

1 A Implementation Details

2 We have developed a library based on PyTorch, which includes a native CUDA implementation.
 3 In order to promote transparency and reproducibility, we will provide the source code for our
 4 implementation on GitHub. However, to comply with the double-blind review process, we have
 5 omitted the link to the GitHub repository in this submission. Instead, you can find the complete
 6 source code within the provided zip file for this paper.

7 B Extended Tables: Experimental Results

8 In this section, we present extended tables that include additional experimental results for the UCI
 9 and MNIST MLPerf Tiny datasets. The tables provide average accuracies, standard deviations, and
 10 training times for the selected hyperparameters. All training times were measured using an Nvidia
 11 GTX-1080ti GPU.

12 **Hyperparameters** n refers to the addressing length of RAM neurons. K is the number of hash
 13 functions used. L is the filter length. H is the number of hidden neurons ($N * C$ in the case for
 14 WNNs, where N is the number of RAMs within a discriminator and C is the number of classes), p is
 15 the dropout probability, and τ is the softmax temperature.

Table 1: Extend results for SoonWISARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the Ecoli Dataset.

| Ecoli | Size | Acc. | Std | Time Train | Hyperparameters |
|----------------|---------|-------|------|------------|--------------------------------------|
| SoonWiSARD | 0.74KiB | 81.4% | 5.0% | 4s | n=4, K=2, L=9, H=84, p=0.5, $\tau=1$ |
| BTHOWeN | 0.87KiB | 87.5% | - | - | n=10, K=2, L=128, H=10 |
| Diff Logic Net | 0.87KiB | 79.3% | 3.6% | 5s | H=1792, p=0.0, $\tau=1/0.1$ |
| FINN | 0.88KiB | 68.9% | 7.0% | 3s | H=447, p=0.2 |
| DeepShift | 0.88KiB | 43.6% | 1.4% | 7s | H=64, p=0.2 |

Table 2: Extend results for SoonWISARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the Iris Dataset.

| Iris | Size | Acc. | Std | Time Train | Hyperparameters |
|----------------|---------|-------|-------|------------|--------------------------------------|
| SoonWiSARD | 0.23KiB | 98.3% | 6.0% | 1s | n=4, K=2, L=9, H=72, p=0.5, $\tau=1$ |
| BTHOWeN | 0.28KiB | 98.0% | - | - | n=2, K=1, L=128, H=6 |
| Diff Logic Net | 0.28KiB | 98.3% | 3.1% | 1s | H=575, p=0.0, $\tau=1/0.1$ |
| FINN | 0.29KiB | 69.2% | 16.9% | 1s | H=287, p=0.2 |
| DeepShift | 0.30KiB | 33.3% | 17.2% | 1s | H=32, p=0.2 |

Table 3: Extend results for SoonWISARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the Letter Dataset.

| Letter | Size | Acc. | Std | Time Train | Hyperparameters |
|----------------|----------|-------|------|------------|--|
| SoonWiSARD | 76.23KiB | 96.0% | 0.8% | 72s | n=11, K=2, L=16, H=1496, p=0.5, $\tau=1$ |
| BTHOWeN | 78.00KiB | 90.0% | - | - | n=20, K=4, L=2048, H=12 |
| Diff Logic Net | 78.00KiB | 90.9% | 0.7% | 85s | H=159744, p=0.0, $\tau=1/0.1$ |
| FINN | 78.00KiB | 4.79% | 0.3% | 96s | H=14859, p=0.2 |
| DeepShift | 78.00KiB | 19.2% | 1.6% | 68s | H=2636, p=0.2 |

Table 4: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the SatImage Dataset.

| SatImage | Size | Acc. | Std | Time Train | Hyperparameters |
|-----------------|---------|-------|------|------------|--|
| SoonWiSARD | 8.54KiB | 92.5% | 0.8% | 20s | n=8, K=2, L=9, H=1295, p=0.5, $\tau=1$ |
| BTHOWeN | 9.00KiB | 88.0% | - | - | n=12, K=4, L=512, H=24 |
| Diff Logic Net | 9.25KiB | 90.2% | 1.1% | 19s | H=18432, p=0.0, $\tau=1/0.1$ |
| FINN | 9.00KiB | 30.8% | 0.0% | 32s | H=1714, p=0.2 |
| DeepShift | 9.50KiB | 48.0% | 1.8% | 23s | H=303, p=0.2 |

Table 5: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the Vehicle Dataset.

| Vehicle | Size | Acc. | Std | Time Train | Hyperparameters |
|----------------|---------|-------|------|------------|--|
| SoonWiSARD | 2.25KiB | 78.3% | 4.3% | 3s | n=6, K=2, L=32, H=144, p=0.5, $\tau=1$ |
| BTHOWeN | 2.25KiB | 76.2% | - | - | n=16, K=3, L=256, H=18 |
| Diff Logic Net | 2.25KiB | 73.5% | 4.0% | 3s | H=4608, p=0.0, $\tau=1/0.1$ |
| FINN | 2.30KiB | 27.2% | 2.8% | 5s | H=801, p=0.2 |
| DeepShift | 2.50KiB | 28.3% | 0.7% | 4s | H=128, p=0.2 |

Table 6: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the Vowel Dataset.

| Vowel | Size | Acc. | Std | Time Train | Hyperparameters |
|----------------|---------|-------|------|------------|---------------------------------------|
| SoonWiSARD | 3.43KiB | 94.0% | 2.9% | 3s | n=6, K=4, L=64, H=44, p=0.5, $\tau=1$ |
| BTHOWeN | 3.44KiB | 90.0% | - | - | n=15, K=4, L=256, H=10 |
| Diff Logic Net | 3.44KiB | 74.9% | 4.1% | 3s | H=7045, p=0.0, $\tau=1/0.1$ |
| FINN | 3.50KiB | 17.7% | 3.0% | 6s | H=1280, p=0.2 |
| DeepShift | 3.50KiB | 8.4% | 1.8% | 4s | H=203, p=0.2 |

Table 7: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the Wine Dataset.

| Wine | Size | Acc. | Std | Time Train | Hyperparameters |
|----------------|---------|-------|-------|------------|--------------------------------------|
| SoonWiSARD | 0.23KiB | 93.3% | 4.2% | 1s | n=2, K=2, L=4, H=36, p=0.5, $\tau=1$ |
| BTHOWeN | 0.42KiB | 98.3% | - | - | n=13, K=3, L=128, H=9 |
| Diff Logic Net | 0.42KiB | 86.0% | 4.7% | 1s | H=864, p=0.0, $\tau=1/0.1$ |
| FINN | 0.42KiB | 14.0% | 2.0% | 1s | H=203, p=0.2 |
| DeepShift | 0.42KiB | 27.3% | 15.6% | 1s | H=20, p=0.2 |

Table 8: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the MNIST Dataset.

| MNIST | Size | Acc. | Std | Time Train | Hyperparameters |
|-------------------------|--------|-------|------|------------|---|
| SoonWiSARD (small) | 23KiB | 97.2% | 0.3% | 8m | n=14, K=2, L=16 H=11776, p=0.5, $\tau=1/0.1$ |
| SoonWiSARD (medium) | 98KiB | 98.0% | 0.2% | 8m | n=14, K=2, L=16 H=50176, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (large) | 186KiB | 98.2% | 0.2% | 8m | n=14, K=2, L=16 H=95232, p=0.5, $\tau=1/0.03$ |
| BTHOWeN (small) | 35KiB | 92.8% | 0.2% | - | n=28, K=2, L=512, H=560 |
| BTHOWeN (medium) | 70KiB | 93.4% | 0.2% | - | n=28, K=2, L=1024, H=560 |
| BTHOWeN (large) | 210KiB | 94.3% | 0.2% | - | n=28, K=2, L=2048, H=840 |
| Diff Logic Net (small) | 23KiB | 94.1% | 0.5% | 7m | H=45000, p=0.0, $\tau=1/0.1$ |
| Diff Logic Net (medium) | 98KiB | 95.2% | 0.3% | 12m | H=20000, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (large) | 188KiB | 95.3% | 0.4% | 20m | H=384000, p=0.0, $\tau=1/0.03$ |
| FINN (small) | 23KiB | 94.6% | 0.2% | 12m | H=230, p=0.2 |
| FINN (medium) | 98KiB | 97.0% | 0.2% | 12m | H=1010, p=0.2 |
| FINN (large) | 188KiB | 97.7% | 0.2% | 12m | H=1940, p=0.2 |
| DeepShift (small) | 23KiB | 96.8% | 0.2% | 8m | H=45, p=0.2 |
| DeepShift (medium) | 98KiB | 98.1% | 0.2% | 8m | H=200, p=0.2 |
| DeepShift (large) | 188KiB | 98.4% | 0.2% | 8m | H=385, p=0.2 |

Table 9: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the CIFAR-10 Dataset.

| CIFAR-10 | Size | Acc. | Std | Time Train | Hyperparameters |
|-------------------------|--------|--------|------|------------|--|
| SoonWiSARD (small) | 20KiB | 49.7% | 1.3% | 8m | n=6, K=2, L=4, H=40960, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (medium) | 240KiB | 55.6% | 1.1% | 28m | n=6, K=2, L=4, H=491520, p=0.5, $\tau=1/0.01$ |
| SoonWiSARD (large) | 620KiB | 57.3% | 0.8% | 76m | n=6, K=2, L=4, H=1269760, p=0.5, $\tau=1/0.01$ |
| BTHOWeN (small) | 32KiB | 14.06% | 1.2% | - | n=30, K=2, L=128, H=2050 |
| BTHOWeN (medium) | 192KiB | 36.47% | 0.6% | - | n=10, K=2, L=256, H=6140 |
| BTHOWeN (large) | 384KiB | 37.72% | 0.4% | - | n=10, K=2, L=512, H=6140 |
| Diff Logic Net (small) | 24KiB | 48.2% | 0.0% | 8m | H=49000, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (medium) | 250KiB | 50.6% | 0.0% | 32m | H=512000, p=0.0, $\tau=1/0.01$ |
| Diff Logic Net (large) | 625KiB | 52.3% | 0.0% | 84m | H=1280000, p=0.0, $\tau=1/0.01$ |
| FINN (small) | 24KiB | 40.0% | 0.8% | 16m | H=64, p=0.2 |
| FINN (medium) | 250KiB | 46.5% | 0.7% | 16m | H=665, p=0.2 |
| FINN (large) | 625KiB | 48.0% | 0.6% | 16m | H=1660, p=0.2 |
| DeepShift (small) | 24KiB | 40.3% | 1.9% | 12m | H=13, p=0.2 |
| DeepShift (medium) | 250KiB | 53.0% | 1.2% | 12m | H=133, p=0.2 |
| DeepShift (large) | 622KiB | 54.1% | 0.9% | 12m | H=331, p=0.2 |

Table 10: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the KWS Dataset.

| KWS | Size | Acc. | Std | Time Train | Hyperparameters |
|-------------------------|--------|-------|------|------------|---|
| SoonWiSARD (small) | 23KiB | 58.2% | 1.6% | 4m | n=6, K=2, L=4, H=47104, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (medium) | 46KiB | 67.7% | 1.1% | 4m | n=6, K=2, L=4, H=94208, p=0.5, $\tau=1/0.01$ |
| SoonWiSARD (large) | 92KiB | 69.6% | 0.8% | 4m | n=6, K=2, L=4, H=188416, p=0.5, $\tau=1/0.01$ |
| BTHOWeN (small) | 15KiB | 39.6% | 0.0% | - | n=6, K=2, L=64, H=1920 |
| BTHOWeN (medium) | 53KiB | 44.7% | 0.0% | - | n=6, K=2, L=64, H=6784 |
| BTHOWeN (large) | 183KiB | 48.3% | 0.0% | - | n=10, K=2, L=512, H=2928 |
| Diff Logic Net (small) | 23KiB | 57.3% | 2.0% | 3m | H=48000, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (medium) | 46KiB | 63.3% | 1.0% | 4m | H=95000, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (large) | 92KiB | 63.7% | 0.9% | 8m | H=188000, p=0.0, $\tau=1/0.03$ |
| FINN (small) | 23KiB | 47.2% | 1.8% | 8m | H=346, p=0.2 |
| FINN (medium) | 46KiB | 53.3% | 2.5% | 8m | H=692, p=0.2 |
| FINN (large) | 92KiB | 55.9% | 1.4% | 8m | H=1384, p=0.2 |
| DeepShift (small) | 23KiB | 18.6% | 5.5% | 4m | H=69, p=0.2 |
| DeepShift (medium) | 46KiB | 22.2% | 2.5% | 4m | H=137, p=0.2 |
| DeepShift (large) | 92KiB | 24.9% | 4.4% | 4m | H=274, p=0.2 |

Table 11: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the ToyADMOS Dataset.

| ToyADMOS | Size | Acc. | Std | Time Train | Hyperparameters |
|-------------------------|-------|-------|-----|------------|---|
| SoonWiSARD (small) | 7KiB | 88.4% | | 48m | n=6, K=1, L=16, H=3840, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (medium) | 15KiB | 89.3% | | 48m | n=6, K=1, L=16, H=7680, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (large) | 30KiB | 90.5% | | 48m | n=6, K=1, L=16, H=15360, p=0.5, $\tau=1/0.03$ |
| BTHOWeN (small) | 8KiB | 72.3% | | - | n=6, K=2, L=64, H=1700 |
| BTHOWeN (medium) | 13KiB | 73.3% | | - | n=6, K=2, L=64, H=2780 |
| BTHOWeN (large) | 80KiB | 74.1% | | - | n=10, K=2, L=1024, H=640 |
| Diff Logic Net (small) | 7KiB | 88.3% | | 52m | H=15000, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (medium) | 15KiB | 89.2% | | 52m | H=31000, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (large) | 30KiB | 89.4% | | 56m | H=62000, p=0.0, $\tau=1/0.03$ |
| FINN (small) | 7KiB | 84.8% | | 64m | H=90, p=0.2 |
| FINN (medium) | 15KiB | 85.9% | | 64m | H=190, p=0.2 |
| FINN (large) | 30KiB | 86.6% | | 64m | H=380, p=0.2 |
| DeepShift (small) | 7KiB | 57.8% | | 88m | H=18, p=0.2 |
| DeepShift (medium) | 15KiB | 57.8% | | 88m | H=38, p=0.2 |
| DeepShift (large) | 30KiB | 57.9% | | 88m | H=76, p=0.2 |

Table 12: Extend results for SoonWiSARD, BTHOWeN, Diff Logic Net, FINN, and DeepShift on the VWW Dataset.

| VWW | Size | Acc. | Std | Time Train | Hyperparameters |
|-------------------------|--------|-------|------|------------|--|
| SoonWiSARD (small) | 12KiB | 57.9% | 1.5% | 12m | n=6, K=1, L=16, H=6144, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (medium) | 120KiB | 59.8% | 0.9% | 16m | n=6, K=1, L=16, H=61440, p=0.5, $\tau=1/0.03$ |
| SoonWiSARD (large) | 240KiB | 60.6% | 1.1% | 20m | n=6, K=1, L=16, H=122880, p=0.5, $\tau=1/0.03$ |
| BTHOWeN (small) | 12KiB | 57.3% | 0.0% | - | n=6, K=2, L=64, H=1536 |
| BTHOWeN (medium) | 120KiB | 58.4% | 0.0% | - | n=10, K=2, L=1024, H=960 |
| BTHOWeN (large) | 240KiB | 59.3% | 0.0% | - | n=10, K=2, L=2048, H=960 |
| Diff Logic Net (small) | 20KiB | 52.6% | 1.6% | 20m | H=40960, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (medium) | 120KiB | 55.4% | 1.4% | 32m | H=245760, p=0.0, $\tau=1/0.03$ |
| Diff Logic Net (large) | 250KiB | 55.7% | 1.3% | 56m | H=512000, p=0.0, $\tau=1/0.03$ |
| FINN (small) | 20KiB | 51.7% | 1.5% | 24m | H=17, p=0.2 |
| FINN (medium) | 120KiB | 52.1% | 1.1% | 24m | H=106, p=0.2 |
| FINN (large) | 250KiB | 52.3% | 1.2% | 24m | H=222, p=0.2 |
| DeepShift (small) | 20KiB | 52.9% | 1.2% | 16m | H=3, p=0.2 |
| DeepShift (medium) | 120KiB | 53.8% | 0.9% | 16m | H=21, p=0.2 |
| DeepShift (large) | 250KiB | 54.6% | 0.8% | 16m | H=44, p=0.2 |