

# Instructions for running CIFAR10 experiments

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## File overview:

- `README_CIFAR10.md` - this readme file for CIFAR10.
- `CNN_1` - CNN 1 for CIFAR10.
  - `tensorlayer` - our provided tensorlayer package.
  - `Quant_CNN1_CIFAR10.py` - the training script for `CNN 1` with optional quantization precision  $k$  on CIFAR10.
  - `Spiking_CNN1_CIFAR10.py` - the evaluation script for `spiking CNN 1` with optional quantization precision  $k$  on CIFAR10.
  - `FP32_CNN1_CIFAR10.py` - the training script for `CNN 1` with `full precision (float32)` on CIFAR10.
  - `spiking_utils.py` - the functions of spiking convolution and linear.
  - `figs` - visualization folder for SNN performance.
    - `accuracy_speed.py` - the accuracy versus speed script for `spiking CNN 1` with different quantization precisions on CIFAR10.
    - `sops.py` - the computing operations script for `spiking CNN 1` with different quantization precisions on CIFAR10.
    - `sparsity.py` - the spike sparsity script for `spiking CNN 1` with different quantization precisions on CIFAR10.
- `CNN_2` - CNN 1 for CIFAR10.
  - `tensorlayer` - our provided tensorlayer package.
  - `Quant_CNN2_CIFAR10.py` - the training script for `CNN 2` with optional quantization precision  $k$  on CIFAR10.
  - `Spiking_CNN2_CIFAR10.py` - the evaluation script for `spiking CNN 2` with optional quantization precision  $k$  on CIFAR10.
  - `FP32_CNN2_CIFAR10.py` - the training script for `CNN 2` with `full precision (float32)` on CIFAR10.
  - `spiking_utils.py` - the functions of spiking convolution and linear.
  - `figs` - visualization folder for SNN performance.
    - `accuracy_speed.py` - the accuracy versus speed script for `spiking CNN 2` with different quantization precisions on CIFAR10.
    - `sops.py` - the computing operations script for `spiking CNN 2` with different quantization precisions on CIFAR10.
    - `sparsity.py` - the spike sparsity script for `spiking CNN 2` with different quantization precisions on CIFAR10.

## ANN Training

### Before running:

- Please note your default dataset folder will be `./data`

- please modify the command line parameters: `--resume True`, and `--learning_rate 0.0001` for another 100 epochs after the first 100 epochs. Totally, 200 training epoch need be performed.

### Run the code:

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for example (training,  $k=0$ , CNN1, CIFAR10):

```
$ cd CIFAR10/CNN_1
$ python Quant_CNN1_CIFAR10.py --k 0 --resume False --learning_rate 0.001 --mode
'training'
```

finally, it will generate the corresponding model files including: `checkpoint`, `model_CIFAR10_advanced.ckpt.data-00000-of-00001`, `model_CIFAR10_advanced.ckpt.index`, `model_CIFAR10_advanced.ckpt.meta` and `model_cifar_10.npz`.

## ANN Inference

### Run the code:

for example (inference,  $k=0$ , CNN1, CIFAR10):

```
$ python Quant_CNN1_CIFAR10.py --k 0 --resume True --mode 'inference'
```

Then, it will print the corresponding ANN test accuracy.

## SNN inference

### Run the code:

for example (inference,  $k=0$ , spiking CNN1, CIFAR10):

```
$ python Spiking_CNN1_CIFAR10.py --k 0
```

it will generate the corresponding log files including: `accuracy.txt`, `sop_num.txt`, `spike_collect.txt` and `spike_num.txt` in `./figs/k0/`.

## Visualization

### Accuracy versus speed:

```
$ cd figs
$ python accuracy_speed.py
```

## Firing sparsity:

```
$ python sparsity.py
```

## Computing operations:

```
$ python sops.py
```

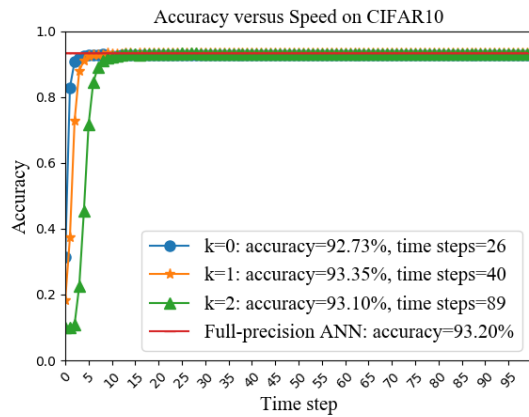
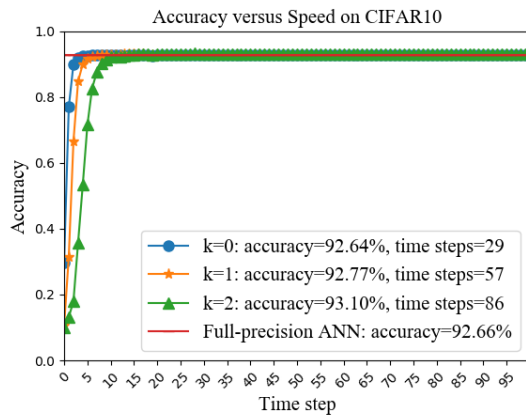
## Results

Our proposed spiking CNN1 and CNN2 achieve the following performances on CIFAR10:

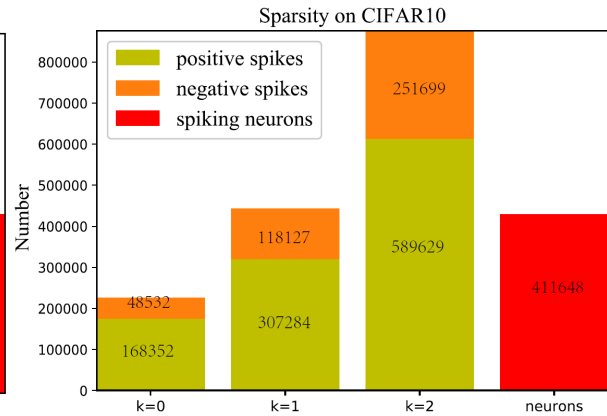
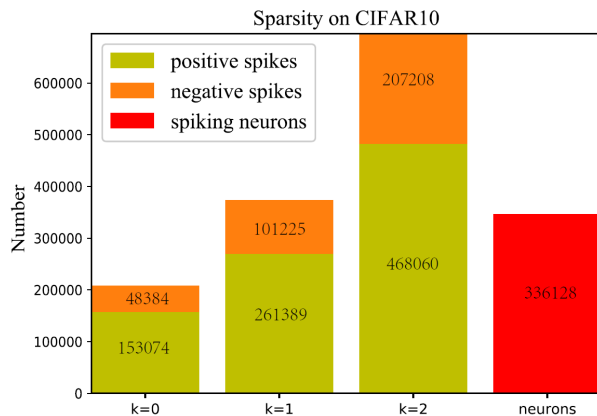
CNN 1: 96C3-256C3-P2-384C3-P2-384C3-256C3-1024-1024

CNN 2: 128C3-256C3-P2-512C3-P2-1024C3-512C3-1024-512

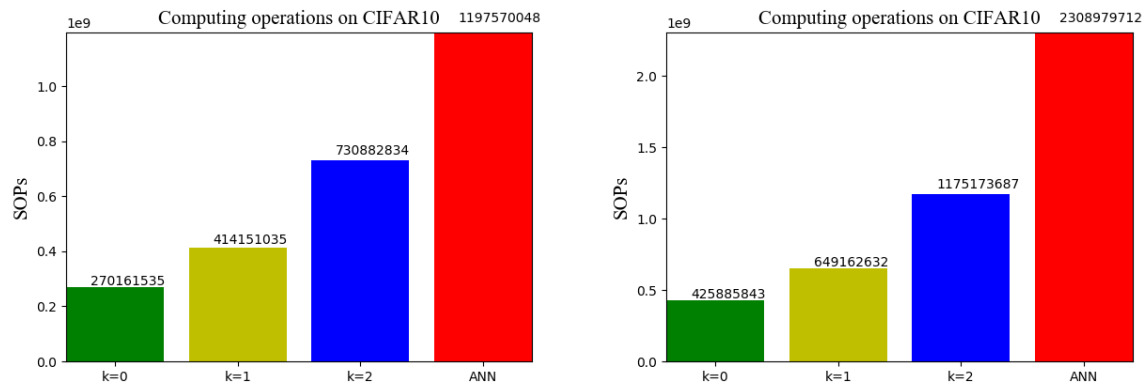
## Accuracy versus speed:



## Firing sparsity:



## Computing operations:



## Notes

- We do not consider the synaptic operations in the input encoding layer and the spike outputs in the last classification layer (membrane potential accumulation instead) for both original ANN counterparts and converted SNNs.
- We also provide some scripts for visualization in `./figs`, please move to this folder and directly run the three scripts.

## More question:

- There might be a little difference of results for multiple training repetitions, because of the randomization.
- Please feel free to reach out here or email: xxx@xxx, if you have any questions or difficulties. I'm happy to help guide you.