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CSCI496

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Code Changes

Major updates to program architecture

- functions -> 'Resources'
- notebooks dir.
- reports dir.
- bash script
- tossed scrap

```
glomerulus-lab
├── slow_feature_learning
│   ├── DatasetScratch.ipynb
│   ├── Untitled.ipynb
│   ├── a.out
│   ├── accuracy_metrics
│   ├── accuracy_metrics011
│   ├── accuracy_metrics012
│   ├── accuracy_metrics013
│   └── data
│       ├── 0_1
│       │   ├── accuracy_metrics
│       │   ├── reg_model.pt
│       │   └── slow_model.pt
│       ├── 2_7
│       │   ├── accuracy_metrics
│       │   ├── reg_model.pt
│       │   └── slow_model.pt
│       └── 8_9
│           ├── accuracy_metrics
│           ├── reg_model.pt
│           └── slow_model.pt
├── dataset
│   └── MNIST
│       └── raw
│           ├── t10k-images-idx3-ubyte
│           ├── t10k-images-idx3-ubyte.gz
│           ├── t10k-labels-idx1-ubyte
│           ├── t10k-labels-idx1-ubyte.gz
│           ├── train-images-idx3-ubyte
│           ├── train-images-idx3-ubyte.gz
│           ├── train-labels-idx1-ubyte
│           └── train-labels-idx1-ubyte.gz
├── exploratory.ipynb
├── kernel-alignment-scratch.ipynb
├── reg_model.pt
├── slow-feature-learning
├── slow_learning_rates.ipynb
├── slow_model.pt
├── src
│   ├── __pycache__
│   │   ├── network.cpython-39.pyc
│   │   └── network_functions.cpython-39.pyc
│   ├── dataset
│   │   └── MNIST
│   │       └── raw
│   │           ├── t10k-images-idx3-ubyte
│   │           ├── t10k-images-idx3-ubyte.gz
│   │           ├── t10k-labels-idx1-ubyte
│   │           ├── t10k-labels-idx1-ubyte.gz
│   │           ├── train-images-idx3-ubyte
│   │           ├── train-images-idx3-ubyte.gz
│   │           ├── train-labels-idx1-ubyte
│   │           └── train-labels-idx1-ubyte.gz
│   ├── job.sh
│   ├── main.py
│   ├── models
│   ├── network.py
│   ├── network_functions.py
│   ├── r69.json
│   └── s69.json
```



```
glomerulus-lab
├── slow_feature_learning
│   ├── notebooks
│   │   ├── exploratory.ipynb
│   │   ├── mse_loss_test.ipynb
│   │   └── plotting.ipynb
│   └── src
│       ├── dataset
│       │   └── MNIST
│       │       └── raw
│       │           ├── t10k-images-idx3-ubyte
│       │           ├── t10k-images-idx3-ubyte.gz
│       │           ├── t10k-labels-idx1-ubyte
│       │           ├── t10k-labels-idx1-ubyte.gz
│       │           ├── train-images-idx3-ubyte
│       │           ├── train-images-idx3-ubyte.gz
│       │           ├── train-labels-idx1-ubyte
│       │           └── train-labels-idx1-ubyte.gz
│       ├── job.sh
│       ├── main.py
│       ├── models
│       ├── records
│       │   ├── r01.json
│       │   ├── r27.json
│       │   ├── r89.json
│       │   ├── s01.json
│       │   ├── s27.json
│       │   └── s89.json
│       └── resources
│           ├── __init__.py
│           ├── __pycache__
│           │   ├── __init__.cpython-310.pyc
│           │   ├── __init__.cpython-39.pyc
│           │   ├── cka_functions.cpython-39.pyc
│           │   ├── kernel.cpython-39.pyc
│           │   ├── mnist_loader.cpython-39.pyc
│           │   ├── network.cpython-310.pyc
│           │   └── network.cpython-39.pyc
│           ├── kernel.py
│           ├── mnist_loader.py
│           └── network.py
```

Code Changes

src

- 'dataset' contains MNIST data
- 'job.sh' -> bash-script for running multi. models
- 'records' contains past models data
- 'resources' contains functions used in main.py

```
src
├── dataset
│   └── MNIST
│       └── raw
│           ├── t10k-images-idx3-ubyte
│           ├── t10k-images-idx3-ubyte.gz
│           ├── t10k-labels-idx1-ubyte
│           ├── t10k-labels-idx1-ubyte.gz
│           ├── train-images-idx3-ubyte
│           ├── train-images-idx3-ubyte.gz
│           ├── train-labels-idx1-ubyte
│           └── train-labels-idx1-ubyte.gz
├── job.sh
├── main.py
├── models
├── records
│   ├── r01.json
│   ├── r27.json
│   ├── r89.json
│   ├── s01.json
│   ├── s27.json
│   └── s89.json
├── resources
│   ├── __init__.py
│   ├── __pycache__
│   │   ├── __init__.cpython-310.pyc
│   │   ├── __init__.cpython-39.pyc
│   │   ├── cka_functions.cpython-39.pyc
│   │   ├── kernel.cpython-39.pyc
│   │   ├── mnist_loader.cpython-39.pyc
│   │   ├── network.cpython-310.pyc
│   │   └── network.cpython-39.pyc
├── kernel.py
├── mnist_loader.py
└── network.py
```

Code Changes

MSE implementation

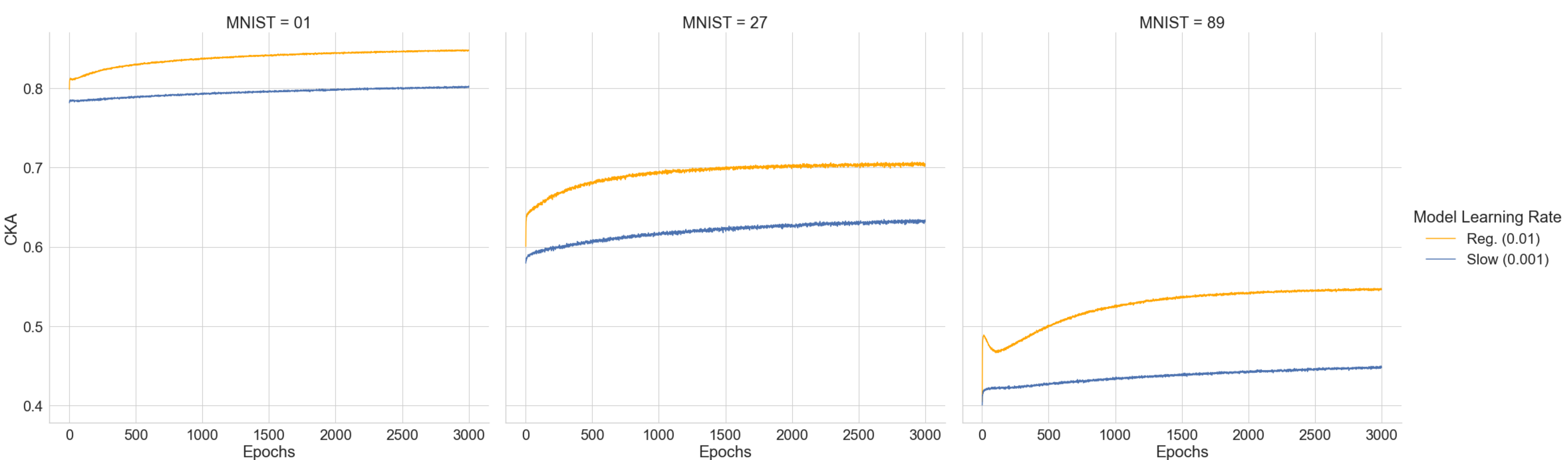
changed previous

‘classify_targets’ to

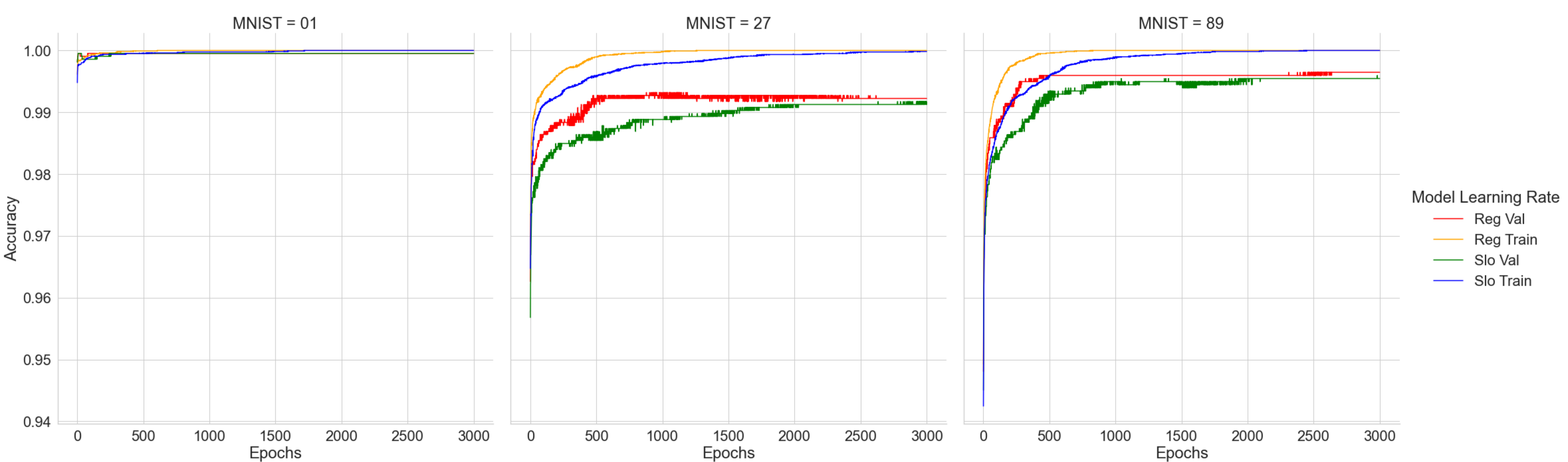
‘one_hot’.

```
40
41 def train_one_epoch(self, loader, loss_function, optimizer, record=True):
42
43     # Array of centered kernel analysis.
44     cka = torch.zeros(len(loader))
45
46     for i, (data, targets) in enumerate(loader):
47         data = data.reshape(data.shape[0], -1).to(device=self.device)
48         targets = targets.to(torch.float32).to(device=self.device)
49
50         # Forwards pass.
51         scores = self(data)
52
53         labels = one_hot(targets.long() % len(self.values)).to(torch.float32)
54         output = loss_function(scores, labels)
55
56         # Backwards Pass.
57         optimizer.zero_grad()
58         output.backward()
59
60         # Step.
61         optimizer.step()
62
63         # Recording the C.K.A. for the batch index.
64         if record:
65             cka[i] = kernel_calc(self.device, targets, self.features(data).to(device=self.device))
66
67     # Returning the C.K.A. if the option to record was chosen.
68     if record:
69         return cka
```

Plots



- 89 has hardest time achieving high CKA, followed by 27 then 01.
- Slow learning achieves lower CKA/epoch and converges slower.
- 01 grows the least but follows a similar pattern to 27
- 89 drops for 100 Epochs before CKA starts to increase then follows same pattern.



- 01 appears to be the easiest to predict, while 27 is the hardest.
- 01 also achieves near perfect accuracy very fast