**Using Deep Learning Methods to**

**Detect Elements in Choropleth Map Images**

Automatically understanding a map image by machines is still a challenging task in the ear of artificial intelligence. This paper aims at automatically detecting map elements in choropleth map images, which can be further utilized to understand a map image. 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 map images. 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 two 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 online sources. Additionally, each of the two methods will be evaluated by mean Average Precision (mAP) and frame rate (number of frames processed per second) for detection accuracy and speed respectively. According to expected experiment results, conclusion will be made that both detection methods are able to detect elements in choropleth map images accurately. And comparing the two detectors, Faster R-CNN can detect map elements with higher mAP than YOLO, while YOLO is much more efficient.