Peru Report

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As a computer scientist without a degree in geology, my time in Peru helped me to learn the basic concepts of that vast field of knowledge. In fact, geology is learned in the field as stated by S. W. Muller in the *Journal of Geological Education* (1983, v. 31): "Field Geology is learned in the field; therefore one must go there as soon and as frequently as possible". In the field, it was amazing to learn from other Creationists with specialties not just in geology, but also in areas such as chemistry and theology.

During the trip to Peru, I could see firsthand the daily activities that geologists carry out. In order to facilitate their work, I am designing a smart phone app that takes a picture of a rock in the field and then suggests an identification. I believe this project can be of help especially to young geologists with limited knowledge about mineralogy.

The rock classification app will use a model trained by means of a deep neural network. Specifically, this neural network will be trained with pictures of the following igneous rocks: gabbro, diorite, tonalite, monzonite, granite, and syenite. In the first experiments, the model was trained with pictures of rocks from the Web. However, in a second stage, additional experiments were conducted with pictures of granitic rocks provided by Dr. Ana Martínez. Since the classification model needs a good number of pictures per rock type to increase accuracy, I used the following three types (or classes) of rocks with the highest number of pictures from Dr. Martinez: gabbro, tonalite, and granite.

The deep learning algorithm for training requires at least 20 pictures per type. Therefore, I had to add some pictures to the set of pictures provided by Dr. Martinez to get this number. To this end, I looked for accurately classified pictures on the Web as follows:

- Gabbro: 12 pictures from the dataset provided by Dr. Martinez + 8 pictures from the Web
- Tonalite: 9 pictures from the dataset provided by Dr. Martinez + 11 pictures from the Web
- Granite: 15 pictures from the dataset provided by Dr. Martinez + 5 pictures from the Web

The training dataset can be downloaded at: https://drive.google.com/open?id=1vjscgdb4M37TOVPORQ0PjBz5tTn1Jp8C

I cropped most of the pictures in order to train the model with pictures that focus on the patterns on the rock, avoiding shapes and backgrounds.

The algorithm automatically cross validates the model after training. The final test accuracy of the model after 16 experiments was 75% (the model was right 12 times out of 16). Also, I evaluated the model with another 24 pictures downloaded from the Web (different from the ones used during training). In this case, the algorithm was right 15 times out of 24 (62.5%).

I believe that we are near to getting higher accuracy results. Nevertheless, more pictures are necessary to train the model. Therefore, together with Dr. Ana Martinez, Lance Pompe, and Dr. Luciano González, we are trying to find reliable online libraries of images of rocks and museums where we could find rock samples to take some pictures of them.

Last but not least, during the field trip I tried to be as helpful as possible in logistics and translations (English/Spanish). Also, I had the opportunity to carry out the following activities at UPeU Juliaca during the weekend prior the field trip: (1) I gave a motivational presentation to university students to invite them to go to the 10/40 Window; (2) I preached a sermon at Los Uros Church; and (3) I gave a presentation to UPeU professors and students about the importance of research.

My pictures taken at Peru are available at: https://drive.google.com/open?id=1-yGQSOVvnvPawwqh0J-bBTLR0Zn32Oy4

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