



**KEEWI**

*Business Insights from  
Intelligent Plugs*

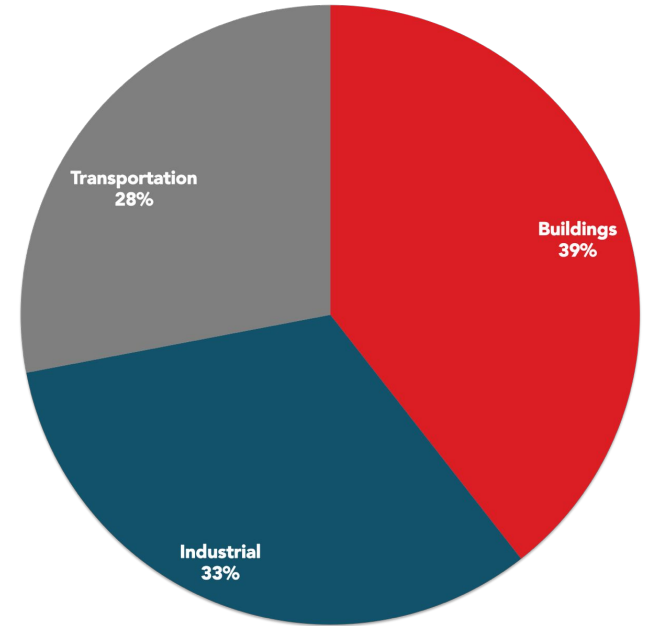
**Hedi Razavi, PhD**

**April 17, 2019**

# BUILDINGS ARE LARGEST U.S. ENERGY CONSUMERS

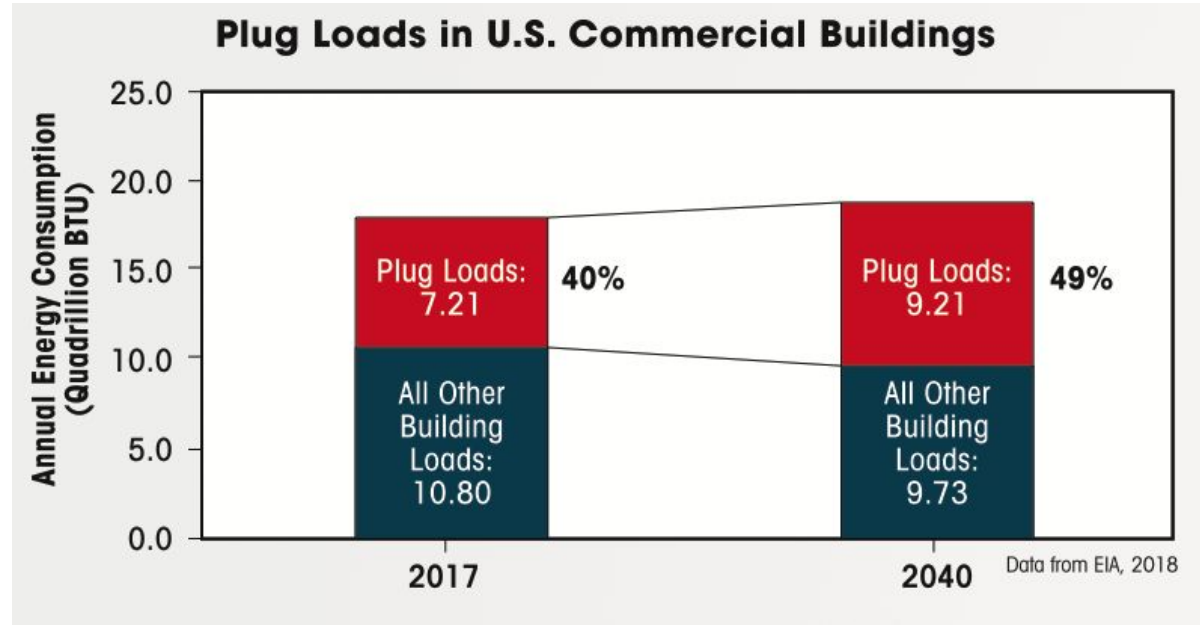


## U.S. Energy Consumption in 2018



Rising plug load energy consumption is the biggest challenge for building energy management

## Annual Energy Spend in the US



# PLUG LOADS:

## A Challenge and an Opportunity



**Massive scale: 20B+ outlets**

**No infrastructure for monitoring and controls**

**Greatly affected by occupant behavior**

# A NEW APPROACH

**KEEWI USES THE POWER OF BIG DATA  
AND OCCUPANT ENGAGEMENT TO  
ADDRESS THE PLUG LOAD CHALLENGE**

# PREMIER CUSTOMERS

Leading institutions are working with Keewi to address the plug load challenge



STANFORD  
UNIVERSITY



TEXAS A&M  
UNIVERSITY



San Francisco  
International  
Airport



CLARION  
PARTNERS



EASTERN  
MENNONITE  
UNIVERSITY



EnergyAustralia



UC DAVIS  
UNIVERSITY OF CALIFORNIA



ECHELON®



UNIVERSITY OF  
MARYLAND



University  
of Colorado  
Boulder



mastercard.

INTEGRAL  
GROUP

KEEWI

# DATA IS KEY TO UNLOCKING NEW VALUE

1

RAW  
DATA



Plug

Current

Voltage

Time

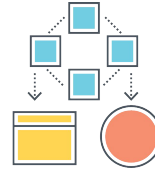
# DATA IS KEY TO UNLOCKING NEW VALUE

1

RAW  
DATA



CORE  
ANALYTICS



Plug

Current

Voltage

Time



Visibility

What?

When?

Who?

Where?



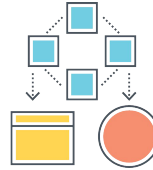
# DATA IS KEY TO UNLOCKING NEW VALUE

1

RAW  
DATA



CORE  
ANALYTICS



ADVANCED  
ANALYTICS

Plug

Current

Voltage

Time

Visibility

What?

When?

Who?

Where?

Predictions

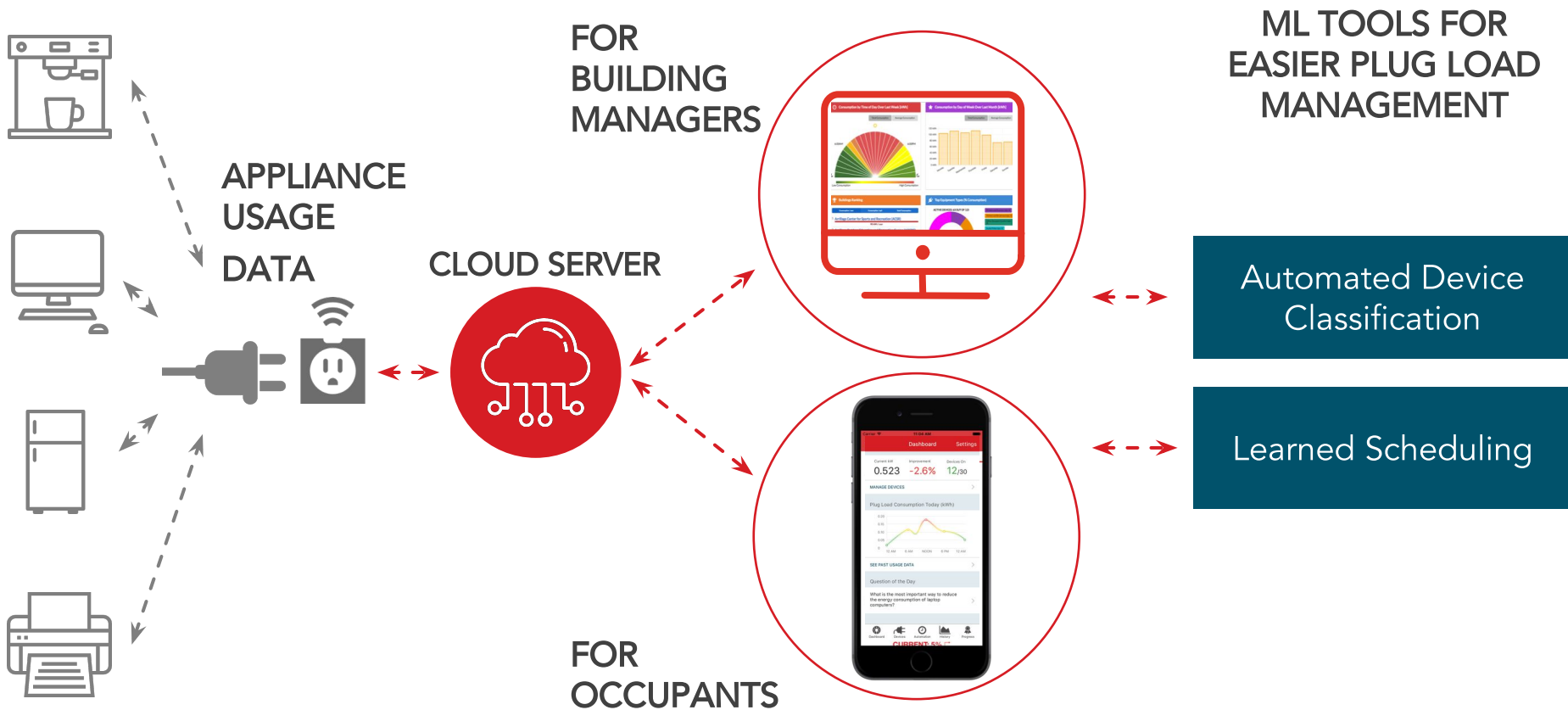
What's a good schedule for each device?

Will device fail at crucial event?

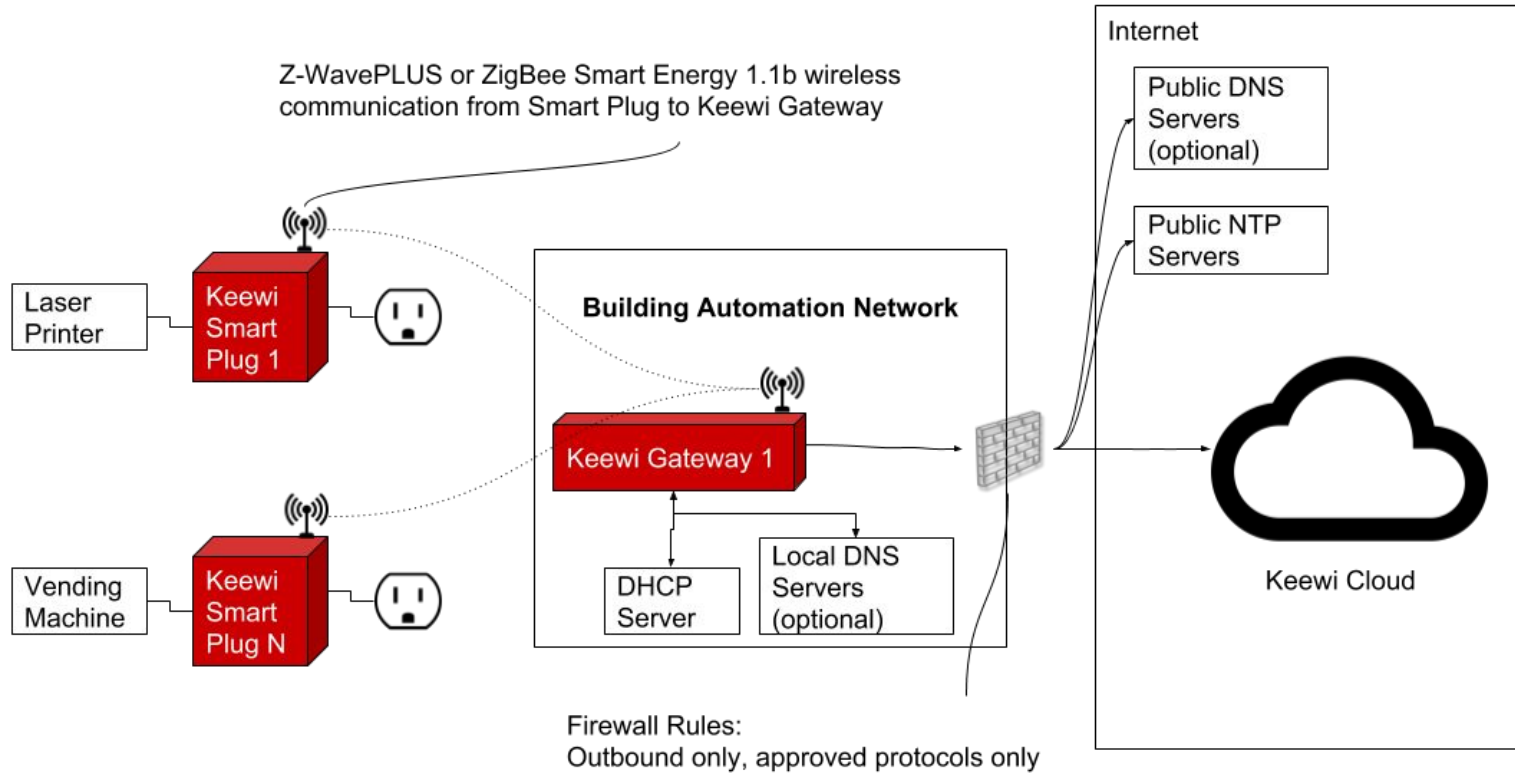
Is the space used enough? How much money am I wasting on rent?



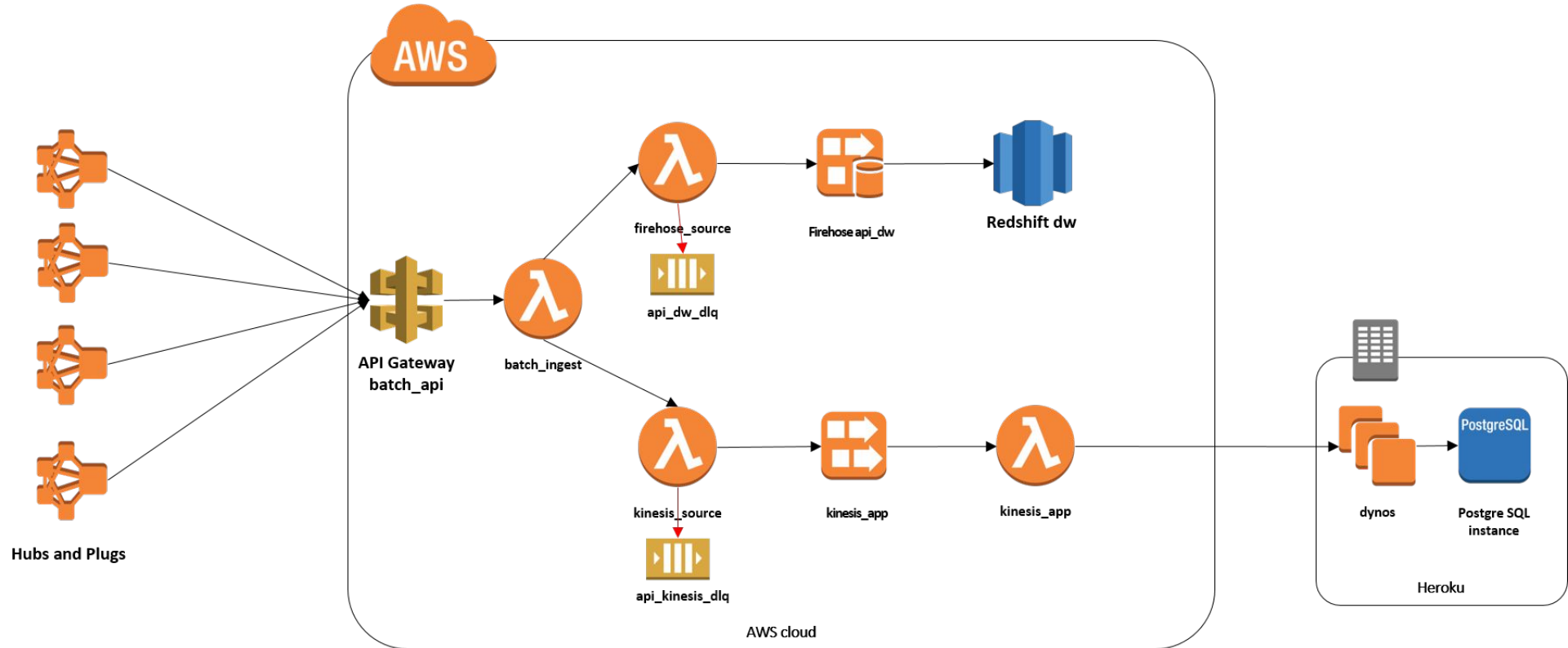
# THE KEEWI SOLUTION



# DATA COLLECTION WITH IOT



# DATA PIPELINE



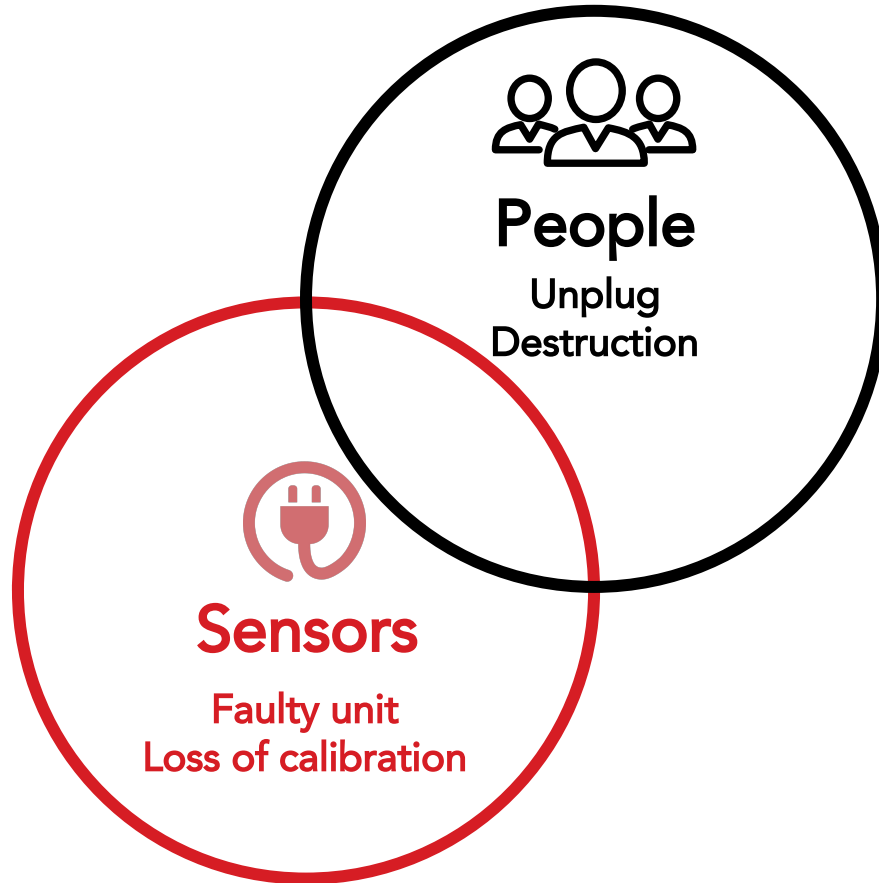
# THE IOT CHALLENGERS



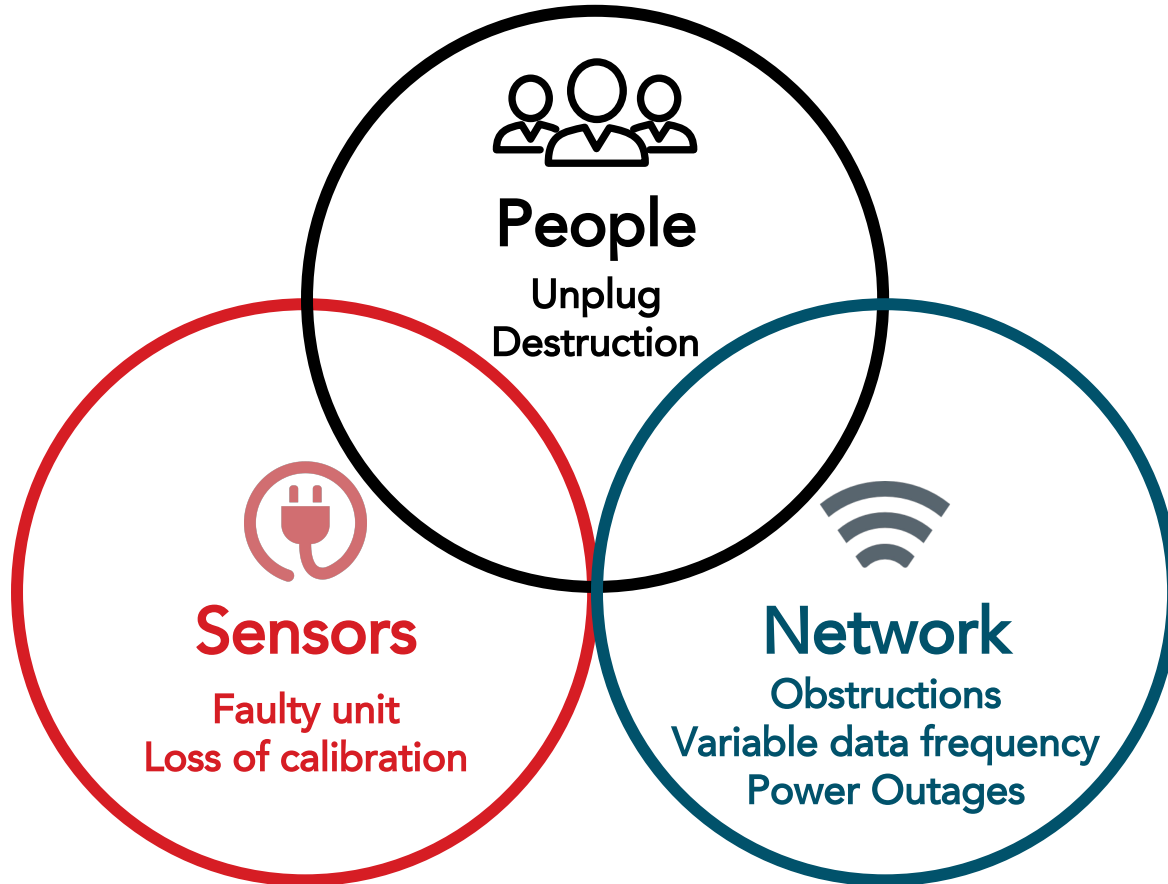
**People**

Unplug  
Destruction

# THE IOT CHALLENGERS



# THE IOT CHALLENGERS



# ML TOOLS FOR IOT

Tool #1

-

Expect  
the  
Unexpected

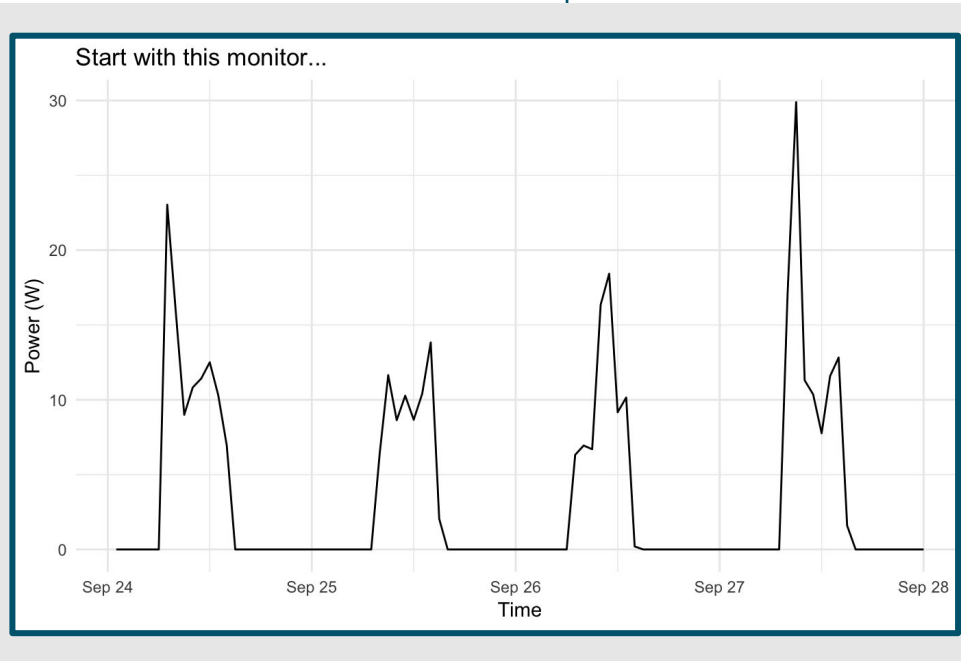




# EXPECT THE UNEXPECTED



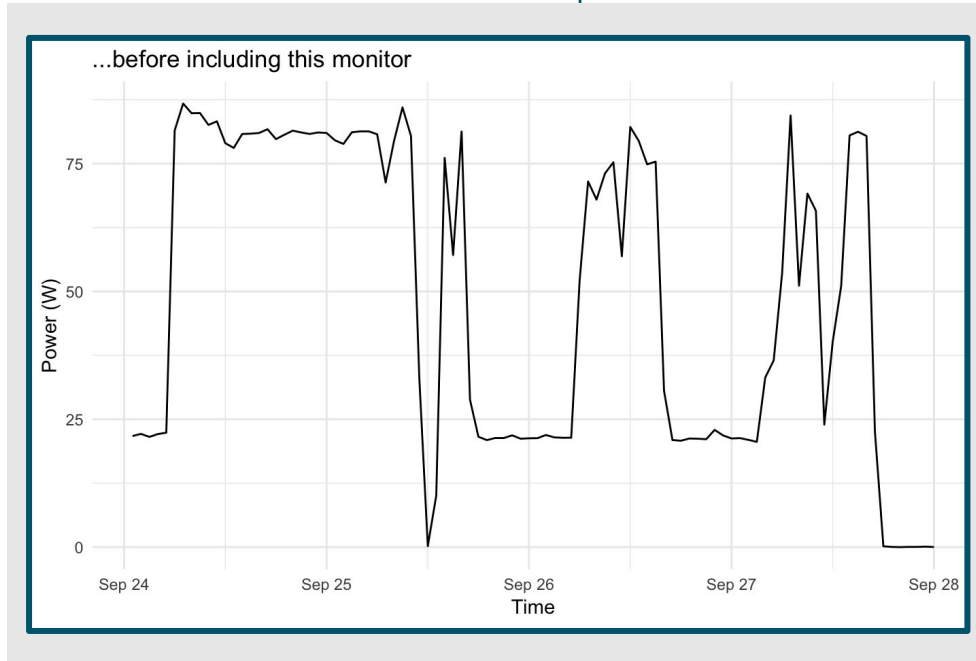
During development, start with clean input data before messy data



# EXPECT THE UNEXPECTED



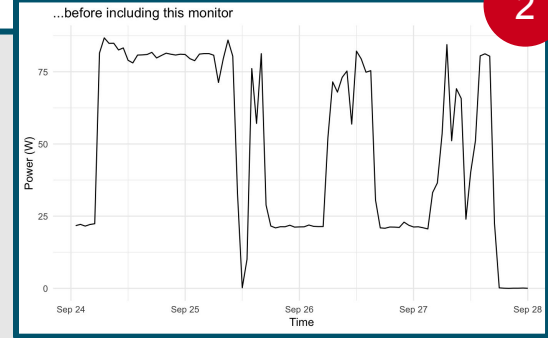
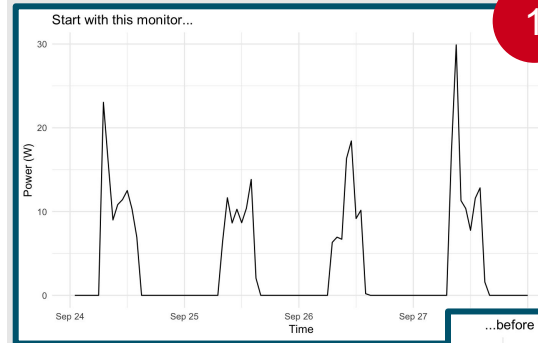
During development, start with clean input data before messy data



# EXPECT THE UNEXPECTED

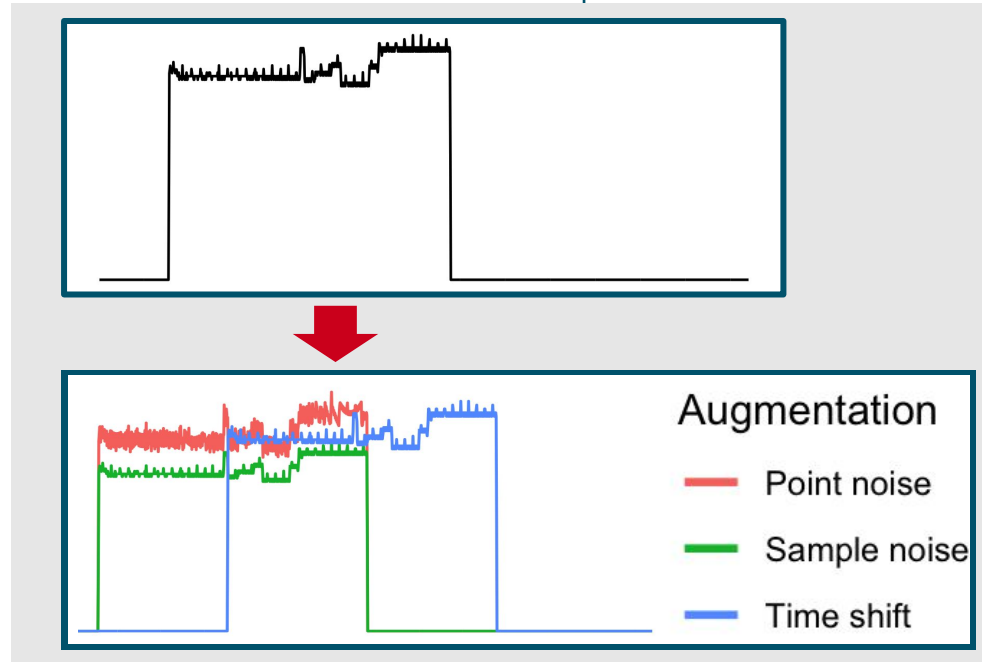


During development, start with clean input data before messy data



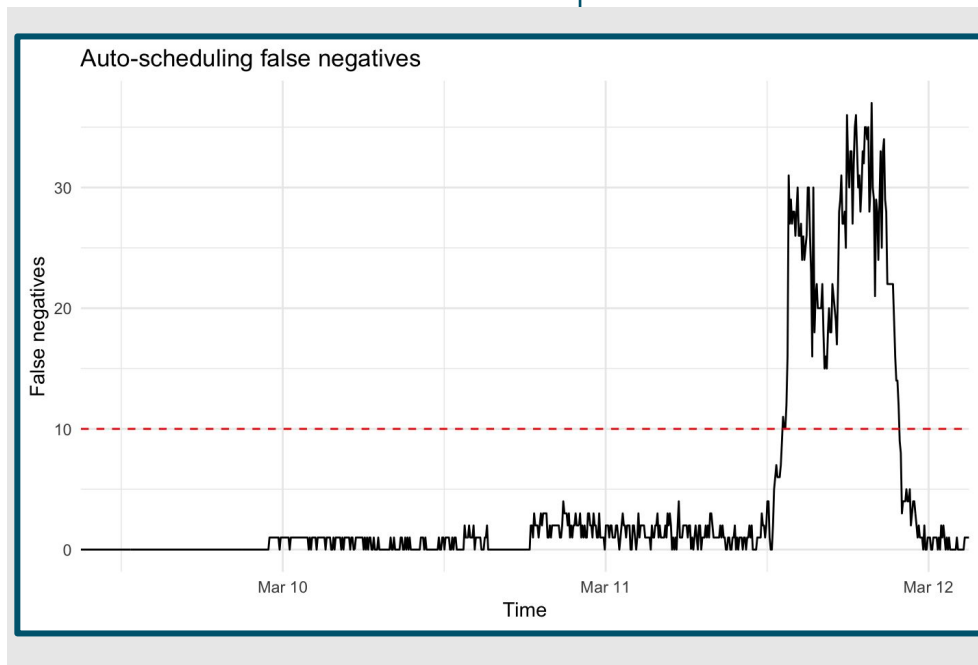
# EXPECT THE UNEXPECTED

- ✓ During development, start with clean input data before messy data
- ✓ Apply data augmentation to training data for more robustness



# EXPECT THE UNEXPECTED

- ✓ During development, start with clean input data before messy data
- ✓ Apply data augmentation to training data for more robustness
- ✓ Monitor pipeline performance



# ML TOOLS FOR IOT

## Tool #2

-

# Minimize Effects of Expected Challenges

**MATT  
DAMON**

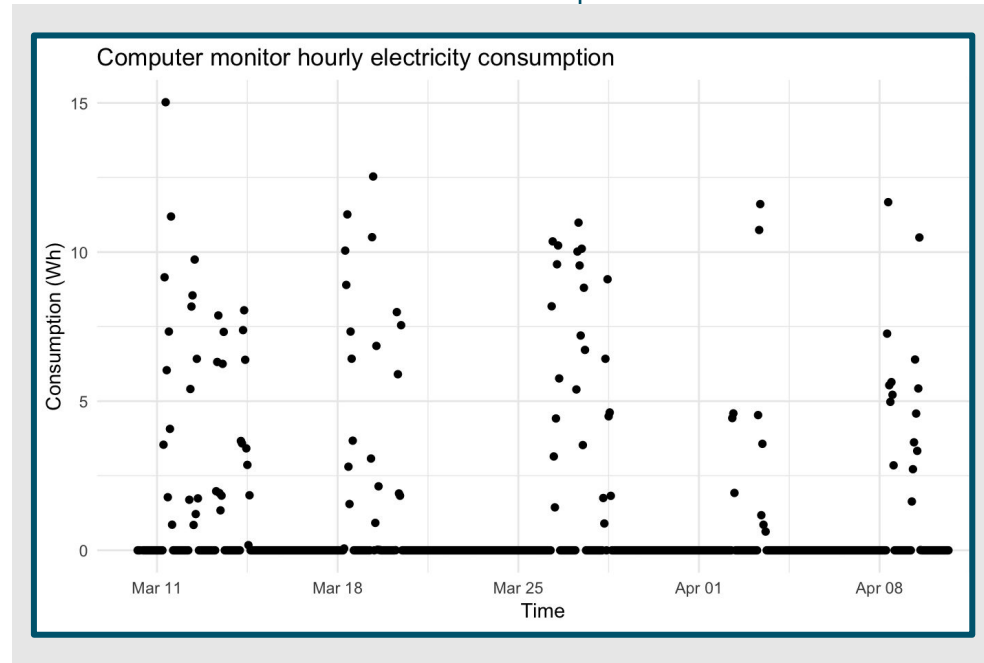


**DOWNSiZiNG**

# MINIMIZE AND SIMPLIFY



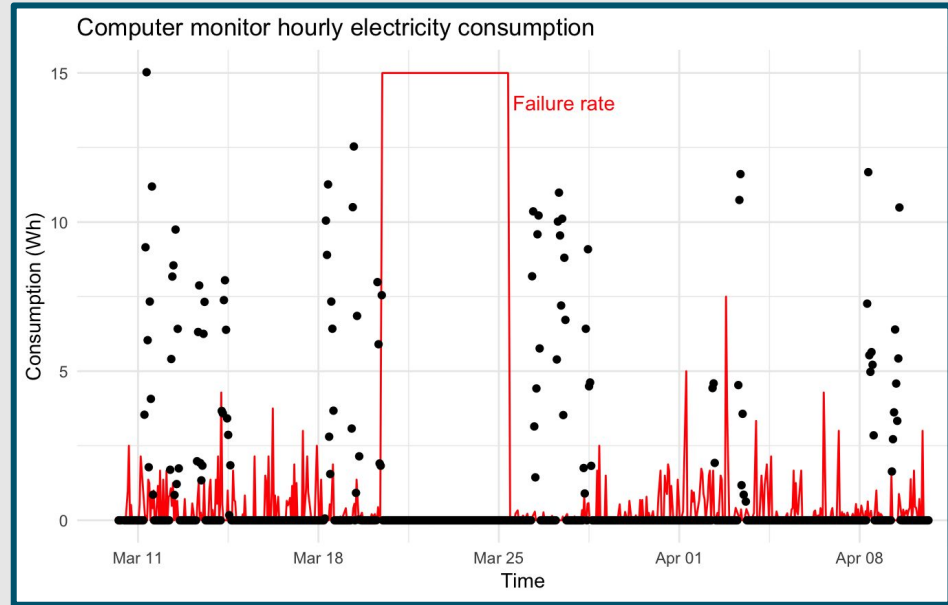
Incorporate system health information



# MINIMIZE AND SIMPLIFY



Incorporate system health information





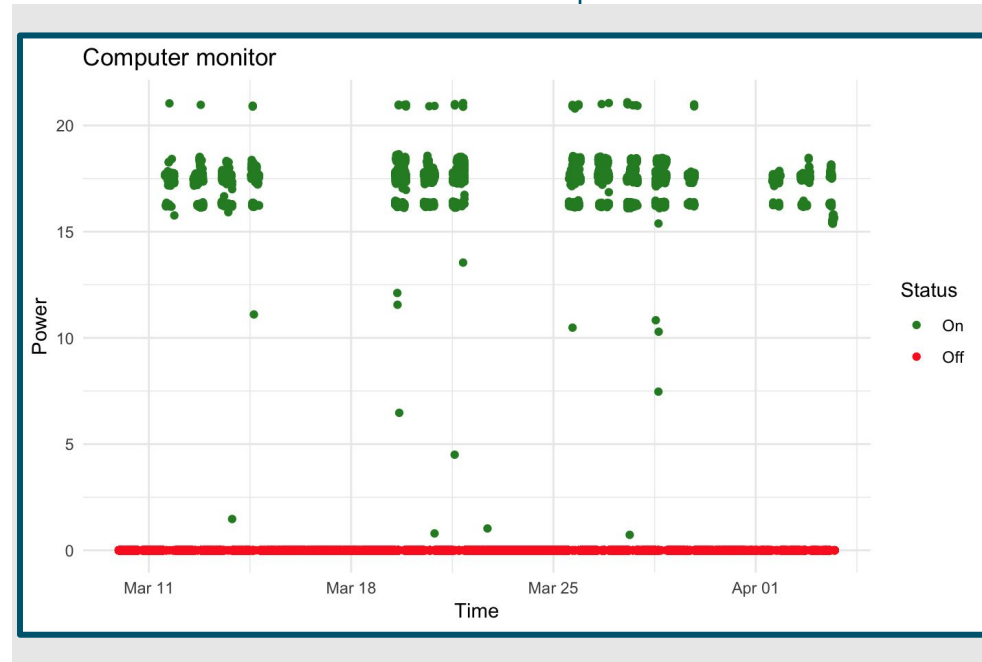
# MINIMIZE AND SIMPLIFY



Incorporate system health information



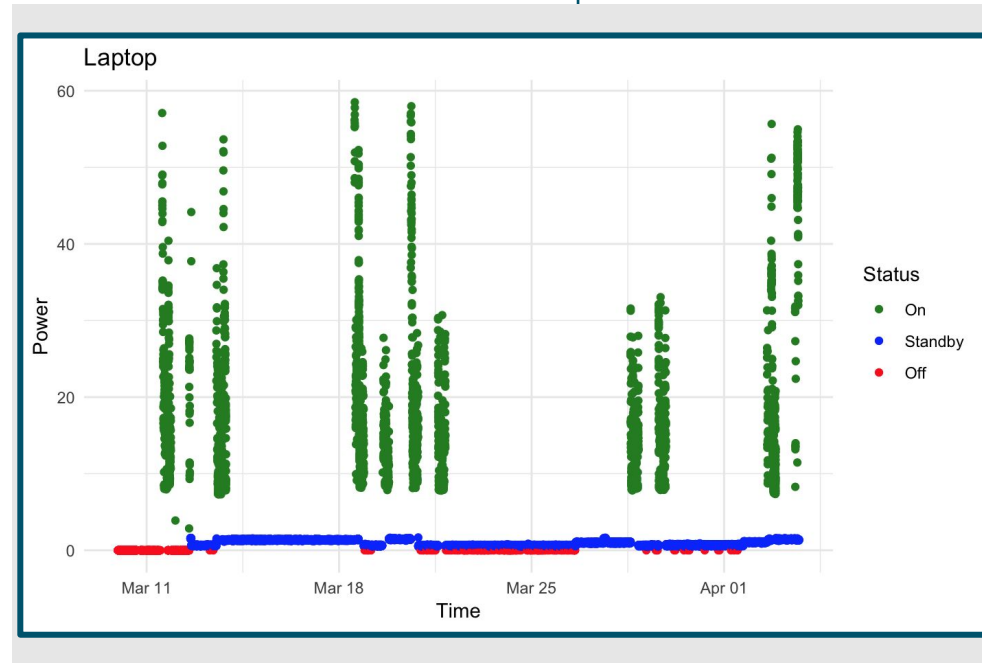
Transform data from continuous to discrete



# MINIMIZE AND SIMPLIFY

✓ Incorporate system health information

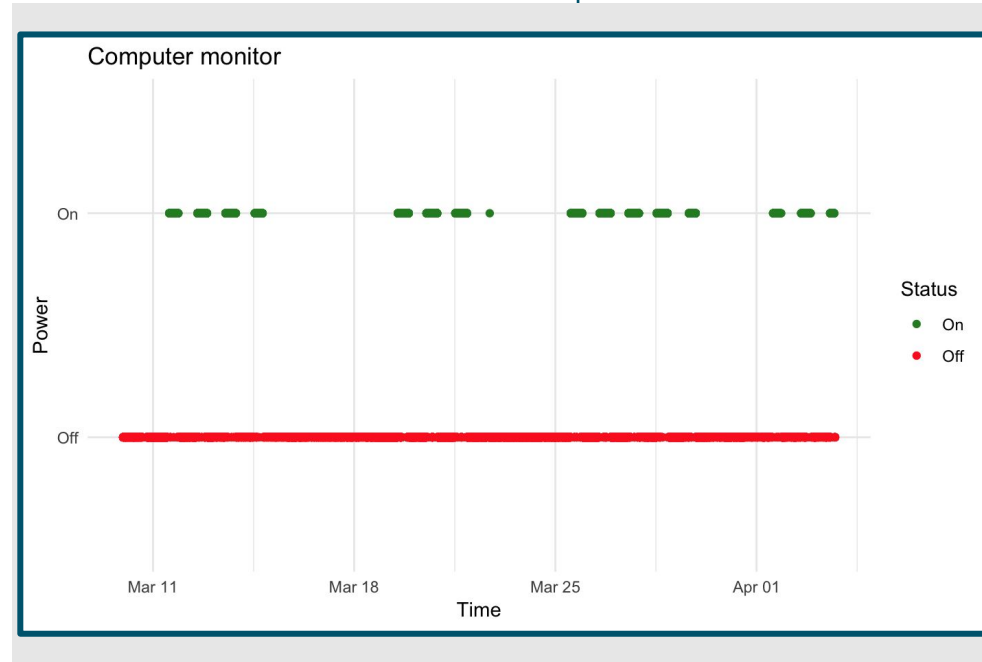
✓ Transform data from continuous to discrete



# MINIMIZE AND SIMPLIFY

✓ Incorporate system health information

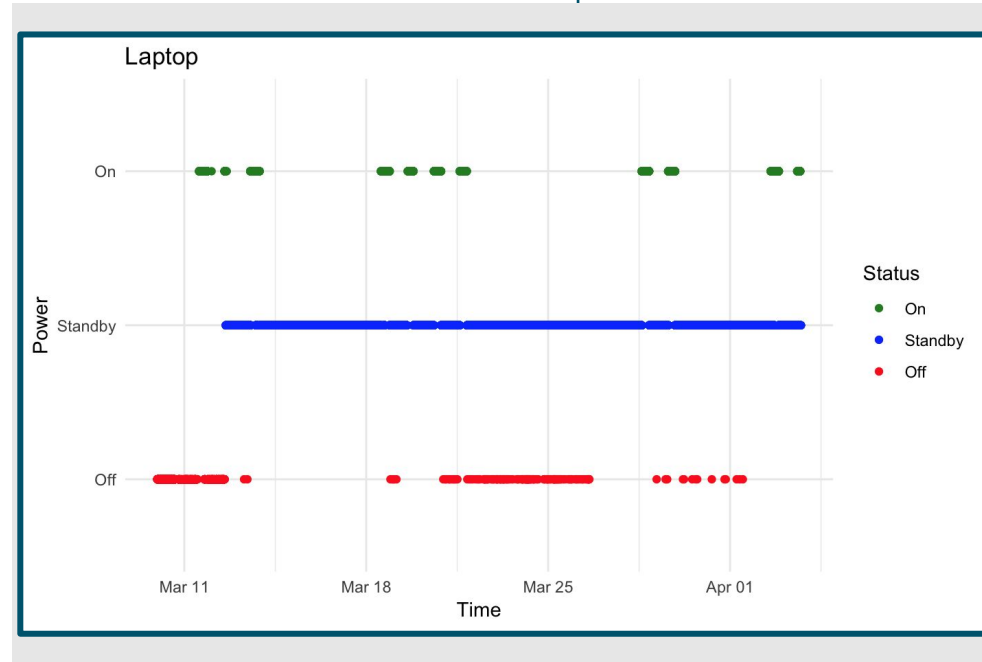
✓ Transform data from continuous to discrete



# MINIMIZE AND SIMPLIFY

✓ Incorporate system health information

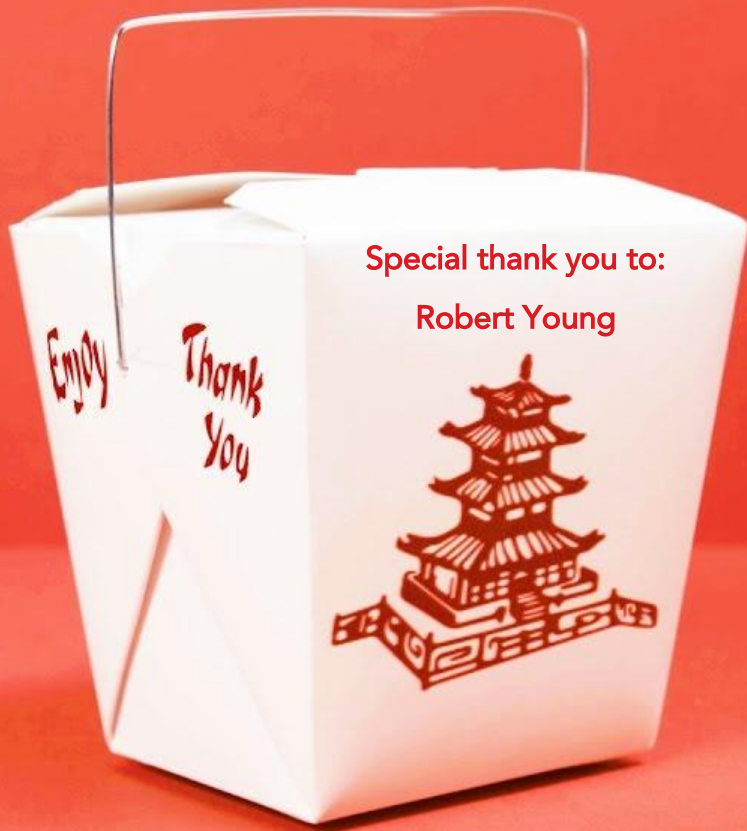
✓ Transform data from continuous to discrete





**TAKE  
AWAYS**





TAKE  
AWAYS

