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Enabling ADAS feature development/validation using MATLAB Database Toolbox

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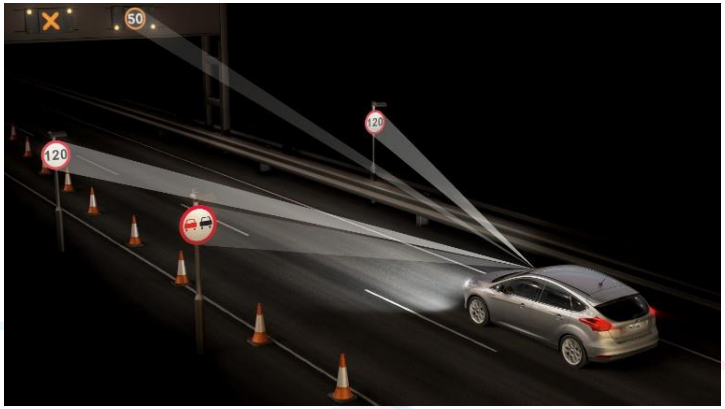
Introduction

- Every automobile OEM is developing some features to make driving a safe experience for their customers. To beat the competition, OEM's are trying to come up with new technologies at the earliest.

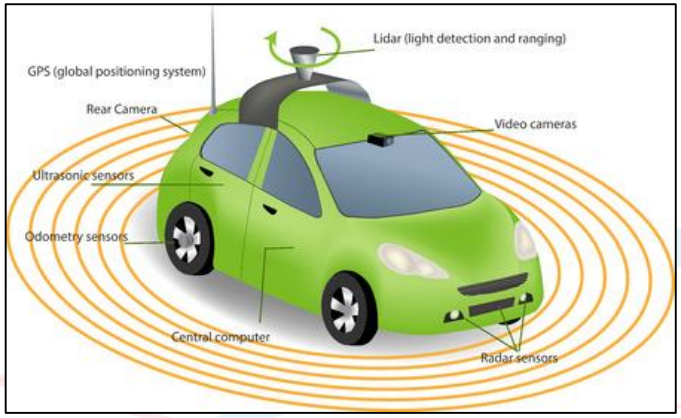
- Adaptive Cruise Control and Traffic Sign Recognition are such features that help a car maintain its speed as per current road regulations.



Introduction

- As ADAS (Advanced Driving Assistance System) features are safety critical, its validation becomes very important and time consuming.

- To achieve this, quick, smart and robust validation methods are required. One of such methods could be achieved by using MATLAB database toolbox.

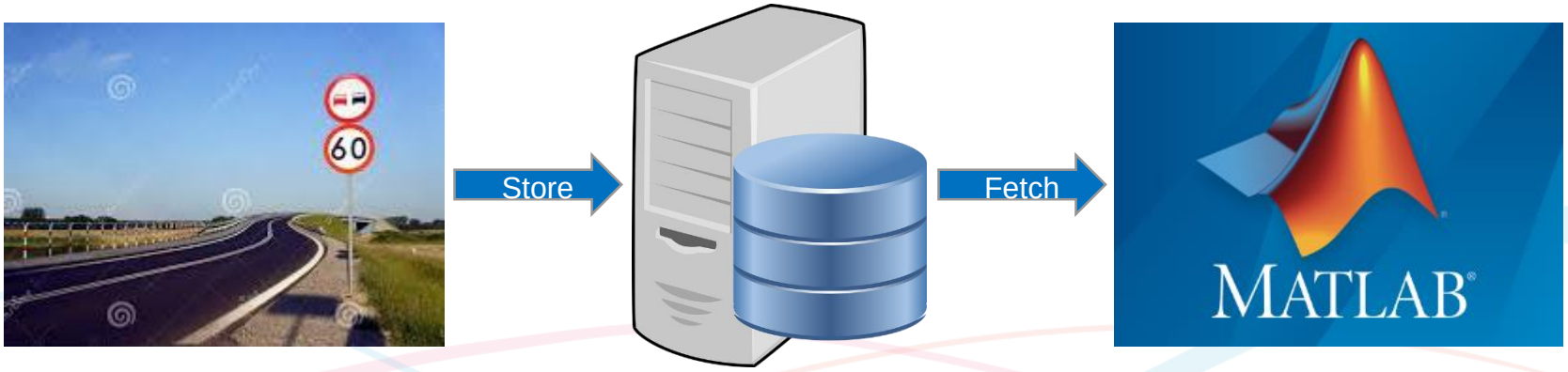


Problem Statement

- To ensure the safety of the passengers, features like Traffic Sign Recognition have to be error free, which needs rigorous testing.
- The distance travelled during these drives may range around a few hundreds of thousands of kilometers. The maintenance and processing of such a huge data becomes a difficult task.
- To analyze model behavior for a particular driving scenario like a turn event inside city, a robust database searching tool is required.
- This is where we make use of MATLAB Database Toolbox.

Approach used to solve

- To validate the feature performance, the first step is to observe test drive videos offline, label their different attributes and store them on a database server.
- This would leverage the benefits of relational database like easy retrieval & updating of data, speed, and security.
- Later, the stored data can be compared with actual feature behavior.



Data Labelling | Database Server | Comparison with model output

Workflow

1. Data labelling of vehicle drive videos:

- Test drive videos are observed offline to record relevant information in reference with the vehicle logged data.
- Here we make use of MATLAB Database Toolbox to establish a connection to the server and write the ground truth data into the database.

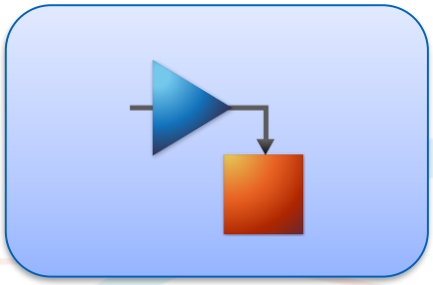
Workflow

2. Fetching the stored data from database:

- For validation of Simulink model of the feature, comparison of model outputs and ground truth data is required.
- To achieve this, the required data from particular test drive is fetched from database with the help of MATLAB Database Toolbox.
- Once the ground truth data is in MATLAB workspace, it can be easily compared with Simulink model outputs.

Ground truth data from Database

Comparison



Simulink Model logged output

Workflow

3. Exploring various driving scenarios:

- With the Database Explorer app, we can explore relational data without writing any code. In future, MATLAB code can be generated with simple SQL queries for automating the workflow which is a big time saver.

- For example, to search certain test drive files where vehicle has taken an exit from motorway.

  The results would then be exported to MATLAB workspace for further analysis.

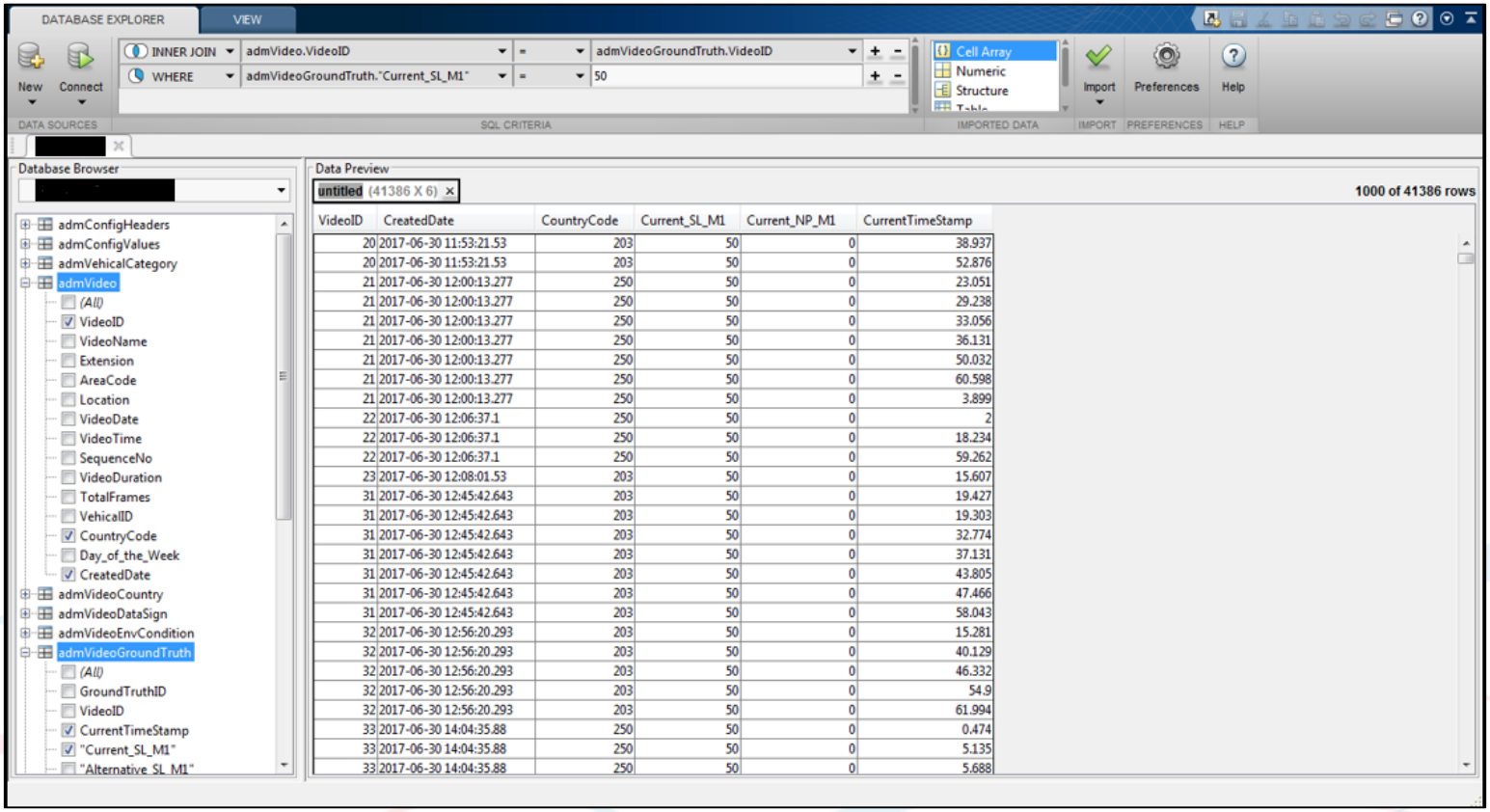
Results

- A MATLAB based GUI was developed to label the ground truth data of test drives with respect to different attributes and the labelled data was stored on a database server using Database toolbox.

- Another MATLAB based GUI was developed to search certain driving scenarios from database. The search result was then exported to MATLAB workspace where it was compared with model's simulated outputs.

Results

- When searching the scenarios using SQL queries was difficult, the Database Explorer app helped us to search desired scenarios from database with in-built selection options in the app.



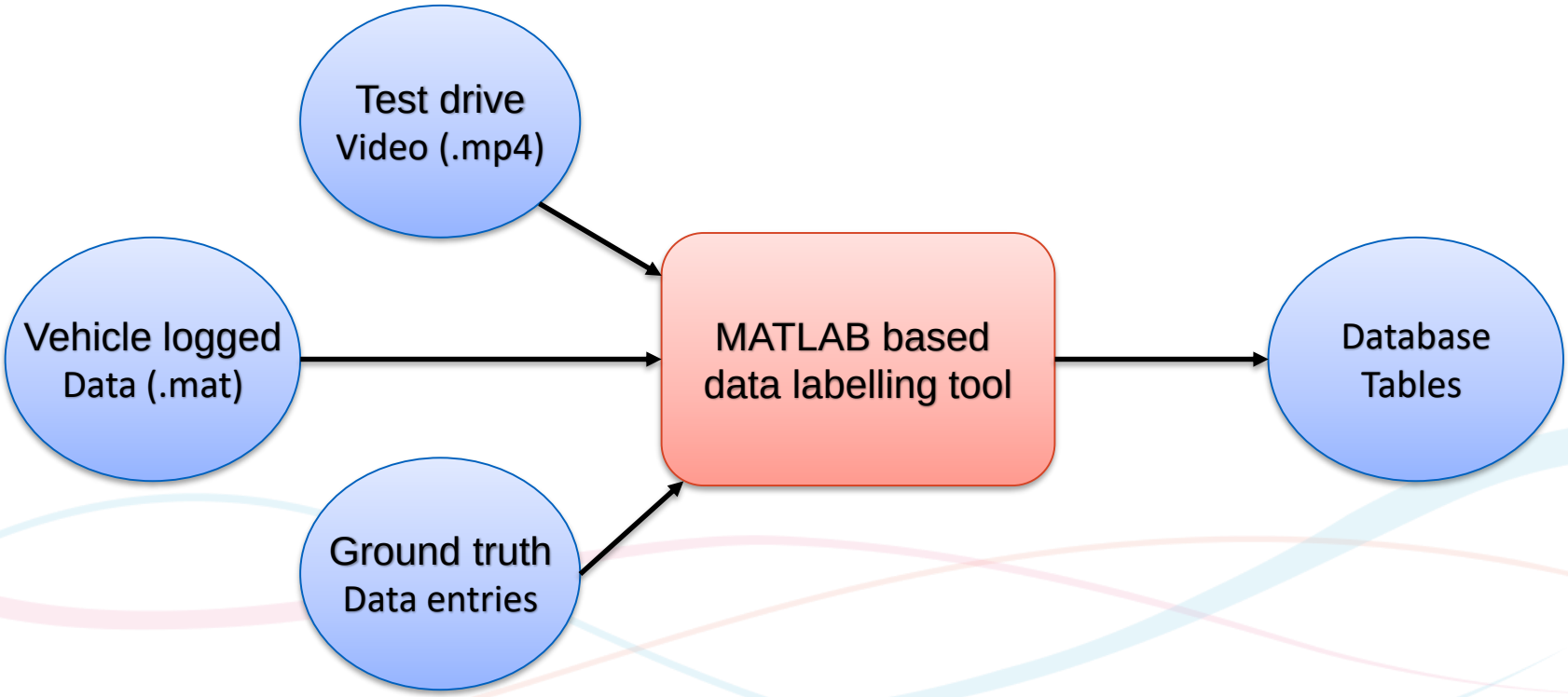
Results

- Timing Analysis

Activity	Time taken without Database Toolbox	Time taken with Database Toolbox
Scenarios Search	30 min	2 min
Model comparison (per mat file)	4 min	2 min
Data Labelling (per video)	2 min	1 min

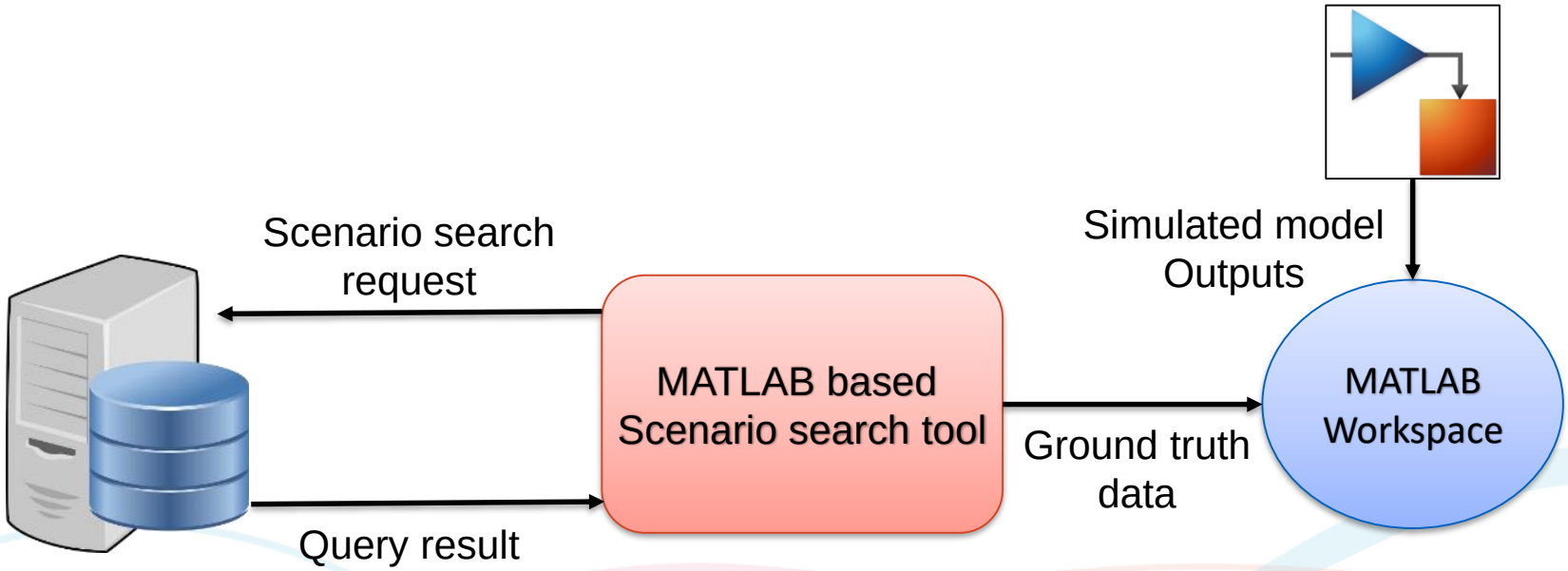
How did MATLAB Database Toolbox help ?

- While labelling the test drive videos, we need actual vehicle logged data which is in .mat format. With the help of Database Toolbox, it became possible to read .mat files, label ground truth data and write the same into database server simultaneously in the same tool.



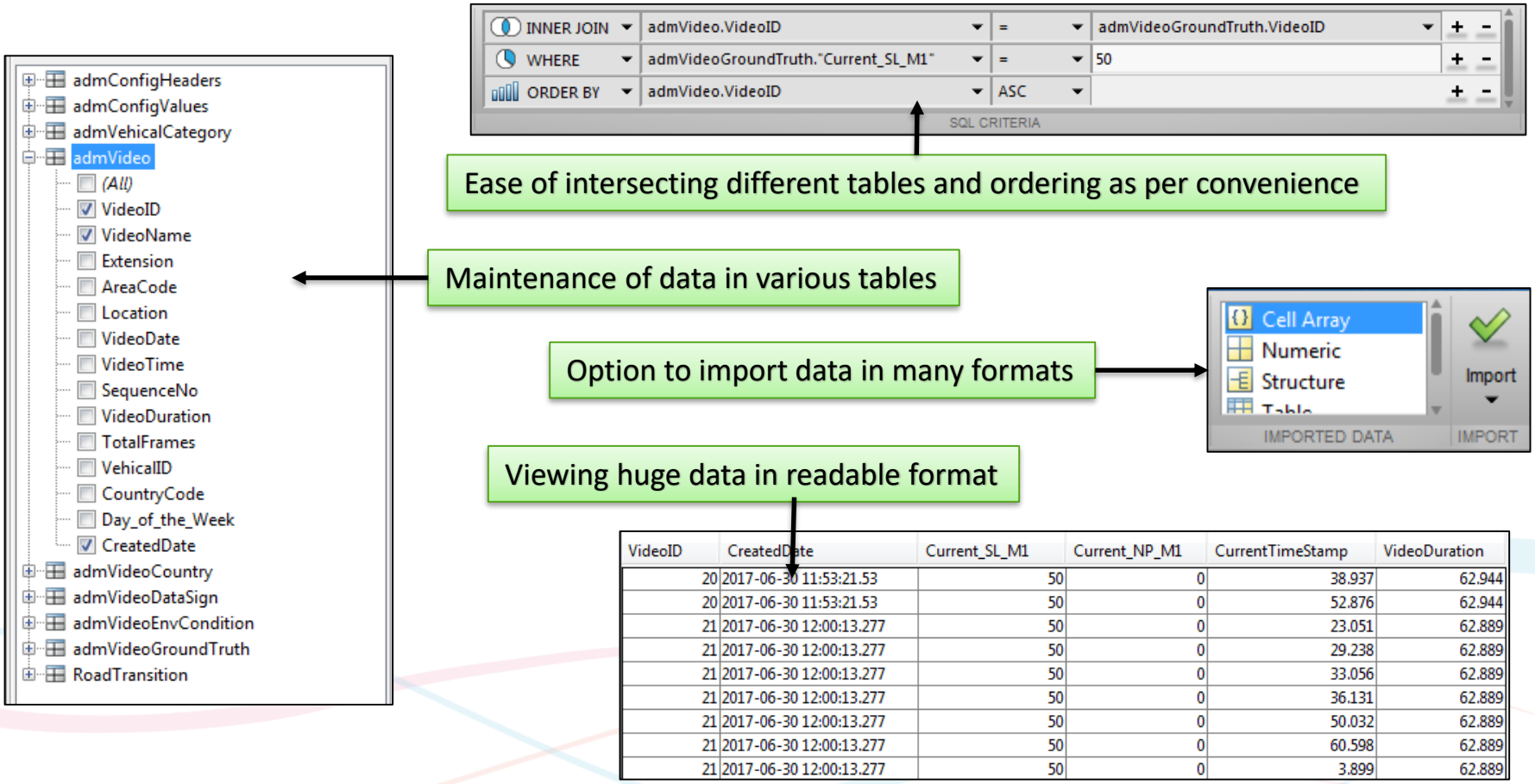
How did MATLAB Database Toolbox help ?

- Additionally, the feature model under test is Simulink based. The database toolbox helped us to import the ground truth data from database server into the MATLAB workspace, which made validation of the feature more convenient.



How did MATLAB Database Toolbox help ?

- Moreover, the searching of driving scenarios without writing complex SQL queries became possible with the help of Database explorer app.



VideoID	CreatedDate	Current_SL_M1	Current_NP_M1	CurrentTimeStamp	VideoDuration
20	2017-06-30 11:53:21.53	50	0	38.937	62.944
20	2017-06-30 11:53:21.53	50	0	52.876	62.944
21	2017-06-30 12:00:13.277	50	0	23.051	62.889
21	2017-06-30 12:00:13.277	50	0	29.238	62.889
21	2017-06-30 12:00:13.277	50	0	33.056	62.889
21	2017-06-30 12:00:13.277	50	0	36.131	62.889
21	2017-06-30 12:00:13.277	50	0	50.032	62.889
21	2017-06-30 12:00:13.277	50	0	60.598	62.889
21	2017-06-30 12:00:13.277	50	0	3.899	62.889

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Thank you

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