X-ray image body part clustering using deep convolutional neural network: SNUMedinfo at ImageCLEF 2015 medical clustering task

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Abstract. This paper describes our participation at the ImageCLEF 2015 Medical clustering task. The task is about clustering digital x-ray images into four groups with regard to the body parts. We experimented with deep convolutional neural network (GoogLeNet), finetuning pretrained models for ImageNet dataset. Experimental results showed competitive performance with other top-performing runs.

Keywords: Image clustering, Image classification, Deep convolutional neural network

1 Introduction

In this paper, we describe our participation at the ImageCLEF 2015 [1, 2] medical clustering [3] task. Given digital x-ray images of various body parts, task purpose is clustering images into four different body parts: head-neck, upper-limb, body and lower-limb. For a detailed introduction of the task, please see the overview paper of this task [4].

2 Methods

In this study, we experimented with deep convolutional neural network (CNN). In recent years, CNN showed quite effective performance in image classification tasks [5]. We formulated this task as an image classification among four different body part labels. We experimented with GoogLeNet which was used in recent ImageNet Challenge [6]. GoogLeNet incorporates Inception module with the intention of increasing network depth with computational efficiency.

We randomly divided training set into five-fold. Images from one fold is used as validation set, and images from other four fold is used as training set. We finetuned GoogLeNet pretrained on ImageNet dataset (initial learning rate 0.001; batch_size:40). 90 degree rotation (90', 180', 270' and 360') of images, mirroring (random left-right flipping of image) and image cropping (random cropping 224 x

224 image window out of 300 x 300 resized image) is applied for input data augmentation. Our trained CNN models scored 0.89~0.93 top-1 accuracy in our validation set.

We trained five separate CNNs. Five ranked list is combined into single ranking using Borda-fuse method [7]. Only top-ranked body parts are marked as output in test set. Borda-fuse method combines individual ranks without utilizing score. Combining multiple CNN classification output is considered to be effective to cope with CNN's variance. We postponed experimenting with other metasearch techniques such as CombSUM [8] to the future work.

3 Results

In GoogLeNet, there are three output layers (loss1, loss2 and loss3), two of them (loss1 and loss2) is located in the middle of layer hierarchy. We used these three layers per each run. Our run SNUMedifo1 corresponds to the lowest output layer (loss1). SNUMedinfo3 corresponds to the uppermost output layer (loss3).

Table 1. Evaluation results of our submitted runs

	Exact match	**Any match**	**Hamming similarity**
SNUMedinfo1	0.679	0.820	0.879
SNUMedinfo2	0.699	0.844	0.890
SNUMedinfo3	0.709	0.856	0.895

Evaluation results showed competitive performance. In our future study, we want to experiment with more data augmentation options to improve CNN's performance.

4 References

1. Cappellato, L., Ferro, N., Jones, G., and San Juan, E., *CLEF 2015 Labs and Workshops*. 2015, CEUR Workshop Proceedings (CEUR-WS.org).
2. Villegas, M., Muller, H., Gilbert, A., Piras, L.,Wang, J., Mikolajczyk, K., de Herrera, A.G.S., Bromuri, S., Amin, M.A., Mohammed, M.K., Acar, B., Uskudarli, S., Marvasti, N.B., Aldana, J.F., del Mar Roldan Garcia, M. *General Overview of ImageCLEF at CLEF2015 Labs*. 2015. Springer International Publishing.
3. Faruque, M.S.S., Banik, S., Mohammed, M. K., Hasan, M., Amin, M. A. *Teaching & Learning System for Diagnostic Imaging; Phase I: X-Ray Image Analysis & Retrieval*. in *6th International Conference on Computer Supported Education*. 2015.
4. M. Ashraful Amin, M.K.M. *Overview of the ImageCLEF 2015 medical clustering task*. in *CLEF2015 Working Notes*. 2015. Toulouse, France: CEUR-WS.org.
5. Krizhevsky, A., I. Sutskever, and G.E. Hinton. *Imagenet classification with deep convolutional neural networks*. in *Advances in neural information processing systems*. 2012.

6. Szegedy, C., et al., *Going deeper with convolutions.* arXiv preprint arXiv:1409.4842, 2014.
7. Aslam, J.A. and M. Montague, *Models for metasearch*, in *Proceedings of the 24th annual international ACM SIGIR conference on Research and development in information retrieval*. 2001, ACM: New Orleans, Louisiana, USA. p. 276-284.
8. Fox, E.A. and J.A. Shaw, *Combination of multiple searches.* NIST SPECIAL PUBLICATION SP, 1994: p. 243-243.