NanoML

NanoLearners [MLG 16]

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1 Team Members

- Manish Kumar Bera   mkbera@iitk.ac.in

- Tushar Gupta   tusharg@iitk.ac.in

- Madhukant   mkant@iitk.ac.in

- Prann Bansal   prann@iitk.ac.in

- Abhishek Kumar   abhikr@iitk.ac.in

2 Problem Statement

Develop Machine learning algorithms for Classification that can operate with just a few KBs of memory and very low power. Our main aim will be to both train and test on low memory and weak processors e.g. processors used in embedded systems.

2.1 Applications

There has been a stark increase in use of embedded systems and IoT devices recently. The machine learning done till now relies heavily on computing resources. Our aim is to use ML algorithms in IoT devices e.g. Home Automation systems, smart watches in such a way that watches take basic body data like temperature and heartbeat rate to predict a health parameter.

3 Existing Work

- **ProtoNN Compressed and Accurate kNN for Resource-scarce device**[GSG$^+$]

  - This paper focuses on implementing kNN in low calibre devices efficiently.
  - Even though the concept is based on kNN, the complexity is much lower.
  - Learns a small number of prototypes to represent the entire set.
  - Sparse low dimensional projection of data.
  - Joint discriminative learning of the projection and prototypes with explicit model size constraint.

- **Resource efficient Machine Learning in 2KB RAM for Internet of Things**[KGV]

  - Develops novel tree based algorithms for efficient prediction.
  - Developing a tree model which learns a single, shallow, sparse tree with powerful nodes.
  - Sparsely projecting all data into a low-dimensional space in which the tree is learnt.
  - Jointly learning all tree and projection parameters.

3.1 Our Agenda

Most of the works on Nano ML make use of the technique that trains the model on a remote high-end server, but the prediction algorithm is executed in IoT devices. This hugely affects user privacy and data security. A good amount of energy and resources are also wasted on transmitting data. Our goal will be to devise a methodology in which we train the model in an online fashion using a IoT device as well along with executing the prediction algorithm. This will help protect the privacy of user and reduce wastage of resources.

We will try to implement one or more of the following classification techniques - Logistic Regression , Decision Tree, SVMs etc.

4 Resources

- **Data Set**
  We will select any binary classification data where memory of each x^i is within few Bytes.

- **Libraries**
  - And Since we have to implement highly optimized function with very low memory so using a library wouldn't help instead we have to implement it on our own using basic libraries.
  - If we need other highly optimized function like matrix multiplication and matrix inverse calculation, then we can refer to armadilo [ARM]- a C++ library for linear algebra.

References

[ARM]   http://arma.sourceforge.net/.

[GSG+] Chirag Gupta, Arun Sai Suggala, Ankit Goyal, Harsha Vardhan Simhadri, Bhargavi Paranjape, Ashish Kumar, Saurabh Goyal, Raghavendra Udupa, Manik Varma, and Prateek Jain. Protonn: Compressed and accurate knn for resource-scarce devices. Proceedings of Machine Learning Research. http://proceedings.mlr.press/v70/gupta17a.html.

[KGV]   Ashish Kumar, Saurabh Goyal, and Manik Varma. Resource-efficient machine learning in 2 kb ram for the internet of things. Proceedings of Machine Learning Research. http://proceedings.mlr.press/v70/kumar17a.html.