SEATTLE POWER OUTAGE

Team 4

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MOTIVATION

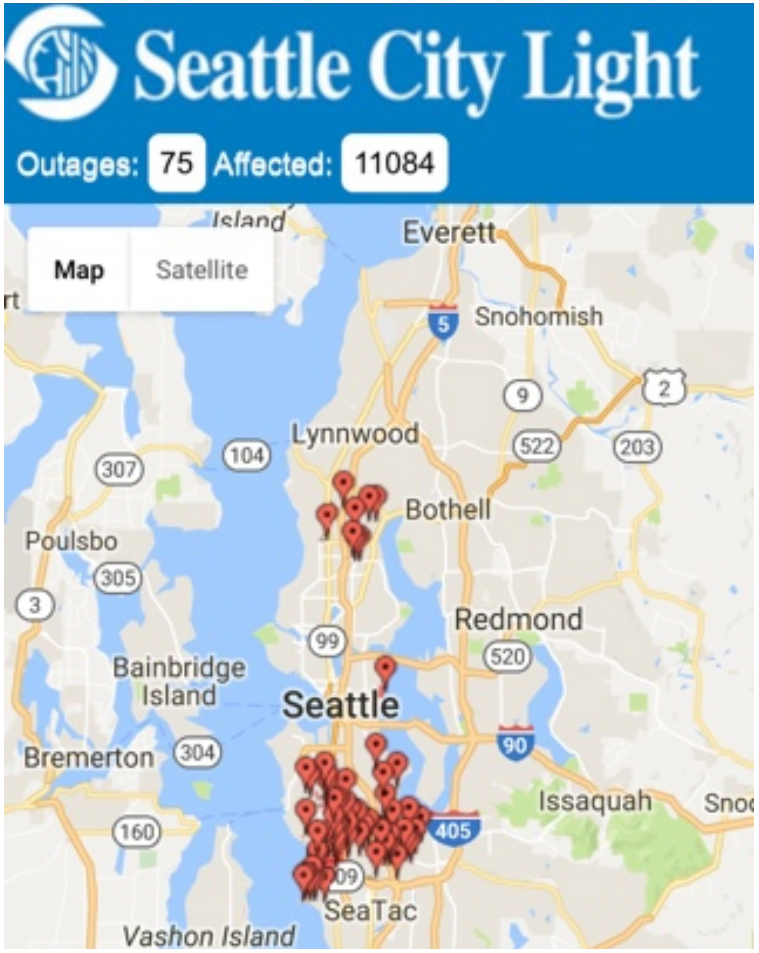
We LOVE Seattle ❤️

Pain points

- Power outage happens almost everyday in Seattle from couples to hundreds.
- Seattle City Light
  - Doesn't know how many specialists should be hired daily. The cost is high for emergency repair, or customers need to wait longer time because the short of personal.
  - Doesn't know where is the possible locations and what types of equipment failure could happen. Underground transformer failure and insulator failure require different teams to repair.

Solutions

- Use Machine Learning…
  - Predict the number of power outage daily.
    (e.g. 70% chance of having 6-10 outages)
  - Predict the failure type.
    (e.g. equipment-caused or tree/animal-caused failure)
- Visualize…
  - Use dashboard and heat map to help users to understand the outage history



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REVIEW

New York City (Columbia, MIT)

- Machine Learning for the New York City Power Grid (Rudin et. al., 2012)
  - Goal: Predict the risk of failures for components and systems by rank
  - Input: Outage History + Transformer telemetry + System Load + Temp. (2002-2009)
  - ML: Ranking (k-fold cross validation) + ROC plots / region, citywide

Kansas City (Kansas State University)

- Estimation of Overhead Distribution System Outages Caused by Wind and Lightning Using an Artificial Neural Network (Kankanala, 2012)
  - Goal: Overhead distribution system; Distribution reliability; Weather & animal-related outages
  - Input: weather (wind, light strokes) (2005 - 2009)
  - ML: 3-layer neural network

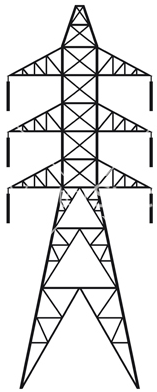
Seattle City (UW)

- Power Outages in Seattle: Where, Why and How long? (CSE546 Course project)
  - Goal: Predict outage duration
  - Input: Outage History (Type, Location, maintenance time, affected customer) + Weather (Wind, Humidity, Temp.) (2000 - 2016)
  - ML: LASSO model / 2-layer neural network

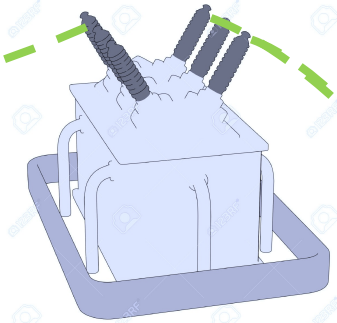
POWER GRID

Power generation

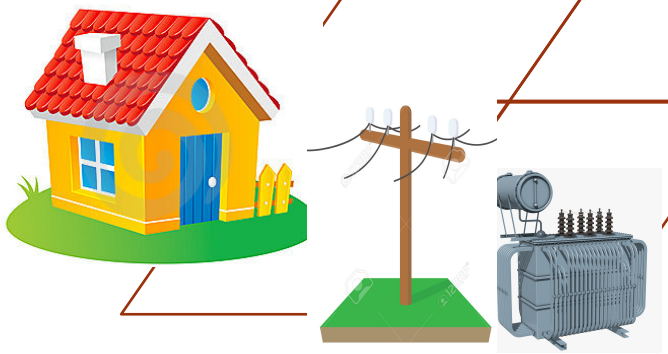
High-voltage
Transmission



Substation
(step-down transformer)



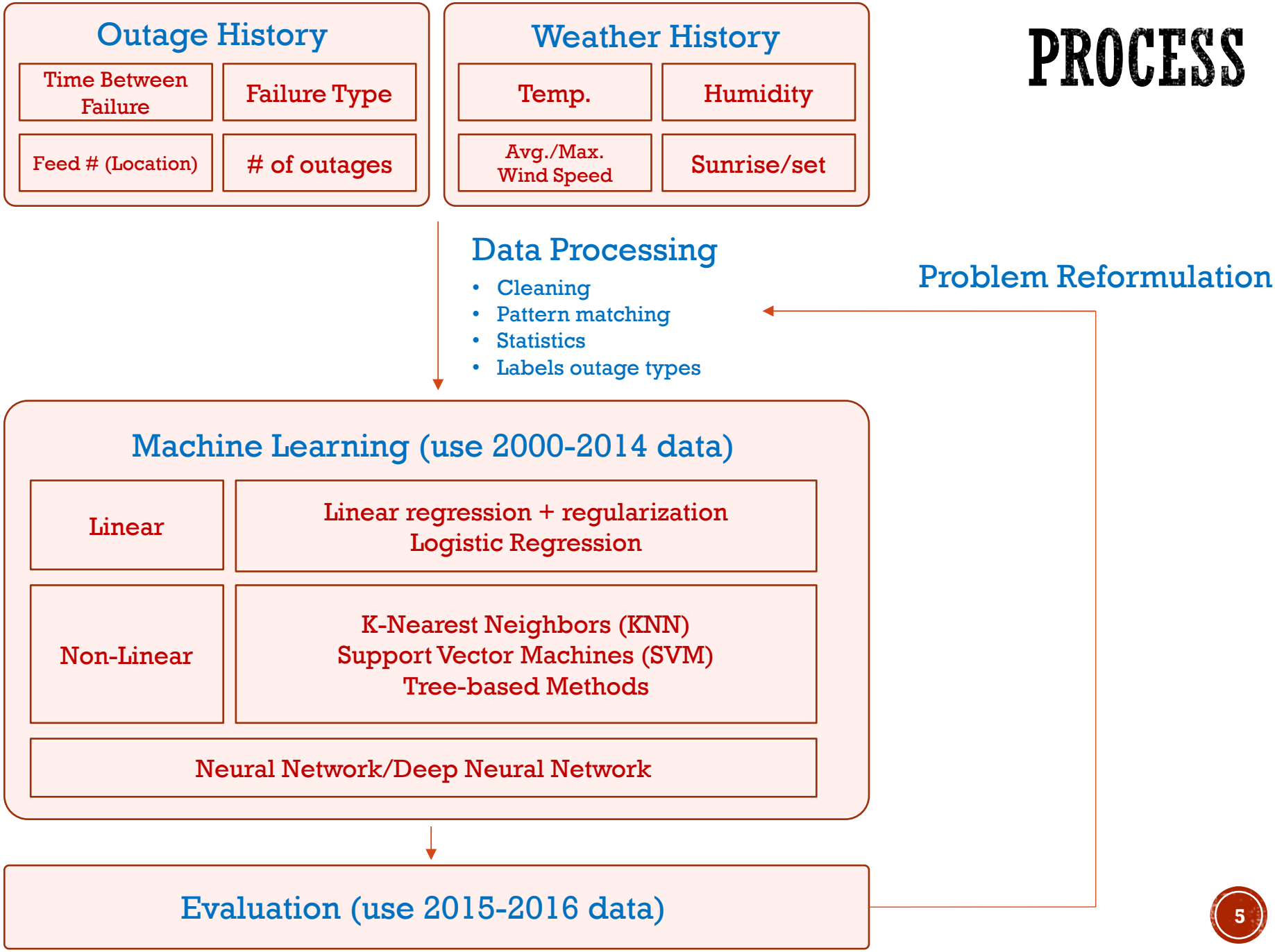
Feeders
(Primary network)
27,000V



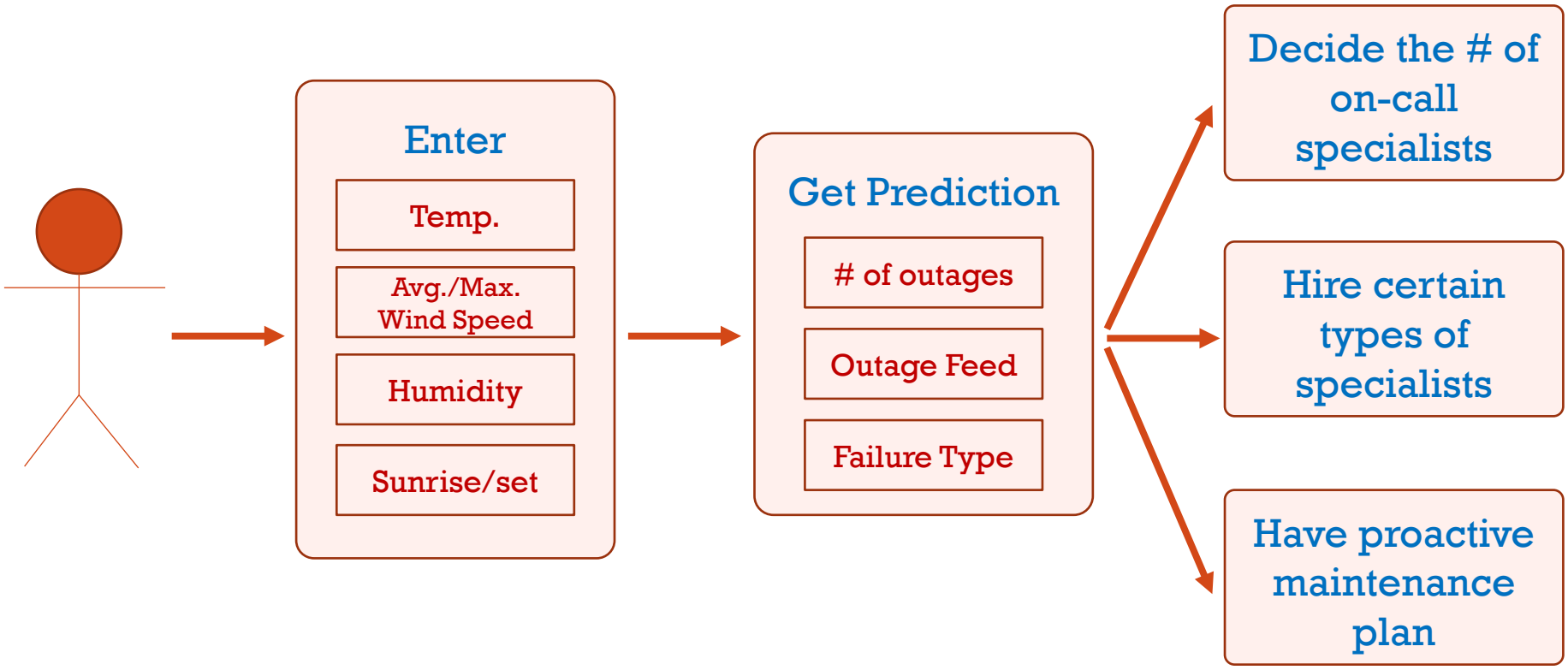
Transformer
(Secondary network)
120V

Image source: Google Image

PROCESS


Outage History
Time Between Failure
Failure Type
Feed # (Location)
# of outages
Weather History
Temp.
Humidity
Avg./Max. Wind Speed
Sunrise/set
Data Processing
• Cleaning
• Pattern matching
• Statistics
• Labels outage types
Problem Reformulation
Machine Learning (use 2000-2014 data)
Linear
Linear regression + regularization
Logistic Regression
Non-Linear
K-Nearest Neighbors (KNN)
Support Vector Machines (SVM)
Tree-based Methods
Neural Network/Deep Neural Network
Evaluation (use 2015-2016 data)

USE CASE


Enter
Temp.
Avg./Max. Wind Speed
Humidity
Sunrise/set
Get Prediction
# of outages
Outage Feed
Failure Type
Decide the # of on-call specialists
Hire certain types of specialists
Have proactive maintenance plan

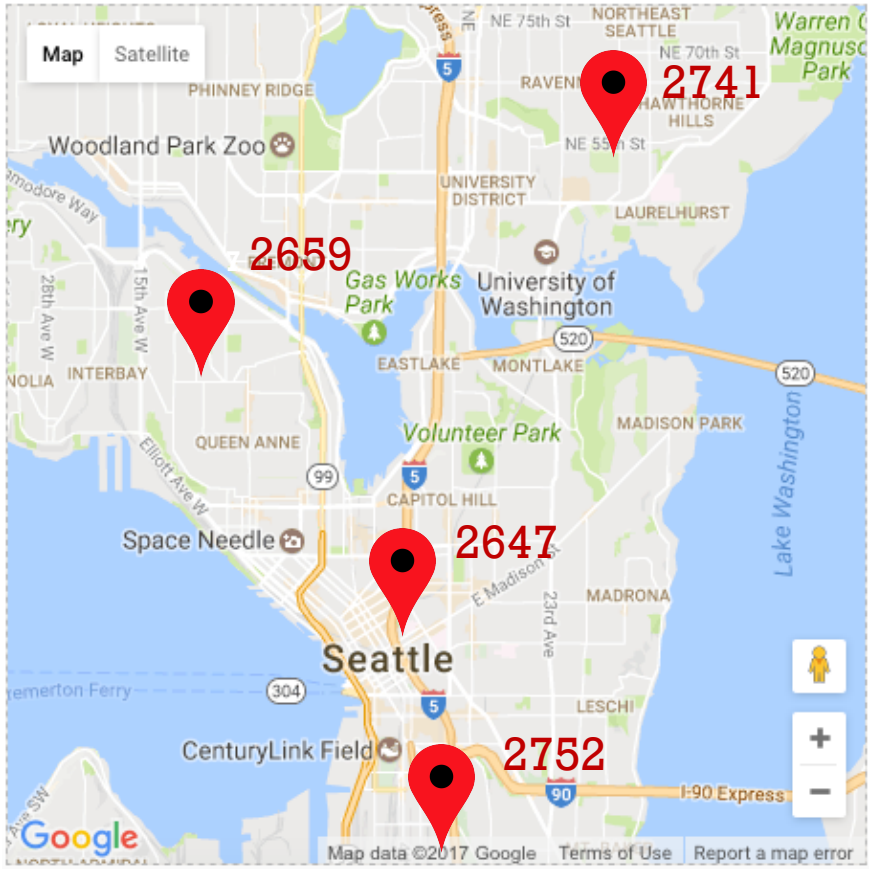
VISUALIZATION

Current Time: 02/13/2017 14:20

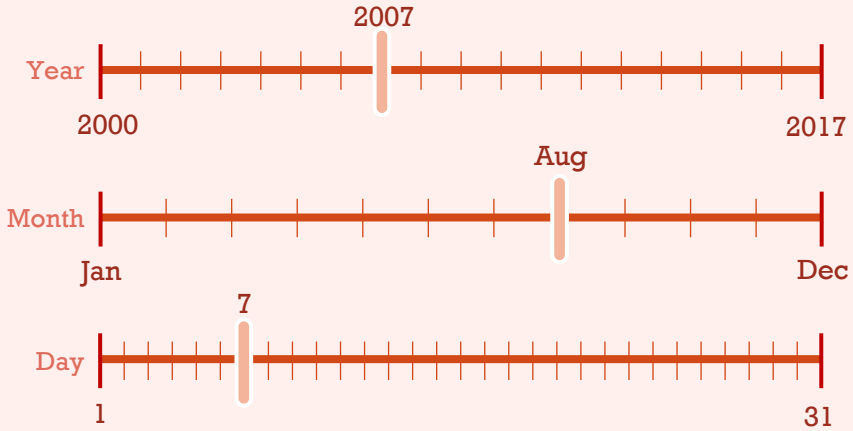
Tomorrow	Total	Chance
Controlled	0 - 10	60 %

Equipment	Tree/Animal
4	2

Seattle Power Outage
Ver. 0.1



Start	End
08/07/2007	08/07/2007



Feed	Type
2741	UG riser fuse
2647	Insulator
2752	Insulator
2659	UG Transformer