Assignment 3
CE 787A: Computational Tools for Transportation Engineering
Total Marks: 35

Instructions: Use Jupyter notebook to work on this assignment using Python language. All cell outputs and visualizations (if any) should be visible and necessary comments should be put to make the code readable. Once the code is ready, convert it to HTML (File > Download as HTML), save the html as pdf, and submit the pdf. Also, submit the *.ipynb file* of the jupyter notebook.

Q1. The file "track_data.csv" contains pixel coordinates of vehicle trajectories for 3 different videos (represented as "video_id").

The file schema is:

video_id, *veh_id*, *frame*, *bb_top*, *bb_left*, *bb_height*, *bb_width*

video_id : ID number of video.
veh_id: Tracking ID of vehicle. Each unique vehicle tracked in a video is provided with a unique id
frame: frame number of the corresponding video_id
bb_top: vehicle bounding box coordinate (in pixels) from top edge (see Figure 2)
bb_left: vehicle bounding box coordinate (in pixels) from left edge (see Figure 2)
bb_width: vehicle bounding box width (in pixels) (see Figure 2)
bb_height: vehicle bounding box height (in pixels) (see Figure 2)

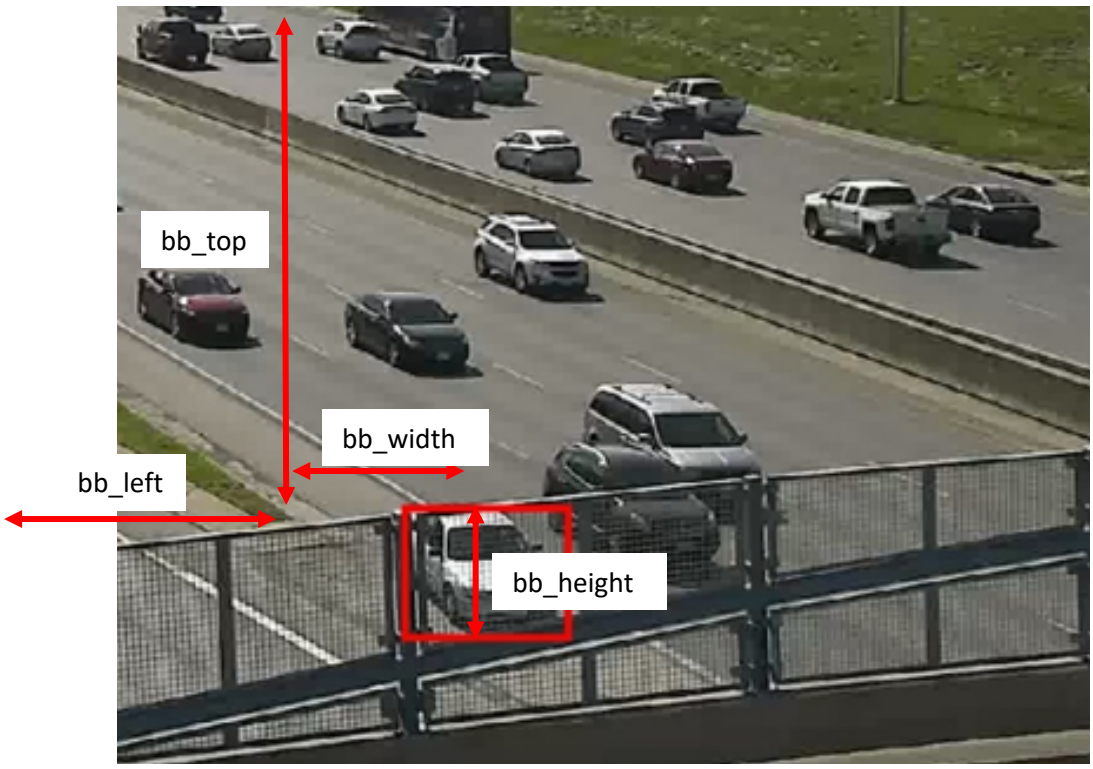

Figure 1

With this required information, perform the following tasks:

a) Read the file. Find the number of unique vehicle IDs in each *video_id* 2

b) Find the maximum frame number for each *video_id*. Assuming frame rate is 30 frames per second, what is the video duration for each *video_id* (For example, if maximum frame is 120, then video duration will be 120/30 = 4 seconds). 2

c) Remove all rows where bounding box height (*bb_height*) is less than 30 pixels. 1

d) For each *veh_id* and *video_id*, find out the standard deviation of bb_left and the range of frame count (difference between maximum and minimum frame count). 3

e) A vehicle can be said to be a stalled vehicle if it's position doesn't shift significantly for a specific period of time (say, at least 10 seconds). Therefore, for each *video_id*, find out the 3 *veh_ids* (total 9 *veh_ids* for 3 videos) having the lowest standard deviation of *bb_left* and their corresponding range of frame count. (Note, standard deviation of *bb_left* of a given veh_id can be an estimator of whether the vehicle is moving or not). Comment on whether any of them can be classified as a stalled vehicle. 5+2

Q3. The *wave_data.csv* and *inrix_data.csv* contain speed data obtained from two different sensors, named Inrix and Wavetronix. Inrix data is collected at 1 minute interval, while Wavetronix data is collected at 20-seconds interval.

The schema of *inrix_data.csv* and *wave_data.csv* is: *Code*, *Time*, *Speed*

Code: Unique sensor ID
Time: Timestamp in the format yyyy-mm-dd HH:MM:SS (For example, 2016-10-05 17:30:00)
Speed: Speed observed for the given code at the given timestamp

Each Inrix *Code* is associated with a specific Wavetronix *Code*. The correspondence between Inrix *Code* and Wavetronix *Code* is given below:

Inrix *Code*	Wavetronix *Code*
5033374	I-80-EB at WEST MIX-EB
5033375	I-235 EB to VALLEY WEST-EB
5033347	I-235 EB from Vly West Dr-EB
5032600	I-235 EB EAST OF 63RD-EB

With the above information, perform the following tasks:

1. Read both the data files *wave_data.csv* and *inrix_data.csv*. Use the Time column as the index column and parse the Time column in the datetime format. 3

2. Inrix data is collected at 1-minute interval. Resample the Inrix data with any interpolation method to obtain Inrix data at 20-seconds interval. 4

3. Merge the resampled Inrix data and Wavetronix data based on the timestamp and *code*. using the correspondence between Wavetronix and inrix code. 4

4. Determine the average Inrix and Wavetronix speed for 15-minute interval of each date (e.g., 2016-10-05 17:00, 2016-10-05 17:15, 2016-10-05 17:30, 2016-10-05 17:45, etc.) 4

5. We want to determine if the difference of speed between inrix and wavetronix is higher during any specific time period of the day. Therefore, determine the 15-minute intervals for each inrix-wavetronix pair for each date where the difference in Inrix and Wavetronix speed are maximum. 5