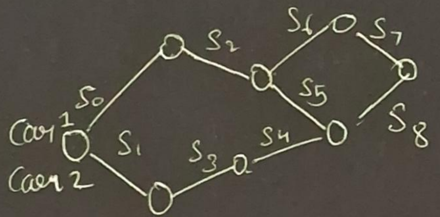
- $$C = \sum_{S_m \in S} \left(\sum_{q_{ij} \in B_{S_m}} w_{ij} q_{ij} \right)^2 + K \cdot \sum_{i=1}^{n} \left(\sum_{j=1}^{3} q_{ij} - 1 \right)^2$$

Here $S_m = \{ S_0, S_1, S_2, S_3 \ldots \}$ → all the edges involved in our routes

- 

→ A network example

On expanding the above cost function we get two types of term $(q_{ij})^2$ which becomes equivalent q_{ij} because of binary variable and another term of $q_{ij} \times q_{km}$ which can be ignored and some constant term.

- Similarly for traffic signal timing :

1) Each signal has two phases only (for simplicity): green or red
2) We optimize timing of green light signals (red can be evaluated) at each edge (j, i). Signal can be kept a i^{th} point
3) Each signal has a total cycle time combining all the phases and increasing green light at some signal decreases the timing at another.

So we have a constraint $= p \sum_{(i,j)} \left(g_{ij} - T \right)^2$

where T is cycle times and g_{ij} represent sum of binary variable of green time at edge (j, i)

Overall Cost function:

$$C = -\sum_{(i,j)} w_{ij} \cdot g_{ij} + P\sum_{(i,j)} \left(g_{ij} - T \right)^2$$

where w_{ij} is the edge congestion and we want to maximize the timing of green signal with maximum congestion.

- We have m number of constraint equations where m is the number of edges
- and for each edge from (j,i) we have constraint

$$\underbrace{g_{ij}}_{\text{sum of binary variable}} = T$$

$\rightarrow x_0 + 2x_1 + 4x_2 + \cdots$