4360/6360 Final Project Proposal
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Sartorius - Cell Instance Segmentation (Kaggle Competition)

Overview

The SH-SY5Y human cell line is a triple-subcloned cell line from the SK-N-SH neuroblastoma cell line believed to contribute towards adverse effects in the adenosinergic, glutamatergic, and acetylcholinergic neuromodulator systems. Rapid analysis of these cells is essential to the efficiency and scalability of modern drug testing for neurodegenerative diseases. The SH-SY5Y cell line in particular exhibits low precision scores when segmented with current solutions, making it an ideal target for improvement. The epithelial-like morphology of the aforementioned cell line complicates common segmentation methods. *Our mission is to detect and delineate distinct objects from phase contrast microscopy imagery.*

Approach

The typical Mask-Head segmentation architecture struggles with the SH-SY5Y cell line due to the irregular, concave shape of the cells. Other approaches to consider include model-based segmentation, Voronoi segmentation, graphical model segmentation, and seeded watershed segmentation among other unmentioned techniques. Further research is necessary to see which strategy best represents the structure of given imagery.

Evaluation

The model performance is evaluated on mean average precision at different intersection over union thresholds.

$$IoU(A, B) = \frac{A \cap B}{A \cup B}.$$

An IoU ratio greater than or equal 0.5 is considered a correct segmentation, however the accuracy of the model is evaluated over a range of thresholds from 0.5 to 0.95, incremented by 0.05. At each threshold t, precision is computed based on the number of true positives, false positives, and false negatives. The final competition metric is based on the mean of each precision score for each image in the dataset.

$$\frac{1}{|thresholds|} \sum_t \frac{TP(t)}{TP(t) + FP(t) + FN(t)}.$$

Reference

- https://www.kaggle.com/c/sartorius-cell-instance-segmentation/overview/description

General References (Refining Later)

- https://www.mayoclinic.org/diseases-conditions/neuroblastoma/symptoms-causes/syc-20351017
- https://ai.googleblog.com/2021/09/revisiting-mask-head-architectures-for.html
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- https://pubmed.ncbi.nlm.nih.gov/23975817/