16th IEEE International Conference on
Smart Cities: Improving Quality of Life using ICT, IoT and AI

A Matching Model for Vehicle Sharing Based on User Characteristics and Tolerated-Time

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October 06-09, 2019

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Today’s Agenda For Presentation

1. Introduction
2. Architecture of the System
3. Rider Matching Layers
4. Experimentations
5. Observations
6. Results
7. Conclusion & Future Work

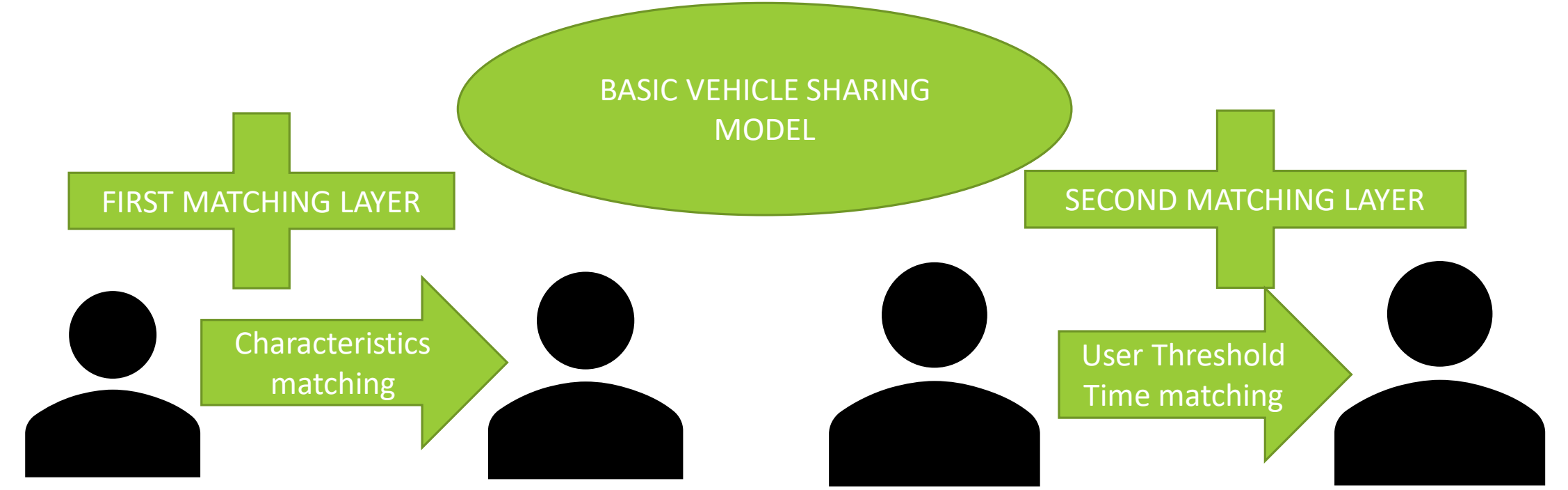
1(a). Introduction – Basic Vehicle Sharing Model & Advantages

- Riders travel through a common path to reach the same or nearby destination.
- Vehicle Sharing leads to reduced number of vehicle count resulting in:
  - Reduction of vehicle pollution and traffic congestion.
  - Reduction in road accidents and cardiovascular effects on human health.
- Improvise overall global environment and preserve natural resources.
- Current models perform matching based on closest distance based locations.

1(b). Introduction - The Purpose of Our Model

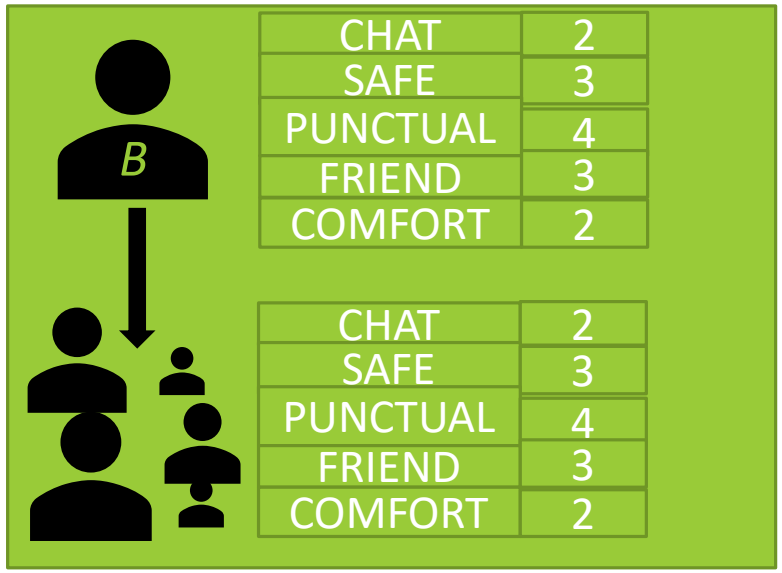
- Vehicle sharing only efficient when the seating capacity of the car is reached.
  - Our model design tries to complete the pool for maximum trips based on the both matching layers. Our model results specify there is 80% of our trips complete the pool.
- Car pooling discouraged due to social barriers or riders do not have any knowledge of other users they will be commuting with.
  - As the trip formation is completed, the meta-data of the trip is sent to all the riders plus the driver.
- Sudden elongation of trips due to unexpected addition of riders.
  - User tolerated time avoid the sudden addition of riders which are at a higher travelling time.
- Current model not inclusive of multiple sources and multiple destinations.
  - Our model design incorporates this design of Multiple Source and Multiple Destination. Users can start from a similar or different source and reach the same or different destination.
- Absence of rider feedback system.
  - We have implemented a rider feedback system where riders can provide a feedback not only to drivers but also to riders. The feedback system is utilized for providing better recommendation for future trips.

1(c). Introduction – Our Model in a Nut-Shell

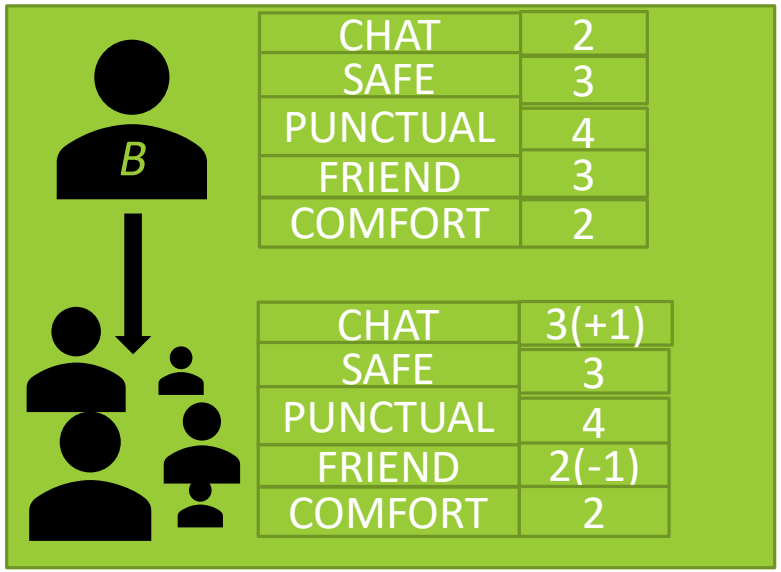


1(d). Introduction - What are Characteristics?

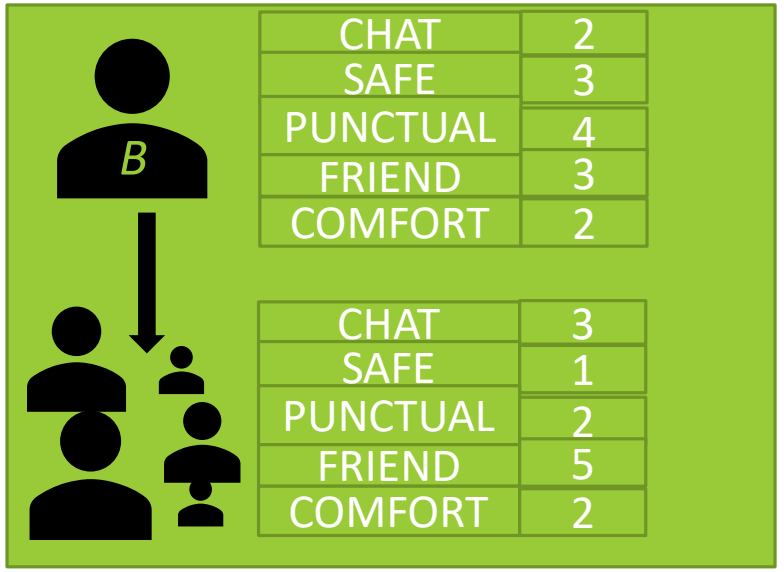
- Characteristics are 5 features or rider requirements. They include: *CHATTY, SAFETY, PUNCTUALITY, FRIEDLINESS, COMFORTIBILITY (CSPFC)*
- A rider registers with these 5 characteristics on a scale of 1 to 5 and searches other riders with similar, altered and alternative characteristics.



Same/ Exact/ Similar Match



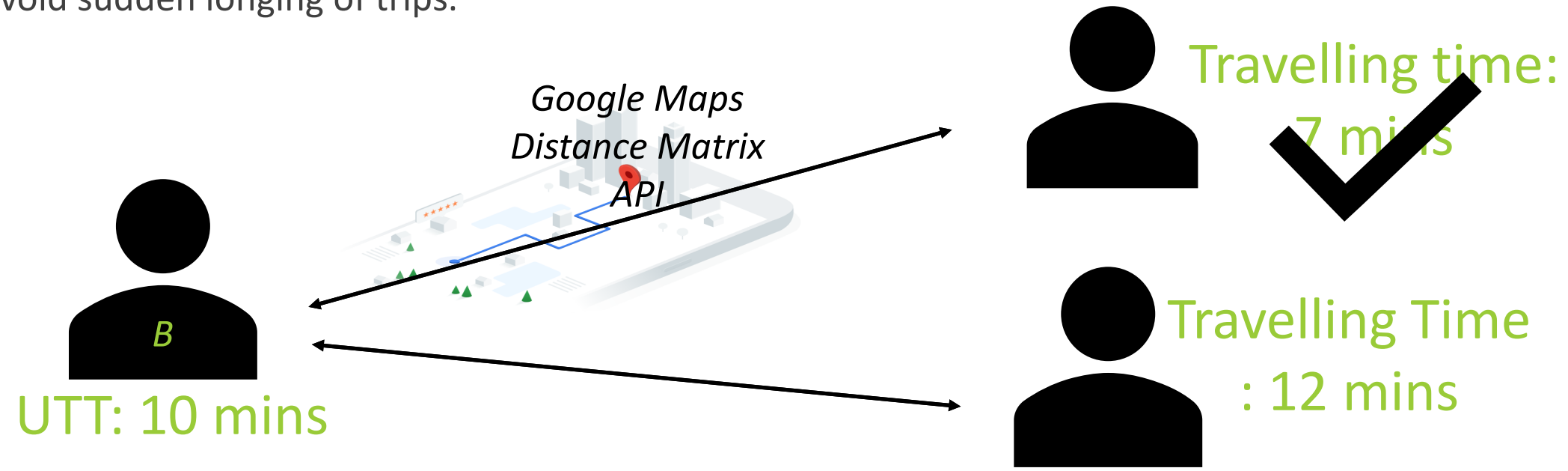
Altered/ Closer Match



Uber/ Lyft -Alternative Match

1(e) Introduction. The Concept of UTT

- UTT stands for User Threshold Time or User Tolerated Time. Users provide UTT at the registration on a scale of 10 to 30 and in multiples of 5.
- UTT is the extra time riders are willing to spend to pick up other riders. It was orchestrated to avoid sudden longing of trips.



2. SYSTEM ARCHITECTURE

Broadcasting Rider

BROADCASTING REQUEST

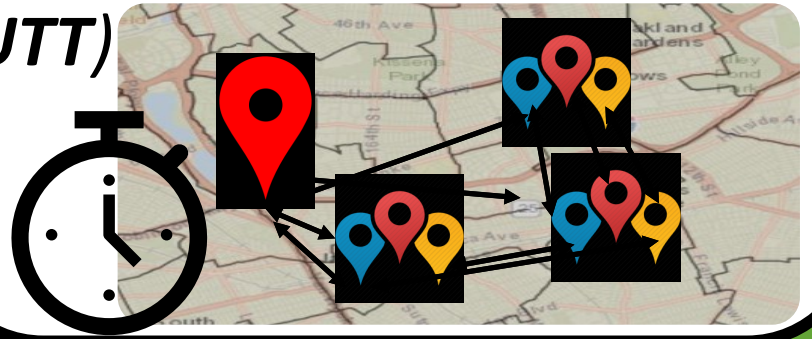
source, destination,5 user characteristics, UTT

Data Server

1. Find Closest Driver & Vehicle Seat Capacity

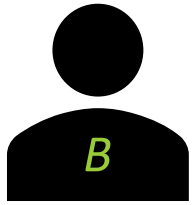
2. Find Riders Using Broadcasting Rider's Characteristics

*3. Find Riders Using UTT (Rider's Sources, Destinations Are Within **UTT**)*



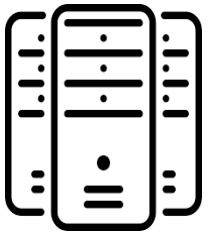
*4. Complete Trip & Get **Rider Feedback** for All Other Riders & Driver.*

3. RIDER MATCHING LAYERS



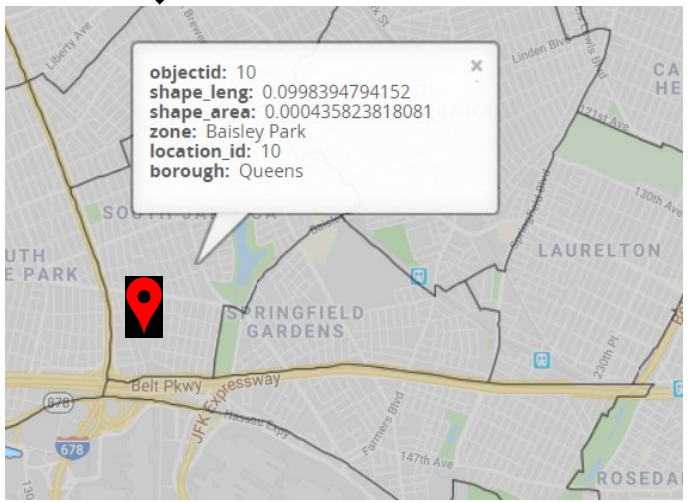
- USER ID
- MONGO_ID
- SOURCE (Zone and Location)
- DESTINATION (Zone and Location)
- TIME_STAMP

Broadcasting User Request Details (BURD)

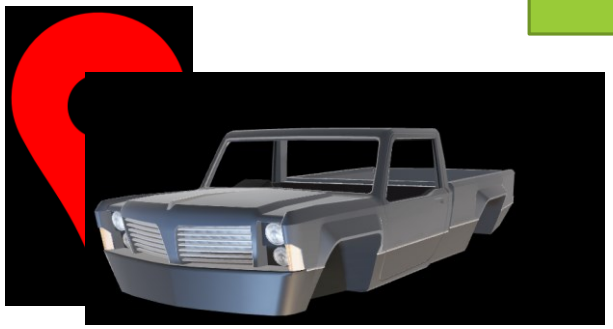


- BURD
- CHATTY REQ
- SAFETY REQ
- PUNCTUALITY REQ
- FRIENDLINESS REQ
- COMFORT REQ
- UTT

SOURCE (Zone and Location)



Fetch Available Driver List From Same Zone (Ex. Zone 10)

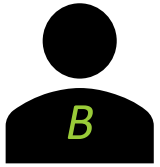


Get Driver Current Location

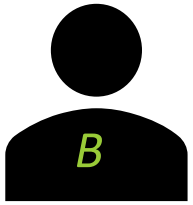
Get Travelling Time Using Google Map Api

USER LOCATION

If time <= 1 min: add driver
Else: Fetch closest driver



1. FINDING THE CLOSEST DRIVER – TRIP 1st STEP



- USER ID
- MONGO_ID
- SOURCE (Zone and Location)
- DESTINATION (Zone and Location)
- TIME_STAMP
- CHATTY REQ
- SAFETY REQ
- PUNCTUALITY REQ
- FRIENDLINESS REQ
- COMFORT REQ
- UTT

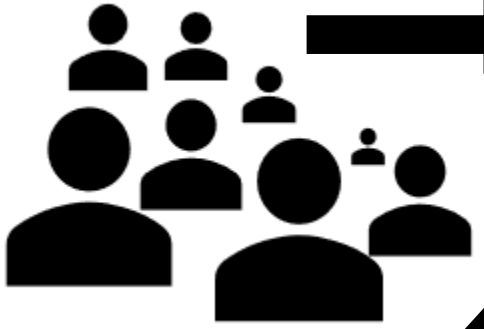
SAME ZONE

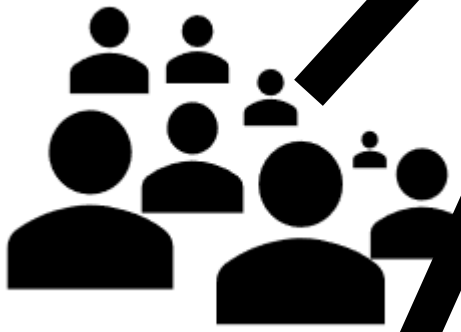
OTHER ZONE

Riders with Same/ Exact Characteristics

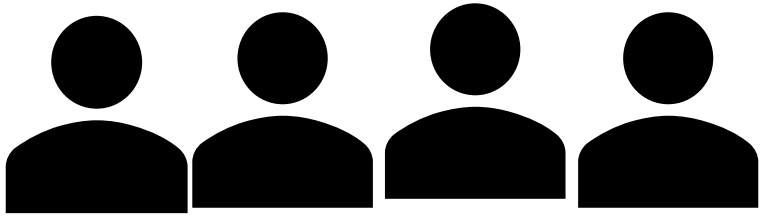
Riders with Altered/ Closer Characteristics

All Broadcasting Riders with Alternative Characteristics





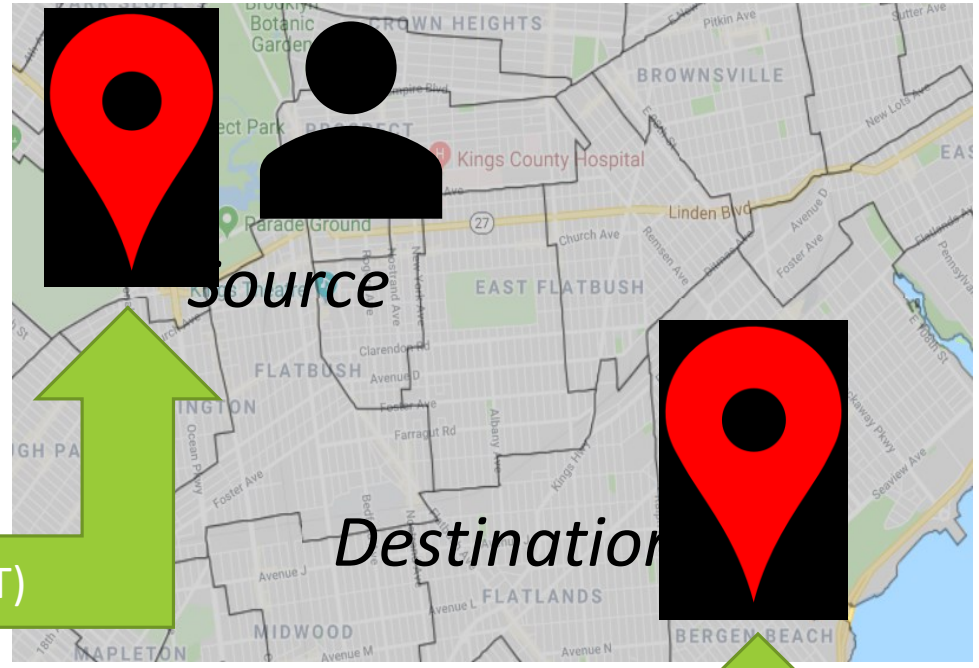
UTT CHECK
IF SEAT CAPACITY = 0
OR
IF NO RIDERS IN THE QUEUE

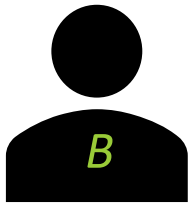


Other Riders Having Same or Closer Characteristics

IF SEAT CAPACITY = 0 AND
IF NO RIDERS IN THE QUEUEU

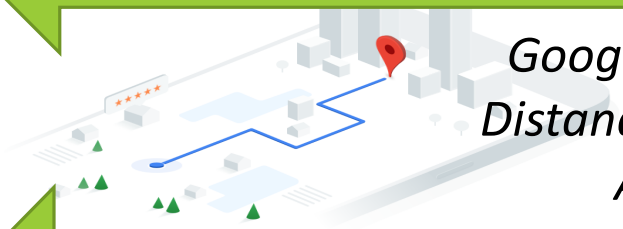
Found Riders After Every Cursor Search





SOURCE (Zone and Location)

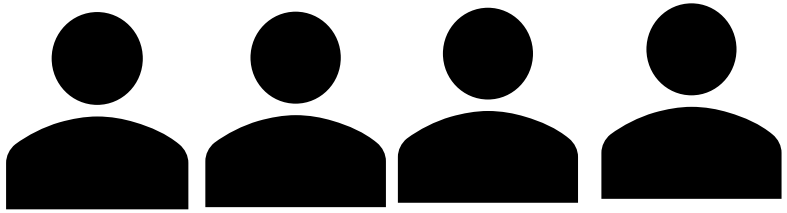
TRAVEL TIME CHECK (LESS THAN UTT)



Google Maps Distance Matrix API

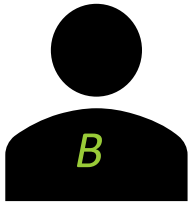
DESTINATION (Zone and Location)

TRAVEL TIME CHECK (LESS THAN UTT)



Riders Matched Based on Characteristics & UTT

3. SECOND RIDER MATCHING LAYER – MATCHING BASED ON UTT



Find closest driver

ers with Same/ Closer / Alternative Characteristics

Filter Riders
Based on UTT Matching

This Event Marks Completion of Trip Formation

Complete Trip &
Get User Feedback

USER ID
MONGO_ID
SOURCE (Zone and Location)
DESTINATION (Zone and Location)
TIME_STAMP
CHATTY REQ
SAFETY REQ
PUNCTUALITY REQ
FRIENDLINESS REQ
COMFORT REQ
UTT
Vehicle Seat Capacity

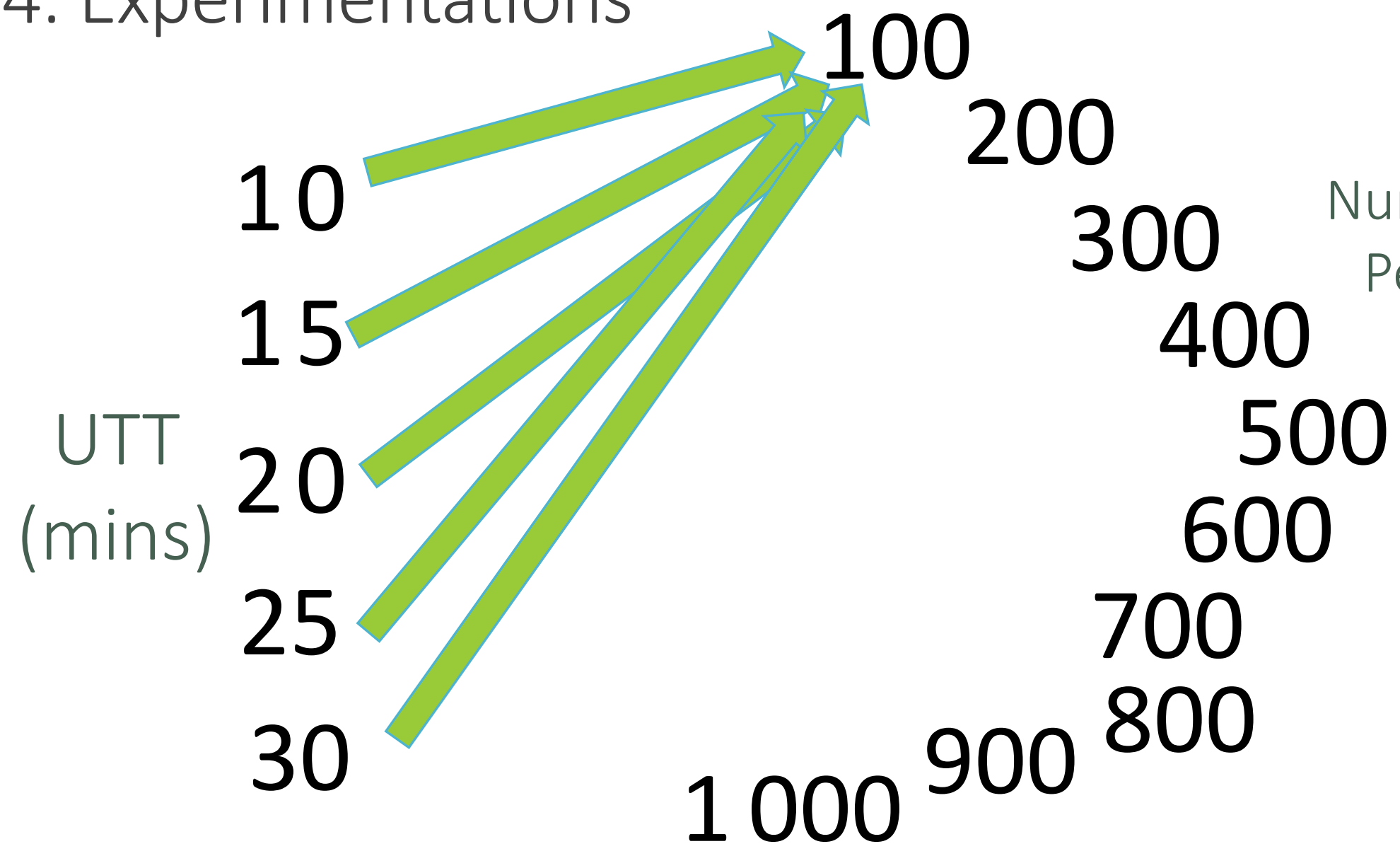
The Trip Sequence

- Start with Broadcasting rider.
- Find characteristics and user threshold time (UTT) based on userId of broadcasting rider.
- Find closest driver using Google Map API.
- Search and get Rider List based on Similar Characteristics, Closer and Alternative Characteristics from same zone (Other zone if the trip seat capacity is not reached).
- Subject found riders to UTT matching until vehicle seat capacity is completed or there are no riders in the Rider List. Trip formation completed.
- Complete the trip and assign driver location as the last user destination location or random location from the zone of last user dropped off. Update rider and driver location and status.
- Record the rider feedback and save in database.

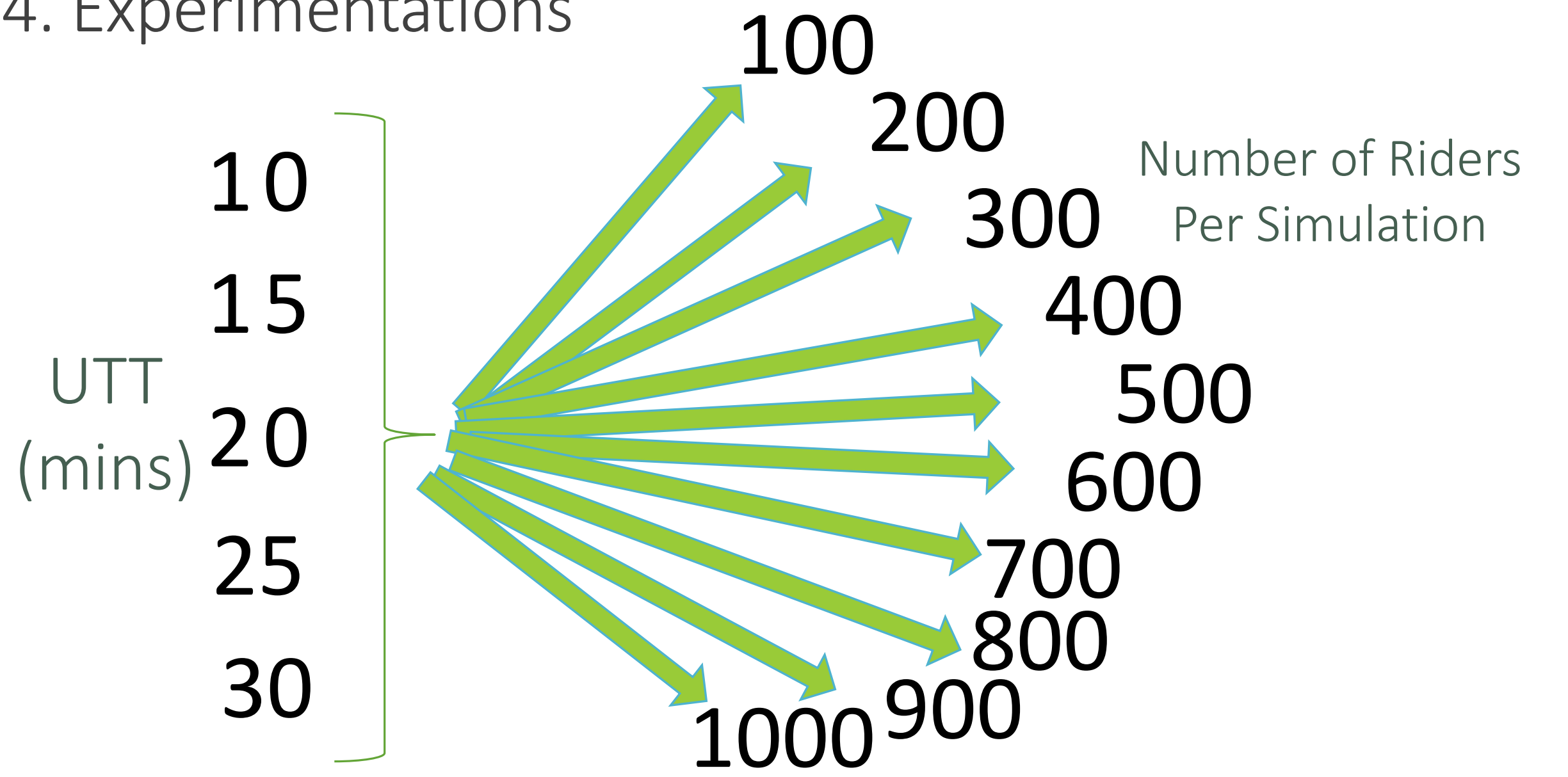
4. Experimentations (The First Simulation)

- Start with a Broadcasting Rider With UTT 10 minutes.
- Find closest Driver.
- Traverse through 100 riders.
- Matching Layer 1 - Find Riders with Same, Closer & Alternative Characteristics.
- Matching Layer 2 – Filter Riders Based on UTT.
- Add Riders in the Trip until vehicle Seating Capacity Reached or No riders in the Queue.
- Utilized Real time NYC Taxi Cab Locations Data for every simulation.

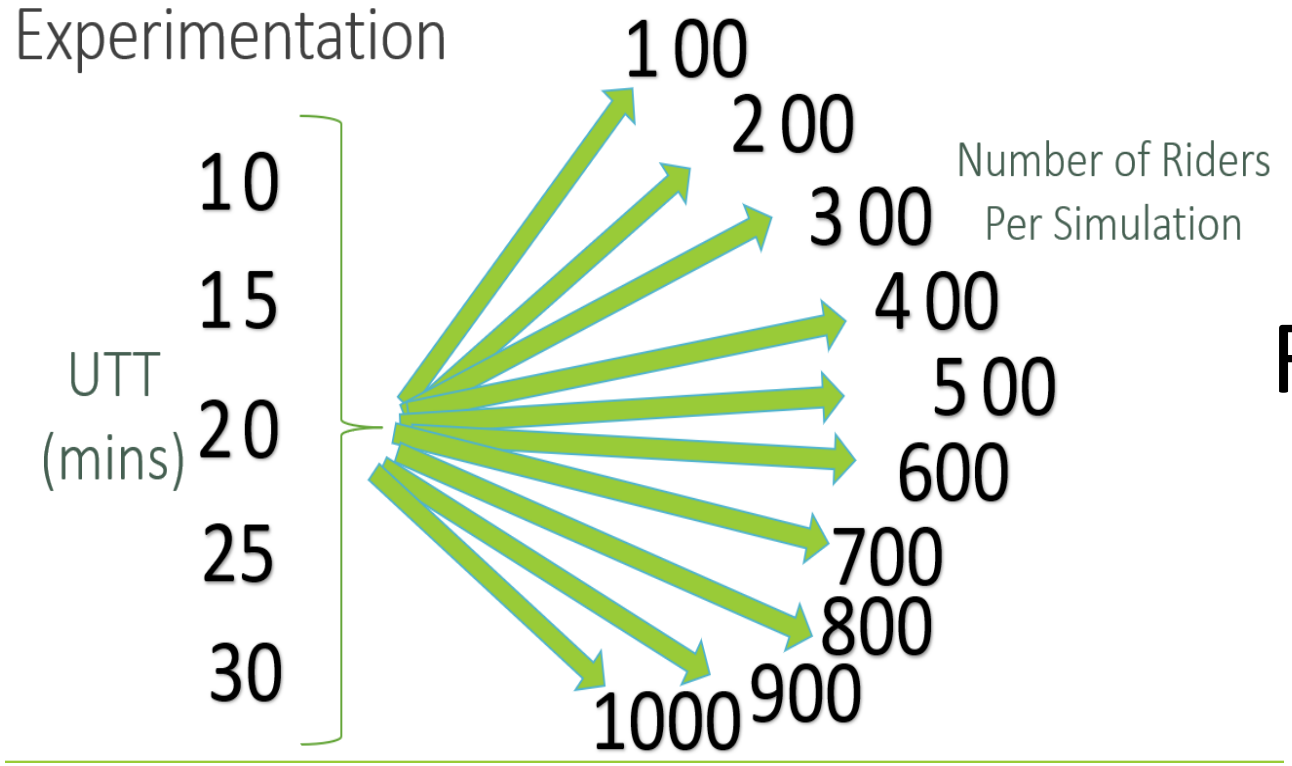
4. Experimentations



4. Experimentations



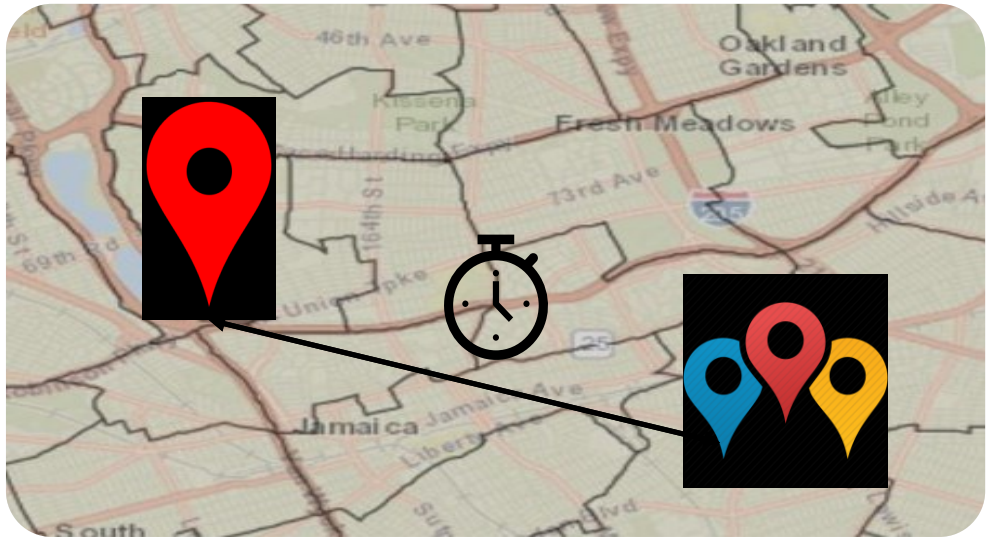
4. Experimentations – The Complete Simulation



Repeat Simulation 10 Times

5. Observations

Total Number of Trips: 7159

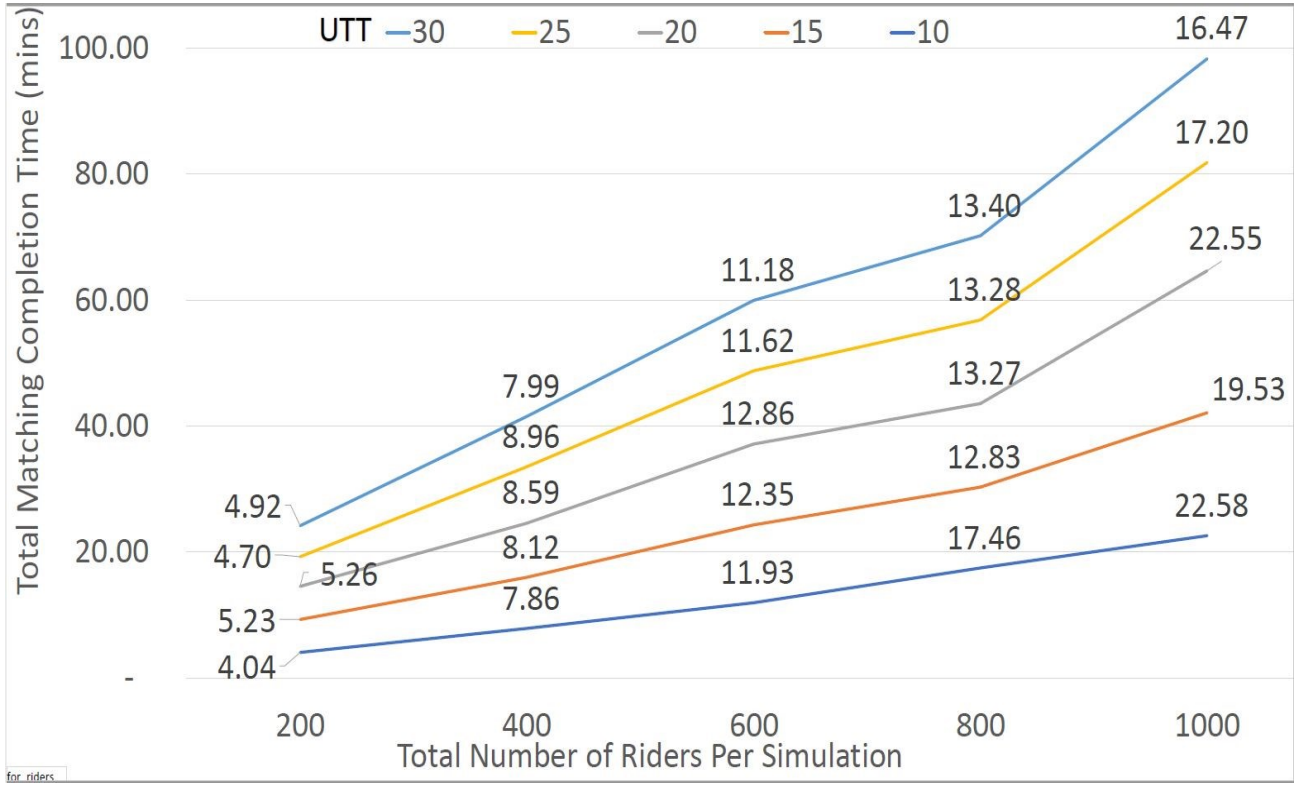


Average Trip Formation Time: 0.80 minute

Total Riders Traversed in Complete Simulation: 276400

6(a). Results

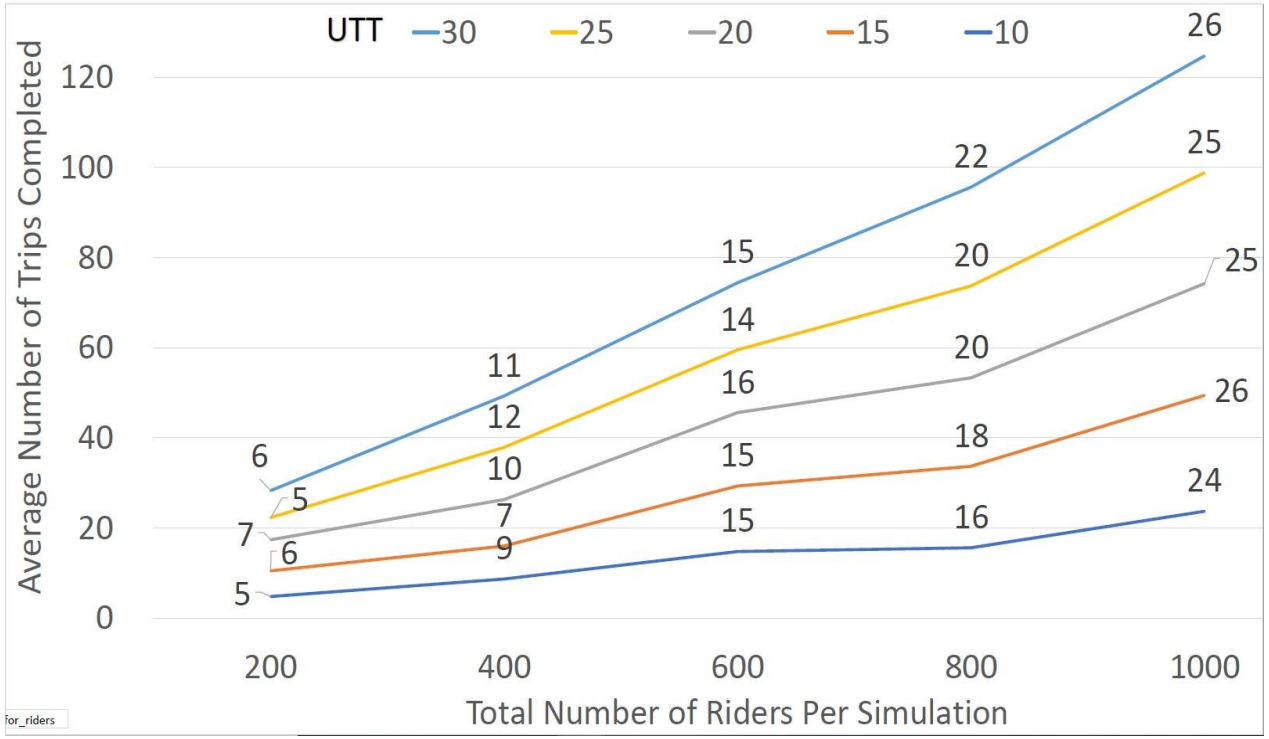
Objective: Simulation time with the status of pool completion and number of trips provides the system efficiency. If the simulation time increases and trip number with pool completion is increasing, the system is efficient.



- Result for Average Simulation Time.
- Results reflect total time taken for completion of a simulation per specific number of riders.
- The graph depicts as the number of riders and UTT increases the simulation time increases.
- Indeed more trips are covered in the elongated time (represented in next resultant graph).

6(b). Results

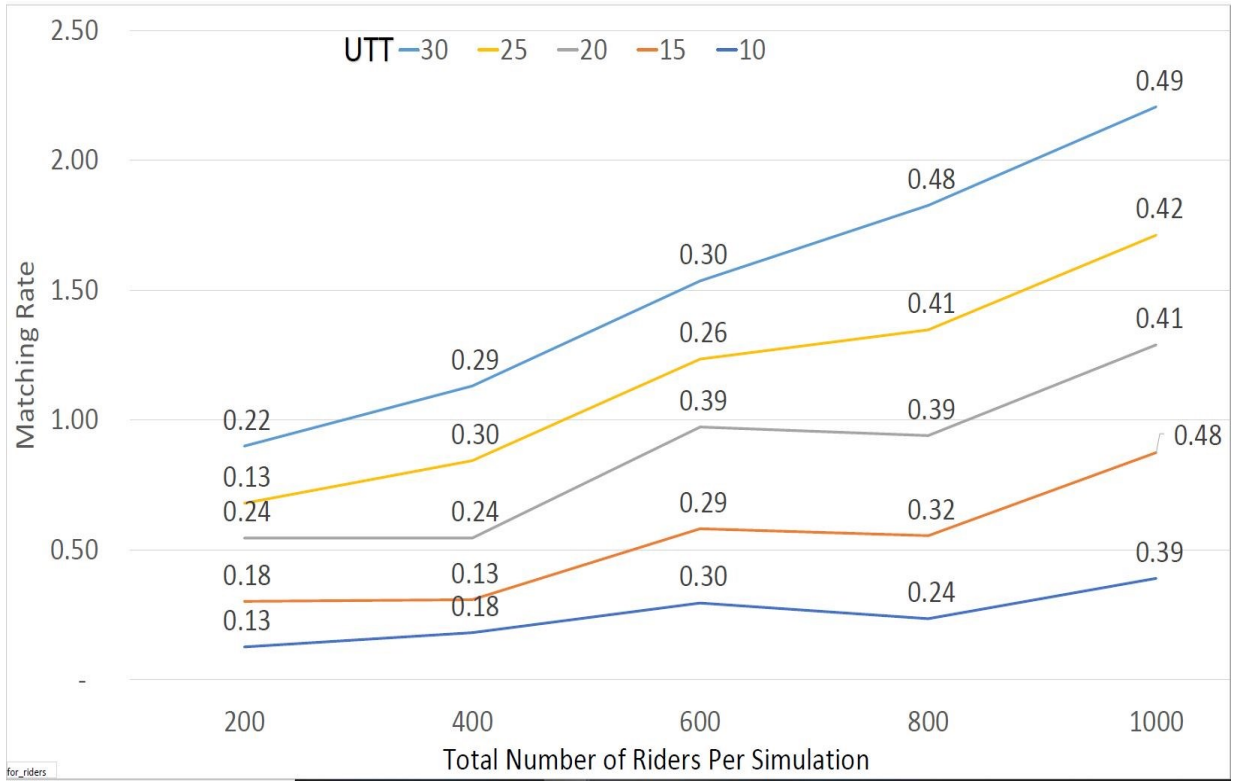
Objective: The number of trips should not downgrade as the number of riders increase. The number should increase with the simulation time, riders and UTT.



- Result for Average Number of Trips Covered or Completed Per Simulation.
- Number of Trips = Number of Drivers.
- Results reflect the average number of trips completed per simulation for n riders.
- As more riders are traversed with increasing UTT, more trips are executed, indeed increasing execution time.

6(c). Results

Objective: Matching rate should increase as the count in user and UTT increases. Matching rate is to check the level of user experience and quality of system.

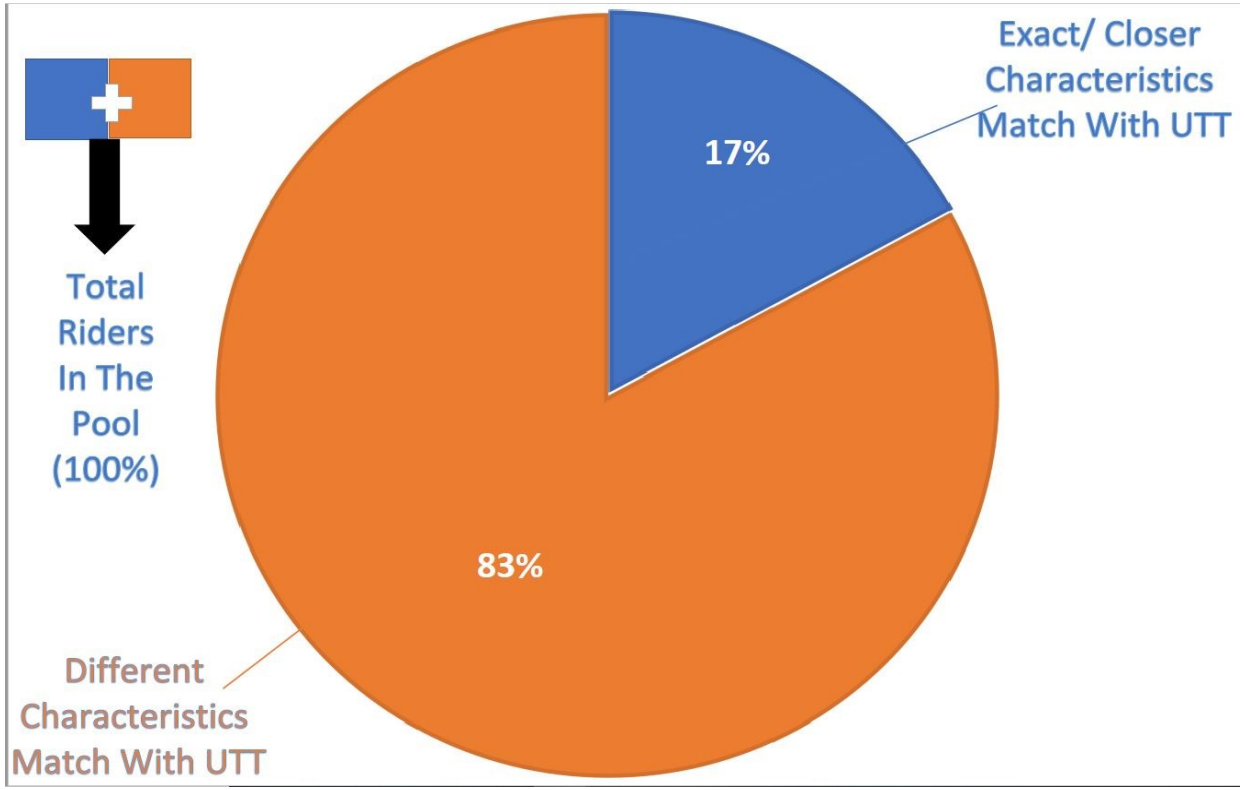


- Result for Matching Rate Per Simulation.
- Matching rate is defined as:

  riders_in_pool/ total_riders_traversed.
- The matching rate depends on number of riders and UTT. There is more room for riders to get accepted if there are more riders to be traversed and more user threshold time.
- Matching rate is proportional to number of riders and UTT.
- Matching rate, number of trips, simulation time increases as count of riders and UTT increases.

6(d). Results

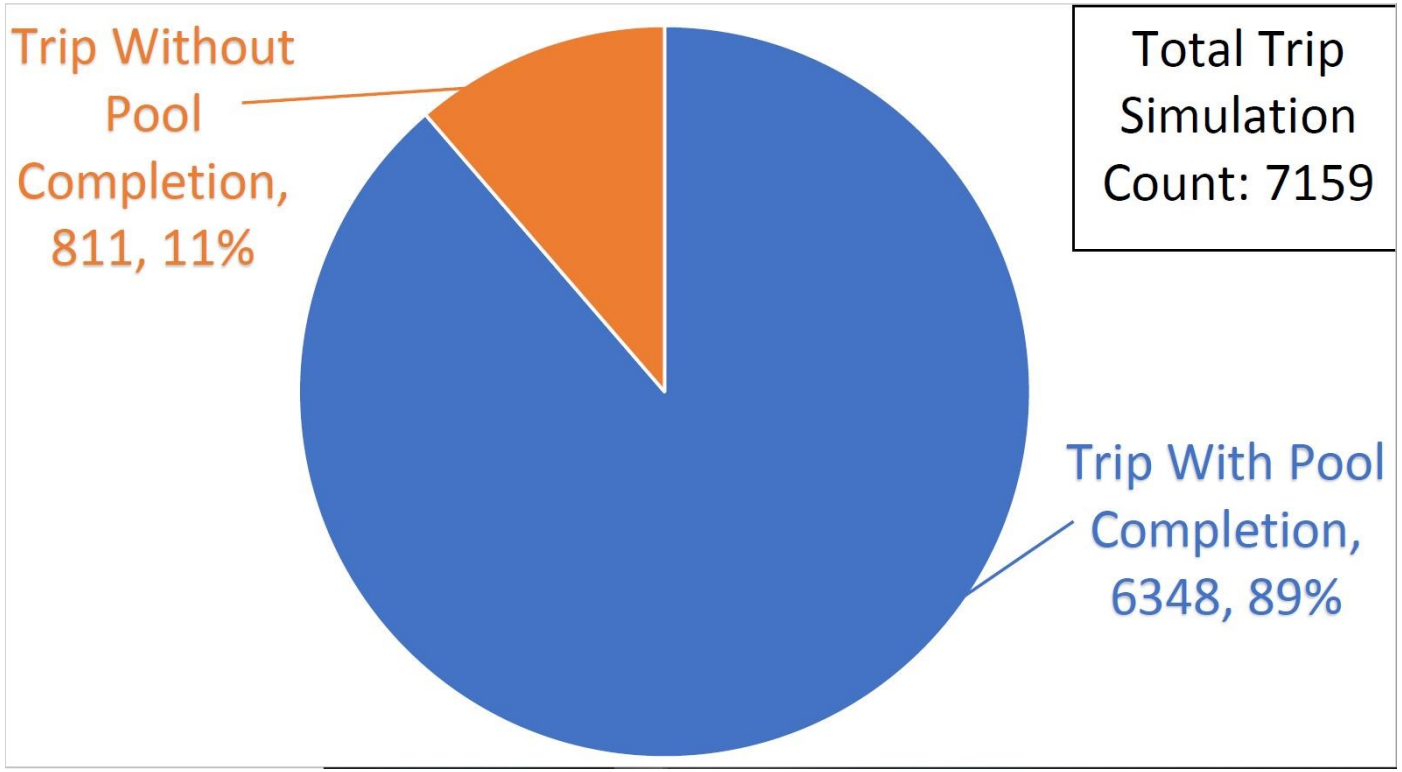
Objective: Any type of characteristic matching with UTT matching should contribute to maximum number of pool completion. A matching with rider tolerated time leading to pool completion is one of the goals system aims to achieve.



- Classification of Exact, Closer VS Alternative Characteristics
- 100% = Total Riders in the pool = 93766 riders.
- Classification graph shows 17% are accepted by closer and exact characteristics matching. 83% are accepted by different characteristics matching.
- The matching includes characteristics and UTT matching. It is made sure that the riders added to the pool are subjected to UTT matching.

6(e). Results

Objective: One of the goals of the system is to encourage carpooling or verify if the system observes maximum number of trips with pool completion.



- Resultant Pie Chart classifies trips according to the “pool status”.
- Out of 7159 trips, 6348 completed the pool using characteristics and UTT matching.
- A high percentage of trips complete the pool. About 89% complete the pool, while 11% do not complete the pool.
- The system efficiency is good as the trip with pool completion are higher even with the elongated simulation time, increasing number of trips and matching rates.

7(a). Conclusion

We implemented the proposed matching model of vehicle sharing based on rider characteristics and User Threshold Time (UTT) addressing user expectations and issues we found in the previous systems.

Rise in rider count and UTT proportional to the overall matching rate, simulation time and number of trips.

Average trip formation time is less than a minute, which aims at better user experience, quality of system and reaches user expectation of minimal time response.

Goal of pool completion for maximum number of trips achieved (89%).

7(b). Future Work

- Developing an Android/ Web Application for providing UI for riders and drivers.
- Using Machine Learning Recommender Model for closer matching between rider characteristics.
- Using Logistic Regression model to predict characteristic classifiers for users based on the feedback they have got from other riders and feedback they have given to other riders.
- A sophisticated pricing model in Android/ Web application reflecting rider transactions.

A Matching Model for Vehicle Sharing Based on User Characteristics and Tolerated-Time

THANK YOU

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9th October 2019

A Matching Model for Vehicle Sharing Based on User Characteristics and Tolerated-Time

Q & A

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