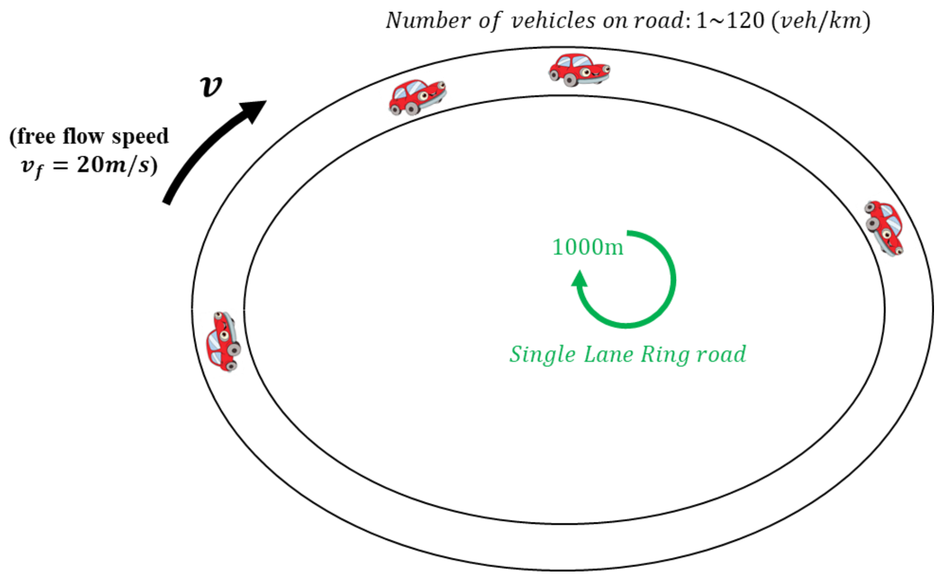
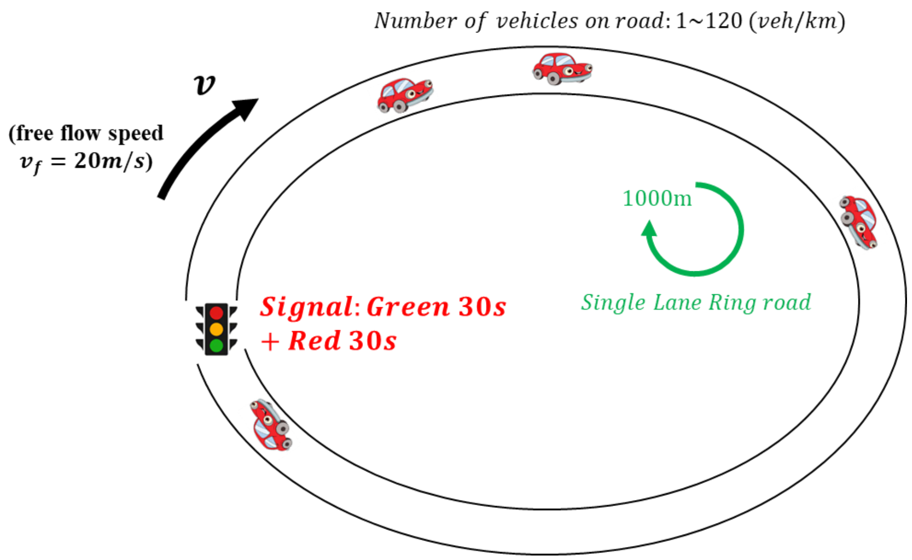
Fundamental Diagram

A. Traffic scenarios





B. Car-following model

Each vehicle (n) updates its speed and location at each time following Newell's Car-following model (without considering accelerations or any random vehicle behaviors), as shown below:

$$v_n(t+\Delta t) = \min\{\frac{x_{n+1}(t) - x_n(t) - L}{\tau}, v_f\}$$

$$x_n(t+\Delta t) = x_n(t) + v_n(\mathrm{t}+\Delta t) * \Delta t$$

where 1. gap $\tau = 2s$, vehicle length $L = 5m$, simulation time step $\Delta t = 0.1s$.

C. Simulation

During each simulation, plot vehicle trajectories for your reference (check if anything wrong), and keep observing the average space-mean speed ($\bar{v}$, SMS) at each time and see if it reaches a steady state, i.e., the average speed is not changing as time goes by. Record the steady SMS and density and calculate the average flow-rate in this simulation ($q = k\bar{v}$). To generate the fundamental diagram, you need to adjust the number of vehicles on road (i.e., the density in fundamental diagram). And calculate the flow rates respectively.

D. Expected Results

Use python to **(1)** check vehicle trajectories (give me one set of trajectories in each scenario) and **(2)** get fundamental diagrams (FD) under each traffic scenario. You should get a triangular FD in the first scenario. I am wondering what FD you can get in the second scenario. If you have more time (optional): **(3)** try to adjust green ratio of the signal to see how FD changes; **(4)** think about why you can get a triangular FD with Newell's Car-following model; and **(5)** talk with me if you are interested in exploring next steps.

Good Luck!