Contents

PyTorch Scholarship

Challenge Project

Build and train a model that identifies flower species from images.

My name is Luciana and I'm taking part in the PyTorch Scholarship. This document gathers some information on the phases of my final project. I hope this document can contribute in some way.

This document is still in progress and is not the final document.
I also do not pretend to be correct at all points, this is just one way I have found to organize my material and share it with anyone who has an interest.

The project is broken down into multiple steps:

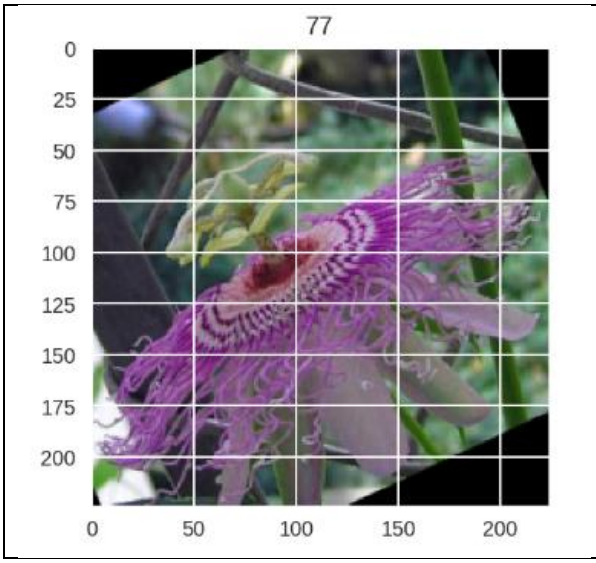
1. Load and preprocess the image dataset
2. Train the image classifier on your dataset
3. Use the trained classifier to predict image content

I am currently in phase 2. I am analyzing which is the best model. I'm also analyzing the performance of each optimizer within each model. This is not an easy task, at least for me. I chose 3 models and 6 optmizers.
All results have been collected and are available in this document.

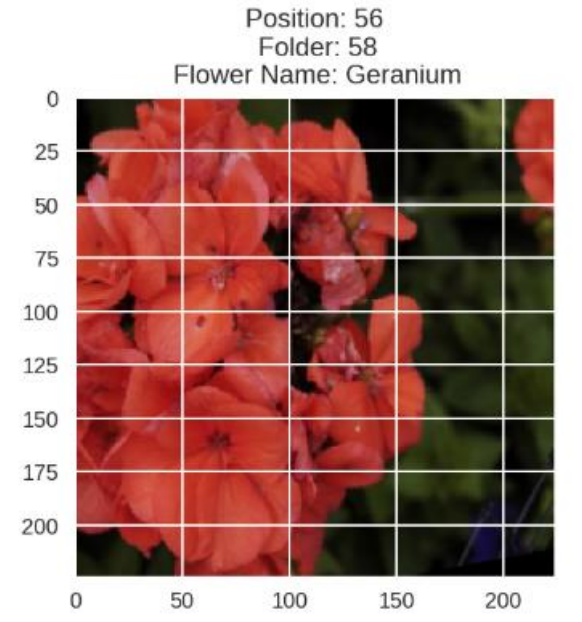
Load and preprocess the image dataset

The dataset is split into three parts, training, validation and testing. For the training, I applied transformations such as random scaling, cropping, and flipping. This will help the network generalize leading to better performance. I'll use a pre-trained network, the input data was resized to 224x224 pixels as required by the networks.
The validation set is used to measure the model's performance on data it hasn't seen yet. For this I didn't any scaling or rotation transformations, but I resized then crop the images to the appropriate size.
The pre-trained networks available from torchvision were trained on the ImageNet dataset where each color channel was normalized separately. For both sets I normalized the means and standard deviations of the images to what the network expects. For the means, it's [0.485, 0.456, 0.406] and for the standard deviations [0.229, 0.224, 0.225], calculated from the ImageNet images. These values will shift each color channel to be centered at 0 and range from -1 to 1.

Load the data

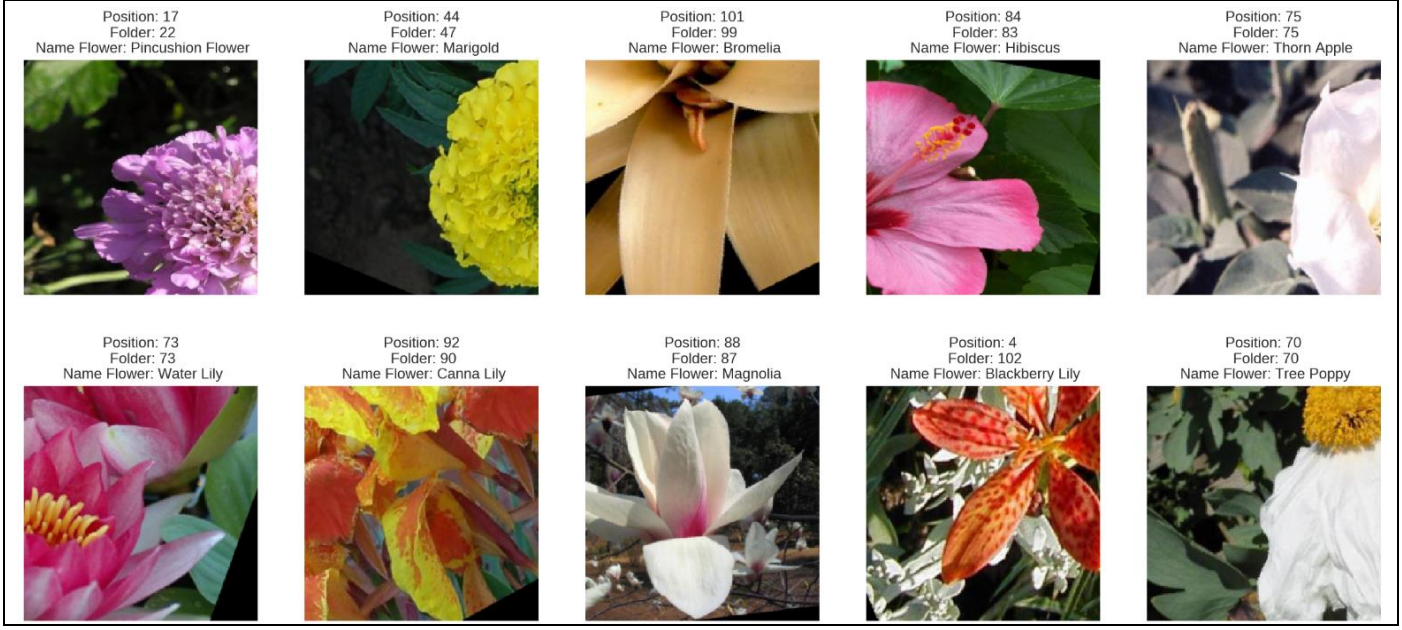
	At that moment I load the label of the image and in the title we can verify its position into dataloader. The number on the label is not the name of the folder where the figure is located. I'll deal with that next step.

Label mapping

	I loaded in a mapping from category label to category name. I used the file cat_to_name.json. It's a JSON object which you can read in with the json module. This given me a dictionary mapping the integer encoded categories to the actual names of the flowers.

Data validation

I have performed a validation between flower names, positions and correct labels.



Train the image classifier on your dataset

Before choosing my final model, I chose 3 models and 6 optimizers. I tested each optimizer with a specific model. Based on the data collected I will choose which model will be the best, optimizer. In addition, I will also increase the number of times so that I can achieve satisfactory results.

For these tests I have always performed 20 epochs. The tables below are the result of executions.

Models	Optimizers
Densenet121	Adam (Adam)
Densenet161	Adamax (Ad
Resnet152	Adadelta
	Adagrad
	SGD
	SGD + Momentum

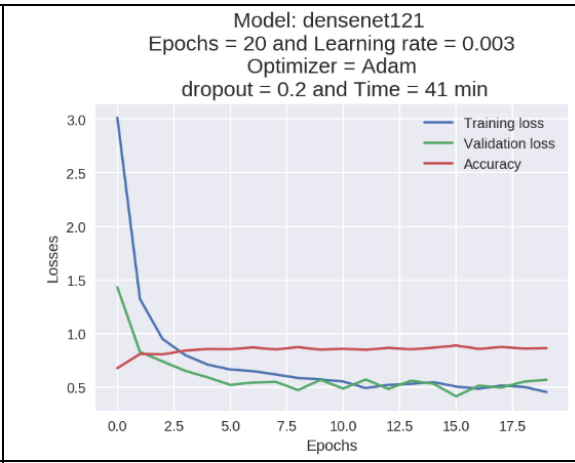
Abbreviations

Dropout	Drop	**Adam**	Adam
Criterion	Criter	**Adamax**	Adamax
Optimizer	optm	**Adadelta**	Delta
Learning Rate	lr	**Adagrad**	Grad*
Scheduler	sche	**SGD**	SGD
Epoch	Ep	**Momentum**	SGD + Momentum
Training Loss	T_L		
Validation Loss	V_L		
Accuracy	AC		

Densenet121

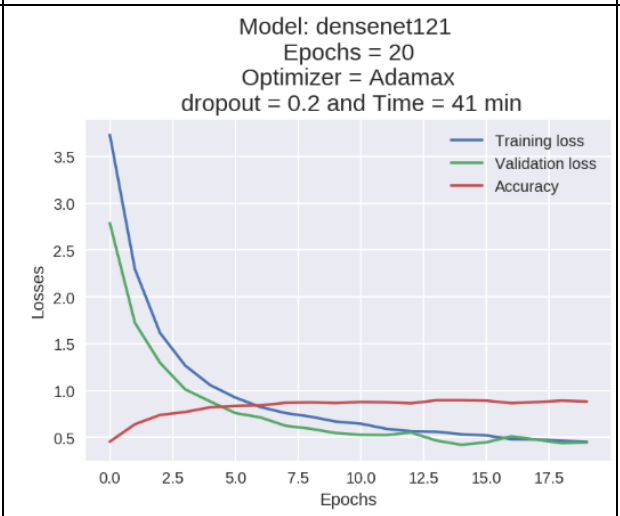
	in	ou	in	ou	drop	criter	optm	lr	sche	ep	T_L	V_L	AC
1	1024	256	256	102	0.2	NLLLOS	Adam	0.003	Step()	20	0,455	0,569	86
2	1024	256	256	102	0.2	NLLLOS	ADAMax	Default	Step()	20	0.453	0.443	88
3	1024	256	256	102	0.2	NLLLOS	Delta	Default	Step()	20	0.405	0.465	87
4	1024	256	256	102	0.2	NLLLOS	Grad*	Default	Step()	20	0,74	0.69	84
5	1024	256	256	102	0.2	NLLLOS	SGD	0.1	Step()	20	0.41	0.44	89
6	1024	256	256	102	0.2	NLLLOS	mometu	0.1-0.9	Step()	20	0.73	0.59	88

1



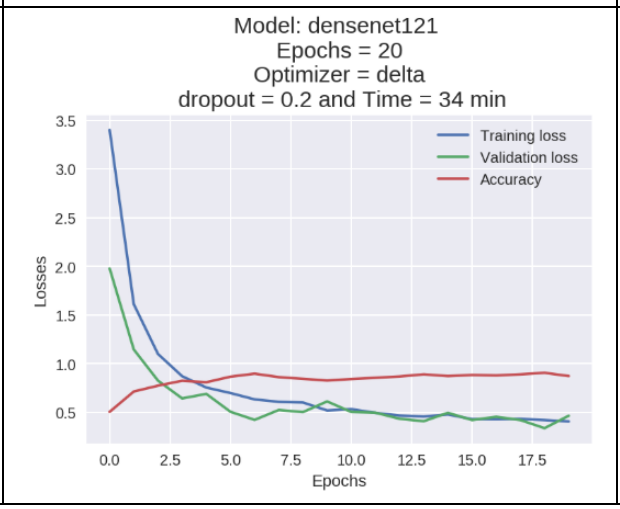

```
Epoch 1/20.. Train loss: 3.012.. Valid loss: 1.431.. Accuracy: 67.718 %
Epoch 2/20.. Train loss: 1.323.. Valid loss: 0.830.. Accuracy: 80.923 %
Epoch 3/20.. Train loss: 0.950.. Valid loss: 0.740.. Accuracy: 80.562 %
Epoch 4/20.. Train loss: 0.799.. Valid loss: 0.653.. Accuracy: 84.107 %
Epoch 5/20.. Train loss: 0.710.. Valid loss: 0.592.. Accuracy: 85.566 %
Epoch 6/20.. Train loss: 0.665.. Valid loss: 0.522.. Accuracy: 85.451 %
Epoch 7/20.. Train loss: 0.650.. Valid loss: 0.543.. Accuracy: 87.041 %
Epoch 8/20.. Train loss: 0.619.. Valid loss: 0.551.. Accuracy: 85.206 %
Epoch 9/20.. Train loss: 0.586.. Valid loss: 0.473.. Accuracy: 87.281 %
Epoch 10/20.. Train loss: 0.572.. Valid loss: 0.568.. Accuracy: 84.964 %
Epoch 11/20.. Train loss: 0.553.. Valid loss: 0.487.. Accuracy: 85.817 %
Epoch 12/20.. Train loss: 0.491.. Valid loss: 0.571.. Accuracy: 84.835 %
Epoch 13/20.. Train loss: 0.522.. Valid loss: 0.483.. Accuracy: 86.669 %
Epoch 14/20.. Train loss: 0.530.. Valid loss: 0.560.. Accuracy: 85.332 %
Epoch 15/20.. Train loss: 0.547.. Valid loss: 0.532.. Accuracy: 86.793 %
Epoch 16/20.. Train loss: 0.506.. Valid loss: 0.414.. Accuracy: 88.862 %
Epoch 17/20.. Train loss: 0.485.. Valid loss: 0.514.. Accuracy: 85.693 %
Epoch 18/20.. Train loss: 0.515.. Valid loss: 0.497.. Accuracy: 87.405 %
Epoch 19/20.. Train loss: 0.503.. Valid loss: 0.551.. Accuracy: 86.055 %
Epoch 20/20.. Train loss: 0.455.. Valid loss: 0.569.. Accuracy: 86.425 %
```

2

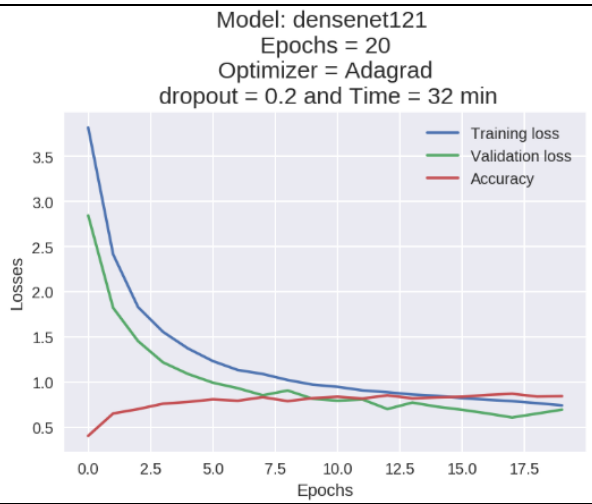
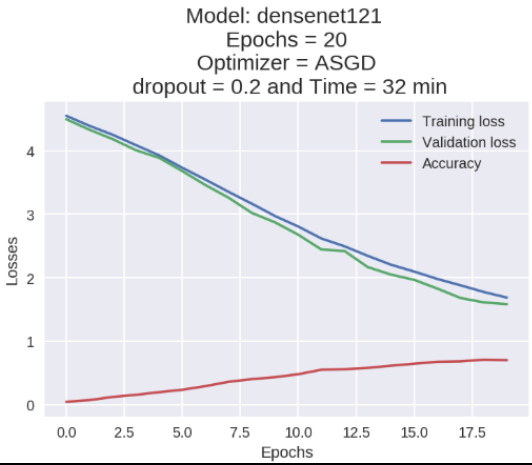
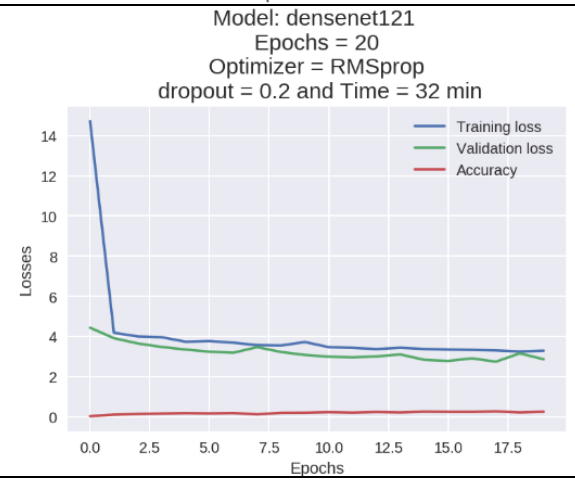


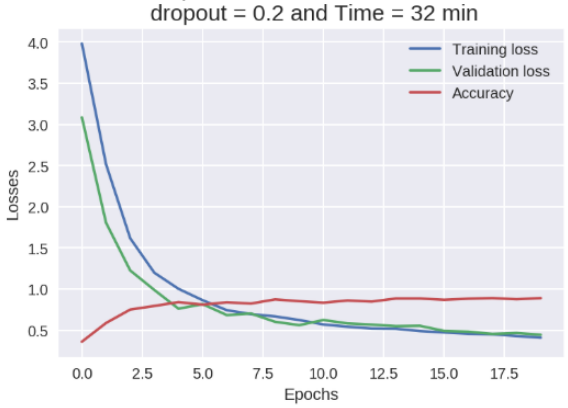
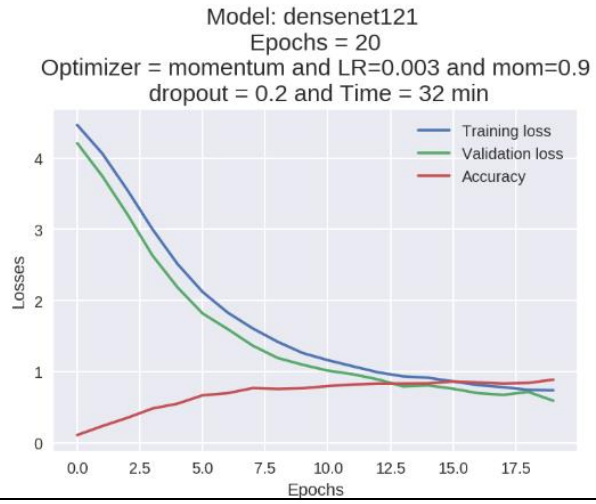

```
Epoch 1/20.. Train loss: 3.731.. Valid loss: 2.788.. Accuracy: 45.345 %
Epoch 2/20.. Train loss: 2.296.. Valid loss: 1.722.. Accuracy: 63.922 %
Epoch 3/20.. Train loss: 1.615.. Valid loss: 1.296.. Accuracy: 73.827 %
Epoch 4/20.. Train loss: 1.267.. Valid loss: 1.012.. Accuracy: 77.004 %
Epoch 5/20.. Train loss: 1.057.. Valid loss: 0.882.. Accuracy: 82.032 %
Epoch 6/20.. Train loss: 0.924.. Valid loss: 0.758.. Accuracy: 83.492 %
Epoch 7/20.. Train loss: 0.823.. Valid loss: 0.712.. Accuracy: 84.109 %
Epoch 8/20.. Train loss: 0.759.. Valid loss: 0.623.. Accuracy: 86.804 %
Epoch 9/20.. Train loss: 0.720.. Valid loss: 0.591.. Accuracy: 87.279 %
Epoch 10/20.. Train loss: 0.668.. Valid loss: 0.545.. Accuracy: 86.550 %
Epoch 11/20.. Train loss: 0.645.. Valid loss: 0.527.. Accuracy: 87.767 %
Epoch 12/20.. Train loss: 0.591.. Valid loss: 0.524.. Accuracy: 87.401 %
Epoch 13/20.. Train loss: 0.564.. Valid loss: 0.551.. Accuracy: 86.299 %
Epoch 14/20.. Train loss: 0.559.. Valid loss: 0.465.. Accuracy: 89.476 %
Epoch 15/20.. Train loss: 0.532.. Valid loss: 0.420.. Accuracy: 89.483 %
Epoch 16/20.. Train loss: 0.520.. Valid loss: 0.446.. Accuracy: 89.118 %
Epoch 17/20.. Train loss: 0.479.. Valid loss: 0.510.. Accuracy: 86.427 %
Epoch 18/20.. Train loss: 0.478.. Valid loss: 0.474.. Accuracy: 87.641 %
Epoch 19/20.. Train loss: 0.462.. Valid loss: 0.438.. Accuracy: 89.111 %
Epoch 20/20.. Train loss: 0.453.. Valid loss: 0.443.. Accuracy: 88.257 %
```

3



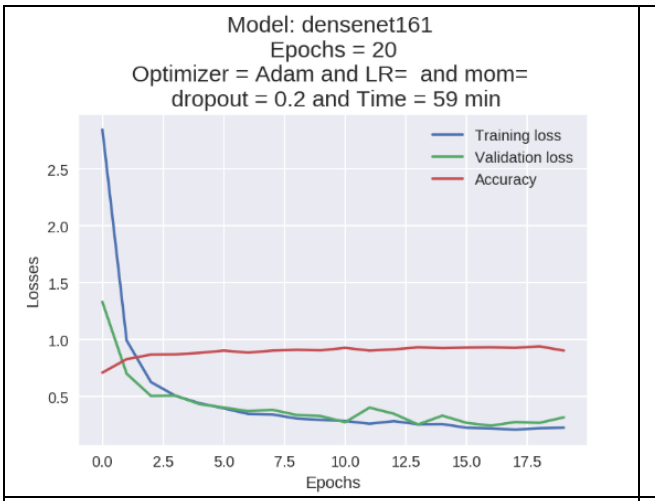

```
Epoch 1/20.. Train loss: 3.400.. Valid loss: 1.977.. Accuracy: 50.442 %
Epoch 2/20.. Train loss: 1.610.. Valid loss: 1.145.. Accuracy: 71.341 %
Epoch 3/20.. Train loss: 1.099.. Valid loss: 0.825.. Accuracy: 77.328 %
Epoch 4/20.. Train loss: 0.871.. Valid loss: 0.643.. Accuracy: 82.359 %
Epoch 5/20.. Train loss: 0.754.. Valid loss: 0.689.. Accuracy: 80.825 %
Epoch 6/20.. Train loss: 0.697.. Valid loss: 0.505.. Accuracy: 86.564 %
Epoch 7/20.. Train loss: 0.633.. Valid loss: 0.422.. Accuracy: 89.656 %
Epoch 8/20.. Train loss: 0.607.. Valid loss: 0.524.. Accuracy: 86.115 %
Epoch 9/20.. Train loss: 0.600.. Valid loss: 0.502.. Accuracy: 84.361 %
Epoch 10/20.. Train loss: 0.519.. Valid loss: 0.611.. Accuracy: 82.598 %
Epoch 11/20.. Train loss: 0.532.. Valid loss: 0.503.. Accuracy: 84.137 %
Epoch 12/20.. Train loss: 0.494.. Valid loss: 0.496.. Accuracy: 85.460 %
Epoch 13/20.. Train loss: 0.467.. Valid loss: 0.433.. Accuracy: 86.779 %
Epoch 14/20.. Train loss: 0.456.. Valid loss: 0.408.. Accuracy: 88.991 %
Epoch 15/20.. Train loss: 0.477.. Valid loss: 0.495.. Accuracy: 87.199 %
Epoch 16/20.. Train loss: 0.429.. Valid loss: 0.420.. Accuracy: 88.317 %
Epoch 17/20.. Train loss: 0.428.. Valid loss: 0.453.. Accuracy: 87.878 %
Epoch 18/20.. Train loss: 0.431.. Valid loss: 0.420.. Accuracy: 88.982 %
Epoch 19/20.. Train loss: 0.420.. Valid loss: 0.337.. Accuracy: 90.530 %
Epoch 20/20.. Train loss: 0.405.. Valid loss: 0.465.. Accuracy: 87.223 %
```

4		Epoch 1/20.. Train loss: 3.816.. Valid loss: 2.845.. Accuracy: 40.718 % Epoch 2/20.. Train loss: 2.414.. Valid loss: 1.823.. Accuracy: 65.411 % Epoch 3/20.. Train loss: 1.830.. Valid loss: 1.455.. Accuracy: 70.261 % Epoch 4/20.. Train loss: 1.557.. Valid loss: 1.219.. Accuracy: 76.210 % Epoch 5/20.. Train loss: 1.374.. Valid loss: 1.092.. Accuracy: 78.203 % Epoch 6/20.. Train loss: 1.234.. Valid loss: 0.995.. Accuracy: 81.045 % Epoch 7/20.. Train loss: 1.135.. Valid loss: 0.933.. Accuracy: 79.512 % Epoch 8/20.. Train loss: 1.091.. Valid loss: 0.856.. Accuracy: 83.477 % Epoch 9/20.. Train loss: 1.024.. Valid loss: 0.908.. Accuracy: 79.062 % Epoch 10/20.. Train loss: 0.973.. Valid loss: 0.817.. Accuracy: 82.383 % Epoch 11/20.. Train loss: 0.949.. Valid loss: 0.796.. Accuracy: 83.922 % Epoch 12/20.. Train loss: 0.910.. Valid loss: 0.810.. Accuracy: 81.939 % Epoch 13/20.. Train loss: 0.889.. Valid loss: 0.703.. Accuracy: 85.470 % Epoch 14/20.. Train loss: 0.864.. Valid loss: 0.775.. Accuracy: 82.154 % Epoch 15/20.. Train loss: 0.849.. Valid loss: 0.729.. Accuracy: 83.263 % Epoch 16/20.. Train loss: 0.825.. Valid loss: 0.695.. Accuracy: 83.917 % Epoch 17/20.. Train loss: 0.806.. Valid loss: 0.655.. Accuracy: 85.900 % Epoch 18/20.. Train loss: 0.791.. Valid loss: 0.610.. Accuracy: 87.233 % Epoch 19/20.. Train loss: 0.768.. Valid loss: 0.653.. Accuracy: 84.137 % Epoch 20/20.. Train loss: 0.744.. Valid loss: 0.697.. Accuracy: 84.571 %
5		Epoch 1/20.. Train loss: 4.547.. Valid loss: 4.494.. Accuracy: 4.615 % Epoch 2/20.. Train loss: 4.390.. Valid loss: 4.329.. Accuracy: 7.287 % Epoch 3/20.. Train loss: 4.250.. Valid loss: 4.181.. Accuracy: 12.327 % Epoch 4/20.. Train loss: 4.087.. Valid loss: 4.007.. Accuracy: 15.634 % Epoch 5/20.. Train loss: 3.926.. Valid loss: 3.887.. Accuracy: 19.810 % Epoch 6/20.. Train loss: 3.730.. Valid loss: 3.678.. Accuracy: 23.565 % Epoch 7/20.. Train loss: 3.543.. Valid loss: 3.458.. Accuracy: 29.280 % Epoch 8/20.. Train loss: 3.351.. Valid loss: 3.258.. Accuracy: 36.117 % Epoch 9/20.. Train loss: 3.165.. Valid loss: 3.020.. Accuracy: 40.313 % Epoch 10/20.. Train loss: 2.971.. Valid loss: 2.871.. Accuracy: 43.380 % Epoch 11/20.. Train loss: 2.806.. Valid loss: 2.677.. Accuracy: 48.020 % Epoch 12/20.. Train loss: 2.617.. Valid loss: 2.444.. Accuracy: 55.092 % Epoch 13/20.. Train loss: 2.494.. Valid loss: 2.420.. Accuracy: 55.951 % Epoch 14/20.. Train loss: 2.344.. Valid loss: 2.166.. Accuracy: 57.939 % Epoch 15/20.. Train loss: 2.205.. Valid loss: 2.049.. Accuracy: 61.446 % Epoch 16/20.. Train loss: 2.096.. Valid loss: 1.967.. Accuracy: 64.542 % Epoch 17/20.. Train loss: 1.980.. Valid loss: 1.828.. Accuracy: 67.619 % Epoch 18/20.. Train loss: 1.880.. Valid loss: 1.680.. Accuracy: 68.264 % Epoch 19/20.. Train loss: 1.776.. Valid loss: 1.612.. Accuracy: 70.911 % Epoch 20/20.. Train loss: 1.687.. Valid loss: 1.583.. Accuracy: 70.256 %
6		Epoch 1/20.. Train loss: 14.714.. Valid loss: 4.435.. Accuracy: 3.521 % Epoch 2/20.. Train loss: 4.183.. Valid loss: 3.915.. Accuracy: 10.779 % Epoch 3/20.. Train loss: 4.001.. Valid loss: 3.651.. Accuracy: 14.100 % Epoch 4/20.. Train loss: 3.962.. Valid loss: 3.477.. Accuracy: 16.303 % Epoch 5/20.. Train loss: 3.737.. Valid loss: 3.348.. Accuracy: 18.271 % Epoch 6/20.. Train loss: 3.772.. Valid loss: 3.241.. Accuracy: 16.957 % Epoch 7/20.. Train loss: 3.688.. Valid loss: 3.189.. Accuracy: 18.730 % Epoch 8/20.. Train loss: 3.567.. Valid loss: 3.469.. Accuracy: 12.322 % Epoch 9/20.. Train loss: 3.550.. Valid loss: 3.227.. Accuracy: 19.819 % Epoch 10/20.. Train loss: 3.722.. Valid loss: 3.079.. Accuracy: 20.259 % Epoch 11/20.. Train loss: 3.467.. Valid loss: 2.992.. Accuracy: 22.930 % Epoch 12/20.. Train loss: 3.433.. Valid loss: 2.958.. Accuracy: 20.689 % Epoch 13/20.. Train loss: 3.372.. Valid loss: 3.008.. Accuracy: 23.785 % Epoch 14/20.. Train loss: 3.437.. Valid loss: 3.103.. Accuracy: 21.587 % Epoch 15/20.. Train loss: 3.376.. Valid loss: 2.837.. Accuracy: 25.778 % Epoch 16/20.. Train loss: 3.348.. Valid loss: 2.782.. Accuracy: 24.645 % Epoch 17/20.. Train loss: 3.331.. Valid loss: 2.910.. Accuracy: 24.464 % Epoch 18/20.. Train loss: 3.304.. Valid loss: 2.744.. Accuracy: 27.111 % Epoch 19/20.. Train loss: 3.252.. Valid loss: 3.159.. Accuracy: 21.587 % Epoch 20/20.. Train loss: 3.291.. Valid loss: 2.863.. Accuracy: 25.343 %
7	No chart	Epoch 1/20.. Train loss: 7.817.. Valid loss: 30.383.. Accuracy: 34.564 % Epoch 2/20.. Train loss: 48.008.. Valid loss: 65.565.. Accuracy: 40.542 % Epoch 3/20.. Train loss: 67.238.. Valid loss: 80.634.. Accuracy: 40.982 % Epoch 4/20.. Train loss: 76.630.. Valid loss: 82.879.. Accuracy: 41.197 % Epoch 5/20.. Train loss: 82.678.. Valid loss: 105.945.. Accuracy: 41.192 % Epoch 6/20.. Train loss: 85.732.. Valid loss: 89.668.. Accuracy: 40.063 % Epoch 7/20.. Train loss: 86.748.. Valid loss: 89.907.. Accuracy: 44.288 % Epoch 8/20.. Train loss: 85.358.. Valid loss: 105.959.. Accuracy: 40.088 % Epoch 9/20.. Train loss: 86.921.. Valid loss: 83.314.. Accuracy: 40.537 % Epoch 10/20.. Train loss: 85.498.. Valid loss: 83.496.. Accuracy: 47.360 % Epoch 11/20.. Train loss: 87.174.. Valid loss: 110.002.. Accuracy: 42.061 % Epoch 12/20.. Train loss: 85.830.. Valid loss: 96.102.. Accuracy: 39.419 % Epoch 13/20.. Train loss: 84.732.. Valid loss: 90.097.. Accuracy: 38.969 % Epoch 14/20.. Train loss: 87.181.. Valid loss: 77.324.. Accuracy: 39.868 % Epoch 15/20.. Train loss: 81.524.. Valid loss: 103.380.. Accuracy: 38.999 % Epoch 16/20.. Train loss: 86.837.. Valid loss: 78.206.. Accuracy: 42.315 % Epoch 17/20.. Train loss: 82.688.. Valid loss: 96.874.. Accuracy: 36.127 % Epoch 18/20.. Train loss: 83.347.. Valid loss: 102.240.. Accuracy: 36.327 % Epoch 19/20.. Train loss: 81.867.. Valid loss: 80.665.. Accuracy: 37.031 % Epoch 20/20.. Train loss: 83.864.. Valid loss: 89.907.. Accuracy: 37.875 %

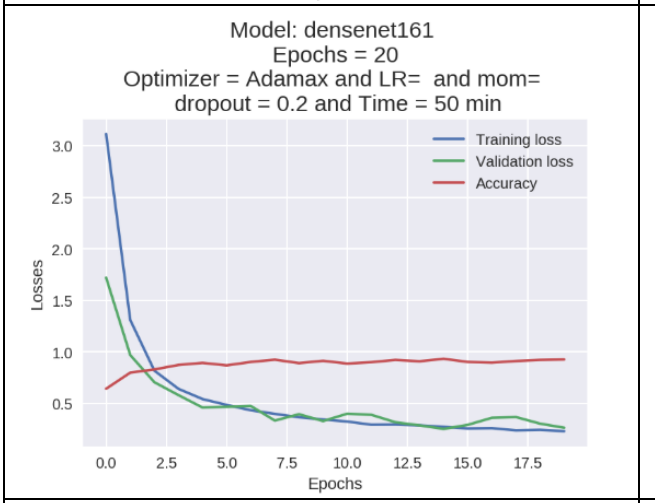
8		Epoch 1/20.. Train loss: 3.980.. Valid loss: 3.084.. Accuracy: 36.127 % Epoch 2/20.. Train loss: 2.514.. Valid loss: 1.804.. Accuracy: 58.823 % Epoch 3/20.. Train loss: 1.617.. Valid loss: 1.226.. Accuracy: 75.121 % Epoch 4/20.. Train loss: 1.198.. Valid loss: 0.989.. Accuracy: 79.521 % Epoch 5/20.. Train loss: 1.003.. Valid loss: 0.762.. Accuracy: 84.151 % Epoch 6/20.. Train loss: 0.865.. Valid loss: 0.817.. Accuracy: 81.060 % Epoch 7/20.. Train loss: 0.744.. Valid loss: 0.684.. Accuracy: 83.917 % Epoch 8/20.. Train loss: 0.696.. Valid loss: 0.703.. Accuracy: 82.364 % Epoch 9/20.. Train loss: 0.668.. Valid loss: 0.602.. Accuracy: 87.453 % Epoch 10/20.. Train loss: 0.624.. Valid loss: 0.562.. Accuracy: 85.245 % Epoch 11/20.. Train loss: 0.570.. Valid loss: 0.624.. Accuracy: 83.468 % Epoch 12/20.. Train loss: 0.543.. Valid loss: 0.583.. Accuracy: 86.120 % Epoch 13/20.. Train loss: 0.521.. Valid loss: 0.568.. Accuracy: 84.801 % Epoch 14/20.. Train loss: 0.519.. Valid loss: 0.550.. Accuracy: 88.552 % Epoch 15/20.. Train loss: 0.490.. Valid loss: 0.554.. Accuracy: 88.557 % Epoch 16/20.. Train loss: 0.474.. Valid loss: 0.492.. Accuracy: 87.004 % Epoch 17/20.. Train loss: 0.458.. Valid loss: 0.483.. Accuracy: 88.327 % Epoch 18/20.. Train loss: 0.451.. Valid loss: 0.456.. Accuracy: 88.987 % Epoch 19/20.. Train loss: 0.430.. Valid loss: 0.467.. Accuracy: 87.678 % Epoch 20/20.. Train loss: 0.410.. Valid loss: 0.445.. Accuracy: 88.996 %
9		Epoch 1/20.. Train loss: 4.463.. Valid loss: 4.208.. Accuracy: 11.033 % Epoch 2/20.. Train loss: 4.063.. Valid loss: 3.746.. Accuracy: 23.585 % Epoch 3/20.. Train loss: 3.550.. Valid loss: 3.210.. Accuracy: 35.248 % Epoch 4/20.. Train loss: 3.001.. Valid loss: 2.631.. Accuracy: 48.230 % Epoch 5/20.. Train loss: 2.513.. Valid loss: 2.184.. Accuracy: 55.067 % Epoch 6/20.. Train loss: 2.120.. Valid loss: 1.818.. Accuracy: 66.769 % Epoch 7/20.. Train loss: 1.830.. Valid loss: 1.599.. Accuracy: 69.802 % Epoch 8/20.. Train loss: 1.608.. Valid loss: 1.366.. Accuracy: 76.869 % Epoch 9/20.. Train loss: 1.419.. Valid loss: 1.192.. Accuracy: 75.785 % Epoch 10/20.. Train loss: 1.261.. Valid loss: 1.097.. Accuracy: 76.664 % Epoch 11/20.. Train loss: 1.161.. Valid loss: 1.014.. Accuracy: 79.741 % Epoch 12/20.. Train loss: 1.075.. Valid loss: 0.964.. Accuracy: 81.949 % Epoch 13/20.. Train loss: 0.991.. Valid loss: 0.891.. Accuracy: 83.253 % Epoch 14/20.. Train loss: 0.934.. Valid loss: 0.793.. Accuracy: 83.258 % Epoch 15/20.. Train loss: 0.915.. Valid loss: 0.807.. Accuracy: 83.477 % Epoch 16/20.. Train loss: 0.862.. Valid loss: 0.760.. Accuracy: 86.335 % Epoch 17/20.. Train loss: 0.812.. Valid loss: 0.698.. Accuracy: 84.791 % Epoch 18/20.. Train loss: 0.782.. Valid loss: 0.674.. Accuracy: 83.267 % Epoch 19/20.. Train loss: 0.745.. Valid loss: 0.716.. Accuracy: 84.142 % Epoch 20/20.. Train loss: 0.738.. Valid loss: 0.592.. Accuracy: 88.772 %

Densenet161

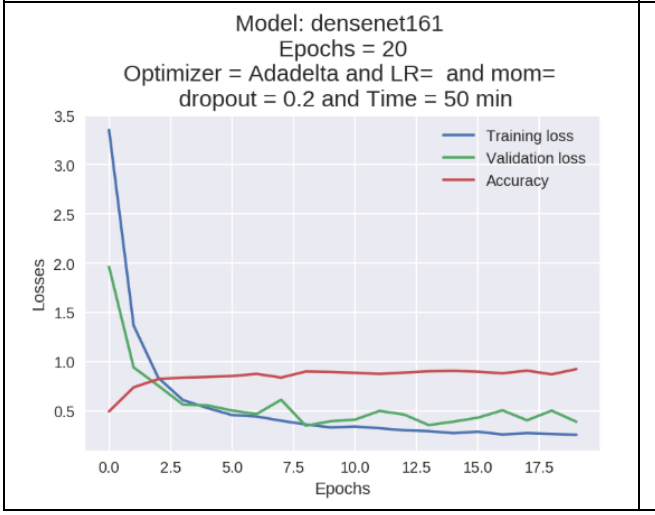
	in	ou	in	ou	drop	criter	optm	lr	sche	ep	T_L	V_L	AC
1	2208	256	256	102	0.2	NLLLOS	ADAM	Default	Step()	20	0,225	0,316	90
2	2208	256	256	102	0.2	NLLLOS	ADAMax	Default	Step()	20	0,232	0,265	92
3	2208	256	256	102	0.2	NLLLOS	Delta	Default	Step()	20	0,256	0,389	92
4	2208	256	256	102	0.2	NLLLOS	Grad	Default	Step()	20	0,401	0,508	87
5	2208	256	256	102	0.2	NLLLOS	SGD	0.1	Step()	20	1,280	1,228	81
6	2208	256	256	102	0.2	NLLLOS	mometu	0.1-0.9	Step()	20	0,262	0,311	91



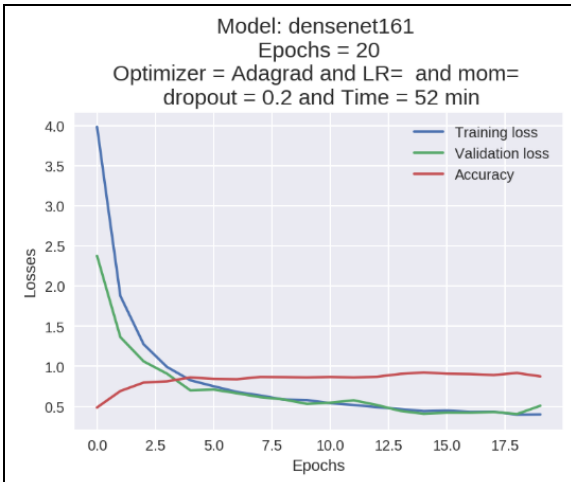

```
Epoch 1/20.. Train loss: 2.846.. Valid loss: 1.331.. Accuracy: 70.935 %
Epoch 2/20.. Train loss: 0.992.. Valid loss: 0.700.. Accuracy: 82.808 %
Epoch 3/20.. Train loss: 0.626.. Valid loss: 0.505.. Accuracy: 86.794 %
Epoch 4/20.. Train loss: 0.507.. Valid loss: 0.508.. Accuracy: 87.013 %
Epoch 5/20.. Train loss: 0.440.. Valid loss: 0.433.. Accuracy: 88.303 %
Epoch 6/20.. Train loss: 0.395.. Valid loss: 0.402.. Accuracy: 90.320 %
Epoch 7/20.. Train loss: 0.346.. Valid loss: 0.371.. Accuracy: 88.542 %
Epoch 8/20.. Train loss: 0.342.. Valid loss: 0.382.. Accuracy: 90.310 %
Epoch 9/20.. Train loss: 0.306.. Valid loss: 0.337.. Accuracy: 90.950 %
Epoch 10/20.. Train loss: 0.294.. Valid loss: 0.327.. Accuracy: 90.520 %
Epoch 11/20.. Train loss: 0.284.. Valid loss: 0.273.. Accuracy: 92.737 %
Epoch 12/20.. Train loss: 0.260.. Valid loss: 0.402.. Accuracy: 90.300 %
Epoch 13/20.. Train loss: 0.283.. Valid loss: 0.348.. Accuracy: 91.399 %
Epoch 14/20.. Train loss: 0.255.. Valid loss: 0.253.. Accuracy: 93.187 %
Epoch 15/20.. Train loss: 0.257.. Valid loss: 0.331.. Accuracy: 92.503 %
Epoch 16/20.. Train loss: 0.224.. Valid loss: 0.267.. Accuracy: 92.957 %
Epoch 17/20.. Train loss: 0.218.. Valid loss: 0.243.. Accuracy: 93.177 %
Epoch 18/20.. Train loss: 0.209.. Valid loss: 0.275.. Accuracy: 92.728 %
Epoch 19/20.. Train loss: 0.220.. Valid loss: 0.268.. Accuracy: 94.061 %
Epoch 20/20.. Train loss: 0.225.. Valid loss: 0.316.. Accuracy: 90.300 %
```



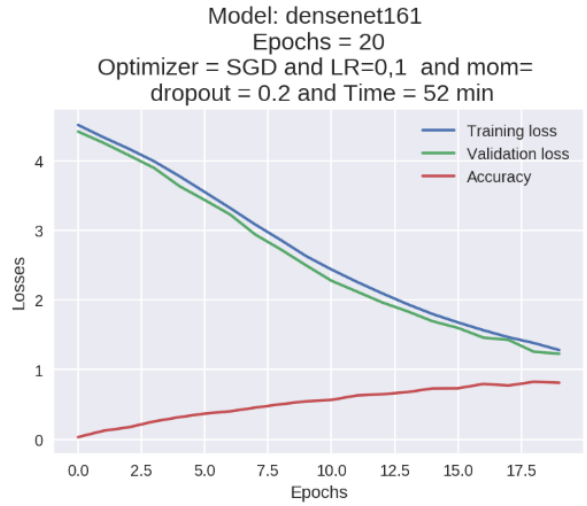

```
Epoch 1/20.. Train loss: 3.114.. Valid loss: 1.720.. Accuracy: 64.332 %
Epoch 2/20.. Train loss: 1.310.. Valid loss: 0.970.. Accuracy: 79.961 %
Epoch 3/20.. Train loss: 0.819.. Valid loss: 0.707.. Accuracy: 83.048 %
Epoch 4/20.. Train loss: 0.643.. Valid loss: 0.582.. Accuracy: 87.429 %
Epoch 5/20.. Train loss: 0.543.. Valid loss: 0.461.. Accuracy: 89.431 %
Epoch 6/20.. Train loss: 0.487.. Valid loss: 0.469.. Accuracy: 87.018 %
Epoch 7/20.. Train loss: 0.435.. Valid loss: 0.476.. Accuracy: 90.310 %
Epoch 8/20.. Train loss: 0.400.. Valid loss: 0.335.. Accuracy: 92.518 %
Epoch 9/20.. Train loss: 0.367.. Valid loss: 0.397.. Accuracy: 89.201 %
Epoch 10/20.. Train loss: 0.345.. Valid loss: 0.330.. Accuracy: 91.404 %
Epoch 11/20.. Train loss: 0.325.. Valid loss: 0.402.. Accuracy: 88.762 %
Epoch 12/20.. Train loss: 0.295.. Valid loss: 0.391.. Accuracy: 90.081 %
Epoch 13/20.. Train loss: 0.296.. Valid loss: 0.319.. Accuracy: 92.288 %
Epoch 14/20.. Train loss: 0.289.. Valid loss: 0.288.. Accuracy: 90.950 %
Epoch 15/20.. Train loss: 0.274.. Valid loss: 0.254.. Accuracy: 93.397 %
Epoch 16/20.. Train loss: 0.258.. Valid loss: 0.293.. Accuracy: 90.310 %
Epoch 17/20.. Train loss: 0.261.. Valid loss: 0.361.. Accuracy: 89.651 %
Epoch 18/20.. Train loss: 0.240.. Valid loss: 0.369.. Accuracy: 91.204 %
Epoch 19/20.. Train loss: 0.245.. Valid loss: 0.305.. Accuracy: 92.298 %
Epoch 20/20.. Train loss: 0.232.. Valid loss: 0.265.. Accuracy: 92.733 %
```



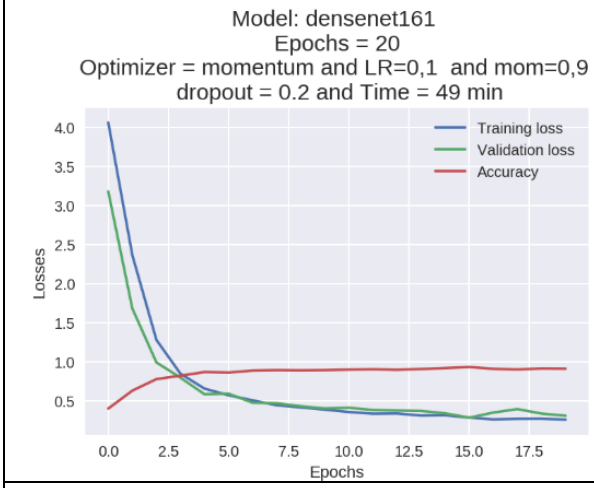

```
Epoch 1/20.. Train loss: 3.353.. Valid loss: 1.963.. Accuracy: 49.348 %
Epoch 2/20.. Train loss: 1.366.. Valid loss: 0.940.. Accuracy: 73.778 %
Epoch 3/20.. Train loss: 0.836.. Valid loss: 0.755.. Accuracy: 82.173 %
Epoch 4/20.. Train loss: 0.609.. Valid loss: 0.564.. Accuracy: 83.707 %
Epoch 5/20.. Train loss: 0.528.. Valid loss: 0.554.. Accuracy: 84.371 %
Epoch 6/20.. Train loss: 0.457.. Valid loss: 0.502.. Accuracy: 85.236 %
Epoch 7/20.. Train loss: 0.442.. Valid loss: 0.466.. Accuracy: 87.453 %
Epoch 8/20.. Train loss: 0.399.. Valid loss: 0.612.. Accuracy: 83.707 %
Epoch 9/20.. Train loss: 0.361.. Valid loss: 0.347.. Accuracy: 89.871 %
Epoch 10/20.. Train loss: 0.331.. Valid loss: 0.393.. Accuracy: 89.436 %
Epoch 11/20.. Train loss: 0.340.. Valid loss: 0.410.. Accuracy: 88.557 %
Epoch 12/20.. Train loss: 0.322.. Valid loss: 0.498.. Accuracy: 87.438 %
Epoch 13/20.. Train loss: 0.302.. Valid loss: 0.462.. Accuracy: 88.772 %
Epoch 14/20.. Train loss: 0.293.. Valid loss: 0.354.. Accuracy: 90.071 %
Epoch 15/20.. Train loss: 0.272.. Valid loss: 0.389.. Accuracy: 90.540 %
Epoch 16/20.. Train loss: 0.287.. Valid loss: 0.430.. Accuracy: 89.646 %
Epoch 17/20.. Train loss: 0.259.. Valid loss: 0.505.. Accuracy: 88.083 %
Epoch 18/20.. Train loss: 0.272.. Valid loss: 0.403.. Accuracy: 90.750 %
Epoch 19/20.. Train loss: 0.264.. Valid loss: 0.501.. Accuracy: 86.989 %
Epoch 20/20.. Train loss: 0.256.. Valid loss: 0.389.. Accuracy: 92.293 %
```




```
Epoch 1/20.. Train loss: 3.982.. Valid loss: 2.376.. Accuracy: 48.674 %
Epoch 2/20.. Train loss: 1.877.. Valid loss: 1.364.. Accuracy: 69.177 %
Epoch 3/20.. Train loss: 1.274.. Valid loss: 1.061.. Accuracy: 79.741 %
Epoch 4/20.. Train loss: 0.992.. Valid loss: 0.908.. Accuracy: 81.275 %
Epoch 5/20.. Train loss: 0.826.. Valid loss: 0.700.. Accuracy: 86.134 %
Epoch 6/20.. Train loss: 0.751.. Valid loss: 0.710.. Accuracy: 84.357 %
Epoch 7/20.. Train loss: 0.680.. Valid loss: 0.664.. Accuracy: 83.907 %
Epoch 8/20.. Train loss: 0.637.. Valid loss: 0.616.. Accuracy: 86.769 %
Epoch 9/20.. Train loss: 0.586.. Valid loss: 0.587.. Accuracy: 86.559 %
Epoch 10/20.. Train loss: 0.579.. Valid loss: 0.531.. Accuracy: 86.120 %
Epoch 11/20.. Train loss: 0.540.. Valid loss: 0.547.. Accuracy: 86.774 %
Epoch 12/20.. Train loss: 0.518.. Valid loss: 0.576.. Accuracy: 86.129 %
Epoch 13/20.. Train loss: 0.491.. Valid loss: 0.517.. Accuracy: 87.004 %
Epoch 14/20.. Train loss: 0.467.. Valid loss: 0.445.. Accuracy: 90.515 %
Epoch 15/20.. Train loss: 0.441.. Valid loss: 0.408.. Accuracy: 92.298 %
Epoch 16/20.. Train loss: 0.448.. Valid loss: 0.422.. Accuracy: 90.755 %
Epoch 17/20.. Train loss: 0.433.. Valid loss: 0.421.. Accuracy: 90.315 %
Epoch 18/20.. Train loss: 0.435.. Valid loss: 0.432.. Accuracy: 89.197 %
Epoch 19/20.. Train loss: 0.398.. Valid loss: 0.405.. Accuracy: 91.643 %
Epoch 20/20.. Train loss: 0.401.. Valid loss: 0.508.. Accuracy: 87.438 %
```



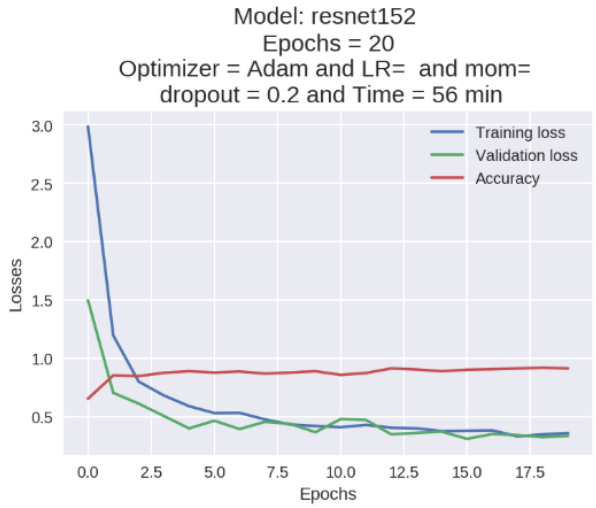

```
Epoch 1/20.. Train loss: 4.510.. Valid loss: 4.415.. Accuracy: 3.077 %
Epoch 2/20.. Train loss: 4.334.. Valid loss: 4.254.. Accuracy: 12.117 %
Epoch 3/20.. Train loss: 4.169.. Valid loss: 4.076.. Accuracy: 17.182 %
Epoch 4/20.. Train loss: 3.989.. Valid loss: 3.894.. Accuracy: 25.543 %
Epoch 5/20.. Train loss: 3.776.. Valid loss: 3.633.. Accuracy: 31.722 %
Epoch 6/20.. Train loss: 3.548.. Valid loss: 3.433.. Accuracy: 36.786 %
Epoch 7/20.. Train loss: 3.319.. Valid loss: 3.226.. Accuracy: 40.068 %
Epoch 8/20.. Train loss: 3.081.. Valid loss: 2.937.. Accuracy: 45.372 %
Epoch 9/20.. Train loss: 2.860.. Valid loss: 2.725.. Accuracy: 50.242 %
Epoch 10/20.. Train loss: 2.629.. Valid loss: 2.497.. Accuracy: 54.437 %
Epoch 11/20.. Train loss: 2.437.. Valid loss: 2.276.. Accuracy: 56.396 %
Epoch 12/20.. Train loss: 2.260.. Valid loss: 2.121.. Accuracy: 62.794 %
Epoch 13/20.. Train loss: 2.095.. Valid loss: 1.965.. Accuracy: 64.557 %
Epoch 14/20.. Train loss: 1.939.. Valid loss: 1.837.. Accuracy: 67.629 %
Epoch 15/20.. Train loss: 1.797.. Valid loss: 1.693.. Accuracy: 72.918 %
Epoch 16/20.. Train loss: 1.676.. Valid loss: 1.598.. Accuracy: 73.109 %
Epoch 17/20.. Train loss: 1.565.. Valid loss: 1.459.. Accuracy: 79.302 %
Epoch 18/20.. Train loss: 1.464.. Valid loss: 1.425.. Accuracy: 77.099 %
Epoch 19/20.. Train loss: 1.381.. Valid loss: 1.255.. Accuracy: 82.398 %
Epoch 20/20.. Train loss: 1.280.. Valid loss: 1.228.. Accuracy: 81.050 %
```



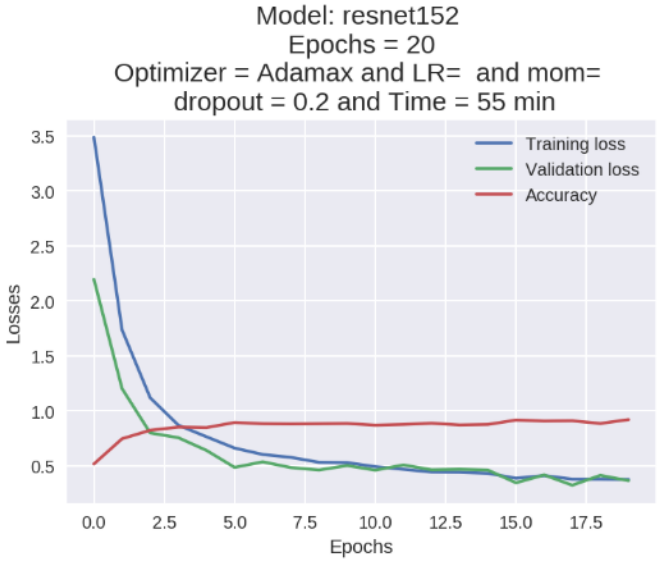

```
Epoch 1/20.. Train loss: 4.064.. Valid loss: 3.181.. Accuracy: 40.278 %
Epoch 2/20.. Train loss: 2.367.. Valid loss: 1.684.. Accuracy: 63.228 %
Epoch 3/20.. Train loss: 1.282.. Valid loss: 0.994.. Accuracy: 77.968 %
Epoch 4/20.. Train loss: 0.849.. Valid loss: 0.798.. Accuracy: 82.369 %
Epoch 5/20.. Train loss: 0.658.. Valid loss: 0.586.. Accuracy: 87.013 %
Epoch 6/20.. Train loss: 0.573.. Valid loss: 0.593.. Accuracy: 86.344 %
Epoch 7/20.. Train loss: 0.508.. Valid loss: 0.478.. Accuracy: 88.991 %
Epoch 8/20.. Train loss: 0.445.. Valid loss: 0.471.. Accuracy: 89.421 %
Epoch 9/20.. Train loss: 0.418.. Valid loss: 0.433.. Accuracy: 89.211 %
Epoch 10/20.. Train loss: 0.389.. Valid loss: 0.404.. Accuracy: 89.446 %
Epoch 11/20.. Train loss: 0.359.. Valid loss: 0.413.. Accuracy: 90.095 %
Epoch 12/20.. Train loss: 0.337.. Valid loss: 0.385.. Accuracy: 90.540 %
Epoch 13/20.. Train loss: 0.340.. Valid loss: 0.377.. Accuracy: 89.861 %
Epoch 14/20.. Train loss: 0.313.. Valid loss: 0.373.. Accuracy: 90.965 %
Epoch 15/20.. Train loss: 0.317.. Valid loss: 0.342.. Accuracy: 92.083 %
Epoch 16/20.. Train loss: 0.288.. Valid loss: 0.286.. Accuracy: 93.382 %
Epoch 17/20.. Train loss: 0.265.. Valid loss: 0.351.. Accuracy: 91.179 %
Epoch 18/20.. Train loss: 0.272.. Valid loss: 0.396.. Accuracy: 90.295 %
Epoch 19/20.. Train loss: 0.274.. Valid loss: 0.339.. Accuracy: 91.643 %
Epoch 20/20.. Train loss: 0.262.. Valid loss: 0.311.. Accuracy: 91.409 %
```

Resnet152

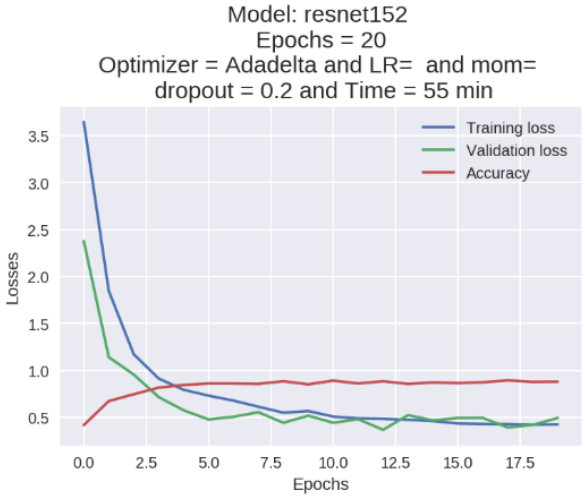
	in	ou	in	ou	drop	criter	optm	lr	sche	ep	T_L	V_L	AC
1	2048	256	256	102	0.2	NLLLOS	ADAM	Default	Step()	20	0,358	0,334	91
2	2048	256	256	102	0.2	NLLLOS	ADAMax	Default	Step()	20	0.377	0.365	92
3	2048	256	256	102	0.2	NLLLOS	Delta	Default	Step()	20	0.427	0.494	88
4	2048	256	256	102	0.2	NLLLOS	Grad	Default	Step()	20	0.565	0.444	89
5	2048	256	256	102	0.2	NLLLOS	SGD	0.1	Step()	20	1.380	1.234	79
6	2048	256	256	102	0.2	NLLLOS	mometu	0.1-0.9	Step()	20	0.338	0.381	90



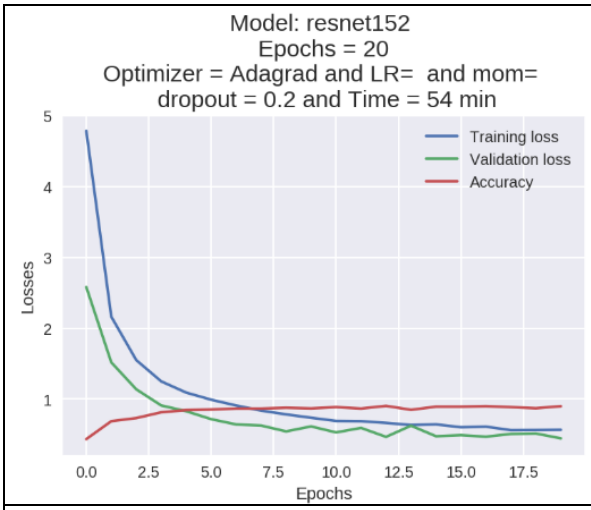

```
Epoch 1/20.. Train loss: 2.985.. Valid loss: 1.495.. Accuracy: 65.206 %
Epoch 2/20.. Train loss: 1.194.. Valid loss: 0.703.. Accuracy: 85.245 %
Epoch 3/20.. Train loss: 0.800.. Valid loss: 0.610.. Accuracy: 84.576 %
Epoch 4/20.. Train loss: 0.680.. Valid loss: 0.505.. Accuracy: 87.458 %
Epoch 5/20.. Train loss: 0.588.. Valid loss: 0.398.. Accuracy: 88.772 %
Epoch 6/20.. Train loss: 0.529.. Valid loss: 0.463.. Accuracy: 87.668 %
Epoch 7/20.. Train loss: 0.531.. Valid loss: 0.392.. Accuracy: 88.537 %
Epoch 8/20.. Train loss: 0.475.. Valid loss: 0.454.. Accuracy: 86.764 %
Epoch 9/20.. Train loss: 0.431.. Valid loss: 0.437.. Accuracy: 87.643 %
Epoch 10/20.. Train loss: 0.419.. Valid loss: 0.365.. Accuracy: 88.767 %
Epoch 11/20.. Train loss: 0.407.. Valid loss: 0.477.. Accuracy: 85.680 %
Epoch 12/20.. Train loss: 0.428.. Valid loss: 0.470.. Accuracy: 87.238 %
Epoch 13/20.. Train loss: 0.403.. Valid loss: 0.347.. Accuracy: 91.199 %
Epoch 14/20.. Train loss: 0.398.. Valid loss: 0.359.. Accuracy: 90.310 %
Epoch 15/20.. Train loss: 0.375.. Valid loss: 0.370.. Accuracy: 88.777 %
Epoch 16/20.. Train loss: 0.378.. Valid loss: 0.309.. Accuracy: 90.090 %
Epoch 17/20.. Train loss: 0.381.. Valid loss: 0.349.. Accuracy: 90.535 %
Epoch 18/20.. Train loss: 0.329.. Valid loss: 0.340.. Accuracy: 91.175 %
Epoch 19/20.. Train loss: 0.346.. Valid loss: 0.323.. Accuracy: 91.858 %
Epoch 20/20.. Train loss: 0.358.. Valid loss: 0.334.. Accuracy: 91.194 %
```



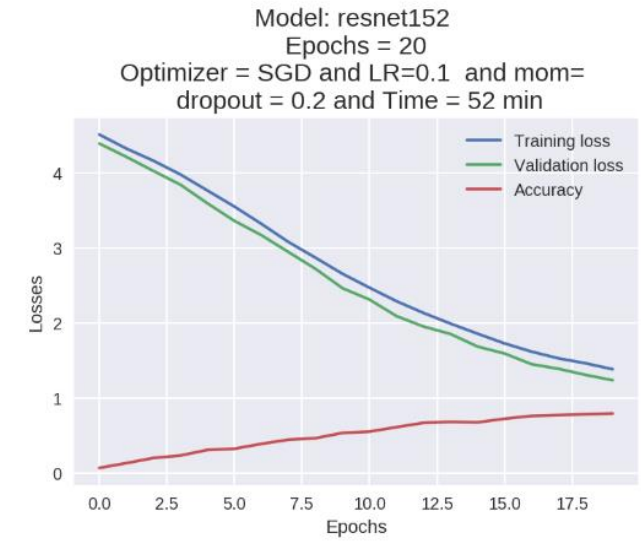

```
Epoch 1/20.. Train loss: 3.487.. Valid loss: 2.196.. Accuracy: 51.751 %
Epoch 2/20.. Train loss: 1.736.. Valid loss: 1.202.. Accuracy: 74.667 %
Epoch 3/20.. Train loss: 1.119.. Valid loss: 0.800.. Accuracy: 82.383 %
Epoch 4/20.. Train loss: 0.870.. Valid loss: 0.756.. Accuracy: 85.250 %
Epoch 5/20.. Train loss: 0.765.. Valid loss: 0.641.. Accuracy: 84.801 %
Epoch 6/20.. Train loss: 0.662.. Valid loss: 0.486.. Accuracy: 89.431 %
Epoch 7/20.. Train loss: 0.604.. Valid loss: 0.537.. Accuracy: 88.337 %
Epoch 8/20.. Train loss: 0.577.. Valid loss: 0.485.. Accuracy: 88.103 %
Epoch 9/20.. Train loss: 0.532.. Valid loss: 0.463.. Accuracy: 88.317 %
Epoch 10/20.. Train loss: 0.530.. Valid loss: 0.503.. Accuracy: 88.537 %
Epoch 11/20.. Train loss: 0.493.. Valid loss: 0.461.. Accuracy: 86.994 %
Epoch 12/20.. Train loss: 0.469.. Valid loss: 0.508.. Accuracy: 87.673 %
Epoch 13/20.. Train loss: 0.444.. Valid loss: 0.464.. Accuracy: 88.772 %
Epoch 14/20.. Train loss: 0.442.. Valid loss: 0.469.. Accuracy: 87.204 %
Epoch 15/20.. Train loss: 0.433.. Valid loss: 0.462.. Accuracy: 87.658 %
Epoch 16/20.. Train loss: 0.388.. Valid loss: 0.346.. Accuracy: 91.648 %
Epoch 17/20.. Train loss: 0.412.. Valid loss: 0.418.. Accuracy: 90.755 %
Epoch 18/20.. Train loss: 0.380.. Valid loss: 0.324.. Accuracy: 90.979 %
Epoch 19/20.. Train loss: 0.380.. Valid loss: 0.414.. Accuracy: 88.547 %
Epoch 20/20.. Train loss: 0.377.. Valid loss: 0.365.. Accuracy: 92.083 %
```



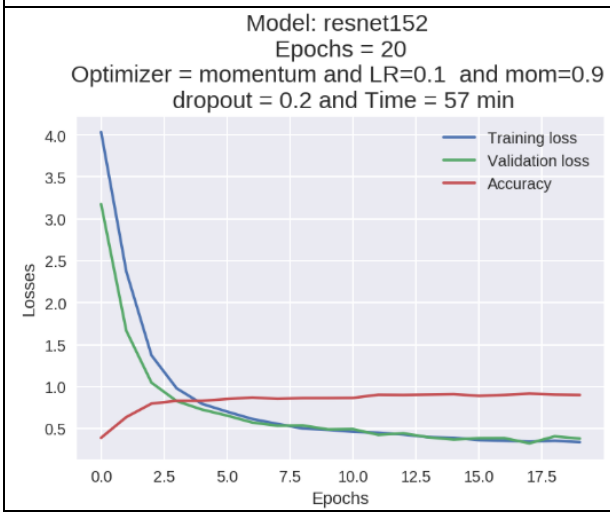

```
Epoch 1/20.. Train loss: 3.645.. Valid loss: 2.376.. Accuracy: 41.861 %
Epoch 2/20.. Train loss: 1.847.. Valid loss: 1.142.. Accuracy: 67.390 %
Epoch 3/20.. Train loss: 1.173.. Valid loss: 0.957.. Accuracy: 74.672 %
Epoch 4/20.. Train loss: 0.915.. Valid loss: 0.717.. Accuracy: 81.729 %
Epoch 5/20.. Train loss: 0.794.. Valid loss: 0.576.. Accuracy: 84.591 %
Epoch 6/20.. Train loss: 0.732.. Valid loss: 0.478.. Accuracy: 86.134 %
Epoch 7/20.. Train loss: 0.679.. Valid loss: 0.507.. Accuracy: 86.125 %
Epoch 8/20.. Train loss: 0.614.. Valid loss: 0.555.. Accuracy: 85.695 %
Epoch 9/20.. Train loss: 0.551.. Valid loss: 0.443.. Accuracy: 88.557 %
Epoch 10/20.. Train loss: 0.568.. Valid loss: 0.519.. Accuracy: 85.231 %
Epoch 11/20.. Train loss: 0.509.. Valid loss: 0.443.. Accuracy: 89.206 %
Epoch 12/20.. Train loss: 0.490.. Valid loss: 0.481.. Accuracy: 86.125 %
Epoch 13/20.. Train loss: 0.486.. Valid loss: 0.368.. Accuracy: 88.537 %
Epoch 14/20.. Train loss: 0.476.. Valid loss: 0.525.. Accuracy: 85.670 %
Epoch 15/20.. Train loss: 0.461.. Valid loss: 0.469.. Accuracy: 87.228 %
Epoch 16/20.. Train loss: 0.435.. Valid loss: 0.494.. Accuracy: 86.559 %
Epoch 17/20.. Train loss: 0.431.. Valid loss: 0.494.. Accuracy: 87.419 %
Epoch 18/20.. Train loss: 0.429.. Valid loss: 0.393.. Accuracy: 89.421 %
Epoch 19/20.. Train loss: 0.424.. Valid loss: 0.420.. Accuracy: 87.883 %
Epoch 20/20.. Train loss: 0.427.. Valid loss: 0.494.. Accuracy: 88.098 %
```




```
Epoch 1/20.. Train loss: 4.786.. Valid loss: 2.581.. Accuracy: 43.404 %
Epoch 2/20.. Train loss: 2.163.. Valid loss: 1.518.. Accuracy: 68.718 %
Epoch 3/20.. Train loss: 1.550.. Valid loss: 1.137.. Accuracy: 73.118 %
Epoch 4/20.. Train loss: 1.249.. Valid loss: 0.909.. Accuracy: 81.280 %
Epoch 5/20.. Train loss: 1.091.. Valid loss: 0.828.. Accuracy: 84.371 %
Epoch 6/20.. Train loss: 0.990.. Valid loss: 0.716.. Accuracy: 85.241 %
Epoch 7/20.. Train loss: 0.908.. Valid loss: 0.641.. Accuracy: 86.564 %
Epoch 8/20.. Train loss: 0.837.. Valid loss: 0.626.. Accuracy: 86.574 %
Epoch 9/20.. Train loss: 0.783.. Valid loss: 0.543.. Accuracy: 87.663 %
Epoch 10/20.. Train loss: 0.736.. Valid loss: 0.613.. Accuracy: 86.774 %
Epoch 11/20.. Train loss: 0.690.. Valid loss: 0.528.. Accuracy: 88.562 %
Epoch 12/20.. Train loss: 0.687.. Valid loss: 0.592.. Accuracy: 86.564 %
Epoch 13/20.. Train loss: 0.663.. Valid loss: 0.466.. Accuracy: 90.300 %
Epoch 14/20.. Train loss: 0.633.. Valid loss: 0.623.. Accuracy: 84.791 %
Epoch 15/20.. Train loss: 0.642.. Valid loss: 0.474.. Accuracy: 89.201 %
Epoch 16/20.. Train loss: 0.602.. Valid loss: 0.490.. Accuracy: 89.211 %
Epoch 17/20.. Train loss: 0.610.. Valid loss: 0.468.. Accuracy: 89.861 %
Epoch 18/20.. Train loss: 0.560.. Valid loss: 0.507.. Accuracy: 88.547 %
Epoch 19/20.. Train loss: 0.562.. Valid loss: 0.513.. Accuracy: 87.004 %
Epoch 20/20.. Train loss: 0.565.. Valid loss: 0.444.. Accuracy: 89.856 %
```




```
Epoch 1/20.. Train loss: 4.513.. Valid loss: 4.393.. Accuracy: 6.379 %
Epoch 2/20.. Train loss: 4.326.. Valid loss: 4.215.. Accuracy: 12.772 %
Epoch 3/20.. Train loss: 4.164.. Valid loss: 4.027.. Accuracy: 19.609 %
Epoch 4/20.. Train loss: 3.980.. Valid loss: 3.844.. Accuracy: 22.906 %
Epoch 5/20.. Train loss: 3.766.. Valid loss: 3.595.. Accuracy: 30.393 %
Epoch 6/20.. Train loss: 3.552.. Valid loss: 3.361.. Accuracy: 31.932 %
Epoch 7/20.. Train loss: 3.321.. Valid loss: 3.170.. Accuracy: 38.520 %
Epoch 8/20.. Train loss: 3.079.. Valid loss: 2.945.. Accuracy: 44.044 %
Epoch 9/20.. Train loss: 2.869.. Valid loss: 2.721.. Accuracy: 46.027 %
Epoch 10/20.. Train loss: 2.655.. Valid loss: 2.462.. Accuracy: 53.084 %
Epoch 11/20.. Train loss: 2.469.. Valid loss: 2.310.. Accuracy: 54.828 %
Epoch 12/20.. Train loss: 2.289.. Valid loss: 2.090.. Accuracy: 60.811 %
Epoch 13/20.. Train loss: 2.132.. Valid loss: 1.951.. Accuracy: 66.530 %
Epoch 14/20.. Train loss: 1.990.. Valid loss: 1.851.. Accuracy: 67.849 %
Epoch 15/20.. Train loss: 1.855.. Valid loss: 1.683.. Accuracy: 67.204 %
Epoch 16/20.. Train loss: 1.725.. Valid loss: 1.591.. Accuracy: 72.024 %
Epoch 17/20.. Train loss: 1.616.. Valid loss: 1.448.. Accuracy: 75.780 %
Epoch 18/20.. Train loss: 1.525.. Valid loss: 1.386.. Accuracy: 76.879 %
Epoch 19/20.. Train loss: 1.460.. Valid loss: 1.305.. Accuracy: 77.978 %
Epoch 20/20.. Train loss: 1.380.. Valid loss: 1.234.. Accuracy: 79.057 %
```




```
Epoch 1/20.. Train loss: 4.035.. Valid loss: 3.176.. Accuracy: 38.989 %
Epoch 2/20.. Train loss: 2.373.. Valid loss: 1.666.. Accuracy: 63.663 %
Epoch 3/20.. Train loss: 1.373.. Valid loss: 1.047.. Accuracy: 79.741 %
Epoch 4/20.. Train loss: 0.979.. Valid loss: 0.828.. Accuracy: 83.053 %
Epoch 5/20.. Train loss: 0.796.. Valid loss: 0.727.. Accuracy: 83.033 %
Epoch 6/20.. Train loss: 0.702.. Valid loss: 0.655.. Accuracy: 85.245 %
Epoch 7/20.. Train loss: 0.614.. Valid loss: 0.572.. Accuracy: 87.009 %
Epoch 8/20.. Train loss: 0.556.. Valid loss: 0.534.. Accuracy: 85.455 %
Epoch 9/20.. Train loss: 0.501.. Valid loss: 0.537.. Accuracy: 86.325 %
Epoch 10/20.. Train loss: 0.485.. Valid loss: 0.490.. Accuracy: 86.359 %
Epoch 11/20.. Train loss: 0.462.. Valid loss: 0.494.. Accuracy: 86.564 %
Epoch 12/20.. Train loss: 0.451.. Valid loss: 0.425.. Accuracy: 90.310 %
Epoch 13/20.. Train loss: 0.429.. Valid loss: 0.444.. Accuracy: 90.095 %
Epoch 14/20.. Train loss: 0.398.. Valid loss: 0.396.. Accuracy: 90.520 %
Epoch 15/20.. Train loss: 0.390.. Valid loss: 0.369.. Accuracy: 90.969 %
Epoch 16/20.. Train loss: 0.362.. Valid loss: 0.386.. Accuracy: 88.977 %
Epoch 17/20.. Train loss: 0.355.. Valid loss: 0.387.. Accuracy: 90.085 %
Epoch 18/20.. Train loss: 0.344.. Valid loss: 0.324.. Accuracy: 91.629 %
Epoch 19/20.. Train loss: 0.354.. Valid loss: 0.407.. Accuracy: 90.525 %
Epoch 20/20.. Train loss: 0.338.. Valid loss: 0.381.. Accuracy: 90.100 %
```

Next step

Choose best combination of model, optimizer and hyparameters.