MILESTONE 2: CORRELATION TEST

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Objective

Define charging cycles within Battery data.

Test correlation between cyclecounts and maximum charging capacity

- Calculate time needed to charge certain State of Charge Delta
- summing power in/out over time with certain State of Charge Delta

Why?

By caculating the maximum charging capacity we can determine the degradation of the battery *and with that predict the duration of the lifetime of a battery.*

Data transformation

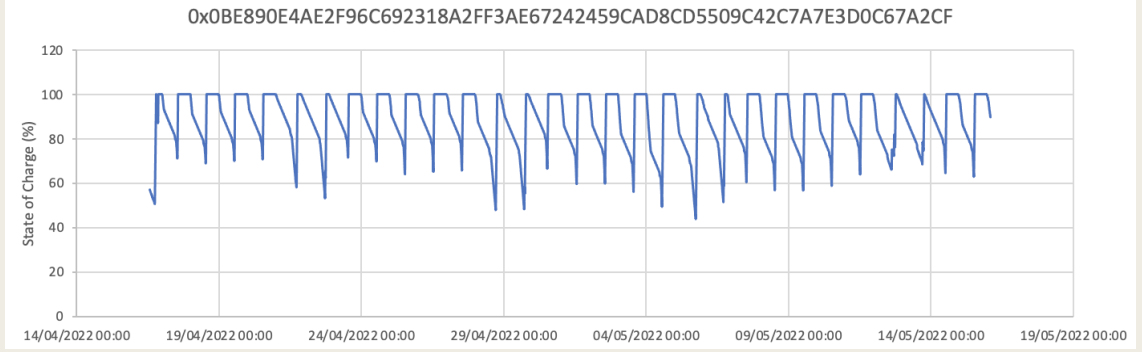
- What did we do with our data?
- Created a combined list of all battery product data. (CombinedProductData)

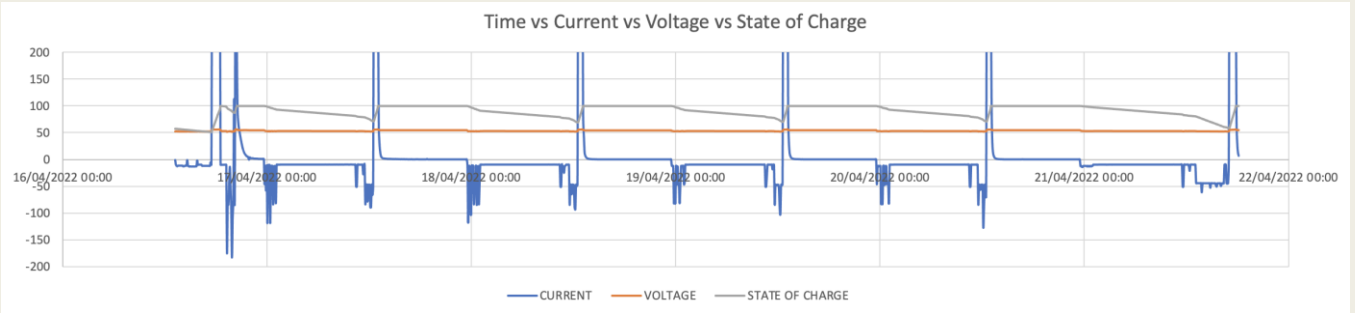
```r
library(dplyr)
library(tidyverse)

productTypes = read.csv(file.path(basePath, "221020_productTypes.csv"), header=TRUE)
summary(productTypes)
installationIs = productTypes$InstallationId
capLevels = parse_number(levels(factor(productTypes$NominalCapacity)))
pt = productTypes %>% filter(InstallationId != "NULL")

# These properties get imported. All the others get discarded.
useFullBatteryProperties = c("TimestampUTC", "Power", "Current", "Voltage", "StateOfCharge", "Temperature")
datePath = "221017"
combinedProductData = list()
for (i in 1:nrow(pt)){
  productType = pt[i,]
  batteryPath = file.path(basePath, paste(paste(datePath, productType$InstallationId, sep = "_"), ".csv", sep = ""))
  if (file.exists(batteryPath)){
    batteryData = read.csv(batteryPath)
    useFullBatteryData = batteryData %>% select(useFullBatteryProperties)
    useFullBatteryData$TimestampUTC = as.POSIXct(useFullBatteryData$TimestampUTC, format="%Y-%m-%d %H:%M:%S", tz="UTC")
    combinedData = list(productType, useFullBatteryData)
    names(combinedData) = c("ProductType", "BatteryData")
    combinedProductData[[i]] = combinedData
  } else {
    print(paste(batteryPath, "Does not exist"))
  }
}
combinedProductData = compact(combinedProductData)
```

Data transformation

- This allowed us to make a combined list with Data frames consisting of:
  - *Static ProductType information*
  - *Battery Data (Time Stamps with corresponding measurements)*

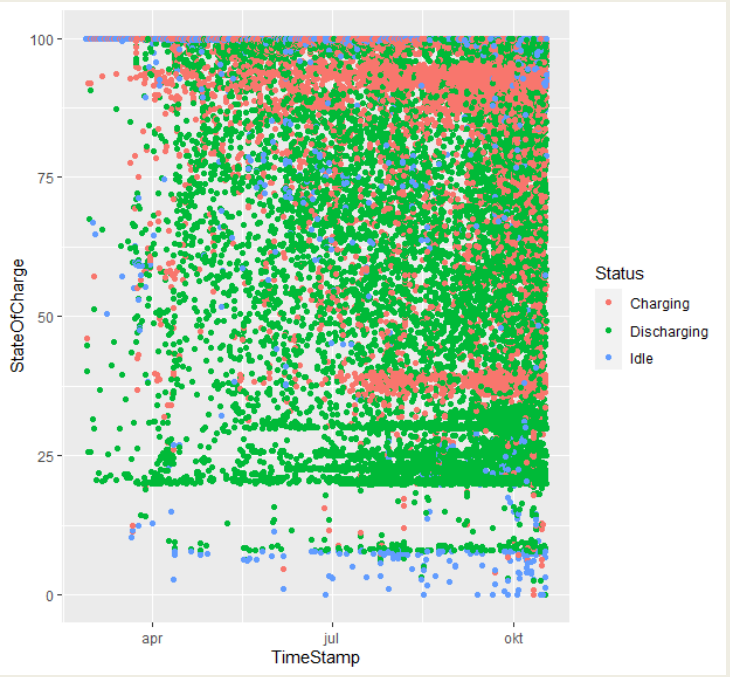
combinedProductData	list [67]	List of length 67
[[1]]	list [2]	List of length 2
ProductType	list [1 x 22] (S3: data.frame)	A data.frame with 1 row and 22 columns
BatteryData	list [67343 x 6] (S3: data.fram	A data.frame with 67343 rows and 6 columns
[[2]]	list [2]	List of length 2
ProductType	list [1 x 22] (S3: data.frame)	A data.frame with 1 row and 22 columns
BatteryData	list [54151 x 6] (S3: data.fram	A data.frame with 54151 rows and 6 columns
[[3]]	list [2]	List of length 2
ProductType	list [1 x 22] (S3: data.frame)	A data.frame with 1 row and 22 columns
BatteryData	list [41170 x 6] (S3: data.fram	A data.frame with 41170 rows and 6 columns
[[4]]	list [2]	List of length 2
ProductType	list [1 x 22] (S3: data.frame)	A data.frame with 1 row and 22 columns
BatteryData	list [61101 x 6] (S3: data.fram	A data.frame with 61101 rows and 6 columns





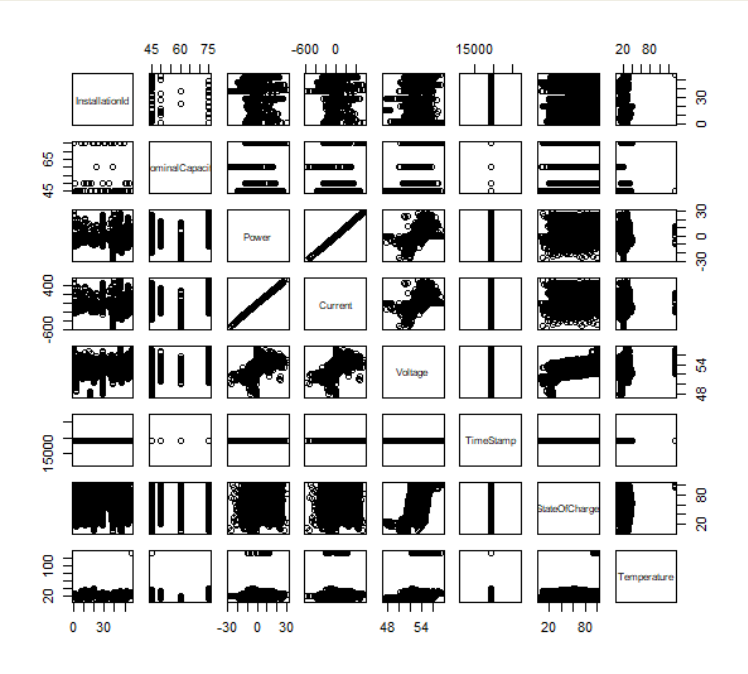
Define cycle

- When Power > 0.1 give it status "Charging”
- When Power < 0.1 give it status “Discharging”
- Otherwise give it status “Idle”

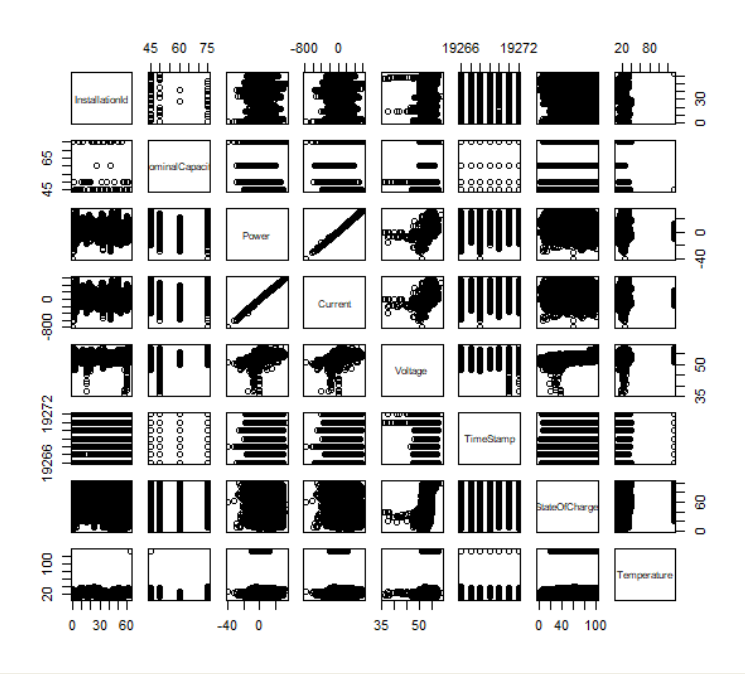


- Current bottleneck:
  defining what a right charging cycle is
- When battery is turned off new cycle should start

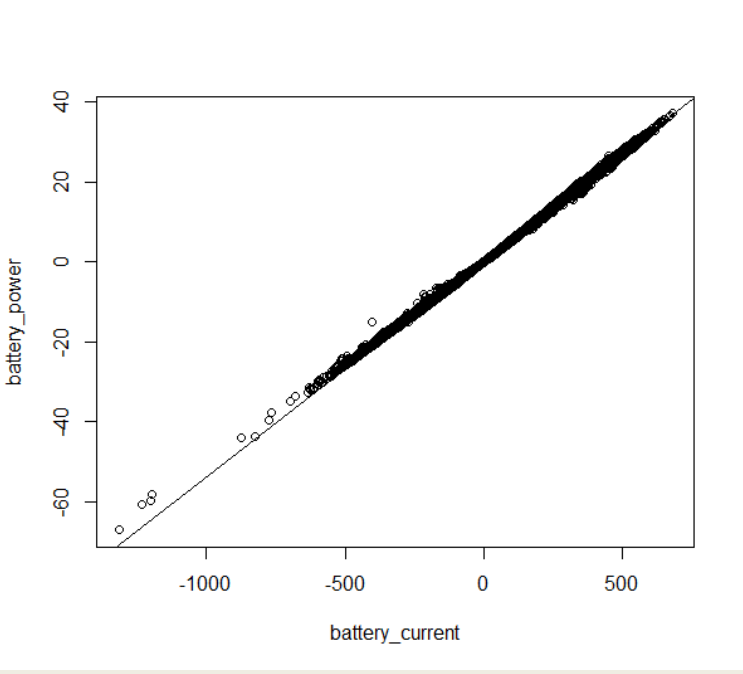
	InstallationId	NominalCapacity	BatteryType	Power	Current	Voltage	TimeStamp	StateOfCharge	Status	CycleId
1	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.00	0.0	54.50	2022-02-25 18:59:36	100.0	Idle	1
2	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-3.25	-62.8	51.68	2022-02-26 05:59:37	40.1	Discharging	2
3	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	15.57	283.6	54.90	2022-02-26 06:14:36	46.0	Charging	3
4	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-7.13	-138.5	51.51	2022-02-26 06:29:37	44.9	Discharging	4
5	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.14	2.5	54.65	2022-02-26 08:34:37	100.0	Charging	5
6	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.00	0.0	54.63	2022-02-26 14:59:35	100.0	Idle	6
7	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-3.89	-76.0	51.21	2022-02-27 07:24:35	25.6	Discharging	7
8	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	15.91	286.8	55.48	2022-02-27 09:14:35	92.0	Charging	8
9	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-3.94	-74.9	52.61	2022-02-27 11:59:36	67.5	Discharging	9
10	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.15	2.8	54.80	2022-02-27 13:29:35	100.0	Charging	10
11	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.02	0.4	54.80	2022-02-27 13:59:35	100.0	Idle	11
12	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-3.29	-63.9	51.46	2022-02-28 03:49:35	25.6	Discharging	12
13	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	15.97	287.8	55.48	2022-02-28 05:39:35	92.0	Charging	13
14	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-8.80	-167.5	52.53	2022-02-28 05:59:35	90.6	Discharging	14
15	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.12	2.1	54.80	2022-02-28 06:59:35	100.0	Charging	15
16	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.00	0.0	54.78	2022-02-28 18:59:35	100.0	Idle	16
17	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-8.64	-170.2	50.76	2022-03-01 05:14:34	31.5	Discharging	17
18	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.15	2.8	54.78	2022-03-01 07:39:33	100.0	Charging	18
19	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	0.00	0.0	54.78	2022-03-01 18:59:34	100.0	Idle	19
20	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	-3.25	-62.6	51.86	2022-03-02 03:59:33	51.4	Discharging	20
21	0x6D7B40C75E1F92D5FF83AAF6F1E936F479D7ED6...	45	LFP	15.82	287.2	55.10	2022-03-02 04:14:33	57.2	Charging	21



Entire data set during 1 day.



Entire data set during 7 days.



Power vs Current.

POSSIBLE CORRELATIONS

Possible correlations

End goal is to find a negative correlation between cyclecount and maximum charging capacity.

Hypothesis:

- H_0: Charging cycles does not negatively influence the maximum charging capacity.
- H_1: The more cycles a battery has the lower the maximum charging capacity is. (negative correlation)

Questions?