

## **Project 2: Rush-hour overpass and underneath main roads**

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### **What will we simulate?**

In a city like Shanghai in China, the complicated overpass in the road system is designed to provide a smoother traffic flow with no traffic lights on the overpass. Many entrances and exits are set to allow cars to enter the overpass or exit it on to the main road beneath the overpass. The road beneath the overpass is the road we commonly see in life with traffic lights, crossroads and pedestrian crossing.

In this project, we will simulate the traffic flow of an overpass-main road system during rush hours. Rush hour traffics has a significant pattern with heavier traffic flow going into the overpass since overpass connects with expressways and highways linking suburbs and the downtown. However, traffic control centers often close some entrances along the overpass to reduce the additional traffic flow into the overpass. This, as a result, increases the traffic flow on the main road beneath the overpass. To see if closing some entrances would really increase the total traffic flow, we will simulate traffic flows under multiple conditions. Firstly, we will simulate the traffic flow when all the entrances are open. Then we will close part of the entrances, and see what result would occur under this circumstance, especially on the main road beneath the overpass. Finally, we will simulate the situation in which two cars start at the same point but take different routes through overpass or through the main road, and we will measure their arrival time at the endpoint. In such a way, we can learn under a condition which road should we choose. Since speed is the main factor drivers depend on to judge the condition of the traffic flow, we will cover it in our simulation and we may use the average speed to represent the actual situation.

### **What will we study?**

Whether the entrance should be closed or not depends on the traffic flows on the overpass and the main road. This leads to comparisons between all the situations where different combinations of entrances are closed. Since the effect on the traffic flow of the overpass and the main road is complex, we will consider the situation based on the following aspects: Firstly, the closure of the entrance may not only affect the traffic flow of the overpass and the main road, but also have impacts on the traffic flow of the following entrances. This is because there may have vehicles still want to enter into the overpass if they have already passed a closed one. We will tune the possibility of each car enter onto the overpass when they are at an entrance. Secondly, delayed traffic lights (traffic light will not turn to red or green at the same time) may affect the total traffic flow on the main road. We will try to set tune the time between adjacent traffic

lights in our simulation. Since the opposite direction is the same as one direction, we will only cover the situation for a single direction. Thirdly, speed is an important parameter which will influence on the traffic flow, we will tune the speed parameter under different circumstances to see how will it influence on the traffic flow and the time that a car will take to reach to a specific point. Other parameters such as traffic light duration time, the number of lanes on each road, the probability of car exit overpass, etc. will also be taken into our consideration.

### **What steps will we follow?**

1. Design the overpass and the main road system, including the parameters such as numbers of entrances and exits on the overpass, the number of crossings on the main road, and the lasting time of green lights of all traffic lights, etc.
2. Initialize traffic flow data. The overall traffic flows are divided into three categories:
  - 1) Initial traffic flow into the starting point of the overpass and the main road
  - 2) The traffic flow for both enter and exit through the entrance and the exit, or the possibilities that vehicles will enter or exit through the entrance or exit. These will be uniform in figures but reversed in direction for the overpass and the main road.
  - 3) The traffic flow to/from the main road from/to the sub-roads, but the traffic flow of sub-roads will not be calculated.
3. Simulate the traffic condition of the overpass and the main road into the endpoint in the basic situation in which all the entrances remain open.
4. Change the traffic flows of different entrances to simulate situations in which some of the entrances are closed, and repeat 3. Change different parameters to see how will they influence the traffic flow.
5. Mark two cars at the start point of our system and compare the time they took to reach the same endpoint under different situations.