Fine-tuning ImageNet on Beetles datasets

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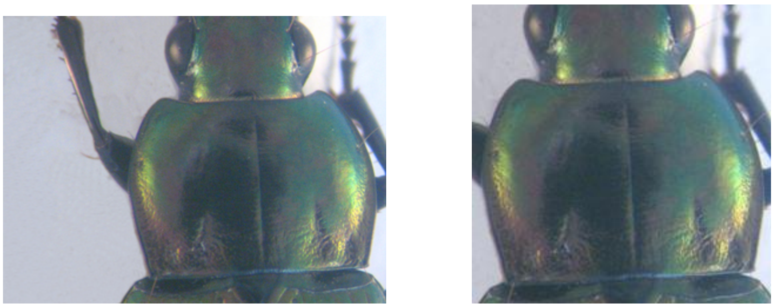
Abstract

In this study, we fine-tune on some trained models on pronotum dataset, such as VGG, GoogleNet, ResNet50. In some case, we use the model which have been designed for classification problem to adapt to a regression problem. The experiments will implement on two steps: freeze and unfreeze some layers in trained models. At the end of the experiment, a comparison between the fine-tune losses will be discussed.

1 Dataset

The dataset includes 293 RGB-images of beetle's pronotum. The images were taken by the same camera with the same conditions of resolution of 3264×2448. The images in the dataset were divided into two subsets: training (including 260 images) and testing (including 33 images). For each image, a set of 8 manual landmarks have been set by biologists. Depending the input of the pre-trained models, the images are down-sampled to fit with the models. Firstly, the images are down-sampled to a resolution of 326×245 and the coordinates of the manual landmarks are also re-scaled. Secondly, the centroid point of manual landmarks is calculated for each image. The centroid point is considered as the center of the new image that has been cropped from the down-sampled image. The size of the new image is depending on the input of the trained model that we would like to fine tune. Fig. 1 presents an example in dataset after down-sampling and crop the image to fit with the input size of neural network.



(a) (b)

Figure 1: An example in dataset. *a)* presents the image after down-sampling. *b)* presents the cropped image from down-sampling image which used as the input of CNN

2 The models

2.1 VGGs models

The models are the improved versions of the models used by the VGG team in ILSVRC-2014 competition. The models were designed to evaluate the depth of the network by using an architecture with very small (3×3) convolution filters and pushing the depth to $16 \rightarrow 19$ weight layers. Table. shows the architecture of the VGGs models.

Layer	$VGG-16$	$VGG-19$
0	Input(3,224,224)	Input(3,224,224)
1	CONV(64,3,1)	CONV(64,3,1)
2	CONV(64,3,1)	CONV(64,3,1)
3	POOL(2)	POOL(2)
4	CONV(128,3,1)	CONV(128,3,1)
5	CONV(128,3,1)	CONV(128,3,1)
6	POOL(2)	POOL(2)
7	CONV(256,3,1)	CONV(256,3,1)
8	CONV(256,3,1)	CONV(256,3,1)
9	CONV(256,3,1)	CONV(256,3,1)
10	POOL(2)	CONV(256,3,1)
11	CONV(512,3,1)	POOL(2)
12	CONV(512,3,1)	CONV(512,3,1)
13	CONV(512,3,1)	CONV(512,3,1)
14	POOL(2)	CONV(512,3,1)
15	CONV(512,3,1)	CONV(512,3,1)
16	CONV(512,3,1)	POOL(2)
17	CONV(512,3,1)	CONV(512,3,1)
18	POOL(2)	CONV(512,3,1)
19	FC(4096)	CONV(512,3,1)
20	DROP(0.5)	CONV(512,3,1)
21	FC(4096)	POOL(2)
22	DROPOUT(0.5)	FC(4096)
23	FC(1000)	DROP(0.5)
24	-	FC(4096)
25	-	DROP(0.5)
26	-	FC(1000)

Table 1: The architecture of VGG-16 and VGG-19

The parameters of CNN are shown in Table.x.

Parameter	Initial value	End value
Epochs	10000	
Training batch size	128	
Testing batch size	128	
Learning rate	0.03	0.0001
Momentum	0.9	0.9999

Table 2: The network parameters in proposed model

2.2 ResNet model

3 Experiments

The dataset includes 260 image in 3-channels was used to fine-tune on each trained model. Table.3 shows the losses during fine-tuning (training and validation loss). During fine-tuning, the learning rate and momentum were kept the same on all trained model (0.000001 and 0.9, respective). Each model was fine-tuned in two steps: *freeze and un-freeze* some "lower" layers in 5000 epochs.

Model	Training loss	Validation loss
VGG-16 (unfreeze)	11.00030	9.41890
VGG-16 (freeze)	0	0
VGG-19 (unfreeze)	0	0
VGG-19 (freeze)	0	0
ResNet (unfreeze)	0	0
ResNet (freeze)	0	0

Table 3: The losses during fine-tuning the trained models

4 Conclusions

A CNN model has been trained on a dataset that includes the images of three parts of beetle. The trained model then has been fine-tuned with the pronotum dataset. Comparing the losses when we trained the pronotum from scratch, the losses during fine-tuning has been improved 40% on validation test. Besides, the coordinates of predicted landmarks are also more accuracy than the last result (training from scratch) (Table.**??**). From the result, we can see that fine-tuning has affected to the results from CNN. However, the effects still limits in our case. The experiments of the techniques on fine-tuning need to do to reach to the result as we expect.

References