Tutorial:- 2

Data Set Analysis

Data analysis is defined as a process of cleaning, transforming, and modeling data to discover useful information for business decision-making. The purpose of Data Analysis is to extract useful information from data and taking the decision based upon the data analysis.

Data collected from discharge cycles of Li-ion batteries cycled under various conditions are analyzed. The battery cycling data is sourced from a publically available repository; provided by the Prognostics Center of Excellence (PCoE) at Ames Research Center, NASA . The dataset referred consists of some different batteries used in this work, along with their respective operating parameters. The data repository contains capacity, voltage, current, temperature, current load and voltage load recorded for each discharge cycle of the batteries. Except the cell capacity, all other parameters are recorded over time during discharge; however these parameters are acquired with non-uniform sampling rate. It is observed that as battery ages there will be change in measured voltage, current and temperature. Hence it is paramount to extract the relevant features from these curves that are crucial in determining battery life. From each discharge cycle, a set of 8 parameters is extracted from voltage and temperature curves representing minimum and maximum values of each curve, and their respective times.

Capacity (Cap): The capacity of battery is computed by integrating discharge current over time.

Voltage (V): Voltage is the pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop, enabling them to do work such as illuminating a light.It is a quantitative expression of the potential difference in charge between two points in an electrical field.
i.e Voltage measured at load (Volts) and Battery terminal voltage (Volts).

Current (I): Current is the flow of electrical charge carriers like electrons and flows from negative to positive points, i.e Battery output current (Amps) and Current measured at charger (Amps).

Temperature (T): Battery temperature (degree C).

Time measured: It is the time measured for the flow of voltage, current and temperature measured at each cycle. i.e.the date and time of the start of the cycle, in MATLAB date vector format.

Cycle: Top level structure array containing the charge, discharge and impedance operations

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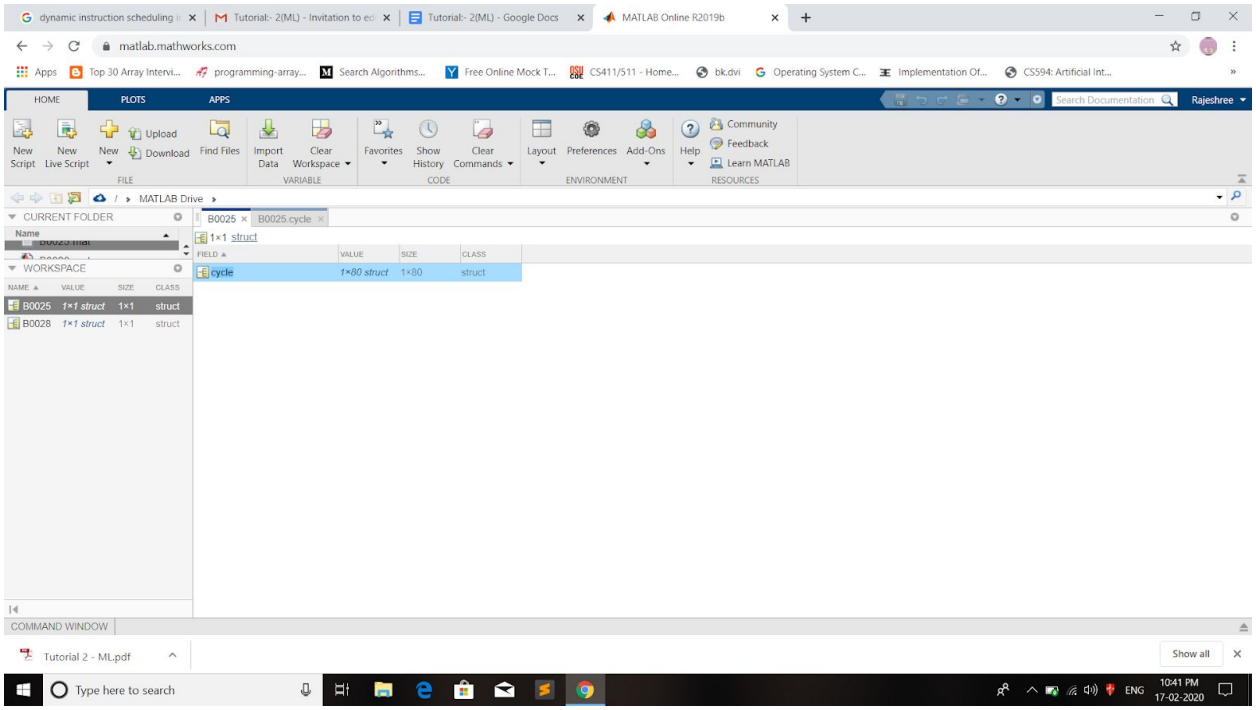
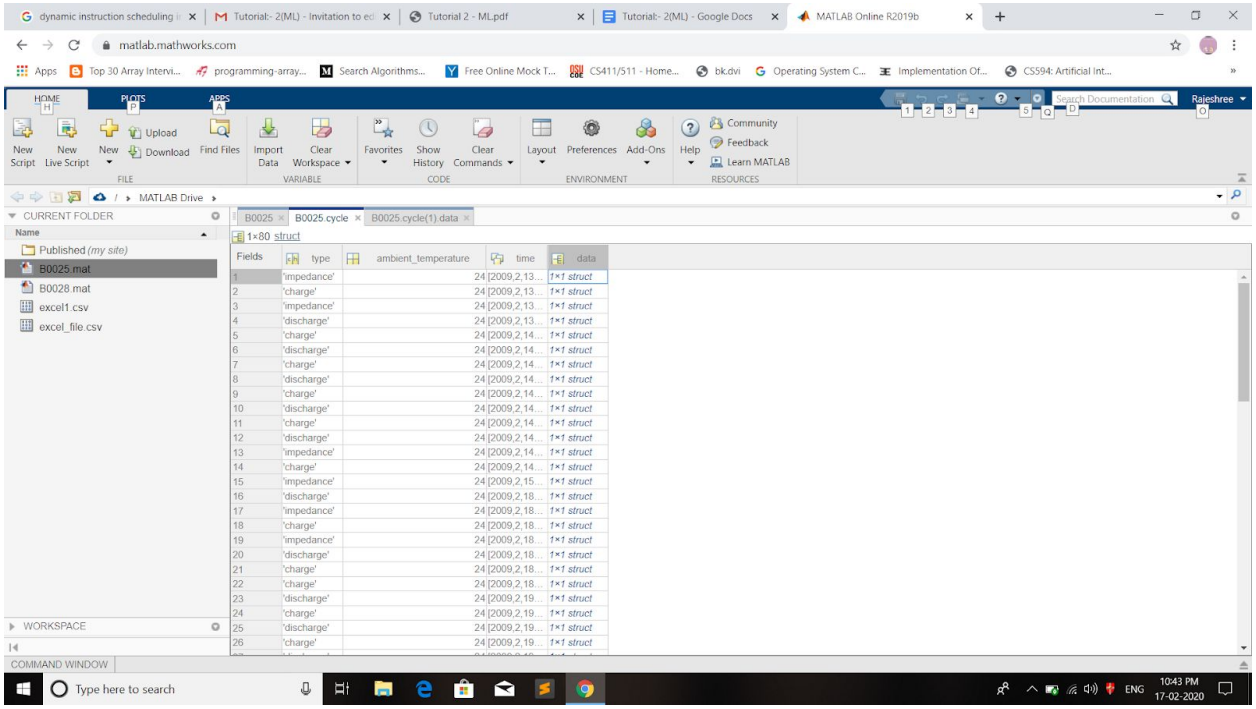
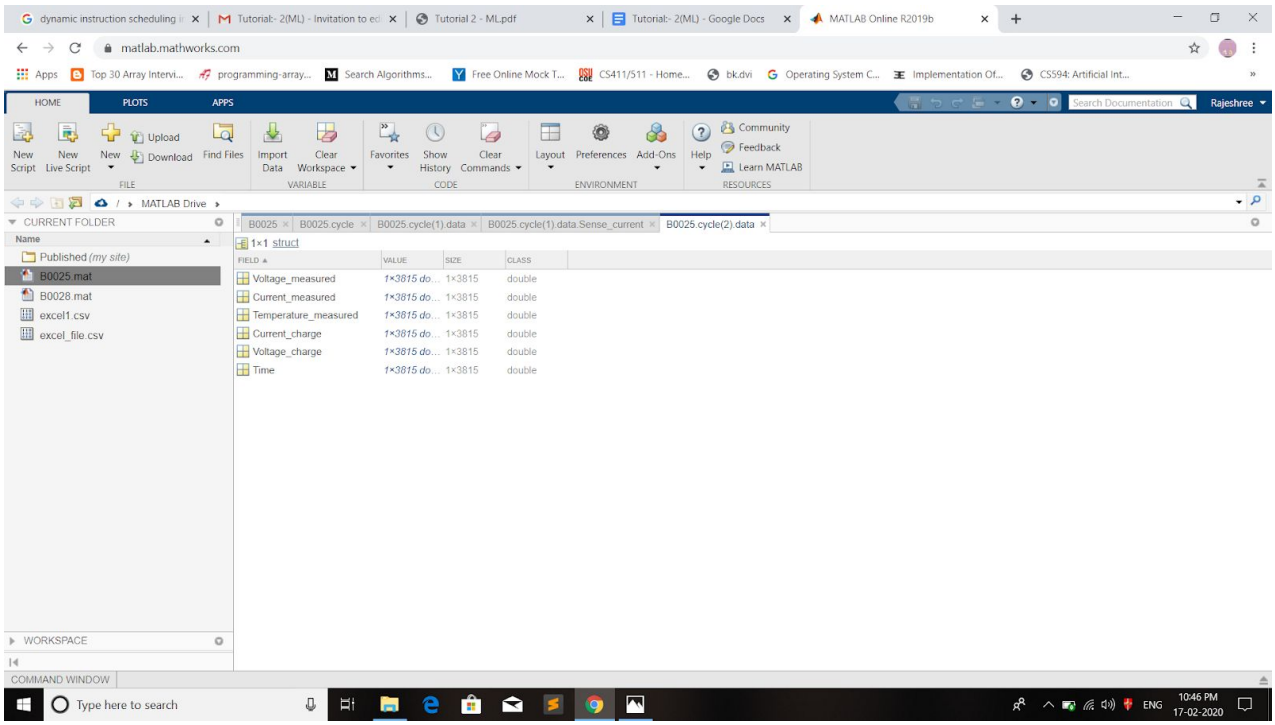


Type: operation type, can be charge, discharge or impedance

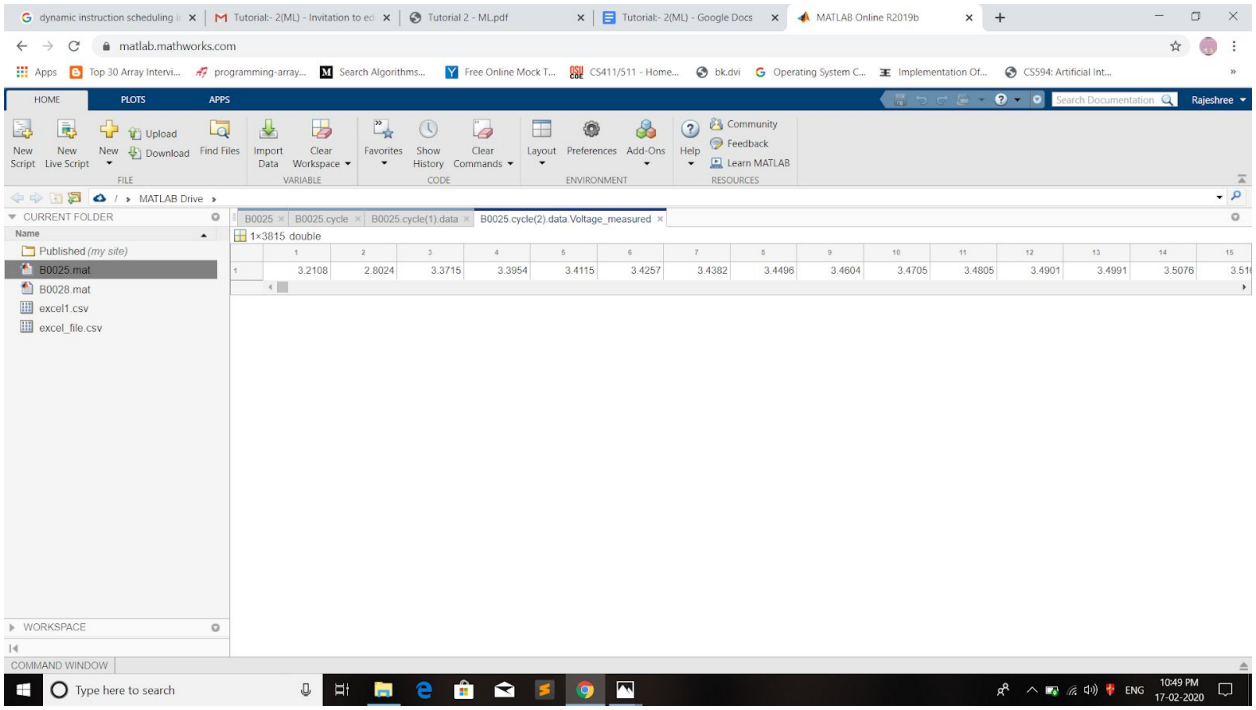


For charge the fields are:

Voltage_measured: Battery terminal voltage (Volts)
Current_measured: Battery output current (Amps)
Temperature_measured: Battery temperature (degree C)
Time: Time vector for the cycle (secs)
Capacity: Battery capacity (Ahr)

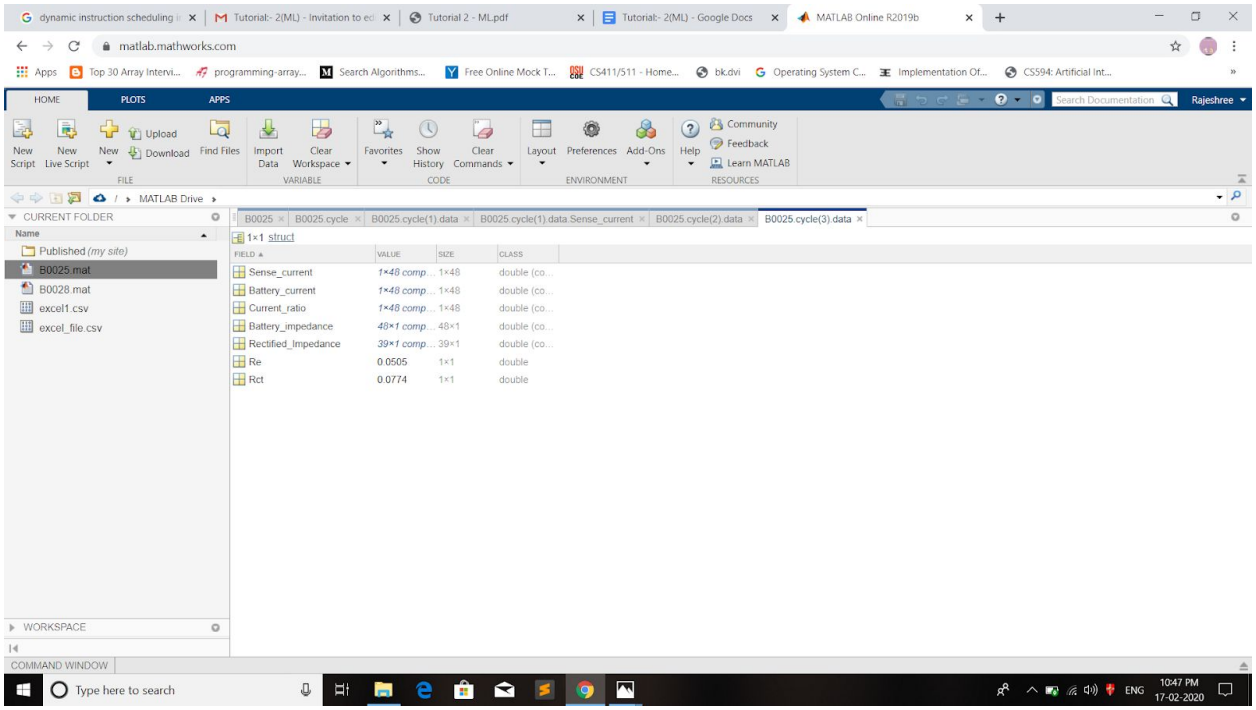


Parameters and Values(Datatype)

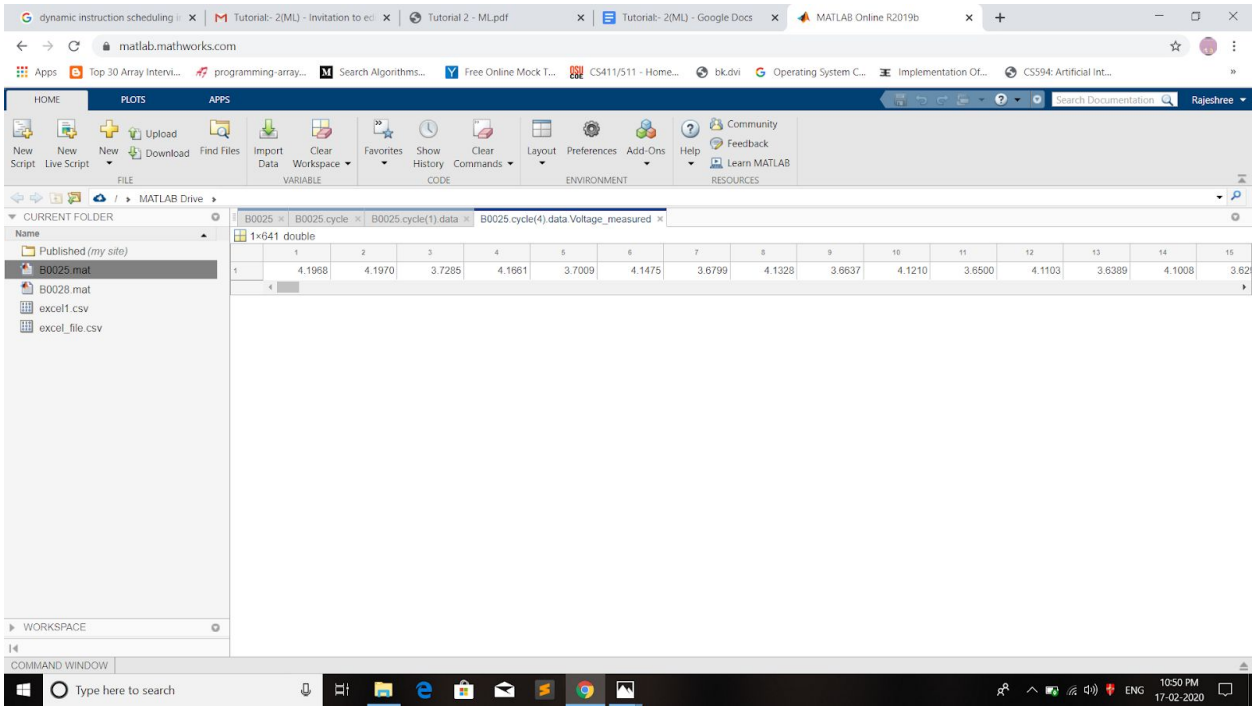


For discharge the fields are:

Voltage_measured: Battery terminal voltage (Volts)
Current_measured: Battery output current (Amps)
Temperature_measured: Battery temperature (degree C)
Time: Time vector for the cycle (secs)
Capacity: Battery capacity (Ahr) for discharge till 2.7V

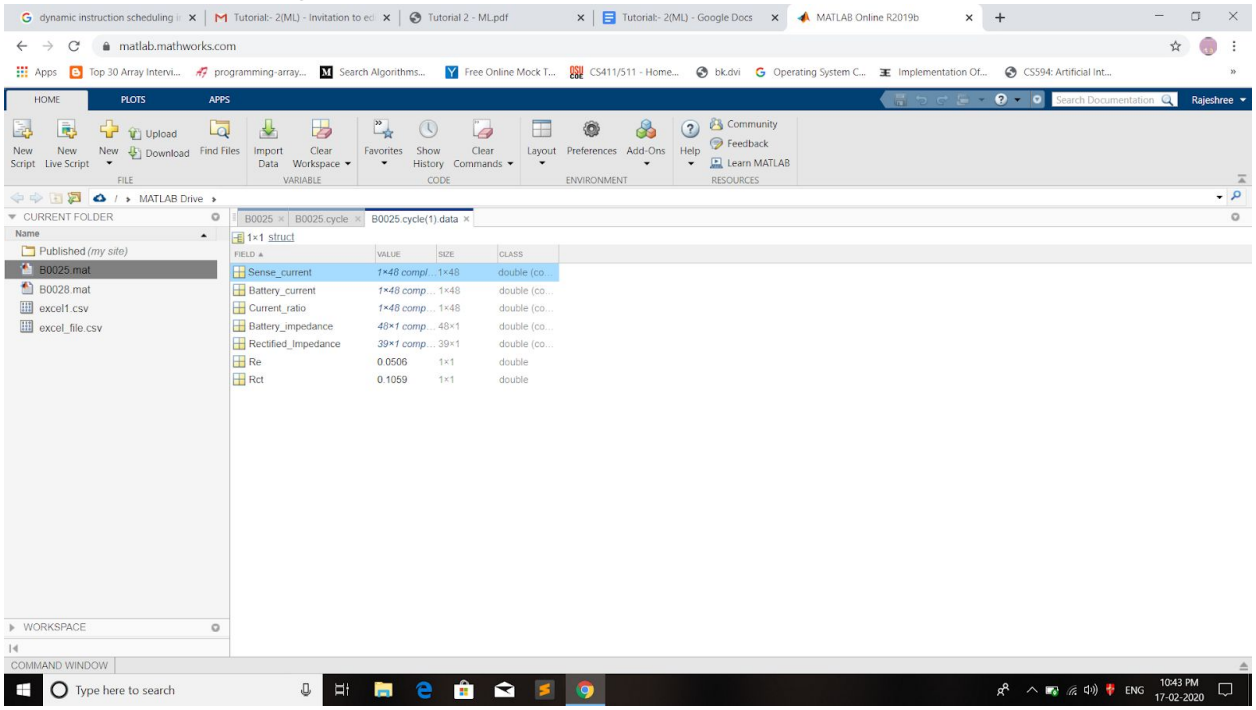


Parameters and Values(Datatype)



For impedance the fields are:

Sense_current: Current in sense branch (Amps)
Battery_current: Current in battery branch (Amps)
Current_ratio: Ratio of the above currents
Battery_impedance: Battery impedance (Ohms) computed from raw data
Rectified_impedance: Calibrated and smoothed battery impedance (Ohms)
Re: Estimated electrolyte resistance (Ohms)
Rct: Estimated charge transfer resistance (Ohms)



Parameters and Values(Datatype)