



2020년 4월 26일

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Class: Special topics in Cybr, Python

Homework 4.

## Goal

1. executing example code and make a variation on variables to make a better modification on simulation.
2. using matplotlib and pandas dataframe, show graph of each result.

Step1. get ratio of North-South lanes to East-West lanes.

Considering we have limited budget making lanes, before decide how many lanes we need, we need to decide ratio of NORTH-SOUTH lanes to EAST-WEST lanes.

To get a proper lane ratio, Reading CSV file, and contract and counting which directions the cars goes.

EAST-WEST direction was 20832 (9255 + 11577)

and SOUTH-NORTH direction was 11188

Roughly, the proper ratio was 2:1

To find out if this figure is ideal, I compare the result of average wait time of different ratio,

first one was 1:1 (3:3) , and second one was 2:1 (4:2)

both condition has same amount of total lanes, 6.

SOUTH-EAST lanes to NORTH-SOUTH lanes ratio

average wait time of 3:3 , 21.689038101186757

average wait time of 4:2 , 18.498906933166772

wait time of 2:4 (reversed condition) : 21.028263585259214

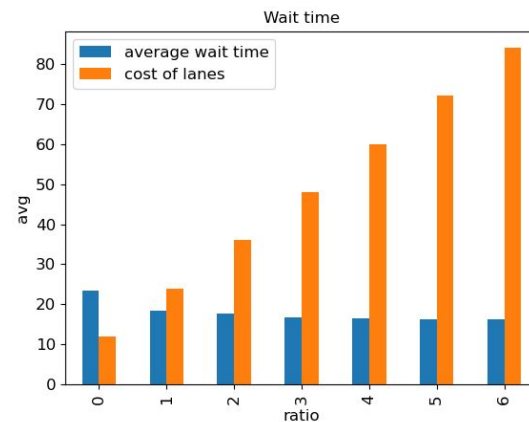
So, from now on, it was not an exact proof, I pretend that ideal ratio of lanes are 2:1

(this code is organized on github)

step 2 . find number of lanes most reasonable.

To find out exact number of lanes, which is most reasonable. I changed number of lanes each time I rerun simulation. The result and result graph is below.

ratio	avg	cost
1:2	23.357671	12
2:4	18.498907	24
3:6	17.758245	36
4:8	16.775422	48
5:10	16.588663	60
6:12	16.293161	72
7:14	16.212586	84



when it goes 1:2 to 2:4, the wait time was decreased most. after 3:6 it does not decreased significantly. Considering, making more lanes is getting expensive linearly, it is reasonable to make 2 lanes to NORTH-SOUTH, and 4 Lanes EAST-WEST.