Senior Thesis Progress

December 20, 2018

Outline

- Problem Statement

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- Problem Statement
  - Background of Phenomena and Technologies
  - Detailed Problem Statement

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- Remaining Work
  - Technical Details
  - Execution Plan

Problem Statement

TLDR

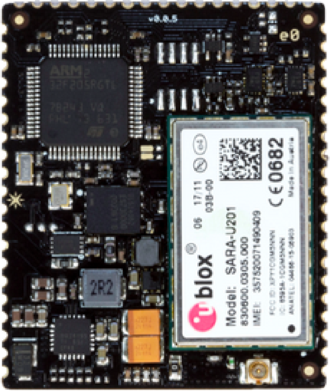
Make a dishwasher autonomously turn on when electricity is cheapest.

Background

IOT

Intelligently interact with everyday objects over a network.

Particle



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Serverless Computing

Outsource the maintenance of a server to a third party. Focus on the product.

Example of Serverless Computing

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        - Ad campaigns
        - TV ad spend
        - Shelving and Display

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    - Optimize trade spend over choices:
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- Until 2013, Kellog's ran queries on an on-premise, relational database.
- Reached 16 TB data
    - They outsourced the infrastructure needed to run and store these queries to AWS (Amazon Web Services).

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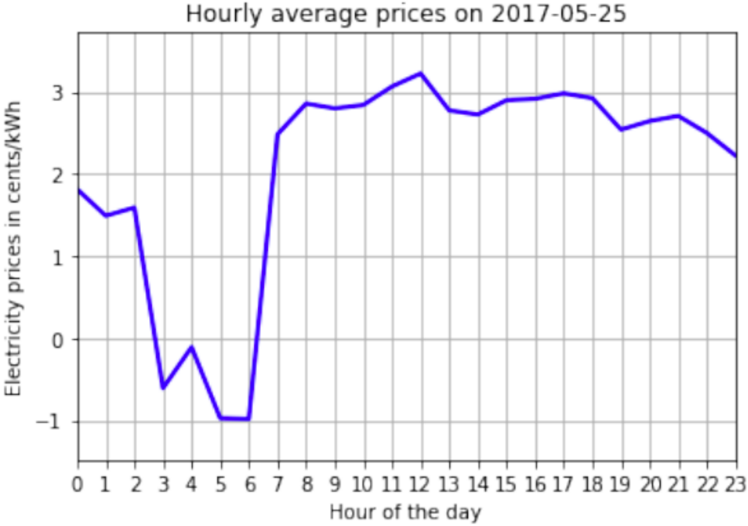
Electricity Price Variability

Predict when rates are the cheapest.

Price Data from ComEd in Illinois



[1]

Background

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Environmental Appeal

There is high correlation between prices are cheap and low grid demand, which is in turn correlated with more environmentally friendly uses of power [5] [3].

Full Problem

- Frame a heuristic in place of identifying when electricity prices are cheapest.

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- Make an algorithm to solve that heuristic.

Algorithm

- Run the algorithm every hour from 12AM to 5AM until the algorithm says “yes.”

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- Classify between 3AM and 4AM.

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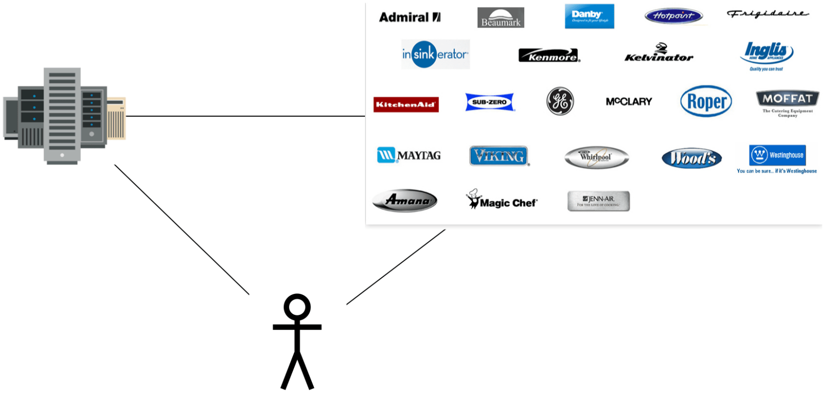
- Make a subscription service that allows consumers to enable their electricity appliances to turn on at later, cheaper times.


Admiral
Beaumark
Danby
Hotpoint
Frigidaire
insinkerator
Kenmore
Kelvinator
Inglis
Quality you can trust
KitchenAid
SUB-ZERO
GE
McCLARY
Roper
MOFFAT
The Catering Equipment Company
MAYTAG
VIKING
Whirlpool
Wood's
Westinghouse
You can be sure... if it's Westinghouse
Amana
Magic Chef
JENN-AIR
FOR THE LOVE OF COOKING

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    - Does this service scale well when used with many clients? What are the results from a heavy simulation?
    - Does this service actually save money when physically implemented [4]? Can we, as service providers, make the service profitable?

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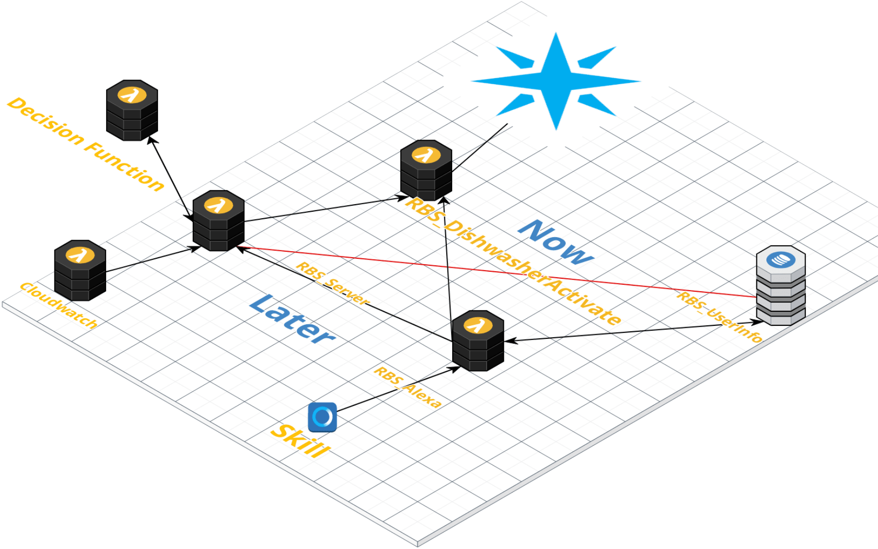
    - Does this service scale well when used with many clients? What are the results from a heavy simulation?
    - Does this service actually save money when physically implemented [4]? Can we, as service providers, make the service profitable?
    - If time permits: If such a service begins to be used en masse, what outlook does the profitability of it have? Is there still a profit that can be made?


Decision Function
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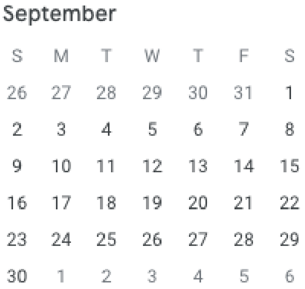

September

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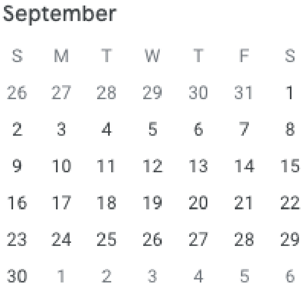
- Learned how to work with:



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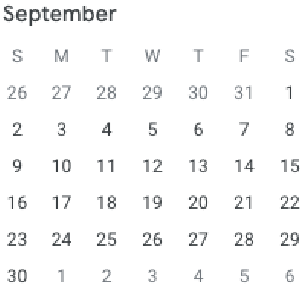
- Learned how to work with:
  - AWS
    - Lambda
    - DynamoDB
    - Cloudwatch



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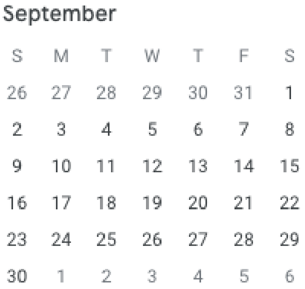

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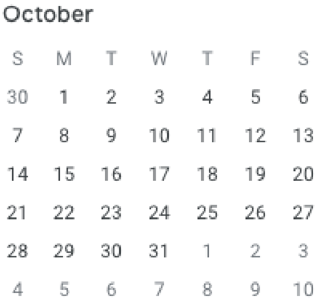
  - Javascript and Node
  - Particle



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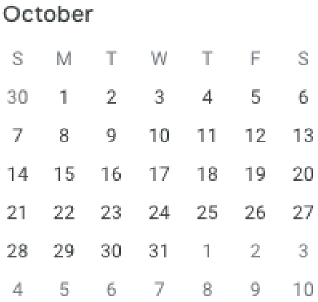
- First two weeks:
    - Revived Old Infrastructure



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- First two weeks:
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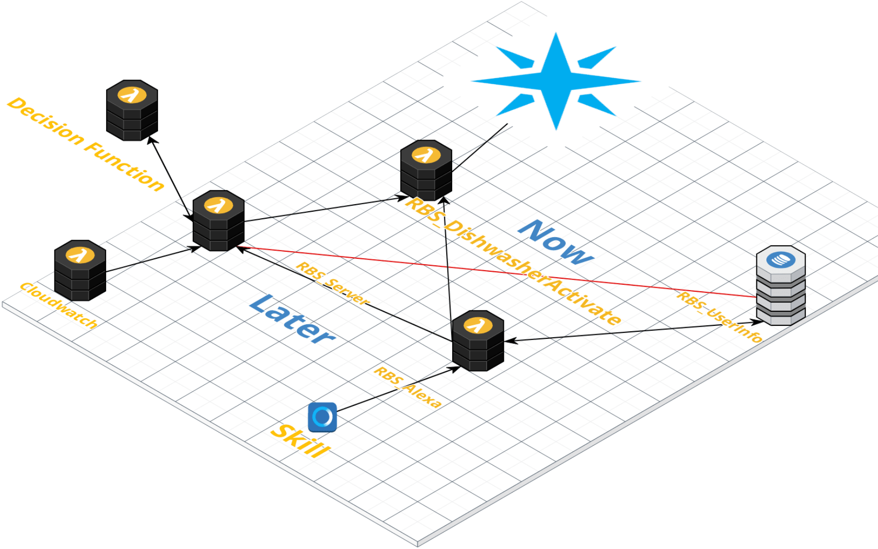
- Second two weeks:
  - Scaled the existing infrastructure to work with two appliances for one user when invoking the appliance immediately.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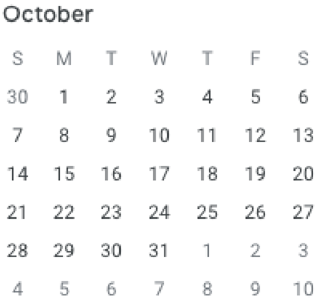

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- First two weeks:
  - Revived Old Infrastructure
- Second two weeks:
  - Scaled the existing infrastructure to work with two appliances for one user when invoking the appliance immediately.
- Noticed problem in workflow.

Workflow Challenges

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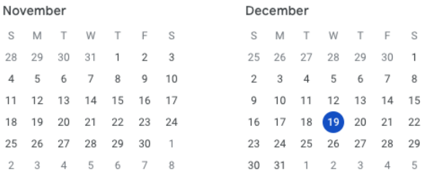
    - Leads to longer development time.
- Solution: Devops

Devops Developments



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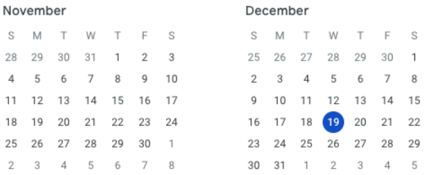

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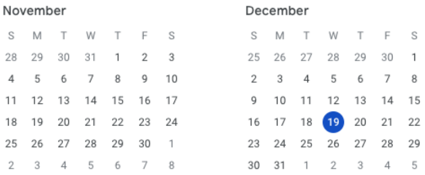

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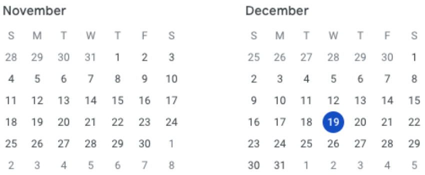

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- Testing frameworks and tests for Alexa Code and Lambda Function Code
  - December
- Using these tools, I've made, thus far, a few slight changes.

Progress with Respect to Milestones

- December 2018
  - Document half of the repository code. 25%
  - ~~Devise a local workflow for the development of the Alexa UI.~~
  - Refactor and test a function called ~~RBS_Lambda~~ RBS_dishwasher_activate. 100%
  - Have a technical report of the prediction models tried by the group up until now. 0%
- November 2018
  - Devise a local workflow for AWS lambda. At present, we use AWS's interface for most of our programming. We need a local workflow to streamline testing and development.100%
  - ~~Refactor and test a function called RBS_argmin.~~
  - Refactor and test a function called RBS_server. 75%
  - Refactor and test a function called RBS_Alexa 75%

Future Work

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- Make the dialogues interactive.

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- Make the dialogues interactive.
- Change the database schema to remove duplication of appliance information.
- Refactor RBS_server to use multiple devices.

Further Reading I

S. Reed.
Power prices go negative in germany, a positive for energy users
New York Times

Baldini
Serverless computing: Current trends and open problems
Research Advances in Cloud Computing

Lombard
A review on buildings energy consumption information.
Energy and Buildings

Faruqui
The impact of informational feedback on energy consumption—A survey of the experimental evidence
Energy

Further Reading II

- Mooney
  There's a big change coming to how we power our homes — and it isn't about solar or batteries
  Washington Post

- Sowers
  A smart power outlet for electric devices that can benefit from Real-Time Pricing
  2017 International Conference on Control, Electronics, Renewable Energy and Communications (ICCREC)