CS4180 Deep Learning
Project Proposal

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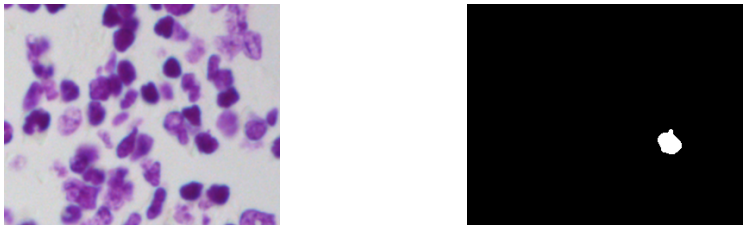
Identifying nuclei allows researchers to identify each individual cell in a sample, and by measuring how cells react to various treatments, the researcher can understand the underlying biological processes at work. Our goal is to create a model to automate nucleus detection.

We get the dataset from Kaggle. The dataset contains a large number of segmented nuclei images. The images were acquired under a variety of conditions and vary in the cell type, magnification, and imaging modality (brightfield vs. fluorescence). Files belonging to an image are contained in a folder with ImageId. Within this folder are two subfolders:

- **images** contains the image file.
- **masks** contains the segmented masks of each nucleus. Each mask contains one nucleus.

The samples are shown in Figure 1(a) and 1(b).



(a) (b)

Figure 1: Image and mask sample

There are many papers related to similar detection problems. The F-CNN[1], DeconvNet[2] and U-Net[3] are some classic frameworks which are used for semantic segmentation. Our main work is to implement a CNN framework. Some basic image processing methods like opening are used as image preprocessing.

Data argumentation is necessary because of the restriction the size of dataset. Then train the model until it converges.

Our final result is evaluated on the mean average precision at different intersection over union (IoU) thresholds. The IoU of a proposed set of object pixels and a set of true object pixels is calculated as:

$$IoU(A, B) = \frac{A \bigcap B}{A \bigcup B}$$

Our timeline is shown as following:

- W1: Reading releated papers. Get the dataset and implement the data reading function.
- W2: Implement image preprocessing. Compare the features of F-CNN, DeconvNet and U-Net and choose one which fits our problem best.
- W3-4: Implement the basic CNN model.
- W5: Implement data argumentation function.
- W6-7: Train our model.

Haoran Yuan, Rui Yu and Ramesh Konatala will implement the image preprocessing function. Mingxi Li and Yizhou Wang will mainly focus on the CNN model. Finally if there is still a bit of time, we will consider some other methods which may improve the performance.

In our mid-term report, we will give the basic framework of our model. If everything goes well, we will also get the performance of our model based on original data without data argumentation.

Since we have all gained some experience last quarter, we think our plan is reasonable and we will finish the project on time.

References

[1] Long, Jonathan, Evan Shelhamer, and Trevor Darrell. "Fully convolutional networks for semantic segmentation."

[2] Hyeonwoo Noh Seunghoon Hong Bohyung Han. "Learning Deconvolution Network for Semantic Segmentation"

[3] Olaf Ronneberger, Philipp Fischer, and Thomas Brox. "U-Net: Convolutional Networks for Biomedical Image Segmentation"