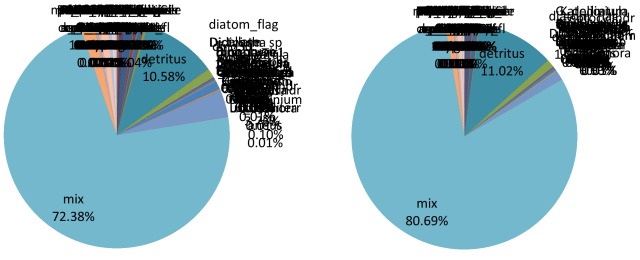
Transfered deep convolutional neural network for large class imblanced plankton databse classifaction

Chao Wang
College of Information Science and Engineering
Ocean University of China
Qingdao 266100, China
Email: chaowangplus@gmail.com

Abstract*—Plankton are critically important to our ecosystem, accounting for more than half the primary productivity on earth and nearly half the total carbon fixed in the global carbon cycle. Loss of plankton populations could result in ecological upheaval as well as negative societal impacts, by contrast, a bloom of phytoplankton can result in red tides which will cause econpmic loss. So it's a valuable things for people to get the species population and distribution information. The thing is that, underwater camera system captures microscopic have developed for many years, obtain the raw images is not the problem, the problem is how to analyze and classify them in an automatic and efficient way. Recently, CNN have achieved state of the art result on large scale image classifaction[1]. Absoutly, we use several popular CNN modles on WHOI large scale plankton database[2], it has achieved high accuray on this dataset, but the data distribution of WHOI is not blance, So it has a very bias problem, to evaluate the classifer in a imparital way, we introdce a evaluation criterion — F1 score. Although the CNN method have achieved high gloable accuracy on the database, but they achieved low F1 score seperately: 0.17, 0.29 on cifar10 CNN model and vgg16 model. In this paper, we introduced a model reinforced aproach to overcome this problem. We pretrained a CNN model on the small classes which have images less than 5,000. Then the pretrained model was treated as a feature extracter to enhance the small classes's features and we fixed all the weights of this pretrained model and combined with a parallel network to train on the whole training database. Through this transfered feature[3] based approach we achieved high F1 score 0.3752, 0.5444 on our model based on cifar10 CNN model and VGG16 model respectively.

I. Introduction

Plankton are critically important to our ecosystem.



(a) Training database (b) Testing database

Fig. 1. Data distribution of WHOI

TABLE I
WHOI DATABASE

classes	Total	Training	Testing
Mix	73.2%	72.4%	80.1%
Detritus	10.6%	10.6%	11.0%
Leptocylindrus	3.5%	3.8%	1.3%
Mix_elongated	1.9%	2.0%	1.1%
Dino30	1.3%	1.4%	1.2%
Sum	90.5%	90.2%	94.7%

TABLE II
SINGAL MODEL RESULT ON FULL DATA

database	model	iteration	accuracy	F1 score
full	cifar10 CNN model	120k	0.9297	0.1975
full	alexnet	100k	0.9	0.2
full	vgg16	70k	0.9335	0.2902

II. Related Work

Recently, several papers have brought some method for plankton classifaction.

III. Transfer reinforce model and Training

Fig. 2 illustrates the final transfer reinforce model archicture. We take the whole data as the input of our model and fixed model A as a feature extracter as expected to reinforce the small class's features.

A. Archicture

The architecture of our model used in the experiment.

B. Training

IV. Experiments

TABLE III
WHOI DATABASE

database	model	iteration	accuracy	F1 score
full+small class	cifar10 CNN model	136k	0.9370	0.3725
full+small class	alexnet	100k	0.9	0.2
full+small class	vgg16	150k	0.9498	0.5444

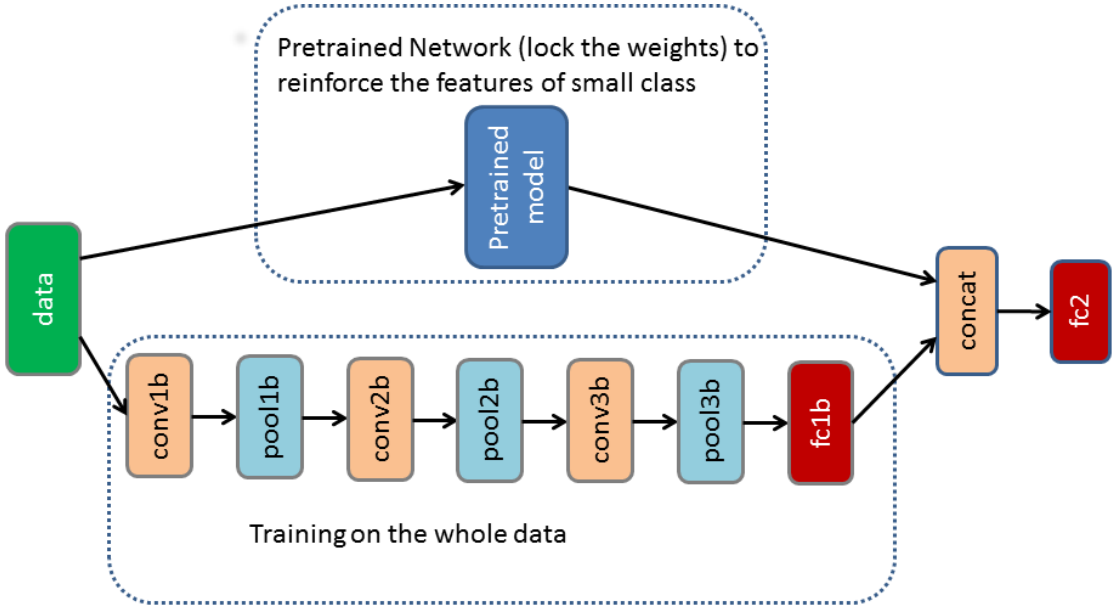
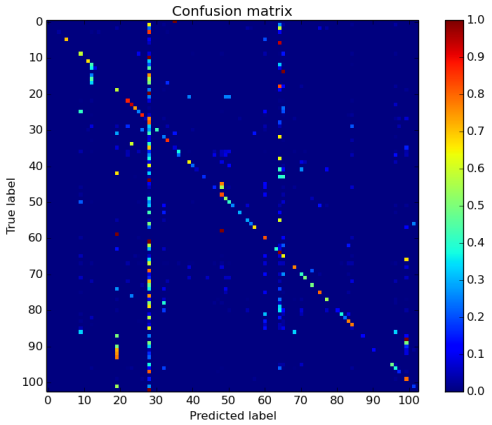
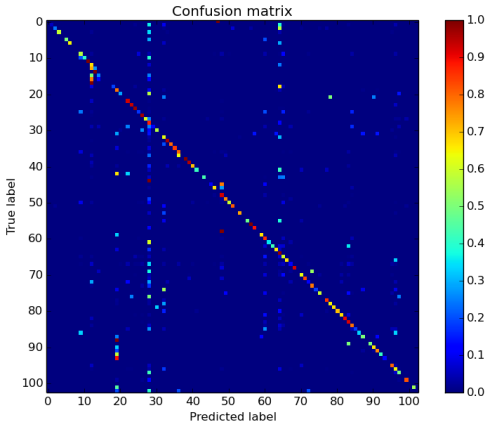


Fig. 2. Model structure of our plankton classifaction neural network.



(a) vgg16 baseline



(b) reinforced model based on vgg16

Fig. 3. Data distribution of WHOI

V. Conclusion

We have presented a model reinforced transfer learning aproach to overcome the class imblanced problem in the large scale plankton database.

References

[1] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "Imagenet classification with deep convolutional neural networks," in *Advances in neural information processing systems*, 2012, pp. 1097–1105.

[2] E. C. Orenstein, O. Beijbom, E. E. Peacock, and H. M. Sosik, "Whoi-plankton- A large scale fine grained visual recognition benchmark dataset for plankton classification," *CoRR*, vol. abs/1510.00745, 2015. [Online]. Available: http://arxiv.org/abs/1510.00745

[3] J. Yosinski, J. Clune, Y. Bengio, and H. Lipson, "How transferable are features in deep neural networks?" in *Advances in neural information processing systems*, 2014, pp. 3320–3328.