Machine learning (Neural network) for fossil image recognition

<https://eos.org/articles/nineteen-eighty-forams>

<https://www.biorxiv.org/content/10.1101/840926v1.abstract>

<https://www.google.com/search?q=Professor+jeremy+young+mikrotax&oq=Professor+jeremy+young+mikrotax&aqs=chrome..69i57.20856j0j1&sourceid=chrome&ie=UTF-8>

1. Introduction

a) Why fossil image recognition is important. How these are used as markers of geologic time for exploration purpose.

b) How traditionally fossil image were detected? Which community it will serve?

c) What are the difficulties in this task?

d) Is there any attempt made

2.Data

a) Source of fossil images

b) Challenges with the data – dimension related

c) Types of image data

d) Multi-class classification

3.Method

a)

4.Result

5.Discussion

6.Conclusion

7.Reference

Dear all,

     I got quite good result with a deep learning model on my fossil image detection project using the brown gpu clusters after transferring my codes from the Kaggle TGS challenge. I can now present some solid results for the November lecture I will be giving for Professor Tung's data science seminar.

     To briefly explain the problem, initially, I have 236 main foram fossil images(you can see in the pdf in the link below). So, there are 79 genus/classes/categories for these 236 images. So, the target is whether given an image to my "deep learning automatic fossil image detection" model, will the model be able to accurately predict which genus/class out of the 79 classes that specific fossil image belongs to? This is a single object detection/image recognition task in computer vision.

     For my model training, I have initially only transformed the images using affine transformation and random noise addition and generated around 2500 images. Importantly, I used only these transformed images for my model training which are relatively similar to the original images. Then after training, I subjected my models to predict the genus/class for those main 236 images. I have used 6-7 different very deep neural network architecture to train various models that you can take a quick understanding from this description[link](https://www.analyticsvidhya.com/blog/2018/07/top-10-pretrained-models-get-started-deep-learning-part-1-computer-vision/), if interested (there's a lot still to be done). The attached image shows the accuracy of my different models. For the deep learning VGG19 architecture, I got 80% accuracy which is a pretty good baseline as I have only done minimal processing for those images and no tweaking for the neural net architectures yet. What this result means is that, out of 236 images, my model is classifying correctly for 198 images and making prediction error for only 38 images. The reason why [VGG19](https://www.quora.com/What-is-the-VGG-neural-network) model can give good result is that, it uses "imagenet-large scale visual recognition challenge" weights for the models from a pretrained network which is pretrained on millions of images. A deep learning model trained over millions of images essentially learn a lot of visual features in different objects. Then when applied to a specific problem (like fossil image detection in my case), it quickly figures out the important features hidden in the given images and classify accordingly with the extension of the pretrained models. You can know more about [pretraining models here](https://keras.io/applications/#usage-examples-for-image-classification-models).

   Now, I wanted to see (as you suggested) the errors(those 38 images) the model was doing, e.g., for which genus/classes, the model is making mistakes? I have enlisted them in this pdf. Just scroll to the page 166, you can see the true class labels and the images and corresponding predicted but mistaken classes and the images. They kinda look similar in general! So, no wonder why the model is confused !

<https://www.analyticsvidhya.com/blog/2018/07/top-10-pretrained-models-get-started-deep-learning-part-1-computer-vision/>

   I am happy and excited with the result. Ideally, I would like to model to perform with about 95% accuracy. I hope I can improve gradually.

   There's a recent 2018 paper on radiolarian fossil image detection published in 2018 26th Signal Processing and Communications Applications Conference, May 2018. Check the paper: <https://ieeexplore.ieee.org/document/8404460/>

  And many thanks to Professor Tung to let me use the Brown GPUS. I hope she will continue letting me use the GPUs. I hope to publish papers on my result(next year GSA or earlier) will all of you as using deep learning model on fossil image detection as using deep learning to this specific area is still nascent, even though there might be existing various supervised/non neural net based architecture in place in different institutions all over the world. Potentially, we can also add this detection feature in our TSCreator java software or online by creating interface and attract the donors.

  Thank you for your time.

[Andy.](https://www.analyticsvidhya.com/blog/2018/07/top-10-pretrained-models-get-started-deep-learning-part-1-computer-vision/)