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B17-SE-01

Report

1. Domain description

The goal of the project is to design and implement a neural network for solving domain adaptation problem. SVHN dataset was chosen for source domain and MNIST dataset for target domain.

2. Dataset concerns

The SVHN dataset is a compilation of colored pictures of Street View House Numbers (SVHN) of different quality. The MNIST dataset is a compilation of handwritten white digits on black background. Both datasets are available with torchvision library as SVHN and MNIST respectively.

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SVHN images (odd columns) and MNIST images (even columns)
Source: https://modelzoo.co/model/mnist-svhn-transfer

As one can see from the "human" perspective, SVHN dataset is colorful and images of SVHN often have more than one digit on them.

3. Baseline model

The baseline model was taken from Kaggle Notebook by user "usharengaraju" available on (Apache 2.0 license):
https://www.kaggle.com/usharengaraju/kannada-mnist-using-pytorch

The explanation of the choden model will be given later after evaluation results.
The model contains:

- 1 input convolution layer with corresponding batch normalization;
- 3 hidden convolution layers with corresponding batch normalization, max pooling and dropout layers;
- 4 fully-connected layers (including 10-channel out layer) with corresponding dropout layers.

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This submission implements a completely different approach.

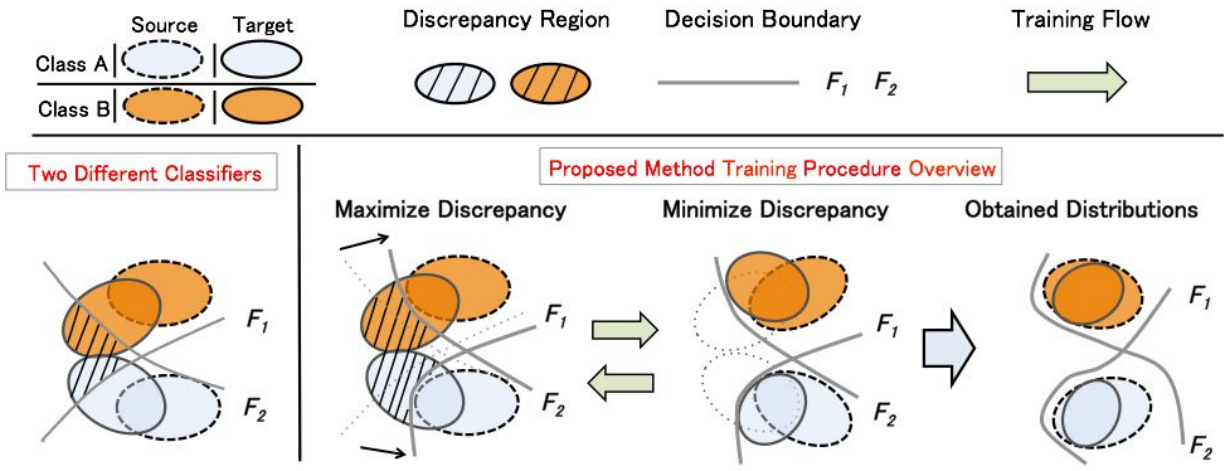
4. Concept

The main concept and the code for the concept was fully taken from the work "Maximum Classifier Discrepancy for Unsupervised Domain Adaptation" by Kuniaki Saito, Kohei Watanabe, Yoshitaka Ushiku, Tatsuya Harada and available within these links:

https://arxiv.org/abs/1712.02560
https://github.com/mil-tokyo/MCD_DA

Thanks to Farit Galeev for showing me this work.

The concept is well-explained in the paper, so I will provide only crucial parts for understanding.



General concept visualization
Source: https://github.com/mil-tokyo/MCD_DA

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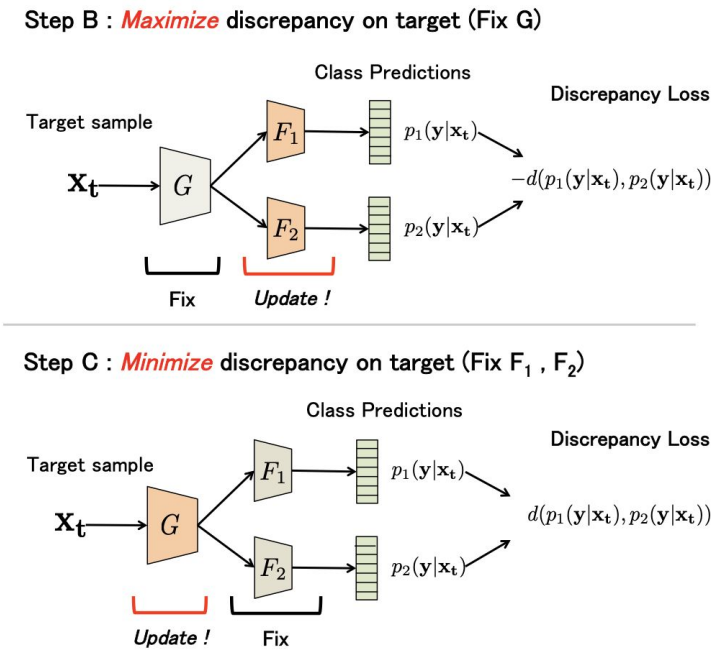
The general idea is to use two classifiers, competing for discrepancy (how much do the outputs differ) and one generator, which takes input from them.

The train steps are these:

A. Train both classifiers and generator to classify the source samples correctly.
B. Train the classifiers as a discriminator for a fixed generator to increase the discrepancy, so they can detect the target samples excluded by the support of the source.
C. Train the generator to minimize the discrepancy for fixed classifiers.



Training process visualization
Source: https://arxiv.org/pdf/1712.02560.pdf

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5. Implementation

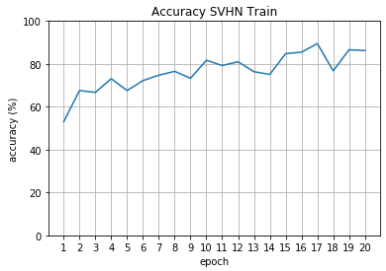
I used PyTorch framework to build, train and evaluate the model within the Kaggle notebook environment. Hyperparameters given in the corresponding POC code were adjusted well enough for my experiments to only make it worse.

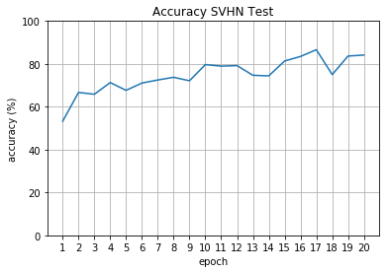
The model showed significant downgrade of accuracy down to 60% (lower than baseline model) when using the baseline learning rate of 0.01 (instead of suggested 0.0001 in the POC). Other experiments with learning rate results of bad accuracy or unacceptable large learning time.

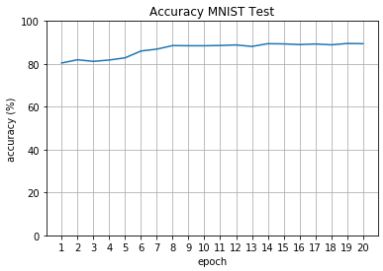
The model were trained for 20 epochs, it completely converges on epoch 8-9.

6. Results

MNIST Test	SVHN Train	SVHN Test
89%	86%	84%







The model showed awesome (in my personal opinion) result of 89% accuracy on MNIST Test as target domain, while paper states ~96% of accuracy. The baseline model has 69%

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of accuracy, which makes the new one much more credible in the domain adaptation problem.

7. Sources

The code is readily available at Kaggle (Apache 2.0):
https://www.kaggle.com/imajou/domain-adaptation-svhn-to-mnist-final

Maximum Classifier Discrepancy for Unsupervised Domain Adaptation
Kuniaki Saito, Kohei Watanabe, Yoshitaka Ushiku, Tatsuya Harada

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