

Supplemental Results

Due to the space limitation, this section provides those experimental results that are not included in the main body of the paper.

0.1 Comparison with Semi-supervised Methods

In this subsection, we present and discuss the comparison results between CDSC-AL and semi-supervised approaches using 5%, 15%, and 20% of labeled data. The best results are in bold-face and the Nemenyi post-hoc test is performed here.

Table 1: Comparison with semi-supervised approaches using 5% labeled data.

| Datasets | Metric | LNP | OReSSL | CDSC-AL |
|------------------|-------------|--------|---------------|---------------|
| Synthetic-1 | BA | 0.8836 | 0.9214 | 0.9323 |
| | F_{macro} | 0.7706 | 0.9220 | 0.9344 |
| Synthetic-2 | BA | 0.8278 | 0.8329 | 0.8297 |
| | F_{macro} | 0.6078 | 0.7796 | 0.8013 |
| Sea | BA | 0.5048 | 0.8068 | 0.9554 |
| | F_{macro} | 0.5879 | 0.8169 | 0.9601 |
| KDD cup 99 | BA | 0.5125 | 0.6182 | 0.8219 |
| | F_{macro} | 0.5007 | 0.6205 | 0.7829 |
| Forest covtype | BA | 0.4838 | 0.6752 | 0.8256 |
| | F_{macro} | 0.4821 | 0.6755 | 0.8066 |
| Gas Sensor Drift | BA | 0.5695 | 0.8474 | 0.8866 |
| | F_{macro} | 0.5951 | 0.8299 | 0.8934 |
| Shuttle | BA | 0.3635 | 0.4475 | 0.4459 |
| | F_{macro} | 0.3661 | 0.4508 | 0.4457 |
| MNIST | BA | 0.7231 | 0.8322 | 0.9307 |
| | F_{macro} | 0.7286 | 0.8327 | 0.9313 |
| CIFAR-10 | BA | 0.4114 | 0.6304 | 0.7625 |
| | F_{macro} | 0.4075 | 0.6198 | 0.7619 |

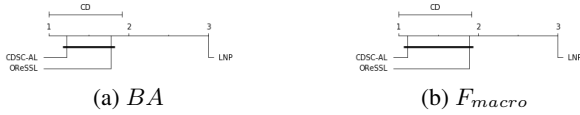


Figure 1: Comparison of CDSC-AL against semi-supervised methods with the Nemenyi test with $\alpha = 0.05$ using 5% labeled data.

Discussions: Table 1 summarizes the experimental results for CDSC-AL and two semi-supervised methods when there is 5% labeled data in each incoming data chunk. As shown in Table 1, CDSC-AL provides better performance on most data streams except for Shuttle. In Figure 1, the Nemenyi post-hoc test indicates that CDSC-AL achieves statistically comparable performance than OReSSL method while showing statistically better performance than LNP method using 5% of labeled data.

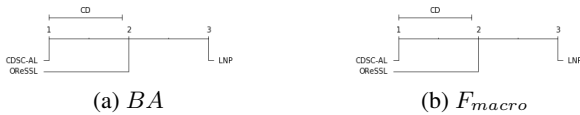


Figure 2: Comparison of CDSC-AL against semi-supervised methods with the Nemenyi test with $\alpha = 0.05$ using 15% labeled data.

Table 2: Comparison with semi-supervised approaches using 15% labeled data.

| Datasets | Metric | LNP | OReSSL | CDSC-AL |
|------------------|-------------|--------|--------|---------------|
| Synthetic-1 | BA | 0.8939 | 0.9307 | 0.9495 |
| | F_{macro} | 0.8126 | 0.9318 | 0.9537 |
| Synthetic-2 | BA | 0.8416 | 0.8542 | 0.8549 |
| | F_{macro} | 0.6598 | 0.7937 | 0.8287 |
| Sea | BA | 0.5418 | 0.8596 | 0.9713 |
| | F_{macro} | 0.6271 | 0.8619 | 0.9754 |
| KDD cup 99 | BA | 0.5528 | 0.7458 | 0.8366 |
| | F_{macro} | 0.5739 | 0.7535 | 0.7923 |
| Forest covtype | BA | 0.5420 | 0.7512 | 0.8612 |
| | F_{macro} | 0.5438 | 0.7485 | 0.8442 |
| Gas Sensor Drift | BA | 0.6756 | 0.9202 | 0.9291 |
| | F_{macro} | 0.6858 | 0.9238 | 0.9299 |
| Shuttle | BA | 0.4259 | 0.5004 | 0.5015 |
| | F_{macro} | 0.4256 | 0.5193 | 0.5205 |
| MNIST | BA | 0.7874 | 0.9451 | 0.9772 |
| | F_{macro} | 0.7955 | 0.9479 | 0.9773 |
| CIFAR-10 | BA | 0.4251 | 0.6596 | 0.8051 |
| | F_{macro} | 0.4264 | 0.6426 | 0.8208 |

Discussions: Table 2 presents the experimental results of CDSC-AL and two semi-supervised methods with 15% labeled data in each incoming data chunk. In Table 2, we can observe that CDSC-AL outperforms the OReSSL and LNP methods on all data streams in terms of BA and F_{macro} . From Figure 2, the CD diagram reveals that CDSC-AL provides statistically better performance than OReSSL and LNP methods using 15% of labeled data.

Table 3: Comparison with semi-supervised approaches using 20% labeled data.

| Datasets | Metric | LNP | OReSSL | CDSC-AL |
|------------------|-------------|--------|---------------|---------------|
| Synthetic-1 | BA | 0.9043 | 0.9333 | 0.9634 |
| | F_{macro} | 0.8343 | 0.9428 | 0.9684 |
| Synthetic-2 | BA | 0.8562 | 0.8634 | 0.8616 |
| | F_{macro} | 0.6862 | 0.7988 | 0.8367 |
| Sea | BA | 0.5620 | 0.8970 | 0.9715 |
| | F_{macro} | 0.6497 | 0.9145 | 0.9758 |
| KDD cup 99 | BA | 0.6088 | 0.7645 | 0.8369 |
| | F_{macro} | 0.6121 | 0.7812 | 0.7927 |
| Forest covtype | BA | 0.5692 | 0.7898 | 0.8809 |
| | F_{macro} | 0.5735 | 0.7834 | 0.8668 |
| Gas Sensor Drift | BA | 0.6791 | 0.9210 | 0.9293 |
| | F_{macro} | 0.6892 | 0.9248 | 0.9301 |
| Shuttle | BA | 0.4436 | 0.5197 | 0.5223 |
| | F_{macro} | 0.4643 | 0.5361 | 0.5455 |
| MNIST | BA | 0.8148 | 0.9612 | 0.9816 |
| | F_{macro} | 0.8249 | 0.9646 | 0.9824 |
| CIFAR-10 | BA | 0.4291 | 0.6872 | 0.8208 |
| | F_{macro} | 0.4381 | 0.6778 | 0.8263 |



Figure 3: Comparison of CDSC-AL against semi-supervised methods with the Nemenyi test with $\alpha = 0.05$ using 20% labeled data.

Discussions: Table 3 shows the experimental results of CDSC-AL and two semi-supervised methods with 20% labeled data in each incoming data chunk. From Table 2, it is clear that CDSC-AL achieves better performance than two compared semi-supervised methods on all data streams for

both BA and F_{macro} . As shown in Figure 3, it is observed that CDSC-AL also shows statistically comparable performance than OReSSL method while showing statistically better performance than LNP method using 20% of labeled data.

Summary of Discussions: In summary, the performance of CDSC-AL method shows better improvement than the two compared semi-supervised methods on all data streams as the label proportion increases.

0.2 Comparison with Supervised Methods

In this subsection, we summarize the comparison results between CDSC-AL and supervised approaches in Tables 4, 5, and 6. Here, we only use 5%, 15%, and 20% of labeled data for CDSC-AL method while the supervised approaches utilize all labels (100%) of the data stream. The best results are in bold-face.

Table 4: Comparison with supervised approaches when CDSC-AL only uses 5% labeled data.

| Datasets | Metric | LB | OBA | AHT | SAMkNN | CDSC-AL |
|----------|-------------|---------------|--------|---------------|--------|---------------|
| Syn-1 | BA | 0.7910 | 0.6640 | 0.6354 | 0.6247 | 0.9123 |
| | F_{macro} | 0.7965 | 0.6675 | 0.6513 | 0.6313 | 0.9044 |
| Syn-2 | BA | 0.7124 | 0.7204 | 0.6926 | 0.6784 | 0.8297 |
| | F_{macro} | 0.7218 | 0.7219 | 0.6977 | 0.6864 | 0.8013 |
| Sea | BA | 0.8204 | 0.7498 | 0.7493 | 0.7205 | 0.9554 |
| | F_{macro} | 0.8227 | 0.7501 | 0.7505 | 0.7345 | 0.9601 |
| KDD 99 | BA | 0.7585 | 0.7812 | 0.8541 | 0.7495 | 0.8219 |
| | F_{macro} | 0.7564 | 0.7798 | 0.8012 | 0.7682 | 0.7829 |
| covtype | BA | 0.8888 | 0.8707 | 0.8612 | 0.8545 | 0.8256 |
| | F_{macro} | 0.8901 | 0.8709 | 0.8688 | 0.8588 | 0.8066 |
| GSD | BA | 0.7185 | 0.6345 | 0.6111 | 0.6357 | 0.8866 |
| | F_{macro} | 0.7199 | 0.6361 | 0.6188 | 0.6412 | 0.8934 |
| Shuttle | BA | 0.4789 | 0.4477 | 0.4508 | 0.4424 | 0.4459 |
| | F_{macro} | 0.5187 | 0.5112 | 0.4987 | 0.4894 | 0.4457 |
| MNIST | BA | 0.8909 | 0.8498 | 0.8393 | 0.8549 | 0.9307 |
| | F_{macro} | 0.8946 | 0.8501 | 0.8412 | 0.8596 | 0.9319 |
| CIFAR10 | BA | 0.7199 | 0.6208 | 0.7366 | 0.6218 | 0.7625 |
| | F_{macro} | 0.7208 | 0.6325 | 0.7381 | 0.6295 | 0.7619 |

Table 5: Comparison with supervised approaches when CDSC-AL only uses 15% labeled data.

| Datasets | Metric | LB | OBA | AHT | SAMkNN | CDSC-AL |
|----------|-------------|---------------|--------|---------------|--------|---------------|
| Syn-1 | BA | 0.7910 | 0.6640 | 0.6354 | 0.6247 | 0.9195 |
| | F_{macro} | 0.7965 | 0.6675 | 0.6513 | 0.6313 | 0.9137 |
| Syn-2 | BA | 0.7124 | 0.7204 | 0.6926 | 0.6784 | 0.8549 |
| | F_{macro} | 0.7218 | 0.7219 | 0.6977 | 0.6864 | 0.8616 |
| Sea | BA | 0.8204 | 0.7498 | 0.7493 | 0.7205 | 0.9713 |
| | F_{macro} | 0.8227 | 0.7501 | 0.7505 | 0.7345 | 0.9729 |
| KDD 99 | BA | 0.7585 | 0.7812 | 0.8541 | 0.7495 | 0.8366 |
| | F_{macro} | 0.7564 | 0.7798 | 0.8012 | 0.7682 | 0.7923 |
| covtype | BA | 0.8888 | 0.8707 | 0.8612 | 0.8545 | 0.8616 |
| | F_{macro} | 0.8901 | 0.8709 | 0.8688 | 0.8588 | 0.8442 |
| GSD | BA | 0.7185 | 0.6345 | 0.6111 | 0.6357 | 0.9291 |
| | F_{macro} | 0.7199 | 0.6361 | 0.6188 | 0.6412 | 0.9299 |
| Shuttle | BA | 0.4789 | 0.4477 | 0.4508 | 0.4424 | 0.5015 |
| | F_{macro} | 0.5187 | 0.5112 | 0.4987 | 0.4894 | 0.5205 |
| MNIST | BA | 0.8909 | 0.8498 | 0.8393 | 0.8549 | 0.9772 |
| | F_{macro} | 0.8946 | 0.8501 | 0.8412 | 0.8596 | 0.9773 |
| CIFAR10 | BA | 0.7199 | 0.6208 | 0.7366 | 0.6218 | 0.8051 |
| | F_{macro} | 0.7208 | 0.6325 | 0.7381 | 0.6295 | 0.8083 |

Summary of Discussions: As mentioned in the paper, we increased the label proportion for CDSC-AL method up to 20% and presented the results in Tables 4, 5, and 6. As shown in Tables 4, 5, and 6, the performance of CDSC-AL method

Table 6: Comparison with supervised approaches when CDSC-AL only uses 20% labeled data.

| Datasets | Metric | LB | OBA | AHT | SAMkNN | CDSC-AL |
|----------|-------------|---------------|--------|---------------|--------|---------------|
| Syn-1 | BA | 0.7910 | 0.6640 | 0.6354 | 0.6247 | 0.9234 |
| | F_{macro} | 0.7965 | 0.6675 | 0.6513 | 0.6313 | 0.9184 |
| Syn-2 | BA | 0.7124 | 0.7204 | 0.6926 | 0.6784 | 0.8616 |
| | F_{macro} | 0.7218 | 0.7219 | 0.6977 | 0.6864 | 0.8367 |
| Sea | BA | 0.8204 | 0.7498 | 0.7493 | 0.7205 | 0.9715 |
| | F_{macro} | 0.8227 | 0.7501 | 0.7505 | 0.7345 | 0.9758 |
| KDD 99 | BA | 0.7585 | 0.7812 | 0.8541 | 0.7495 | 0.8469 |
| | F_{macro} | 0.7564 | 0.7798 | 0.8012 | 0.7682 | 0.7927 |
| covtype | BA | 0.8888 | 0.8707 | 0.8612 | 0.8545 | 0.8809 |
| | F_{macro} | 0.8901 | 0.8709 | 0.8688 | 0.8588 | 0.8668 |
| GSD | BA | 0.7185 | 0.6345 | 0.6111 | 0.6357 | 0.9293 |
| | F_{macro} | 0.7199 | 0.6361 | 0.6188 | 0.6412 | 0.9301 |
| Shuttle | BA | 0.4789 | 0.4477 | 0.4508 | 0.4424 | 0.5223 |
| | F_{macro} | 0.5187 | 0.5112 | 0.4987 | 0.4894 | 0.5445 |
| MNIST | BA | 0.8909 | 0.8498 | 0.8393 | 0.8549 | 0.9816 |
| | F_{macro} | 0.8946 | 0.8501 | 0.8412 | 0.8596 | 0.9824 |
| CIFAR10 | BA | 0.7199 | 0.6208 | 0.7366 | 0.6218 | 0.8208 |
| | F_{macro} | 0.7208 | 0.6325 | 0.7381 | 0.6295 | 0.8263 |

improves as the proportion of labeled data increases. More importantly, with 20% labeled data, CDSC-AL achieves the best performance on all benchmark data streams except for the KDD cup 99 and Forest covtype. For KDD cup 99 and Forest covtype, CDSC-AL shows comparable performance using only 20% labeled data.