## Supplemental Material

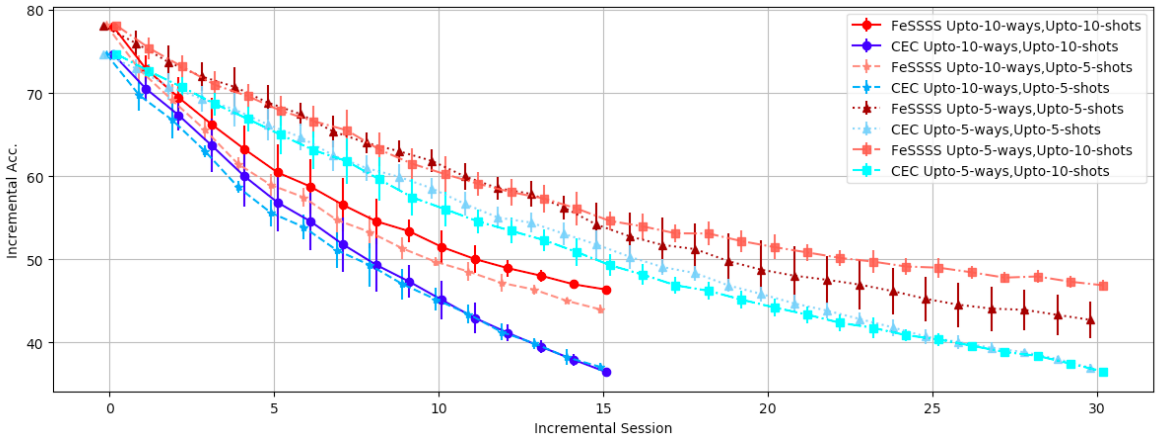
In the main paper we focused on more challenging CUB200 dataset, Tab. 8 provides the VFSCIL results on miniImageNet dataset for 4 experimental settings, comparing our FeSSSS approach against extended CEC. For a comparison between datasets, we re-list the results for CUB200, as there is more data (10 times) in miniImageNet base session than CUB200, we see a much higher average performance for FeSSSS, whereas extended CEC is unable to leverage this abundance of data. In Tabs. 9, and 10 we report the performance of FeSSSS and extended CEC on VFSOWL using miniImageNet. FeSSSS consistently outperforms extended CEC on both 95%, and 90% TPR.

Below, we also show the VFSOWL performance in visual form to demonstrate the trade-offs between Acc and UDA/KDA for CUB200 with varying TPRs of 90%, and 95%.

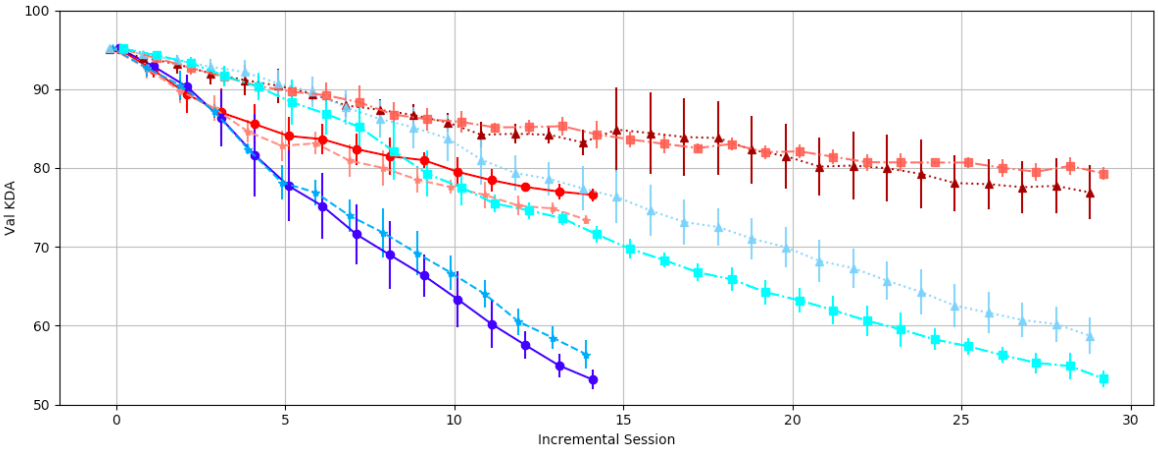
Table 8. Incremental learning comparison of FeSSSS against extended CEC on miniImageNet dataset across all experimental settings. Mean ($\mu$) for 5 experiments per each experimental setting is provided, we further re-list the results for CUB200 dataset to emphasize the challenging nature of CUB200.

**VFSCIL Performance**

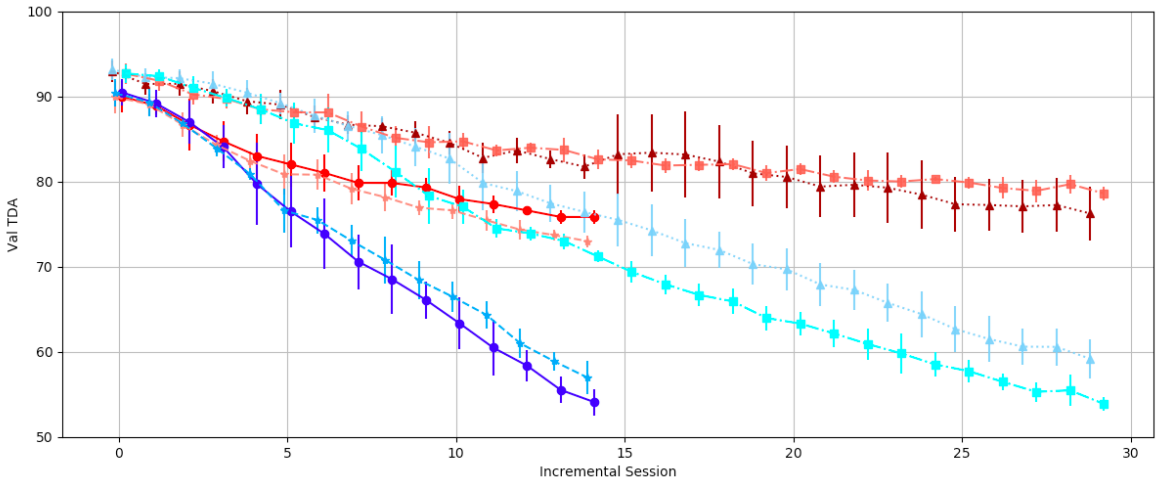
| experimental setting | FeSSSS | | CEC | |
|---|---|---|---|---|
| | mini | CUB200 | mini | CUB200 |
| | $\mu$ | $\mu$ | $\mu$ | $\mu$ |
| Up-to 10-Ways, Up-to 10-Shots | 68.63 | 62.05 | 57.19 | 59.12 |
| Up-to 10-Ways, Up-to 5-Shots | 65.20 | 60.67 | 55.45 | 57.82 |
| Up-to 5-Ways, Up-to 5-Shots | 65.84 | 60.70 | 56.31 | 58.02 |
| Up-to 5-Ways, Up-to 10-Shots | 67.92 | 61.60 | 55.39 | 58.67 |
| Avg ↑ | 66.89 | 61.26 | 56.08 | 58.41 |
| Gain over CEC | **+10.81** | **+2.85** | - | - |




(a) Comparison of incremental recognition accuracy.

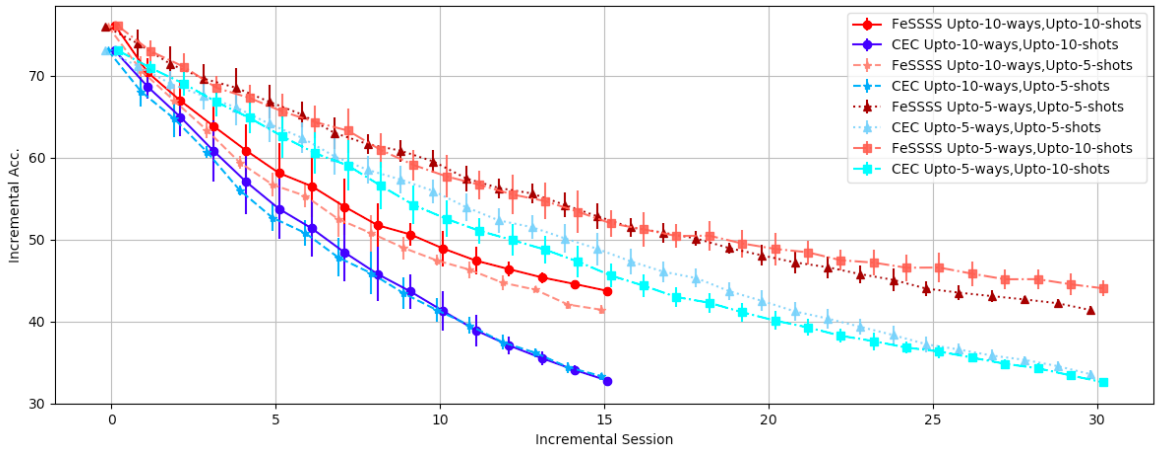



(b) Comparison of incremental knowns detection accuracy (KDA).

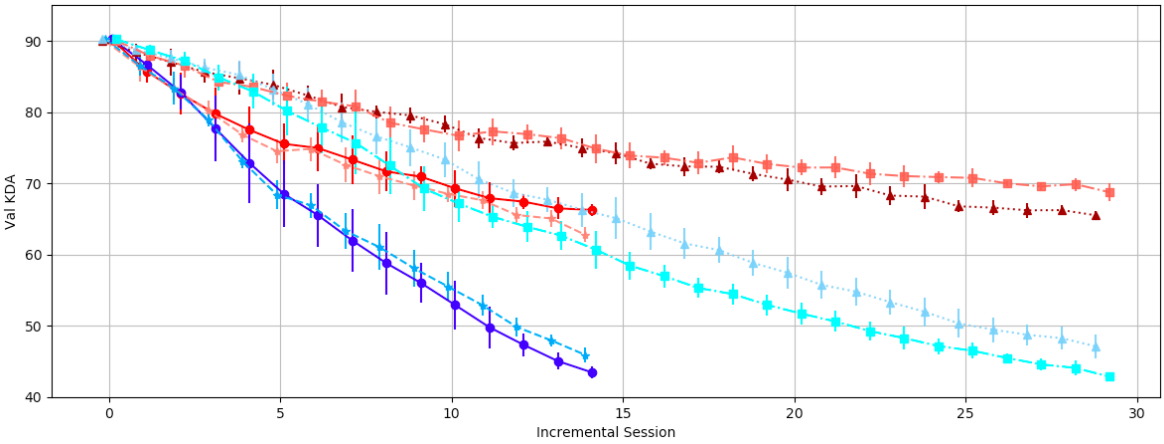



(c) Comparison of incremental total detection accuracy (TDA).

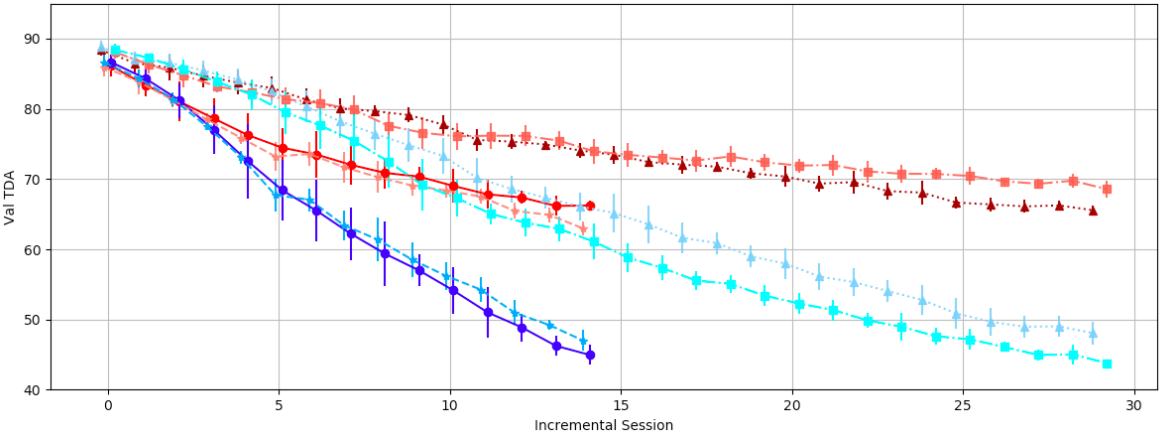
Figure 3. Performance comparison of FeSSSS against CEC on CUB200 dataset for 4 experimental settings of Up-to N-ways, Up-to K-shots. The incremental recognition accuracy (a) declines compared to Fig. 2 as a threshold is chosen for 95% TPR on base session to make both methods work for open-world learning. We can see TDA (c) is a function of KDA (b), as the validation data at any given incremental session is mostly dominated by *knowns i.e.*, sample from classes that have already been enrolled. Nonetheless we see FeSSSS outperforming the baseline approach on all three metrics consistently in all experimental settings.




(a) Comparison of incremental recognition accuracy.




(b) Comparison of incremental knowns detection accuracy (KDA).




(c) Comparison of incremental total detection accuracy (TDA).

Figure 4. Performance comparison of FeSSSS against CEC on CUB200 dataset for 4 experimental settings of Up-to N-ways, Up-to K-shots. The incremental recognition accuracy (a) declines compared to Fig. 2 as a threshold is chosen for 90% TPR on base session to make both methods work for open-world learning. We can see TDA (c) is a function of KDA (b), as the validation data at any given incremental session is mostly dominated by *knowns i.e.*, sample from classes that have already been enrolled. Nonetheless we see FeSSSS outperforming the baseline approach on all three metrics consistently in all experimental settings.

Table 9. Comparison of FeSSSS with the extended baseline (CEC) on miniImageNet dataset for open-world learning at a 95% TPR. For both methods, we report averages of the *average incremental accuracy* (Acc), average *unknown detection accuracy* (UDA), average *known detection accuracy* (KDA), average *total detection accuracy* (TDA) for 4 experimental settings. We further report the average of average *unknown detection accuracy* (UDA-Tr.) for the training data belonging to incremental sessions. The average across all experiments are documented in second-to-last row, and performance gain over CEC is noted in the last row.

**VFSOWL Performance @ 95% TPR**

| experimental setting | FeSSSS | | | | | CEC | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Acc | UDA | KDA | TDA | UDA-Tr. | Acc | UDA | KDA | TDA | UDA-Tr. |
| Up-to 10-Ways, Up-to 10-Shots | 65.8 | 16.05 | 93.16 | 87.82 | 28.48 | 55.27 | 25.40 | 87.49 | 82.98 | 23.13 |
| Up-to 10-Ways, Up-to 5-Shots | 61.74 | 15.79 | 93.25 | 87.84 | 31.47 | 53.75 | 22.93 | 88.07 | 83.36 | 16.57 |
| Up-to 5-Ways, Up-to 5-Shots | 63.52 | 17.83 | 92.7 | 86.93 | 33.74 | 54.89 | 24.73 | 87.91 | 85.62 | 59.55 |
| Up-to 5-Ways, Up-to 10-Shots | 64.04 | 16.42 | 93.65 | 87.18 | 30.79 | 53.0 | 32.02 | 84.21 | 82.14 | 38.61 |
| Avg ↑ | 63.77 | 16.52 | 93.19 | 87.44 | 31.12 | 54.22 | 26.27 | 86.92 | 83.52 | 34.46 |
| Gain over CEC | **+9.55** | **-9.75** | **+6.27** | **+3.92** | **-3.34** | - | - | - | - | - |

Table 10. Comparison of FeSSSS with the extended baseline (CEC) on miniImageNet dataset for open-world learning at a 90% TPR. For both methods, we report averages of the *average incremental accuracy* (Acc), average *unknown detection accuracy* (UDA), average *knowns detection accuracy* (KDA), average *total detection accuracy* (TDA) for 4 experimental settings. We further report the average of average *unknown detection accuracy* (UDA-Tr.) for the training data belonging to incremental session.

**VFSOWL Performance @ 90% TPR**

| experimental setting | FeSSSS | | | | | CEC | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Acc | UDA | KDA | TDA | UDA-Tr. | Acc | UDA | KDA | TDA | UDA-Tr. |
| Up-to 10-Ways, Up-to 10-Shots | 64.58 | 27.91 | 87.00 | 82.93 | 51.87 | 53.36 | 42.17 | 78.75 | 76.00 | 40.25 |
| Up-to 10-Ways, Up-to 5-Shots | 61.43 | 30.25 | 86.18 | 82.19 | 48.89 | 52.28 | 37.58 | 80.17 | 77.02 | 26.04 |
| Up-to 5-Ways, Up-to 5-Shots | 62.77 | 25.84 | 87.62 | 85.43 | 47.35 | 53.43 | 36.66 | 80.71 | 79.10 | 68.42 |
| Up-to 5-Ways, Up-to 10-Shots | 63.39 | 28.52 | 87.8 | 84.39 | 47.94 | 51.42 | 44.99 | 76.63 | 75.27 | 46.54 |
| Avg ↑ | 63.04 | 28.13 | 87.15 | 83.73 | 49.01 | 52.62 | 40.35 | 79.06 | 76.84 | 45.31 |
| Gain over CEC | **+10.42** | **-12.22** | **+8.09** | **+6.89** | **+3.70** | - | - | - | - | - |