**Using Deep Learning Methods to**

**Detect Elements in Choropleth Maps**

Automatically understanding a map image by machines is a challenge in the era of artificial intelligence. This paper aims at automatically detecting map elements in choropleth maps, which can be further utilized to understand a map image in general. Specifically, if we want to know the theme of a choropleth map (e.g. adult obesity rate map), we need to first find the title of the map and then conduct semantic analysis on the title. In this study, deep learning based object detection methods, including Faster Region-based Convolutional Neural Network (Faster R-CNN) and You Only Look Once (YOLO), will be applied to detecting map titles and legend areas of choropleth maps. Faster R-CNN and YOLO are among the most commonly used object detection methods today. Faster R-CNN is the first end-to-end deep learning detector with high detection accuracy, while YOLO is the first one-stage detector in deep learning era with no need to generate region proposals before detection, saving a good deal of computing costs. For both detectors, the input data is choropleth map images, and the output is locations and sizes of bounding boxes in the images and the corresponding object classes, i.e. map title or legend. More than 1000 choropleth map images with either map titles or legends will be collected using Google Images or from other sources. And the map images will be used to train the detection models. Each of the two methods will be evaluated by mean Average Precision (mAP) and frame rate (number of images processed per second) for detection accuracy and speed respectively. This study intends to demonstrate the ability of Faster R-CNN and YOLO in detecting elements of choropleth maps, and comparisons of the detection accuracy and speed of the methods will be made to understand the strength of each method. This research will also provide suggestions about how to select detectors in different conditions for other map element detection tasks.