Offloading Smartphone Computing on Cloud to Save battery Power

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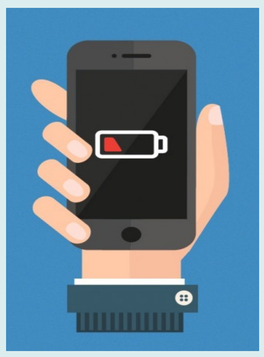
Introduction

Smartphones have become the primary computing platform for many users. Various studies have identified longer battery lifetime as the most desired feature of such systems.

Some studies such as in [1] suggest that many applications are too computation and if offloaded on the cloud then can actually save battery power

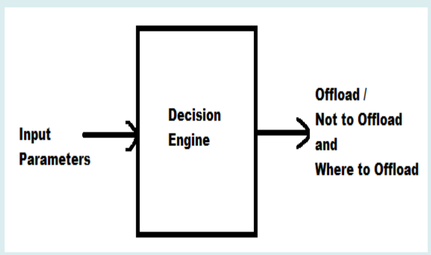


Smartphone Battery Problem?

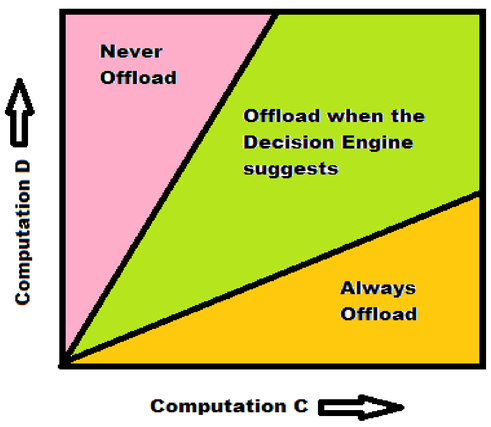
Offload Computing on Cloud !!

Objective

An Offloading decision engine will consider the 'contextual information' of the user such as bandwidth available, Data requirement of the application, CPU instance etc to decide to offload the computing or not. And if it needs to offload then where to offload.



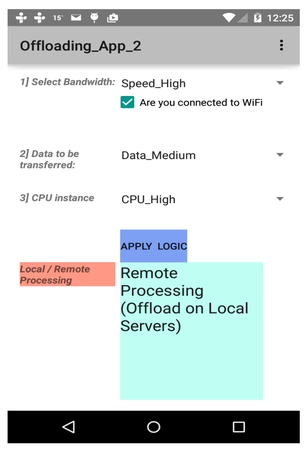
Offloading Decision Engine



Methods Used

In this poster I have presented some machine learning techniques and algorithms that can be used by the offloading decision engine.

1. Classification Engine



Fuzzy Logic Decision Engine

Fuzzy sets considered

- Bandwidth = Speed Low, Speed Normal, Speed High
- WiFi = available, not available
- Data transfered = Data Small, Data Medium, Data Big
- CPU instance = CPU Low, CPU Normal, CPU High

Some of the Rules considered

- Remote Processing = Speed High AND Data Small AND CPU Normal
- Remote Processing = Speed Low AND Data Small AND CPU High
- Local Processing = Speed High AND Data Small AND CPU Low
- Local Processing = Speed Low AND Data Medium AND CPU Normal

2. Reinforcement Learning

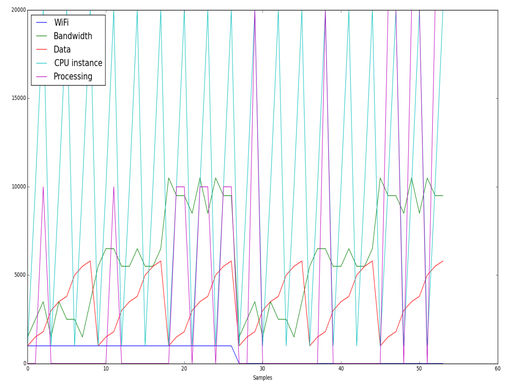
Minimize Battery Power units consumed or Reinforcements

State: Location, Battery Units consumed

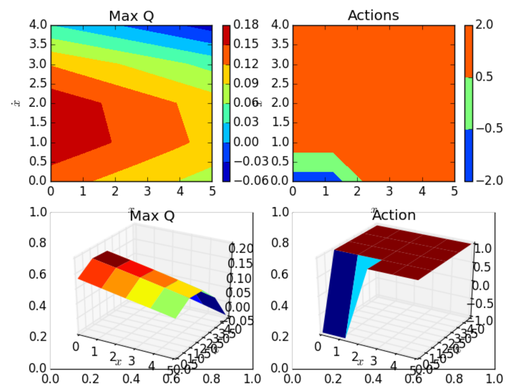
Actions: Offload, Do not Offload

```
def reinforcement(s,s1):
    return -1 if(s1[2] > s[2]) else 0
```

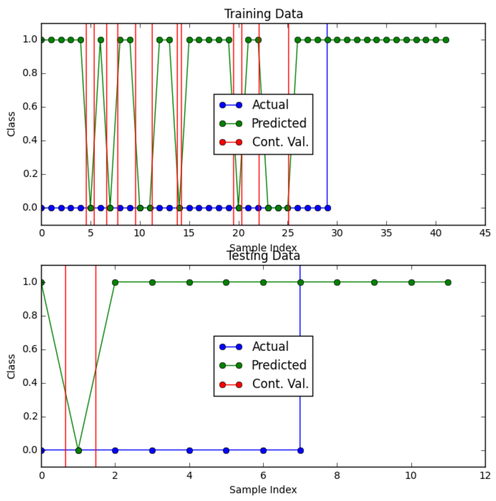
RESULTS



Fuzzy Logic Classification



Reinforcement Learning Trained Q function



Least Squares Classification

Percetage Correct:

Training: 56 % Testing: 20 %

Discussion

For the compute intensive applications the offloading is beneficial. For example if we want to train a neural network for a smartphone device which has thousands of iterations, we can offload he training of Q function on the Cloud, and use the trained function for the decision making.

Conclusion

In this poster I have demonstrated various ways with which we can enhance the offloading process with the help of an offloading engine which uses machine learning techniques.

References

[1] Kumar, Karthik, and Yung-Hsiang Lu. "Cloud computing for mobile users: Can offloading computation save energy?." Computer 43.4 (2010): 51-56.[Add key point.]

[2] Flores Macario, Huber Raul, and Satish Srirama. "Adaptive code offloading for mobile cloud applications: Exploiting fuzzy sets and evidence-based learning." Proceeding of the fourth ACM workshop on Mobile cloud computing and services. ACM, 2013.