WHERE amenity = 'fuel' OR amenity = 'charging_station'
    GROUP BY amenity
UNION
    SELECT amenity, COUNT(amenity) as amenityCount from stations
    GROUP BY amenity) AS subquery
GROUP BY amenity;
```