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For each of the sections below, your reported test accuracy should approximately match the accuracy reported on Kaggle.

Briefly describe the hyperparameter tuning strategies you used in this assignment. Then record your optimal hyperparameters and test/val performance for the four different network types.

NOTE**: I forgot to keep precise track of the various hyperparameters I have altered and modified that got me the result of my Kaggle score, thus I readjusted and wrote the report.

Two-layer Network Trained with SGD

Best hyperparameters (if you changed any of the other default hyperparameters like initialization method, etc. please note that as well):

- *The two-layered SGD network's increased significantly when I increased hidden size to 120 from the default value. Also, changes to learning rates, regularization coefficient caused major difference between results but the strategies of learning rate – decay was the one I spent the most time on. I tried decay by accuracy, where the decrease of validation accuracy compared to previous epoch which did not turn out successfully and constant decrease per 5 epoch, which also did not turn out well. I decided that percentage decrease every epoch yielded the best results. I wanted to see how the learning rate decayed thus I created a list to keep track of the learning rates. The number of iteration is reduced to 40 as it most often plateaus from near 35+~*

Batch size:	200
Learning rate:	0.05
Hidden layer size:	120
Regularization coefficient:	0.0004
Learning rate decay rate:	0.85
Epoch:	40

Record the results for your best hyperparameter setting below:

Validation accuracy:	0.523
Test accuracy:	0.5247

Three-layer Network Trained with SGD

Best hyperparameters (if you changed any of the other default hyperparameters like initialization method, etc. please note that as well):

- *The strategy was essentially the same for the two-layer SGD network. The hyperparameters that yielded the best results had lower regularization coefficients because they were fixed since the validation classification was decreasing. The number of iteration is reduced to 40 as it most often plateaus from near 35+~.*

Batch size:	200
Learning rate:	0.05
Hidden layer size:	120
Regularization coefficient:	0.0004
Learning rate decay rate:	0.85
Epoch:	40

Record the results for your best hyperparameter setting below:

Validation accuracy:	0.535
Test accuracy:	0.5288

Two-layer Network Trained with Adam

Best hyperparameters (if you changed any of the other default hyperparameters like initialization method, etc. please note that as well):

- *Training Network with Adam was different story than that of SGD update network. The update rule was different(exponential) and there were two additional hyperparameters to care about. The learning rate had to be lower due to possible overflow or infinite number. The Adam update, although very quick to converge at such high rates and accuracy, It is not exactly the most stable model. The number of iteration is reduced to 40 as it most often plateaus from near 35+~.*

Batch size:	200
Learning rate:	0.003
Hidden layer size:	120
Regularization coefficient:	0.0001
β_1	0.6
β_2	0.69
Learning rate decay rate:	0.85
Epoch:	40

Record the results for your best hyperparameter setting below:

Validation accuracy:	0.529
Test accuracy:	0.5058

Three-layer Network Trained with Adam

Best hyperparameters (if you changed any of the other default hyperparameters like initialization method, etc. please note that as well):

- *The notes are similar to those of the two-layered Adam network, although I have made changes to the regularization coefficient and the learning rate decreased significantly. This allowed the validation accuracy to get closer to the test accuracy. The number of iteration is reduced to 40 as it most often plateaus from near 35+~.*

Batch size:	200
Learning rate:	0.0003
Hidden layer size:	120
Regularization coefficient:	0.00001
β_1	0.7
β_2	0.79
Learning rate decay rate:	0.85
Epoch:	40

Record the results for your best hyperparameter setting below:

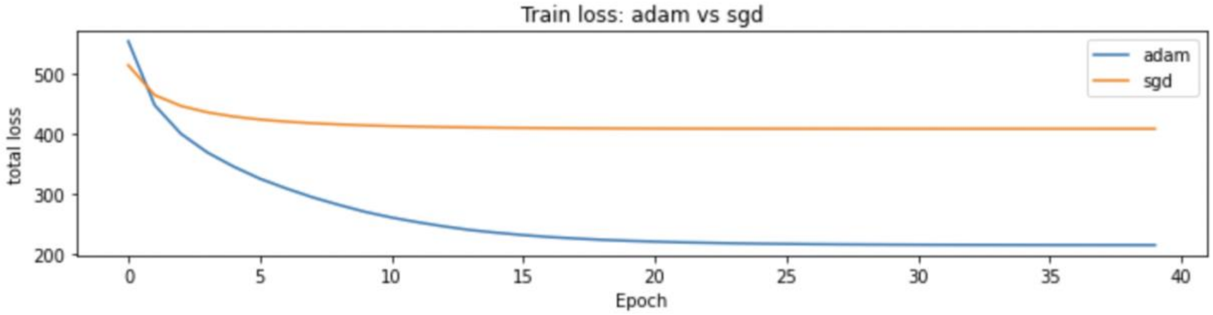
Validation accuracy:	0.526
Test accuracy:	0.5322

Comparison of SGD and Adam

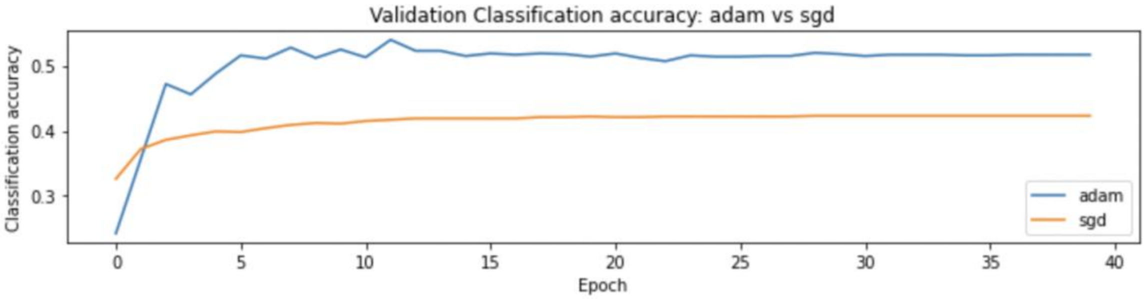
Attach two plots, one of the training loss for each epoch and one of the validation accuracy for each epoch. Both plots should have a line for SGD and Adam. Be sure to add a title, axis labels, and a legend.

Compare the performance of SGD and Adam on training times and convergence rates. Do you notice any difference? Note any other interesting behavior you observed as well.

The following comparison was done on 3-layered Adam and sgd. The hyperparameters were the same.



The train loss for Adam was much steeper for the Adam and it much lower than SGD model.



The validation accuracy for SGD rises little and slowly compared to the Adam, where it rises very steeply in the beginning and plateaus eventually. The validation accuracy for Adam rises to over 50% where as SGD with the same parameters rise barely over 40%.