

## Pseudo Code for Voltage Anomaly Detection

### 1) Anomaly 1 => For sudden spikes in a cell voltage

- a. If ((cap>25) and (delta v1>0.06 or delta v2>0.06 or .... Delta v16>0.06)) => Python and link it with Database using an API
- b. If ((cap<25) and (delta v1>0.07 or delta v2>0.07 or .... Delta v16>0.07)) => Python and link it with Database using an API

### 2) Anomaly 2 => For cell unbalancing and calibration

- a. If Capacity (Ah) <65 Ah when Battery\_Remaining % = 99 => potential indication (Direct Query can work)
- b. If Capacity (Ah) >8 Ah when Battery\_Remaining % = 10 => potential indication (Direct Query can work)
- c. Voltage are not reaching to lower limits i.e., 2.5V => (Direct Query can work)
  - i. Min\_cell\_volt is not 2.5V (sometimes charging and discharging cuts happen around 3.0V only)
- d. If (mod\_v1>0.06 or mod\_v2>0.06 or .... Mod\_v16>0.06) => Python and link it with Database using an API
- e. If Capacity jump is higher than 2 Ah in consecutive values. => (Direct Query can work)

### 3) Anomaly 3 => For loose state of connection

- a. If voltage values are **positive or negative** in five consecutive cell voltages. => Python and link it with Database using an API
- b. If voltages are outbound from [2.5, 3.65] => (Direct Query can work)
- c. If the difference of cell voltages are greater than 0.5 for about 5 seconds or next 5 rows **(requires immediate maintenance)** => Python and link it with Database using API
- d. If the difference of cell voltages are greater than 0.5 for about 30 seconds (problem is just started and hence will requires maintenance in a day or two or so) => Python and link it with Database using an API

## Initializations

- Delta v1 = abs (v1t-v1 t-1), calculate similarly for all the cells.
- Mod voltage = mode (v1, v2...v16)
- mod\_v1 = abs (v1 – mod voltages), Calculate this for all the cells.
- Data = data [asset ID, DI Timestamp, state, current, cap, v1, v2... v16, voltage, all the temperatures]
- Data = data [state == -1]
- Data [anomaly] = 0