Light Rail and Park&Ride facilities in Sioux Falls

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Civil Engineering

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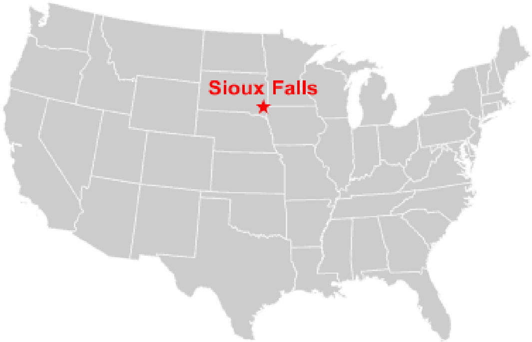
CIVIL-477 - Transport Networks Modelling & Analysis

Outlines

Introduction

Sioux Falls

- Most populous city in South Dakota
- More than 200'000 inhabitants (rapidly growing : 125 000 in 2000) [a]
- Superficy of 210 km^2
- Nice waterfalls
- 9 bus lines ! Run 6 days per week, ≈ every 30 min.
- Public on-demand service to supplement the bus lines.



[a] Source : Wikipedia

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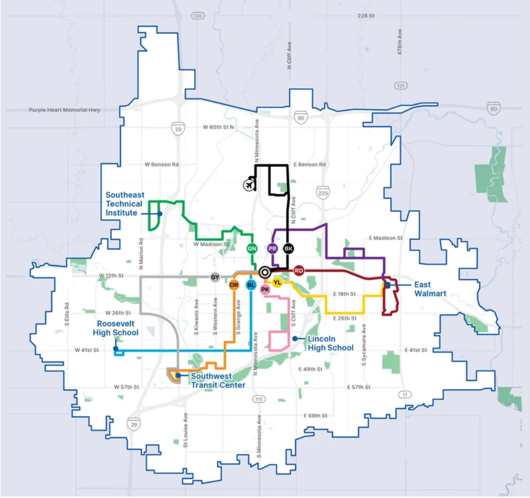

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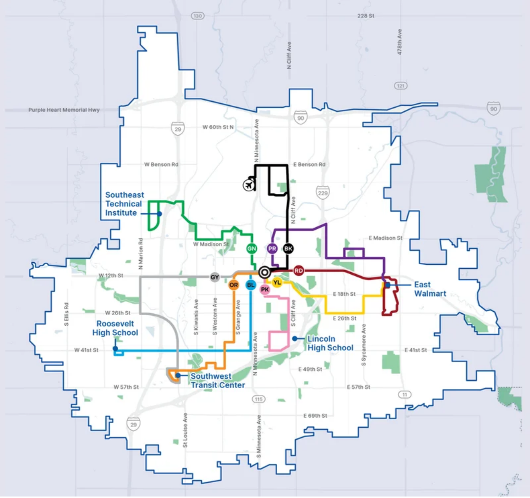
Adding a light rail



- Now let's imagine the city of SiouxFalls decides to enter in the 21st century
- And want to replace a bus line by a light rail line with Park & Ride facilities.
- What will be the impact on the trafic ?

Our study

Considering the classic 'Sioux Falls' benchmark network, and the current bus network of the city of Sioux Falls.

→ Add light rail transit lines to match current bus lines and the most used road links.

→ Test the trafic conditions in the 3 cases :

Base	No light rail
Light Rail	Light rail can only be taken when origin and destination is served by the network.
P&R	Light rail can only be taken when origin **or** destination is served by the network.

Methodology

Defining transit lines

1. Match the classic SiouxFalls network to the bus map (and vice-versa)
2. Compare with the Base situation to identify the most used road links.
3. Define transit lines
4. Compute distance and time of travel for the transit line

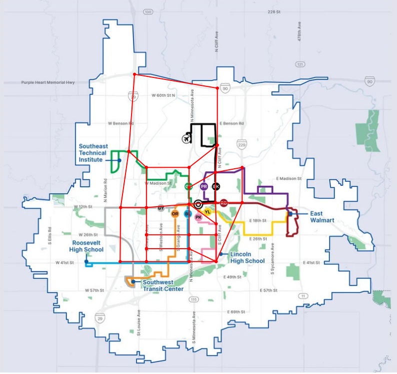


Figure: Sioux Falls nodes and edges matched on the bus map

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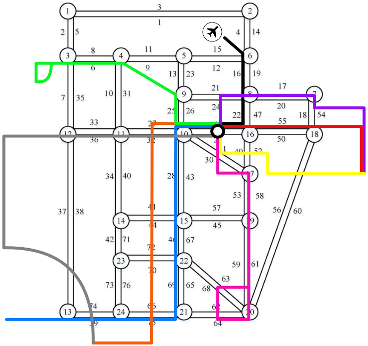

Figure: Sioux Falls bus lines matched on the classic network

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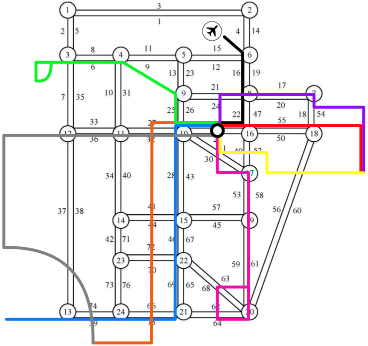

Figure: Base trafic flows (at UE)

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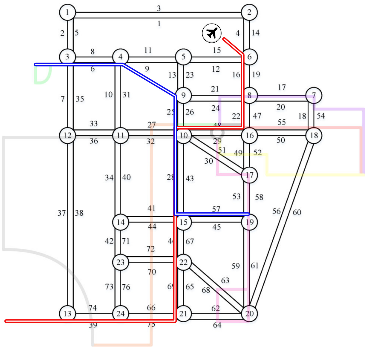

Figure: The two lines defined

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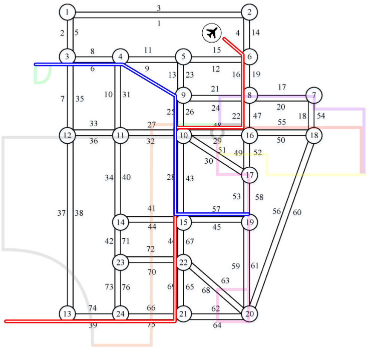

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Modelling trafic (Base case)

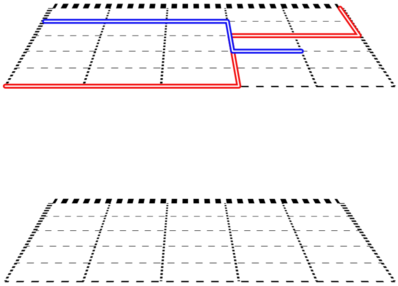
Classic Frank-Wolf algorithm

1. Update travel times
2. Descent direction (All-or-nothing assignment on the shortest path)
3. Determine step (line search)
4. Update link flows

Modelling trafic (Light Rail case)

Two layered approach

- The light rail network is another network
- For now : no connections between the two layers (no Park and Ride)
- For groups where origin and destination on the light rail network: change all-or-nothing assignment.
  - Compute the shortest path on both Networks
  - Assign the trafic only on the one with the shortest time (can use the labels of Dijkstra)



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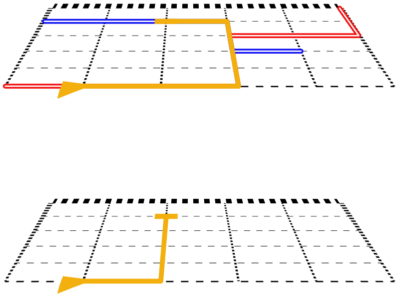
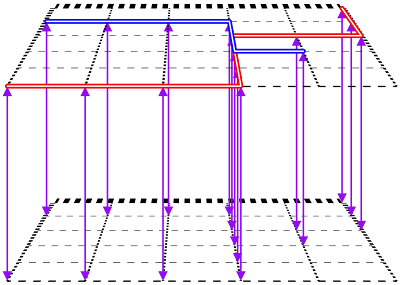


Figure: Shortest paths

Modelling trafic (P&R case)

Two layered approach, with connections

- Park & Ride facilities serve as connections between the two layers
- But, need to enforce only use one P&R facility
  - → Separate onboarding and offboarding links
  - → 3 possible networks
- (All-or-nothing assignment) For every group:
  - Compute travel time without light rail
  - If the origin is at a station, compute travel time with offboarding links
  - If the destination is at a station, compute travel time with onboarding links
  - ⇒ Assign trafic according to the one with the shortest time



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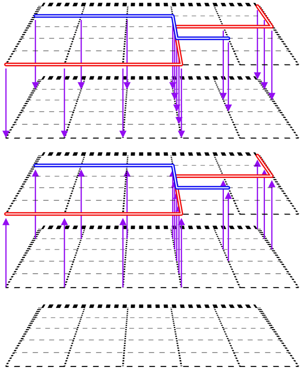

Figure: 3 networks

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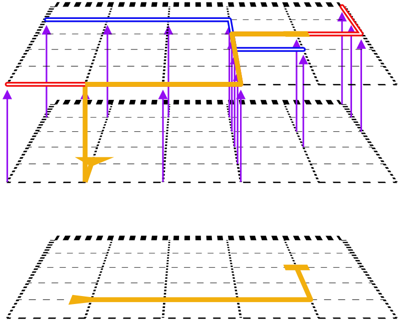

Figure: Shortest path example (onboarding links only)

Results