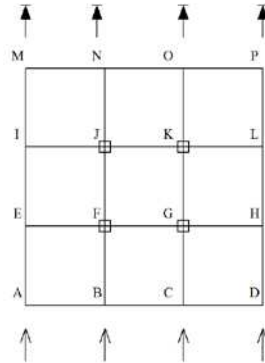# Topic 2

Implement a multi-agent system which manages traffic on a street layout with multiple intersections. The streets and intersections are configured as in the following image:

Each car is represented by an agent. Cars are incoming from entry points A, B, C, or D and each wants to get to one of the exits M, N, O or P.

E … L are intersections; in each intersection there is a traffic light. Traffic lights should be represented by agents as well. Each traffic light will have its own switching time interval. The switching times should be initialized with equal values at first.

At each intersection, the car agents decide which way to go in a *greedy* manner, i.e they will choose a direction which:
- is either left, right or forward
- is selected such that the total distance from entry point to exit is equal to the Manhattan distance between the entry point and the exit
  - for example, if a car wants to get from B to O, it should stay within the rectangle B-C-O-N
- has no obstacles / the least amount of obstacles

Possible obstacles are:
- **binary**: a red street light for that direction
- **continuous**: the amount of traffic in the desired direction (the number of cars in the corresponding road segment)

The cost of choosing a road segment k at a moment in time t can be computed as follows:

$$c_k(t) = \frac{l_k}{v_k(t)}$$

where l_k is the length of the road segment and $v_k(t)$ is the speed the car will be able to use on that road segment:

$$v_k(t) = \overline{v_k} \cdot \left[1 - \frac{q_k(t)}{y_k(t)}\right]$$

where:
$\overline{v_k}$ is the maximum speed attainable on road segment k
$q_k(t)$ is the number of vehicles on road segment k at time t (the vehicle flow on that segment)
$y_k(t)$ is the maximum number of vehicles that can be present on road segment k (i.e. the capacity of road segment k)

The system should be controllable by multiple user-defined parameters, which should be read from a simple config file. The control parameters are:
- the intelligence of traffic lights
  - non-intelligent traffic light: the switching time is constant, no matter the traffic
  - intelligent: the switching time depends on the traffic
    - in this case, another parameter whould be the level of intelligence:
      - level 1: the street light has knowledge of the amount of traffic in its adjacent street segments
      - level 2: the street light has knowledge of the amount of traffic as far as two street segments away from its position
      - level 3: the street light has full knowledge of the amount of traffic, on all street segments
- the rate with which cars are generated at each entry point A, B, C, D. Rate = cars/second, cars/minute etc.
- whether cars will prioritize street lights or the amount of traffic, meaning:
  - whether a car at an intersection will choose a street segment with a green light or
  - whether a car will wait at a red light if there is lower traffic on the following street segment

A visual representation of the street segments, street lights and cars is required in order to better analyze the behavior of the system.
Note: you do not have to implement the intelligent behavior of the street lights, but you have to provide the functionality for the street light to receive the required amount of knowledge.