5 Sample Project 3

This is a project on segmentation and object recognition in 2D medical images using deep learning. You will build an automated system to help characterize histopathology images of cancerous cells.

There are two main parts to this project, detecting the cells and then classifying them.

A key question in cancer research is why two people with the same broad cancer type (e.g. colon cancer) have different outcomes from treatment. One patient will receive treatment and be healthy, and another will receive the same treatment and have a cancer recurrence in a few years. Recent work with genetics and imaging data has begun to break broad classes of cancer into smaller subsets involving different phenotypes of tumors; that in turn respond differently to treatment. One of the barriers to this analysis is characterizing the cell distribution within the tumor to analyze its spatial arrangement (e.g. tightly clustered, vs disperse) or its composition in terms of different types of cell nuclei (see the manuscript for details).

Sirinukunwattana, Korsuk, et al. "Locality sensitive deep learning for detection and classification of nuclei in routine colon cancer histology images." IEEE transactions on medical imaging 35.5 (2016): 1196-1206, link.

1. Download the data set: link.
2. Detect patches with a nucleus at the centre:
   (a) Use techniques learned in the course to build an approach to detect nucleus centres; much like you would faces, cars, etc.
   (b) Experiment with different approaches using both grayscale and colour information; Compare and contrast.
   (c) Reproduce (approximately) their baseline CP-CNN result. Take a look at MatConvNet (link).
   (d) Setup cross-validation and evaluate your results. Compare to those in the paper.
3. Classify the detected nuclei patches in the 4 classes (epithelial, inflammatory, fibroblast, and miscellaneous):
   (a) Build your own patch-feature descriptor
   (b) Classify your detected patches into one of the 4 classes, and visualize your results.
   (c) Experiment with different approaches using both grayscale and colour information; Compare and contrast.
   (d) Implement their NEP classification step (this can be combined with any type of classifier in practice) and try in conjunction with your own approach

neighbouring ensemble predictor