[Fall 2022] CS272 Assignment 1
PyTorch and Domain Adaptation

#NAME #StudentID

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Acknowledgements

1. Deadline: **2022/10/30 23:59:00**. Late Policy please refers to the course slides.

2. Giving your report in English, report in Chinese is not accepted. Besides, handwritten homework is not accepted and we highly recommend you to use LaTeX. LaTeX template has been upload to Blackboard.

3. Please submit your assignment in Gradescope with PDF format.

4. Please upload your code zip to ShanghaiTech cloud disk.

   http://pan.shanghaitech.edu.cn/cloudservice/outerLink/decode?c3Vnb24xNjY0NDIxMDEyNzIxc3Vnb24=

   All source files and *readme* should be included but remember to remove the datasets. Your zip should be named as CS272_NAME_ID_hw1.zip.

5. Plagiarism or cheat is strictly prohibited. Do not share your assignment or code! No fake solution is allowed! Make sure that your codes can run and are consistent with your solutions.

1 [30 points] Train your classification model using PyTorch (source-only training for domain adaptation)

1. Learn PyTorch: https://pytorch.org/tutorials/beginner/basics/quickstart_tutorial.html.

2. Download the Office-31 dataset. **You are required to** show some instances per domain.

3. Using PyTorch to build your data loader (including data augmentation), model (feature extractor + classifier), optimizer in your code. For the backbone selection of feature extractor, we recommand you to use ResNet50. Then build your training and testing pipeline. **You are required to** specify your implement details, including data augmentation, network structure, batch size, optimizer, learning rate, training steps etc.

4. Choose one domain as train set (source domain), and choose another different domain as test set (target domain). Then train your classification model using cross-entropy loss. **You are required to** show the line chart of loss decay, train accuracy (source domain) and test accuracy (target domain) in the training process for at least 3 transfer tasks, such as Amazon→DSLR, DSLR→Webcam, Webcam→Amazon. Performance should excess 50%.

2 [30 points] Maximum Mean Discrepancy (MMD) loss for domain adaptation

1. Revisit MMD loss and go deeper for MMD mathmetical details, then try to figure out how to implement MMD loss in your code. **You are required to** give a detailed description about the implementation of MMD loss and specify how MMD helps in domain adaptation from your view.

2. Implement MMD loss on your own, then add MMD loss into Q1's loss, i.e. cross-entropy and MMD loss.

3. Choose your source and target domain, then train your domain adaptation model. **You are required to** show the line chart of loss decay, source domain accuracy and target domain accuracy in the training process for at least 3 transfer tasks. Performance should excess 60%.

3 [30 points] Adversarial training for domain adaptation

1. Revisit adversarial domain adaptation, and try to figure out how to implement adversarial module and compute loss in your code. **You are required to** illustrate your network structure, give a detailed explaination about adversarial loss and specify how adversarial training helps in domain adaptation from your view.

2. Implement adversarial module and loss, then add them into Q1's framework and loss.

3. Choose your source and target domain, then train your domain adaptation model. **You are required to** show the line chart of loss decay, source domain accuracy and target domain accuracy in the training process for at least 3 transfer tasks. Performance should excess 70%.

4 [10 points] Comparison and visualization

1. **You are required to** show a comparison table about target domain accuracy among Q1, Q2 and Q3 model for at least 3 transfer tasks.

2. Use t-SNE to visualize feature alignment for two domains, which helps you to check whether the same class of two different domains has been aligned. Source features and target features dots can be plot in different colors. **You are required to** show t-SNE comparison figures among Q1, Q2 and Q3 model in a transfer task, such as Webcam→Amazon. You can call API directly for t-SNE.

3. **You are required to** give some analyses about accuracy table and t-SNE figures, especially the pros and cons of MMD as well as adversarial loss, then try to explain it.