Capstone Project Proposal
Pediatric Bone Age Detection using Hand X-ray

Bone age is an indicator of skeletal maturity. A child's bone age may or may not exactly match with the child's age according to his or her birth date. Many factors, such as, nutrition, genetics, hormones, and disease states, influence the development of the skeletal [1]. The bone age study can tell how fast or slowly a child's skeleton is maturing [2] and it can also provide useful information on many clinical concerns. Clinicians use bone age assessment in order to evaluate the maturity of a child's skeletal system [3]. Applications that utilize assessment of the skeletal maturity are ever growing. In addition to the medical application, the skeletal maturity assessment can be used in sports selection and forensics to the international immigrant. For example, many children seeking asylum are required to undergo a bone age study so that required resources can be facilitated for them [1].

Data from the 2017 Pediatric Bone Age Challenge organized by the Radiological Society of North America (RSNA) [4] are used for the child's bone age prediction. Initial training set contains 12,611 hand radiographs and a validation set contains 1,425 images. Skeletal age estimates and sex of the images were labeled from the accompanying clinical radiology report provided at the time of imaging. A separate test set containing 200 images is used to evaluate the performance of the algorithms. Data can be downloaded here

https://stanfordmedicine.app.box.com/s/4r1zwio6z6lrzk7zw3fro7ql5mnoupcv

As the estimated bone ages are available to train the data, the bone age prediction is the supervised problem. The estimation of bone age using hand radiography can be treated as classification or regression problem using deep learning models. Both classification and regression methods will be used and compared the results of two methods. Radiography images are used as the predictors to predict the bone age.

The final deliverable will be an application deployed as a web service with an API. As the total data size of images is > 9 GB, the project will be computationally heavy and requires high memory and GPUs.

References:

[1] https://pediatrics.aappublications.org/content/140/6/e20171486
[2] https://kidshealth.org/en/parents/xray-bone-age.html
[3] Vladimir Iglovikov, Alexander Rakhlin, Alexandr A. Kalinin, Alexey Shvets “Pediatric Bone Age Assessment Using Deep Convolutional Neural Networks”, bioRxiv 234120
[4] RSNA Pediatric Bone Age Challenge. http://rsnachallenges.cloudapp.net/competitions/4 (2017), online; accessed December 12, 2017.