EFFICIENT OUT-OF-DISTRIBUTION DETECTION BASED ON IN-DISTRIBUTION DATA PATTERNS MEMORIZATION WITH MODERN HOPFIELD ENERGY

The document is guidance for reproducing our paper, some codes are from energy-ood.

Preliminaries

Our code is tested under Ubuntu Linux 18.04.1 and Python 3.6 environment. The environment can be accomplished by the following command:

```
pip install -r requirement.txt
```

Download the Out-of-distribution (OOD) Dataset

In our paper, we use nine OOD datasets and two In-distribution (ID) datasets. For the ID datasets CIFAR10 and CIFAR100 and one of the OOD datasets SVHN, it is easy to use them directly by the torchvision as follows (data_path refers to your specified dataset path):

```
dataset = torchvision.datasets.CIFAR10(root=data_path, train=False, download=True)
dataset = torchvision.datasets.CIFAR100(root=data_path, train=False=True)
dataset = torchvision.datasets.SVHN(root=data_path, train=False, download=True)
```

However, another eight OOD datasets need to download and we provide the link to them. LSUN-C,LSUN-R, iSUN, Places,DTD,Tiny Imagenet,SUN,iNaturalist Please place them into your dataset path, and use them as follows:

```
dataset =  torchvision.datasets.ImageFolder(root=data_path)
```

Pretrained Mode

We use ResNet18, ResNet34, and WRN40-2 as our backbone networks. And the pre-trained models are all trained on CIFAR10 and CIFAR100 respectively. For space limitation, we only provide the weight of ResNet18 trained on CIFAR10 in ./checkpoints/cifar10/. As mentioned in our paper, to get better performance, we use data augmentation (e.g., flip, rotate) and resize the image during the training/testing process. We use size = 112 and 64 for ResNet and WRN respectively.

Evaluation process

(1) Prepare the model

All the model weights have been saved at ./checkpoints/cifar10/ and ./checkpoints/cifar100/, you can use them directly if you do not want to train them again.

(2) Prepare the stored pattern we need

We have provided the stored pattern at ./stored_pattern/all_stored_pattern and ./stored_pattern/avg_stored/pattern/. If you want to generate them by yourself, for convenience, you can directly run the bash and the stored pattern used for **HE** and **SHE** will be generated automatically.

```
bash generate_SHEandHE_feature.sh
```

After several time, the stored pattern is stored at ./stored_pattern/all_stored_pattern and ./stored_pattern/avg_stored/pattern/.

(3) Calculate the Hopfield energy score

For convenience, you can directly run the bash to evaluate all the models and methods:

```
bash run_all_methods.sh
```

Also you can evaluate our method by run the following command:

```
python test_score_ood_detection.py --dataset cifar10 --model resnet18 --score SHE
```

The command means you use CIFAR10 as the ID samples and use ResNet18 as the backbone