results_analysis

June 26, 2024

1 Introduction and Code Accessibility

The paper "Contrastive Learning is Spectral Clustering on Similarity Graph" itself contains an information on where to find the code for reproducing the results. It can be found under the link: https://github.com/yifanzhang-pro/Kernel-InfoNCE. The GitHub repository contains a readme file that provides information on how to run the code. Personally, I needed to set it up properly and the version I've used can be found under the link: https://github.com/maxharnot/Kernel-InfoNCE-OK .

My goal of the paper is to reproduce the Table 1 from page 9 of the research paper, where I am focusing on the datasets CIFAR-10 and CIFAR-100.

2 Challenges

During the running of the code I've faced several issues that all in all returned me a very low accuracy in the final results. First of all, we know that the code was ran on a Linux system, using an A 100 GPU. Therefore, my first idea was to run it on a Linux implemented in the google colab environment. Unfortunately, it turned out that the versions of the packages were not compatible with each other. I've tried the same on a Windows and a Mac system but faced the same issues, as the packages were directed towards a Linux environment. Thus, in order to set up the environment, I had to solve a lot of bugs within the versions of the packages. As we can see, the environment of the code was set up some time ago and due to updates and lack of better documentation I could only assume what the proper setup could be. This fact might as well have an influence on the reproducibility and the results, which I will present later.

As a result of this, my major concern during this project was running the random_search.py algorithm, which finally didn't work out due to an error. Even though I have installed the proper libraries, I have faced an error in the ray.tune package. I wasn't able to run the random_search algorithm and thus obtain the proper hyperparameters. Unfortunately, even though I've tried my best in extracting the used hyperparameters from the paper, the information provided was not explicit enough to obtain reasonable results.

The error message I've faced at this step was the following:

ValueError: Trial returned a result which did not include the specified metric(s) `online_val_acc` that `tune.TuneConfig()` expects. Make sure your calls to `tune.report()` include the metric, or set the TUNE_DISABLE_STRICT_METRIC_CHECKING environment variable to 1. Result: {'trial_id': 'a0674_00000', 'date': '2024-06-25_09-59-39', 'timestamp': 1719309579, 'pid': 4381, 'hostname': '0ff6c0759426', 'node_ip': '172.28.0.12', 'done': True, 'config/learning_rate':

0.3983154936089757, 'config/temperature': 0.05078108049027914, 'config/gamma': 0.5, 'config/projection_mu': 1.0, 'config/gamma_lambd': 0.01043102867215806, 'config/acos_order': 0}

I've tried to follow the instructions, nevertheless setting the TUNE_DISABLE_STRICT_METRIC_CHECKING flag to 1 only hid the problem, it didn't resolve it, as it was expected. I couldn't fetch thus the optimal hyperparameters, I could only rely on the information provided in the paper.

In the further steps, the training algorithm in the simclr_module.py file ran without any major issues but unfortunately the results were horribly low. I've ran the finetuning afterwards as well, nevertheless due to problems with the algorithm (some results after the finetuning contained the proper metrics, others didn't) and their very little divergence from the results I have obtained in the simclr_module I have based my reproduction results on the results from the simclr_module.py file.

3 Experiment

In the experiment I start with installing the proper packages and libraries.

My commands I used were:

[143]:
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! pip install -r requirements_versions.txt
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Requirement already satisfied: absl-py==1.4.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 1)) (1.4.0)
Requirement already satisfied: aiohttp==3.8.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 2)) (3.8.3)
Requirement already satisfied: aiohttp-cors==0.7.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 3)) (0.7.0)
Requirement already satisfied: aiorwlock==1.3.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 4)) (1.3.0)
Requirement already satisfied: aiosignal==1.3.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 5)) (1.3.1)
Requirement already satisfied: anyio==3.6.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 6)) (3.6.2)
Requirement already satisfied: async-timeout==4.0.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 7)) (4.0.2)
Requirement already satisfied: attrs==22.2.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 8)) (22.2.0)
Requirement already satisfied: blessed==1.19.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
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requirements_versions.txt (line 9)) (1.19.1)
Requirement already satisfied: byol-pytorch==0.6.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 10)) (0.6.0)
Requirement already satisfied: cachetools==5.2.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 11)) (5.2.1)
Requirement already satisfied: charset-normalizer==2.1.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 12)) (2.1.1)
Requirement already satisfied: click==8.1.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 13)) (8.1.3)
Requirement already satisfied: colorful==0.5.5 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 14)) (0.5.5)
Requirement already satisfied: contourpy==1.0.7 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 15)) (1.0.7)
Requirement already satisfied: cycler==0.11.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 16)) (0.11.0)
Requirement already satisfied: distlib==0.3.6 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 17)) (0.3.6)
Requirement already satisfied: fastapi==0.89.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 18)) (0.89.1)
Requirement already satisfied: filelock==3.9.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 19)) (3.9.0)
Requirement already satisfied: fonttools==4.38.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 20)) (4.38.0)
Requirement already satisfied: frozenlist==1.3.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 21)) (1.3.3)
Requirement already satisfied: fsspec==2022.11.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 22)) (2022.11.0)
Requirement already satisfied: google-api-core==2.11.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 23)) (2.11.0)
Requirement already satisfied: google-auth==2.16.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 24)) (2.16.0)
Requirement already satisfied: google-auth-oauthlib==0.4.6 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
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requirements_versions.txt (line 25)) (0.4.6)
Requirement already satisfied: googleapis-common-protos==1.58.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 26)) (1.58.0)
Requirement already satisfied: gpustat==1.0.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 27)) (1.0.0)
Requirement already satisfied: grpcio in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 28)) (1.64.1)
Requirement already satisfied: h11==0.14.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 29)) (0.14.0)
Requirement already satisfied: idna==3.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 30)) (3.4)
Requirement already satisfied: importlib-metadata==6.0.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 31)) (6.0.0)
Requirement already satisfied: importlib-resources==5.10.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 32)) (5.10.2)
Requirement already satisfied: joblib==1.2.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 33)) (1.2.0)
Requirement already satisfied: jsonschema==4.17.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 34)) (4.17.3)
Requirement already satisfied: kiwisolver==1.4.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 35)) (1.4.4)
Requirement already satisfied: lightning-bolts==0.6.0.post1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 36)) (0.6.0.post1)
Requirement already satisfied: lightning-utilities==0.5.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 37)) (0.5.0)
Requirement already satisfied: markdown==3.4.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 38)) (3.4.1)
Requirement already satisfied: markupsafe==2.1.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 39)) (2.1.1)
Requirement already satisfied: matplotlib==3.6.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 40)) (3.6.3)
Requirement already satisfied: msgpack==1.0.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
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requirements_versions.txt (line 41)) (1.0.4)
Requirement already satisfied: multidict==6.0.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 42)) (6.0.4)
Requirement already satisfied: numpy==1.24.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 43)) (1.24.1)
Requirement already satisfied: oauthlib==3.2.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 44)) (3.2.2)
Requirement already satisfied: opencensus==0.11.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 45)) (0.11.0)
Requirement already satisfied: opencensus-context==0.1.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 46)) (0.1.3)
Requirement already satisfied: packaging==23.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 47)) (23.0)
Requirement already satisfied: pandas==1.5.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 48)) (1.5.2)
Requirement already satisfied: pathtools==0.1.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 49)) (0.1.2)
Requirement already satisfied: pillow==9.4.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 50)) (9.4.0)
Requirement already satisfied: pkgutil-resolve-name==1.3.10 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 51)) (1.3.10)
Requirement already satisfied: platformdirs==2.6.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 52)) (2.6.2)
Requirement already satisfied: prometheus-client==0.13.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 53)) (0.13.1)
Requirement already satisfied: protobuf==3.19.6 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 54)) (3.19.6)
Requirement already satisfied: psutil==5.9.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 55)) (5.9.4)
Requirement already satisfied: py-spy==0.3.14 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 56)) (0.3.14)
Requirement already satisfied: pyarrow in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
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requirements_versions.txt (line 57)) (16.1.0)
Requirement already satisfied: pyasn1==0.4.8 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 58)) (0.4.8)
Requirement already satisfied: pyasn1-modules==0.2.8 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 59)) (0.2.8)
Requirement already satisfied: pydantic==1.10.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 60)) (1.10.4)
Requirement already satisfied: pyparsing==3.0.9 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 61)) (3.0.9)
Requirement already satisfied: pyrsistent==0.19.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 62)) (0.19.3)
Requirement already satisfied: python-dateutil==2.8.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 63)) (2.8.2)
Requirement already satisfied: pytorch-lightning==1.8.6 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 64)) (1.8.6)
Requirement already satisfied: pytz==2022.7.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 65)) (2022.7.1)
Requirement already satisfied: pyyaml in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 66)) (6.0)
Requirement already satisfied: ray==2.7.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 67)) (2.7.0)
Requirement already satisfied: requests==2.28.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 68)) (2.28.2)
Requirement already satisfied: requests-oauthlib==1.3.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 69)) (1.3.1)
Requirement already satisfied: rsa==4.9 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 70)) (4.9)
Requirement already satisfied: scikit-learn==1.2.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 71)) (1.2.2)
Requirement already satisfied: scipy==1.10.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 72)) (1.10.1)
Requirement already satisfied: six==1.16.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
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requirements_versions.txt (line 73)) (1.16.0)
Requirement already satisfied: smart-open==6.3.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 74)) (6.3.0)
Requirement already satisfied: sniffio==1.3.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 75)) (1.3.0)
Requirement already satisfied: starlette==0.22.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 76)) (0.22.0)
Requirement already satisfied: tabulate==0.9.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 77)) (0.9.0)
Requirement already satisfied: tensorboard==2.11.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 78)) (2.11.2)
Requirement already satisfied: tensorboard-data-server==0.6.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 79)) (0.6.1)
Requirement already satisfied: tensorboard-plugin-wit==1.8.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 80)) (1.8.1)
Requirement already satisfied: tensorboardx==2.5.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 81)) (2.5.1)
Requirement already satisfied: thop==0.1.1-2209072238 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 82)) (0.1.1.post2209072238)
Requirement already satisfied: threadpoolctl==3.1.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 83)) (3.1.0)
Requirement already satisfied: torch==1.12.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 84)) (1.12.1)
Requirement already satisfied: torchmetrics==0.10.3 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 85)) (0.10.3)
Requirement already satisfied: tqdm==4.64.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 86)) (4.64.1)
Requirement already satisfied: typing-extensions==4.4.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 87)) (4.4.0)
Requirement already satisfied: urllib3==1.26.14 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 88)) (1.26.14)
Requirement already satisfied: uvicorn==0.20.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
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requirements_versions.txt (line 89)) (0.20.0)
Requirement already satisfied: virtualenv==20.17.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 90)) (20.17.1)
Requirement already satisfied: wcwidth==0.2.6 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 91)) (0.2.6)
Requirement already satisfied: werkzeug==2.2.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 92)) (2.2.2)
Requirement already satisfied: yarl==1.8.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 93)) (1.8.2)
Requirement already satisfied: zipp==3.11.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 94)) (3.11.0)
Requirement already satisfied: gym==0.26.2 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 95)) (0.26.2)
Requirement already satisfied: wandb in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from -r
requirements_versions.txt (line 96)) (0.17.3)
Requirement already satisfied: torchvision>=0.8 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from byol-
pytorch==0.6.0->-r requirements_versions.txt (line 10)) (0.13.1)
Requirement already satisfied: nvidia-ml-py<=11.495.46,>=11.450.129 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
gpustat==1.0.0->-r requirements_versions.txt (line 27)) (11.495.46)
Requirement already satisfied: certifi>=2017.4.17 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
requests==2.28.2->-r requirements_versions.txt (line 68)) (2024.6.2)
Requirement already satisfied: setuptools>=41.0.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
tensorboard==2.11.2->-r requirements_versions.txt (line 78)) (59.8.0)
Requirement already satisfied: wheel>=0.26 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
tensorboard==2.11.2->-r requirements_versions.txt (line 78)) (0.36.2)
Requirement already satisfied: cloudpickle>=1.2.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
gym==0.26.2->-r requirements_versions.txt (line 95)) (3.0.0)
Requirement already satisfied: gym-notices>=0.0.4 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
gym==0.26.2->-r requirements_versions.txt (line 95)) (0.0.8)
Requirement already satisfied: docker-pycreds>=0.4.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from wandb->-r
requirements_versions.txt (line 96)) (0.4.0)
Requirement already satisfied: gitpython!=3.1.29,>=1.0.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from wandb->-r
```

```
requirements_versions.txt (line 96)) (3.1.43)
Requirement already satisfied: sentry-sdk>=1.0.0 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from wandb->-r
requirements_versions.txt (line 96)) (2.6.0)
Requirement already satisfied: setproctitle in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from wandb->-r
requirements_versions.txt (line 96)) (1.3.3)
Requirement already satisfied: gitdb<5,>=4.0.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
gitpython!=3.1.29,>=1.0.0->wandb->-r requirements_versions.txt (line 96))
(4.0.11)
Requirement already satisfied: smmap<6,>=3.0.1 in
/Users/maxharnot/anaconda3/envs/ADSE/lib/python3.8/site-packages (from
gitdb<5,>=4.0.1->gitpython!=3.1.29,>=1.0.0->wandb->-r requirements_versions.txt
(line 96)) (5.0.1)
```

Or sometimes, when I obtained problems with some versions of libraries that wouldn't install, I ran this, more general command for installing the libraries:

[ ]:
```
! pip install -r requirements.txt
```

The first step should be according to the readme file the execution of the random_search.py algorithm. Nevertheless, after entering the command line: ! python random_search.py –dataset cifar10 –optimizer lars –max_epochs 50 the results are like described in the challenges section, the algorithm doesn't calculate the results, the trials don't deliver any results and thus I needed to move to the next step. Normally I should receive from this algorithm metrics like: 'Best trial config' and 'Best trial final validation accuracy', in my case the setup didn't succeed so I had to look for some hyperparameters in the paper and in the code in order to proceed with the following step, skipping the random_search.py file.

In the followin step I have used the hyperparameters that I could extract from the paper. At each point, where there was no information, I have assumed that the default values, that were implemented in the code, were the proper ones. I ran the code on Google Colab in order to use a GPU device.

In order to reproduce the table I had to compare 5 different methods: - SimCLR - Laplacian Kernel - Exponential Kernel - Simple Sum Kernel - Concatenation Sum Kernel

I have prepared myself the exact commands to be executed for all the 5 cases. The only thing that I have changed then was the number of epochs: 50 and 200, and the dataset, varying between CIFAR-10 and CIFAR-100

Here are the 5 commands, that I've used to run the 5 different methods (they are also mentioned in the script_train.sh file that I've created)

- ! python simclr_module.py –batch_size=256 –dataset="cifar10" –fast_dev_run=0 –gpus=1 –gamma=1 –jitter_strength=0.5 –loss_type="spectral" –max_epochs=50 –optimizer="lars" –online_ft (SimCLR)
- ! python simclr_module.py –batch_size=256 –dataset="cifar10" –fast_dev_run=0 –gpus=1 –gamma=1 –jitter_strength=0.5 –loss_type="origin" –max_epochs=50 –optimizer="lars" –online_ft (Laplacian Kernel)

- ! python simclr_module.py –batch_size=256 –dataset="cifar10" –fast_dev_run=0 –gpus=1 –gamma=0.5 –jitter_strength=0.5 –loss_type="origin" –max_epochs=50 –optimizer="lars" –online_ft (Exponential Kernel)
- ! python simclr_module.py –batch_size=256 –dataset="cifar10" –fast_dev_run=0 –gpus=1 –gamma=1 –jitter_strength=0.5 –loss_type="sum" –max_epochs=50 –optimizer="lars" –online_ft (Simple Sum Kernel)
- ! python simclr_module.py –batch_size=256 –dataset="cifar10" –fast_dev_run=0 –gpus=1 –gamma=1 –jitter_strength=0.5 –loss_type="product" –max_epochs=50 –optimizer="lars" –online_ft (Concatenation Sum Kernel)

As an explicit example, this one below could be used to obtain the results for 50 epochs for the Laplacian Kernel, on the dataset CIFAR-10:

[ ]:
```
! python simclr_module.py --batch_size=256 --dataset="cifar10" --fast_dev_run=0␣
↪--gpus=1 --gamma=1 --jitter_strength=0.5 --loss_type="origin"␣
↪--max_epochs=50 --optimizer="lars" --online_ft
```

The results I obtained, I saved under the folders "results_50epochs" and "results_200epochs", which are provided in the project. Below I'm demonstrating the results of the train and validation accuracy for these results.

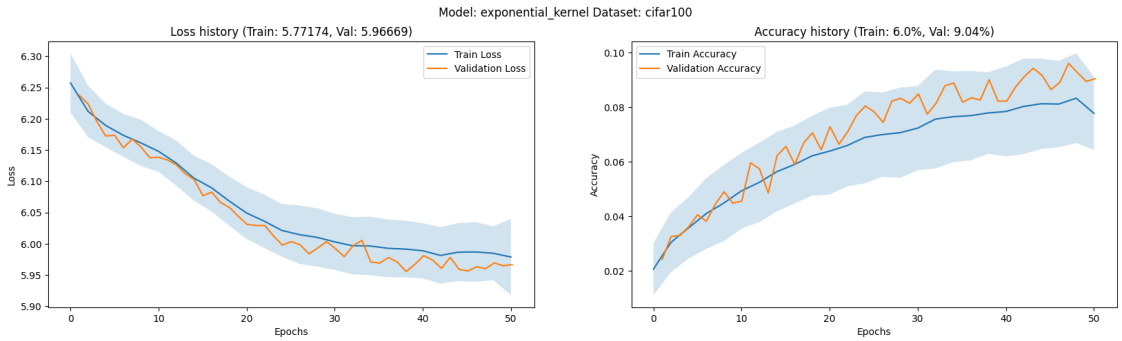
[1]:
```
%load_ext autoreload
%autoreload 2

from visualisation_utils import plot_all_results
```

4 Training 50 epochs

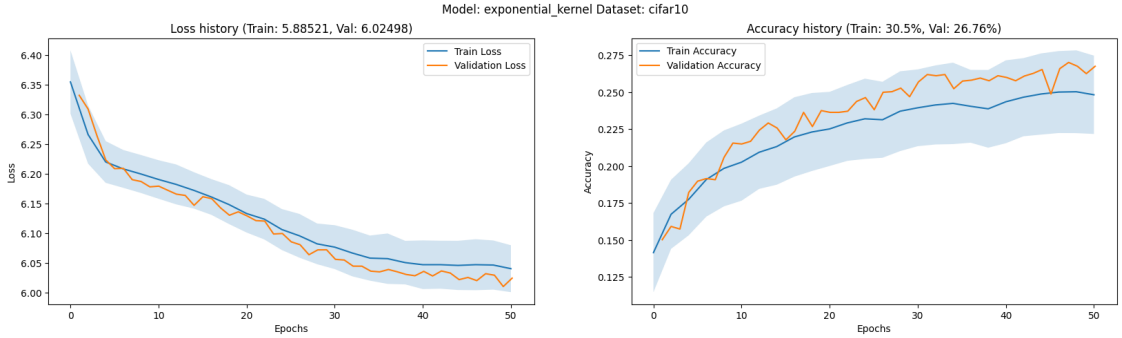
[2]:
```
results = plot_all_results(results_path='results_50epochs', results=[])
```

```
exponential_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
'online_val_loss'])
```

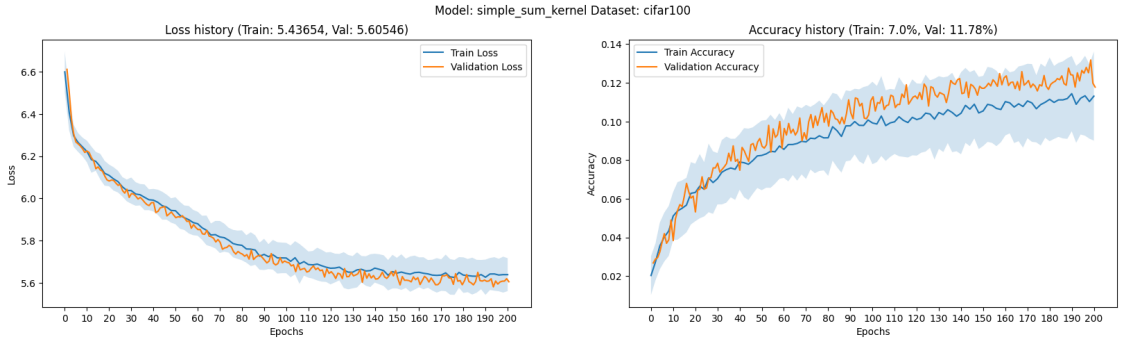



```
exponential_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
```

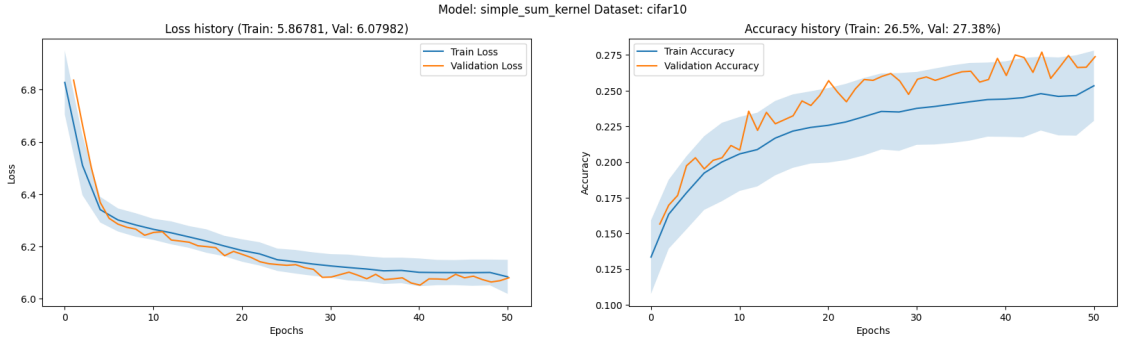
'online_val_loss'])



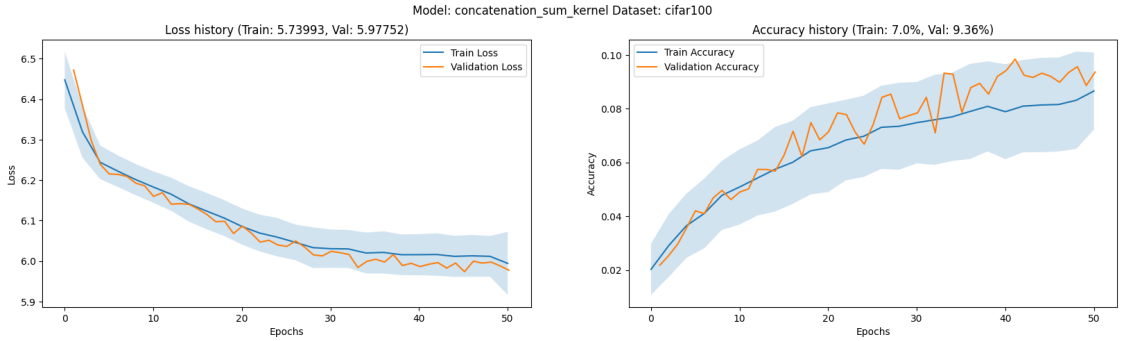
simple_sum_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



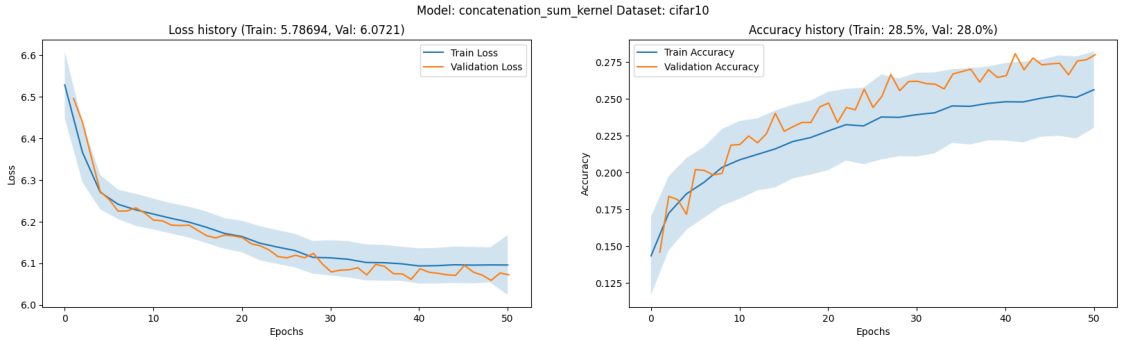
simple_sum_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



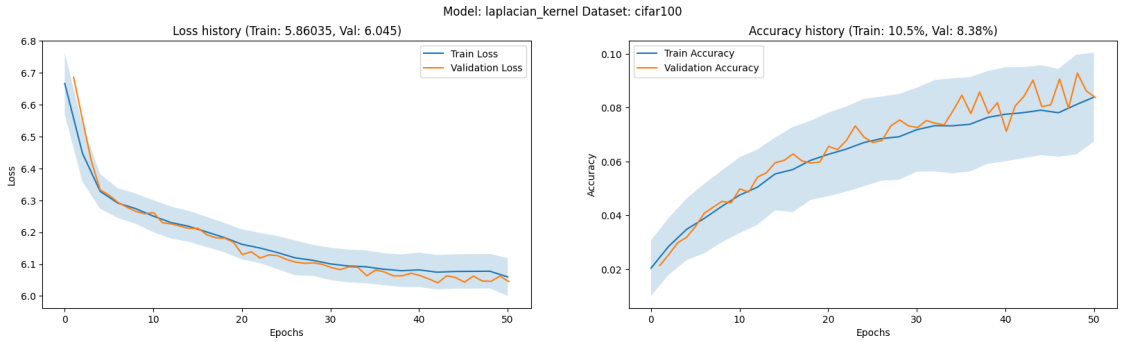
concatenation_sum_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



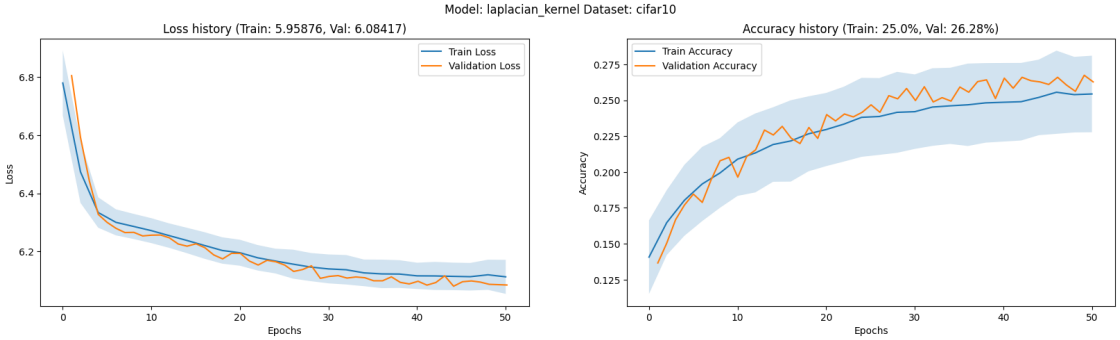
concatenation_sum_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



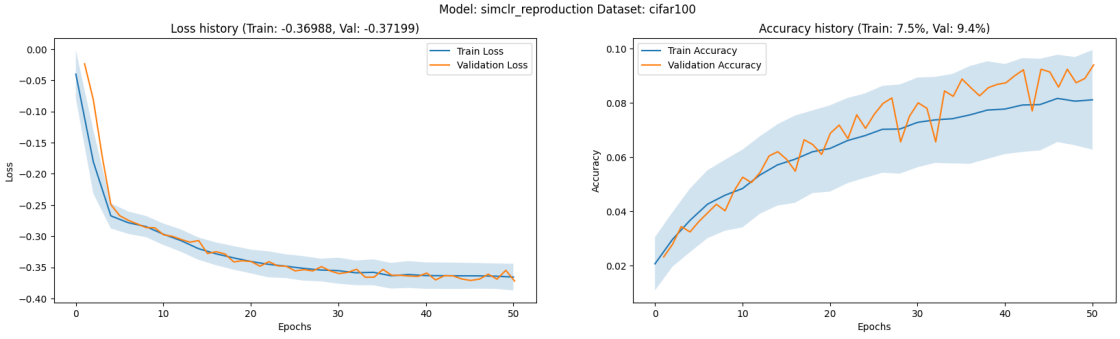
laplacian_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



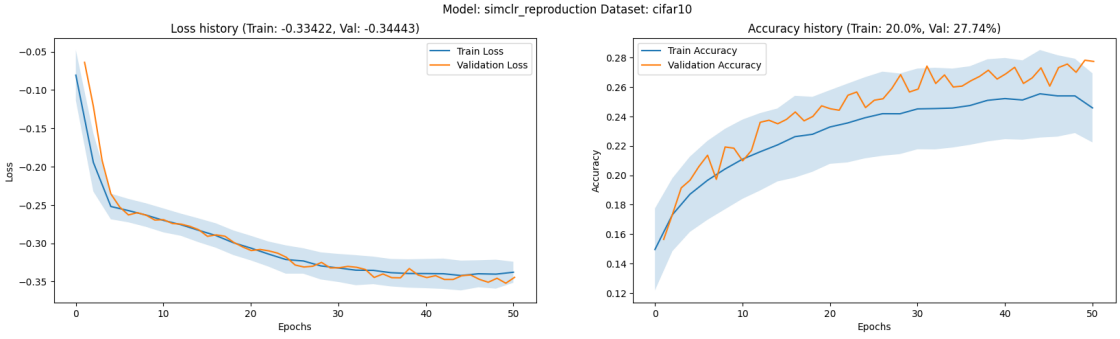
laplacian_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



simclr_reproduction cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



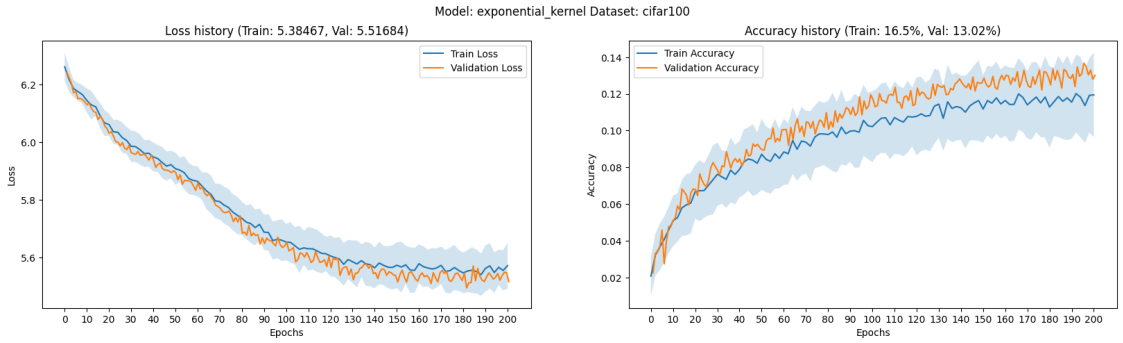
simclr_reproduction cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



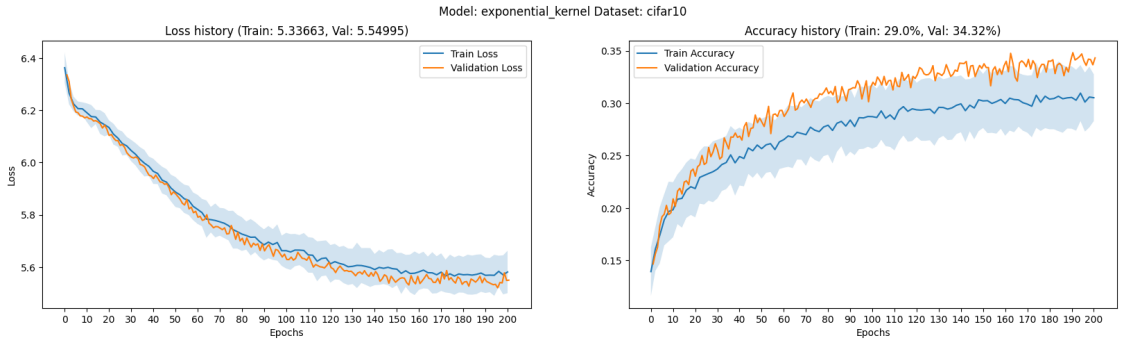
5 Training 200 epochs

[3]:
```
results = plot_all_results(results_path='results_200epochs', results=results)
```

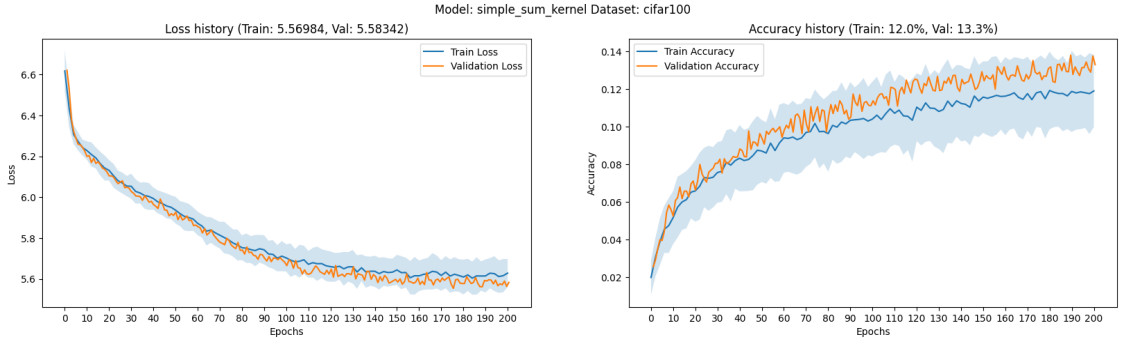
```
exponential_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
'online_val_loss'])
```



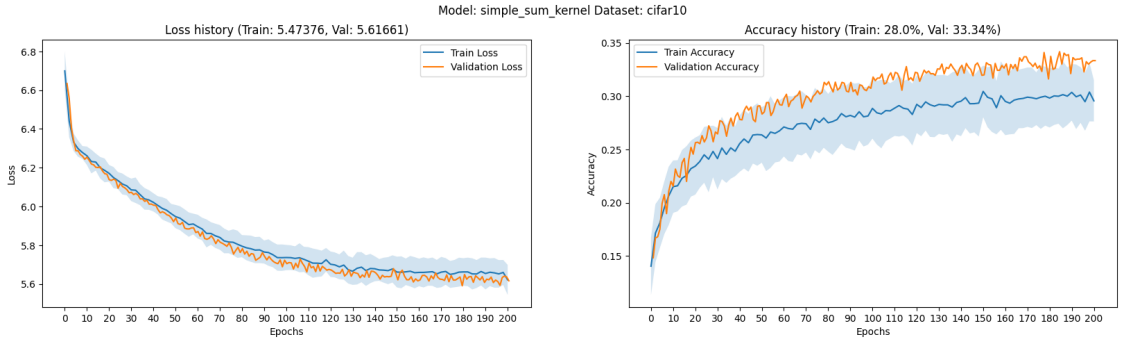

```
exponential_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
'online_val_loss'])
```



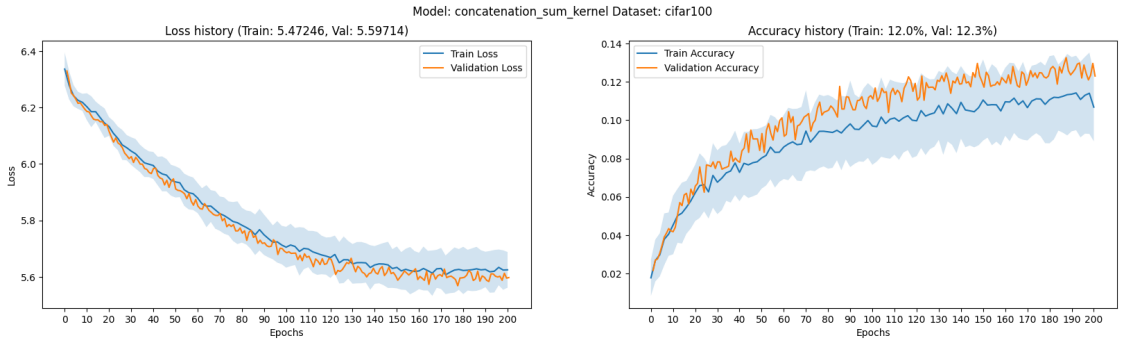

```
simple_sum_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
'online_val_loss'])
```



simple_sum_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])

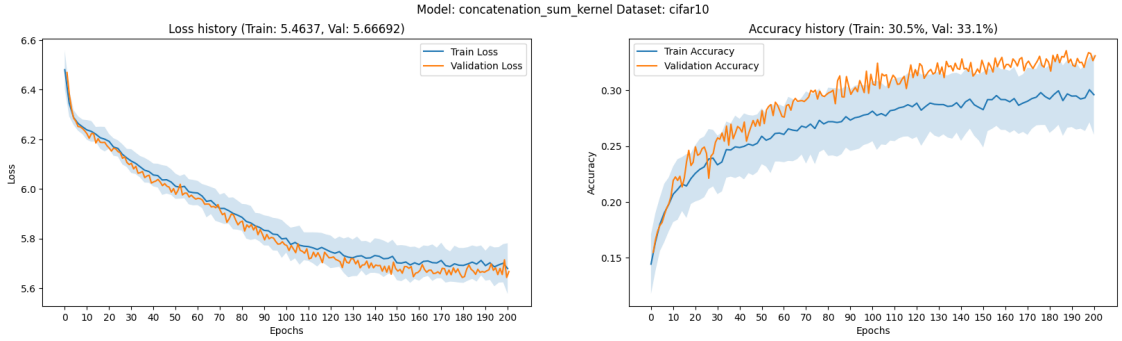


concatenation_sum_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])

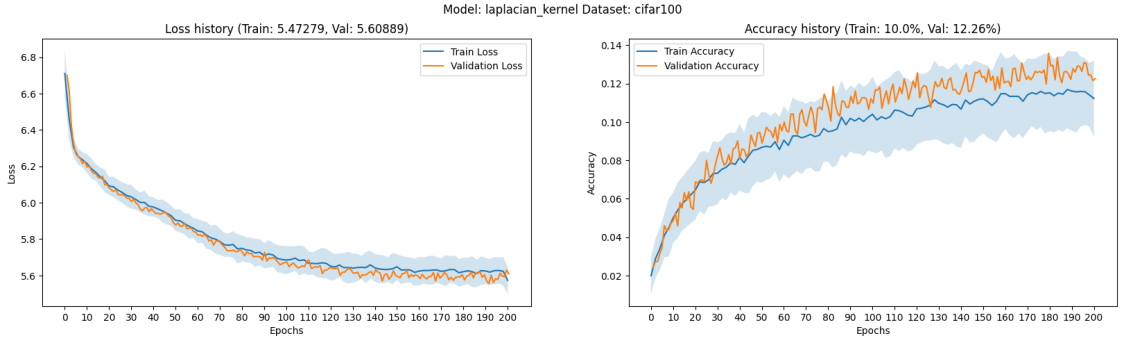


concatenation_sum_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss',

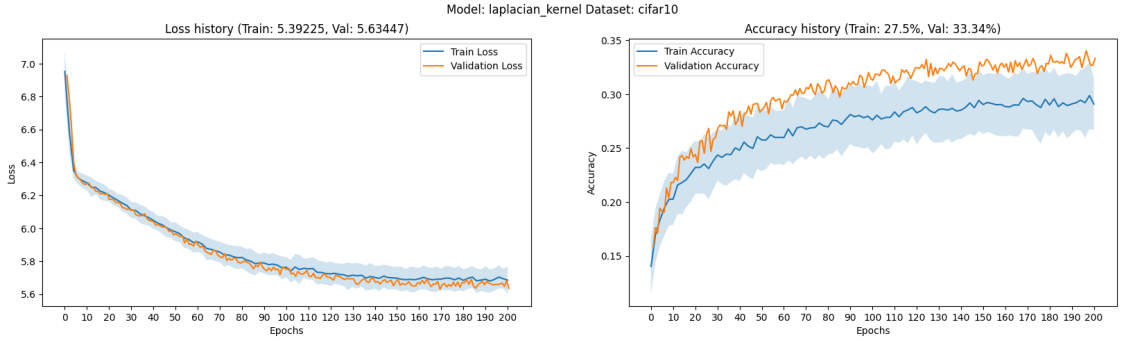
'online_val_acc', 'online_val_loss'])



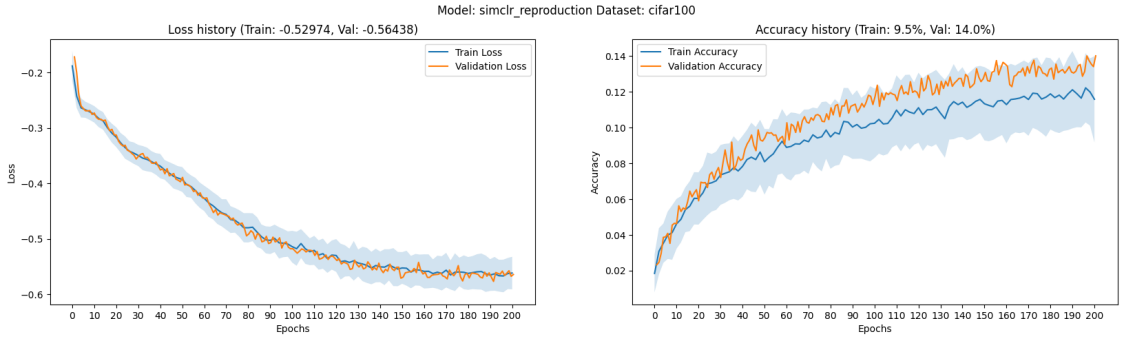
laplacian_kernel cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



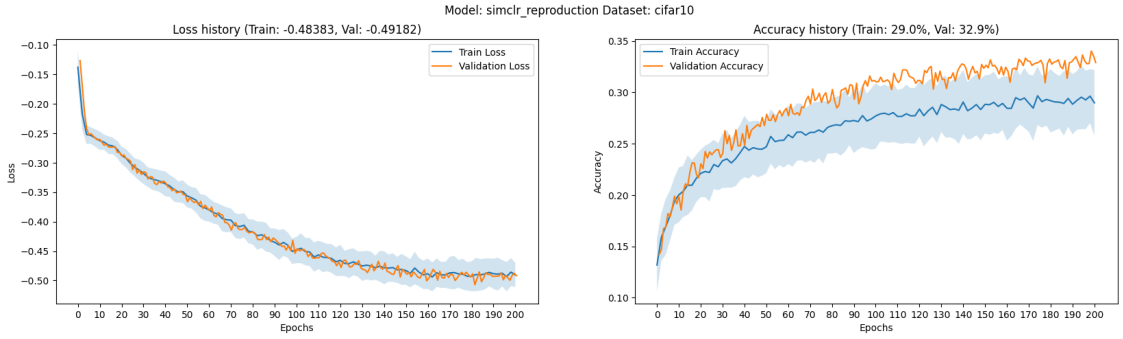
laplacian_kernel cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss', 'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc', 'online_val_loss'])



```
simclr_reproduction cifar100 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
'online_val_loss'])
```




```
simclr_reproduction cifar10 dict_keys(['hp_metric', 'lr-LARS', 'train_loss',
'online_train_acc', 'online_train_loss', 'epoch', 'val_loss', 'online_val_acc',
'online_val_loss'])
```



6 Results Summary

Below we can see the reproduction of the Table 1 from page 9 of the research paper:

[5]:
```
import pandas as pd
pd.DataFrame(results).pivot_table(
    index=['experiment_name'],
    columns=['dataset', 'epochs'],
    values='last_val_acc'
)[[
    ('cifar10',  '50epochs'),
    ('cifar10', '200epochs'),
    ('cifar100',  '50epochs'),
    ('cifar100', '200epochs'),
```

```
]]
```

[5]:

dataset	cifar10		cifar100	
epochs	50epochs	200epochs	50epochs	200epochs
experiment_name				
concatenation_sum_kernel	28.00	33.10	9.36	12.30
exponential_kernel	26.76	34.32	9.04	13.02
laplacian_kernel	26.28	33.34	8.38	12.26
simclr_reproduction	27.74	32.90	9.40	14.00
simple_sum_kernel	27.38	33.34	11.78	13.30

The results presented in the table above unfortunately diverge heavily from the results presented in the paper "Contrastive Learning is Spectral Clustering on Similarity Graph". This can be explained by two major issues that I faced during running the reproduction code. First of all, as the random_search.py algorithm didn't work, I couldn't get the optimal hyperparameters to run the code properly and obtain reasonable results. To overcome this I have used the settings described above, which were the most accurate parameters that I could extract from the paper. Due to the lack of an exact documentation, what were the results of the random_search algorithm I had to use some default values that might have affected the final result. Secondly, I was struggling with the setup of the environment which might have as well influenced the results. Following the exact instructions in the Readme file wasn't helpful in setting up the environment and thus I needed to work around it, finding a way for the code to work. These two issues might have affected the results and that the accuracy turned out to be so low.

Similar to the findings in the paper, we can see that the Simple Sum Kernel has achieved the best average results, nevertheless here due to the very low results, it is very difficult to determine the best performance. We can only deduce that with a much better hyperparameter setting, the trend would possibly maintain while reaching much higher accuracies.

[ ]: