CSE 591 Project Proposal

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1. Literature survey

Binary-Weight-Networks: Binary-Weight-Networks is neural networks with binary weights. A convolutional neural network with binary weights is significantly smaller ($\sim 32\times$) than an equivalent network with single-precision weight values. Binary-weight approximations of large CNNs can fit into the memory of even small, portable devices while maintaining the same level of accuracy [1]

XNOR-Networks: XNOR-Networks have both the weights and the inputs to the convolutional and fully connected layers are approximated with binary values. Binary weights and binary inputs allow an efficient way of implementing convolutional operations. Its result in accurate approximation of CNNs while offering $\sim 58\times$ speed up in CPUs [1].

RFCN: Region-based Fully Convolutional Networks is a simple but accurate and efficient framework for object detection. It consists of region proposal and region classification.

The region proposal is done by Region Proposal Network [3]. Its classification part is based on ResNet-101 with the last layer replaced by a position-sensitive ROI pooling layer. It is the state-of-the-art object detection methods. [2]

2. Research question

Object detection is one of the primary tasks in nowadays research of computer vision. While networks get deeper to work better on object detection, it also gets harder to work on small portable devices like the smartphone because of limited storage, battery power, and computing capabilities. Recent research has shown that binary CNN could save a lot of memory with sacrificing a little accuracy for image classification on ILSVRC2012. We think that the same technology could be used on R-FCN to save memory while getting comparable accuracy. In this research, we will implement R-FCN with Binary-Weight-Networks and XOR-Networks, and we expect that our new neural network will be more efficient and memory-saving than the R-FCN.

3. Analysis direction

Try to use Binary-Weight-Networks and XOR-Networks to implement R-FCN and compare it with the original one. We will first test RPN and FCN in the binary network and then combine them together to check the results. With enough experiments, we expect to build our new neural network as we have mentioned in the previous part.

4. Expected experiments

1) Implement RPN using Binary-Weight-Networks and XOR-Networks.

2) Implement ResNet-101 with Binary-Weight-Networks and XOR-Networks.

3) Combine these two together to form the new R-FCN, and check the performance.

5. Relevance to class

The convolutional network is one of the deep learning paradigms that has been covered in our class. This project will help us to gain a better understand of those kinds of stuff.

6. Tasks for the project

1) Redo the experiments in [1] and [2] to double check the performance of Binary-Weight-Networks, XNOR-Networks, and R-FCN.

2) Implement RPN with Binary-Weight-Networks and compare the results with the original one.

3) Implement RPN with XNOR-Networks and compare the results with the original one.

4) Use the RPN build in 2 and 3 in the original R-FCN to check the results.

5) Implement ResNet-101 with Binary-Weight-Networks and compare the results with the original. one

6) Implement ResNet-101 with XNOR-Networks and compare the results with the original one.

7) Use the ResNet-101 build in 2 and 3 in the original R-FCN to check the results.

8) Combine the networks build in 2,3,5,6 to form the binary R-FCN.

7. Timeline for each task and member responsibility

Task No.	Assignee	Deadline
1	Shanshi,Lei	3/10/2017
2	Shanshi	3/17/2017
3	Lei	3/17/2017
4	Shanshi,Lei	3/24/2017
5	Lei	3/31/2017
6	Shanshi	3/31/2017
7	Shanshi,Lei	4/04/2017
8	Shanshi,Lei	4/11/2017

References

[1] Rastegari, Mohammad, et al. "Xnor-net: Imagenet classification using binary convolutional neural networks." European Conference on Computer Vision. Springer International Publishing, 2016.

[2] Li, Yi, Kaiming He, and Jian Sun. "R-fcn: Object detection via region-based fully convolutional networks." Advances in Neural Information Processing Systems. 2016.

[3] S. Ren, K. He, R. Girshick, and J. Sun. Faster R-CNN: Towards real-time object detection with region proposal networks. In NIPS, 2015.