FR Hack 2024

Challenge #3

Securing the route of Olympic flame in terms of radio coverage

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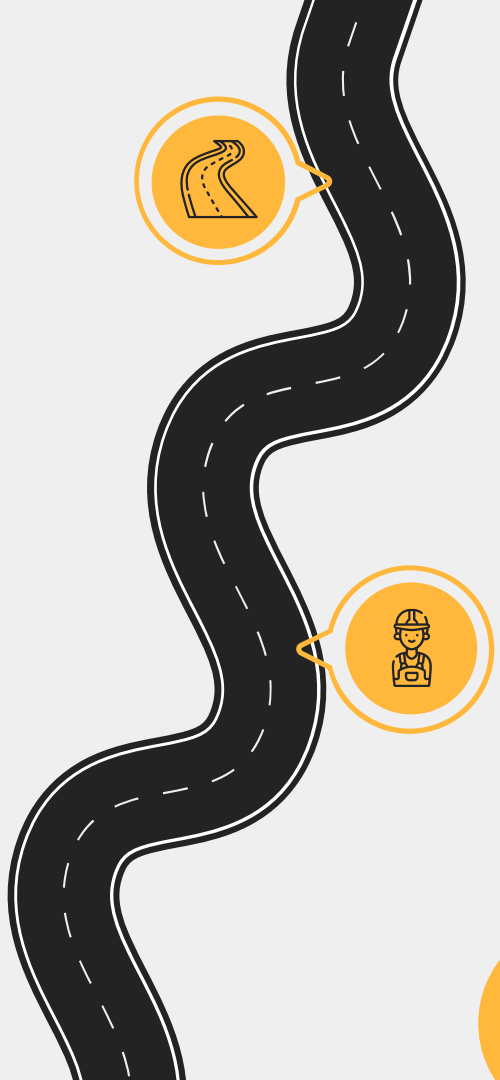
Code: https://github.com/risg99/FRHack2024



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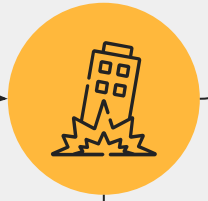
Objectives

What do we aim in this project



Challenges

Brief description of problem statement & associated challenges

Our Solution

The solution chosen and algorithm used

Demo

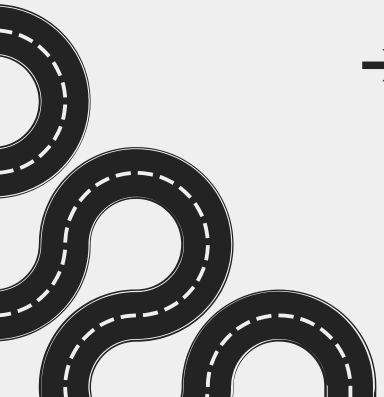
Dashboard

Problem Statement

Securing the route of the Olympic Flame in terms of radio coverage

Objectives

- Identify **rural, peri-urban, urban** areas
- Use **elementary surfaces** to divide these areas
- Obtain **average power** in each elementary surface - 4G/5G
- Determine the **optimal route** for the Olympics flame
- **Automate** the prototype for reproducibility



Challenges Tackled

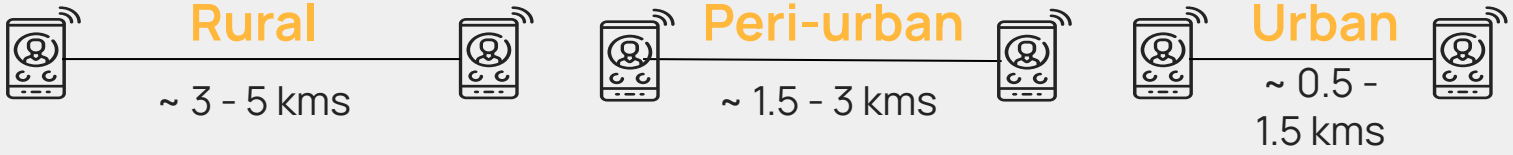
Objective 1: Identify **rural, peri-urban, urban** areas

- Understand 3 departments: Blois (41), Orléans (45) & Auxerre (89)
- Obtain different areas:
  - Rural
  - Peri-urban (Suburban)
  - Urban

Challenges Tackled

Objective 2: Use **elementary surfaces** to divide these areas

- Choose **tiles** to split the areas
- Consider the **density of population** in each department



Challenges Tackled

Objective 3: Obtain **average power** in each elementary surface - 4G/5G

- Calculate the average power for each
  - 4G
  - 5G

Challenges Tackled

Objective 4: Determine **optimal route** for the Olympics flame

- Best route passing through Blois (41), Orléans (45) & Auxerre (89)
  - Prefer 5G network over 4G
  - Optimise the cost (average power) - minimum as possible
- Determine the route for each operator like OP1, OP2, OP3 & OP4

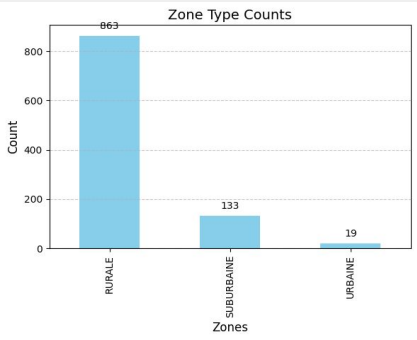
Challenges Tackled

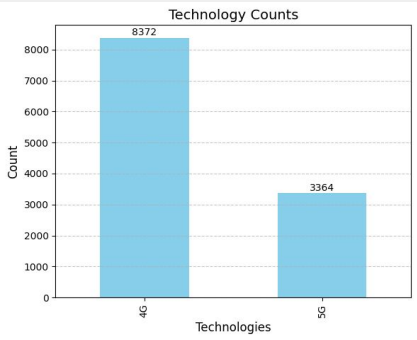
Objective 5: **Automate** the prototype for reproducibility

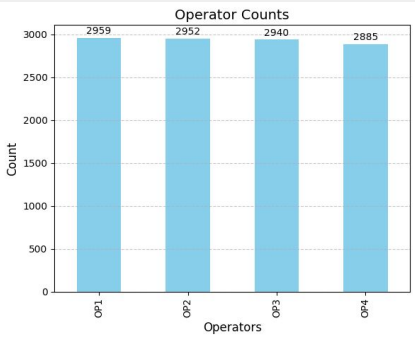
- Sample code for Blois (41), Orléans (45) & Auxerre (89)
- Automate for different departments for reproducibility

Data Exploration

- No empty rows/columns (data is clean)
- **Zones:** 3 in total Urbaine (19 points), Suburbaine (133 points) & Rurale (863 points)
- **Techno:** 2 in total 4G (8372 points) & 5G (3364 points)
- **Operateur**: 4 in total OP1, OP2, OP3, OP4 (all around 2900 points)







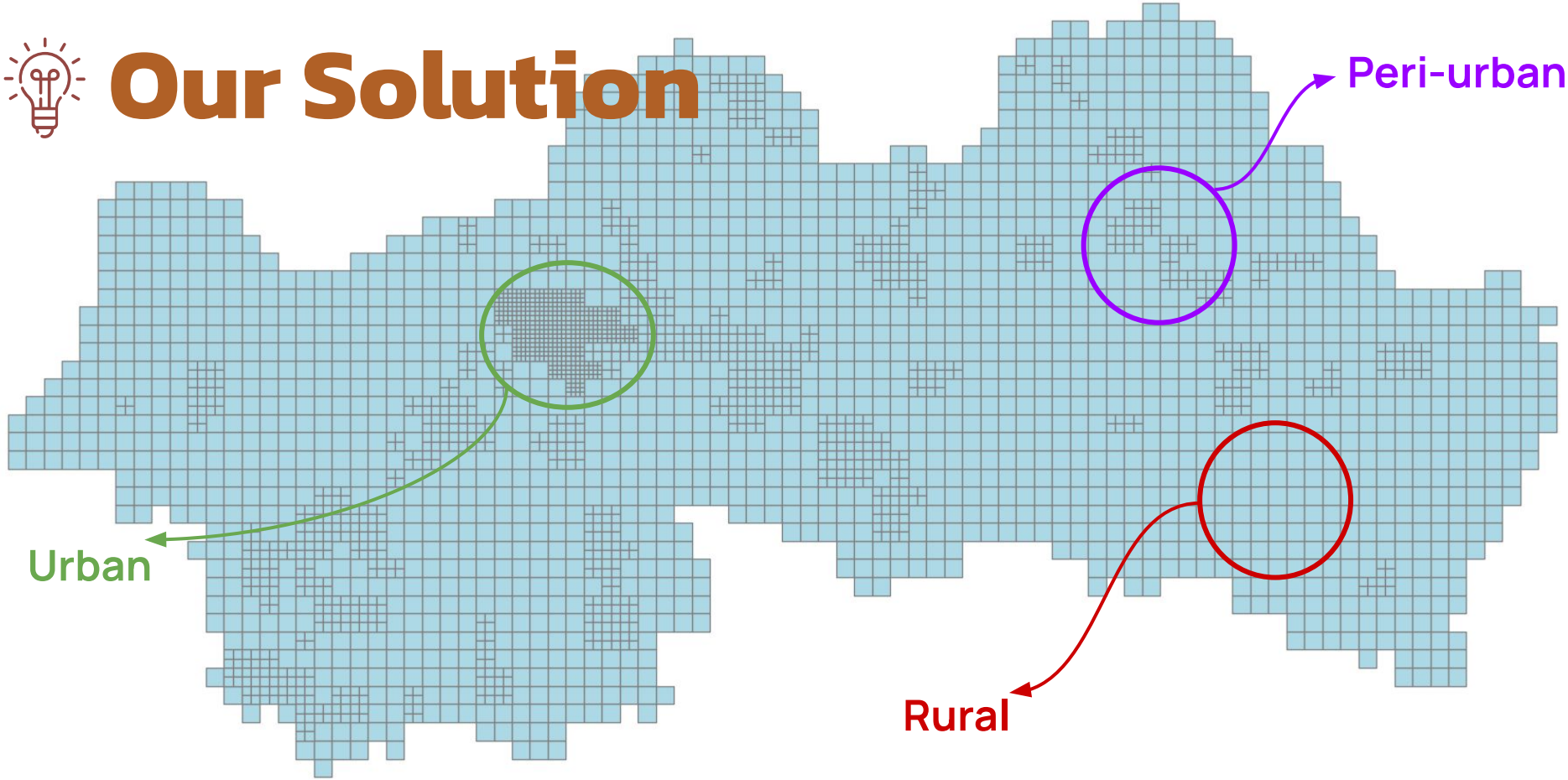
Our Solution

Objective 1: Identify **rural, peri-urban, urban** areas

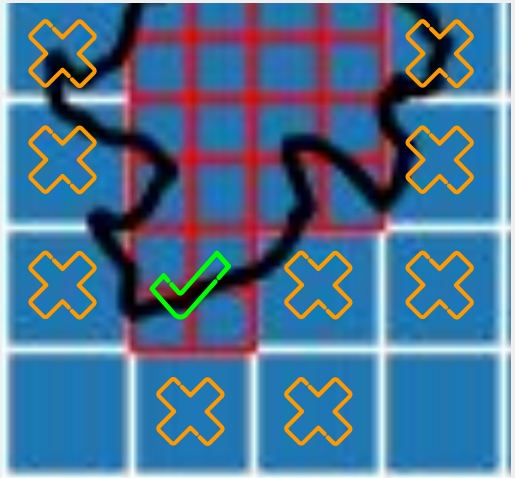
Objective 2: Use **elementary surfaces** to divide these areas

- Tile type used: **Square**
- Correlate density of population to the **size of square tiles**
  - Rural (very big squares)
  - Peri-urban (medium squares)
  - Urban (very small squares)
- Handle **irregular boundaries** conditionally

Our Solution

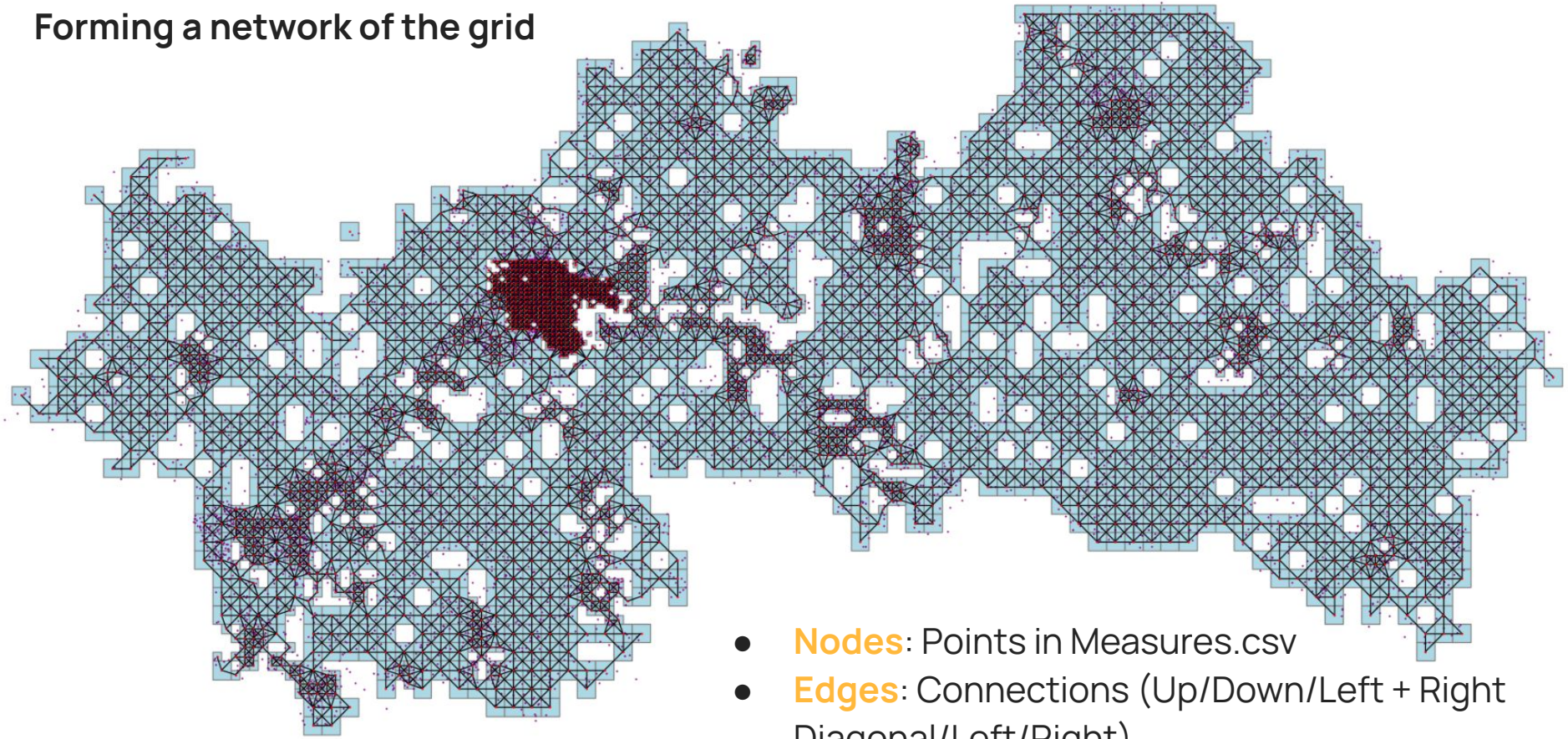


Our Solution



- Use idea of percentage covered in each area
- E.g.: Boundary between rural and peri-urban
  - Check percentage of area covered:
    - More than / Equal to 50% - peri-urban
    - Less than 50% - rural
- Dynamic percentage allowed (automated with a slider in the dashboard)

Forming a network of the grid



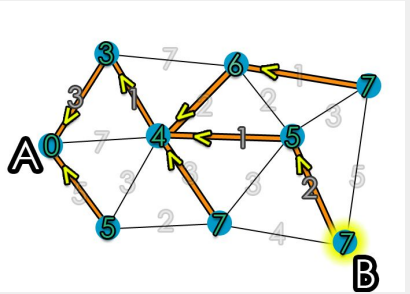
- **Nodes**: Points in Measures.csv
- **Edges**: Connections (Up/Down/Left + Right Diagonal/Left/Right)
- **Edge weights**: dBm value

Our Solution

Objective 3: Obtain **average power** in each elementary surface - 4G/5G

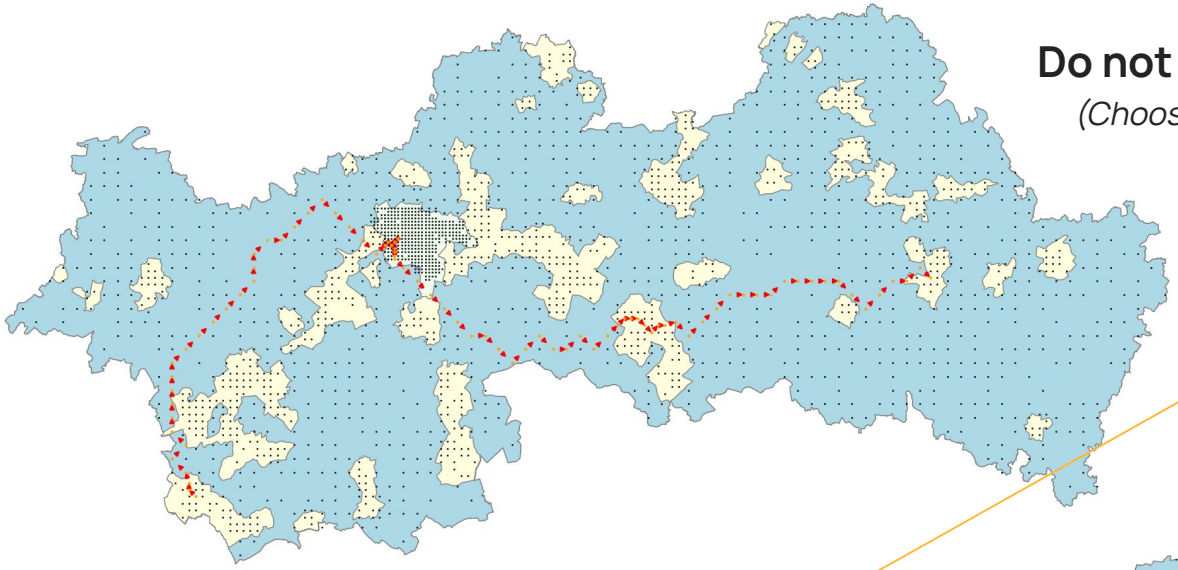
- Calculate the average power for each
  - 4G
  - 5G
- For each square tile: Average of all powers of the points inside it
- Results displayed in the dashboard (at the end)

Our Solution



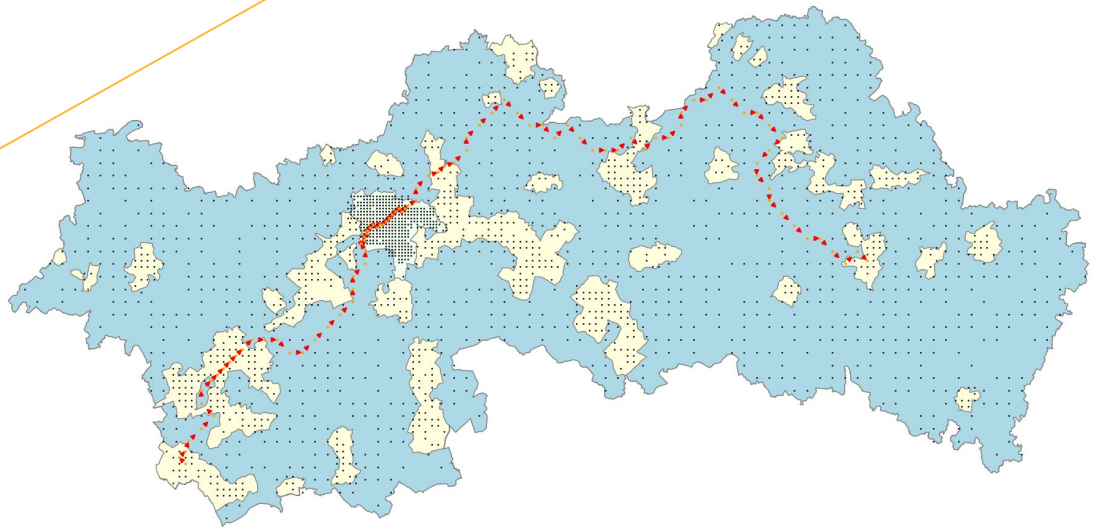
Objective 4: Determine the **optimal route** for each operator for the flame

- Algorithm used for best route: Dijkstra Shortest Path
- Best route passing through Blois (41), Orléans (45) & Auxerre (89)
  - Do not penalise 4G over 5G
  - Prefer 5G network over 4G
    - Always penalise 4G over 5G
  - Optimise the cost (average power) - minimum as possible



Do not penalise 4G over 5G

(Choose whichever is cheapest)



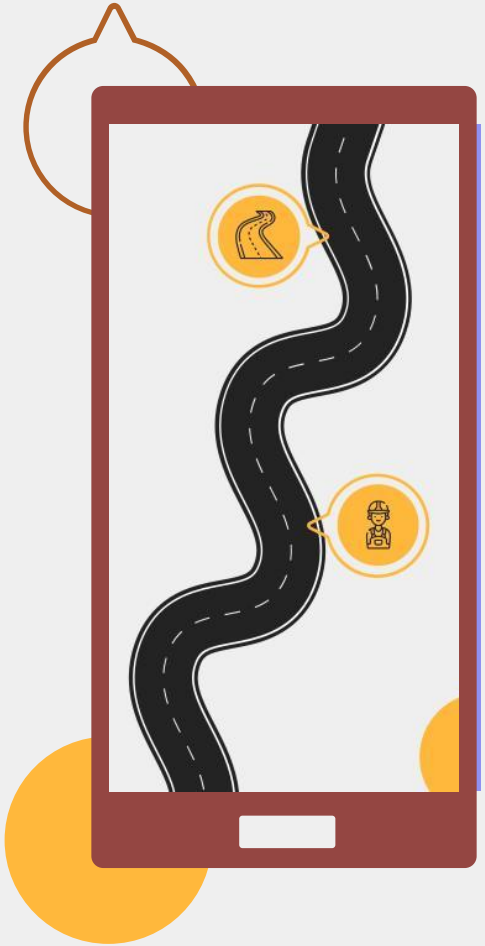
Penalise 4G over 5G

(Choose whichever is cheapest)

Our Solution

Objective 5: **Automate** the prototype for reproducibility

1. Provide input files as:
    - Communes D1_D2_D3_pour info.xlsx
    - Mesures sur D1 D2 D3.csv
    - .cpg, .dbf, .prj, .shp, .shx files for:
        - Zones RURALES D1 D2 D3
        - Zones PERI URBAINES D1 D2 D3
        - Zones URBAINES D1 D2 D3
        - Shape Depts D1 D2 D3
        - Shape D1 D2 D3
2. Structure the directory
3. Run the remaining code

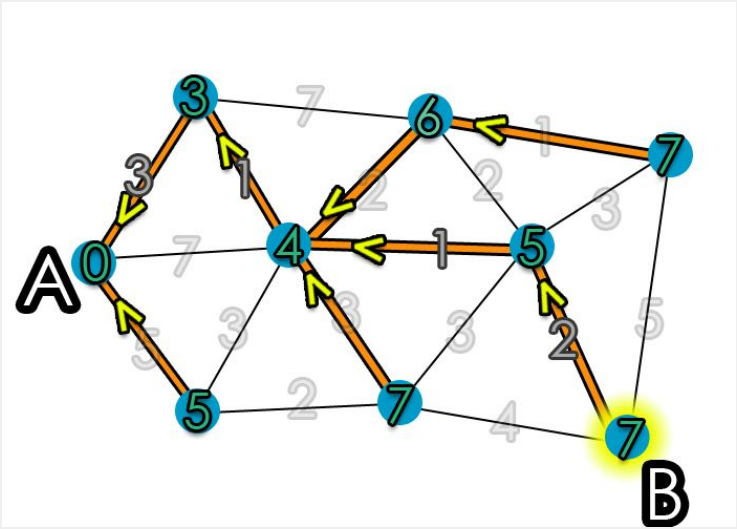


Let’s dive into the dashboard for a quick demo!

Thank you!

QnA?

Appendix



Weighted Dijkstra's Algorithm Shortest Path

- Source Node: from city Blois
- Destination Node: to city Auxerre
- Objective: Lowest cost (= average power)
- Start from source to destination
  - Repeatedly select nodes with lowest cost
    - Variant1: Penalise 4G over 5G
    - Variant2: Choose either 4G or 5G
  - Update if newly found path is better