Project I - Convolutional neural networks
Deep Learning 2024

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Contents

Description of the research problem

| airplane | automobile | bird | cat | deer |
| dog | frog | horse | ship | truck |

Figure: Sample images from each class in the CINIC-10 dataset.

Experiments - network architectures

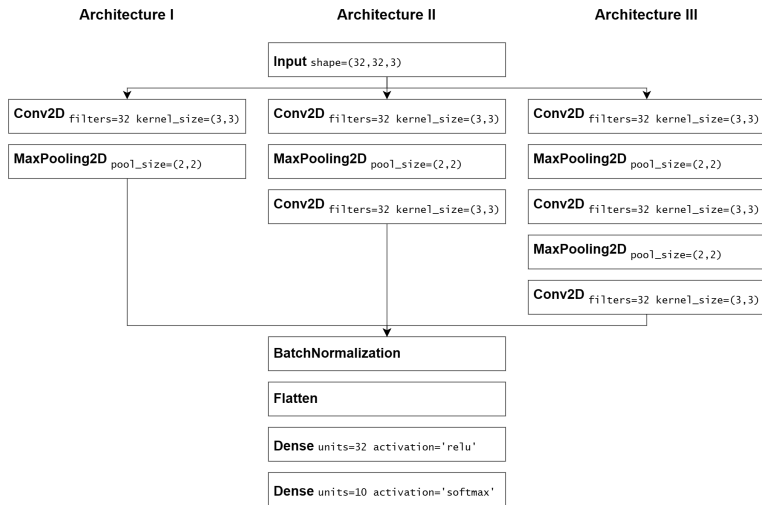
Figure: Three neural network architectures used in the experiments.

Experiments - details

Experiment	Objective	Values
1.1	Optimizer	SGD
		RMSProp
		Adam
		Adadelta
1.2	Learning rate	0.0001
		0.0005
		0.001
		0.005
		0.01
1.3	Dropout rate	0.2
		0.4
		0.6
1.4	Early stopping - patience	2
		4
		6
2	Augmentation technique	image flips
		image rotations
		image shifts
		mix-up

Table: Details of the experiments.

Experiments - augmentation techniques

| Original image | Flipped image | Rotated image | Shifted image | Mixed-up image |

Figure: Sample effect of augmentation techniques.
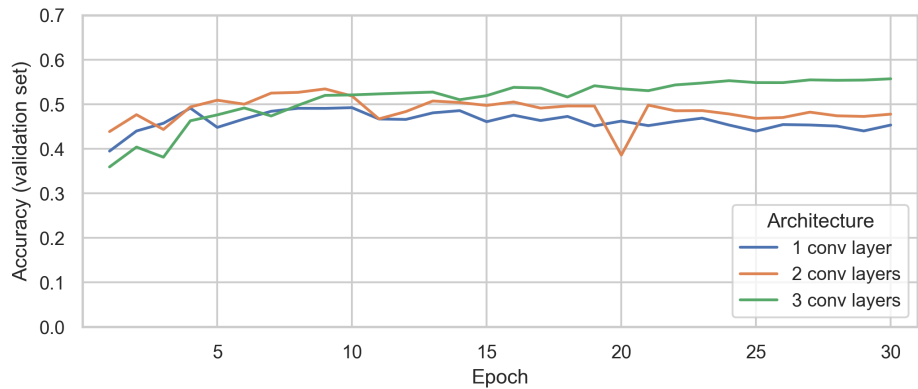
Experiment 0 - architecture

Figure: Accuracy computed on the validation subset for every epoch.
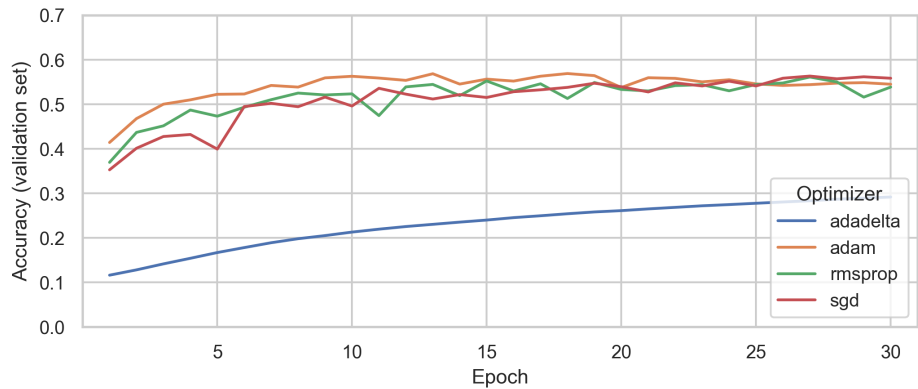
Experiment 1.1 - optimizer

Figure: Accuracy computed on the validation subset for every epoch.

Experiments 1.2 & 1.3 - learning rate and dropout rate

Learning rate	Accuracy	Validation accuracy
0.0001	0.625 (0.007)	0.557 (0.005)
0.0005	0.658 (0.015)	0.574 (0.001)
0.001	0.652 (0.017)	0.568 (0.001)
0.005	0.592 (0.011)	0.542 (0.004)

(a) Experiment 1.2 - learning rate

Drop rate	Accuracy	Validation accuracy
0.2	0.619 (0.020)	0.589 (0.008)
0.4	0.597 (0.007)	0.585 (0.010)
0.6	0.572 (0.008)	0.582 (0.009)

(b) Experiment 1.3 - drop rate

Table: The mean (and standard deviation) of the best values of the accuracy achieved by models.
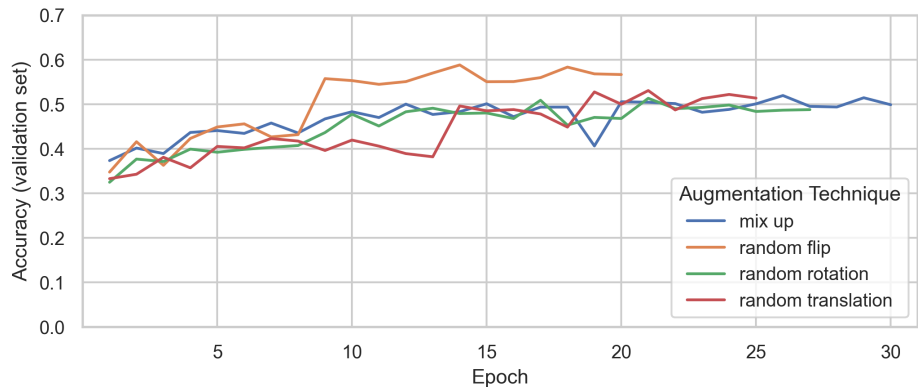
Experiment 2 - augmentation techniques

Figure: Accuracy computed on the validation subset for every epoch.

Conclusions

- The project was prepared according to the instructions.
- The best parameter settings:
    - three convolutional layers;
    - Adam optimizer;
    - learning rate $= 0.001$;
    - dropout rate $= 0.2$;
    - early stopping patience $= 6$;
    - no augmentation techniques.
- The accuracy achieved on the validation subset (around 0.58) is not so high.
- It may be worth to construct more complex architecture.