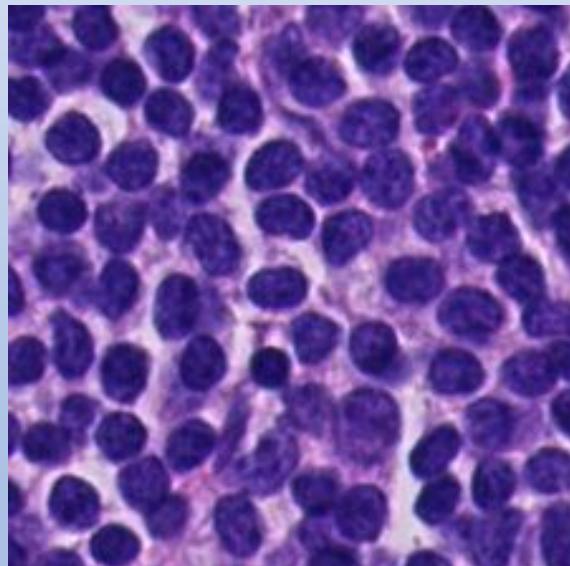


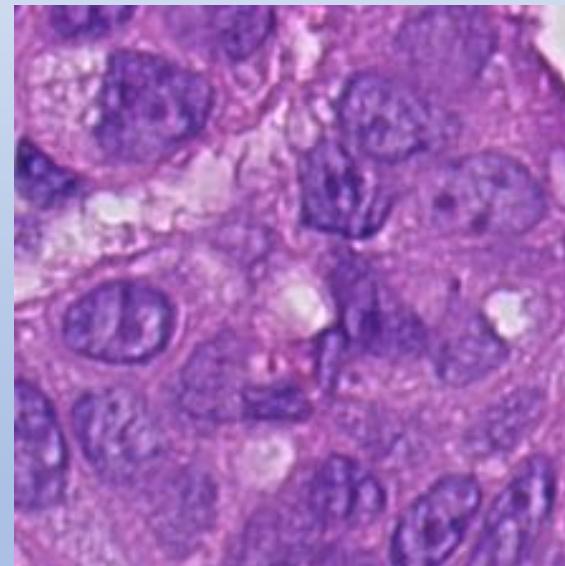
IsThisMetastasis

Machine learning methods for
tissue classification



Peyton Rose

Consulting project
for HistoWiz

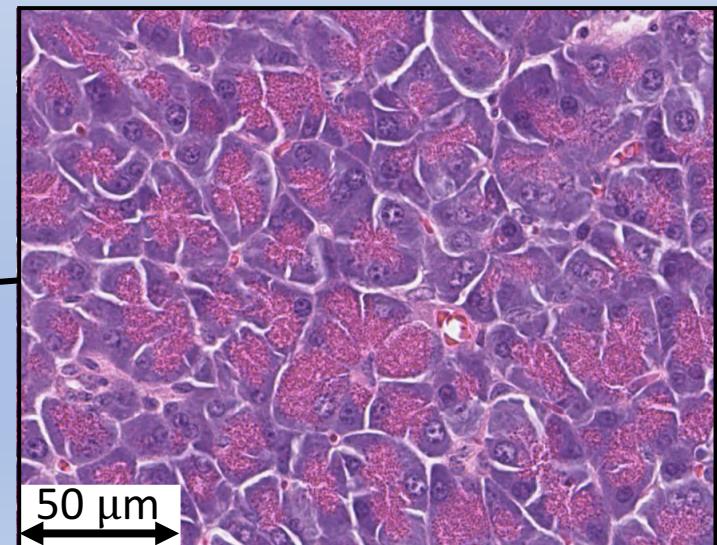
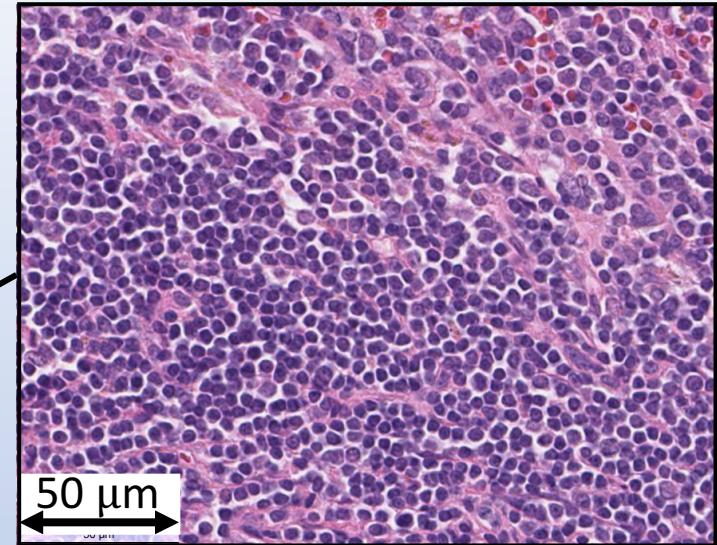
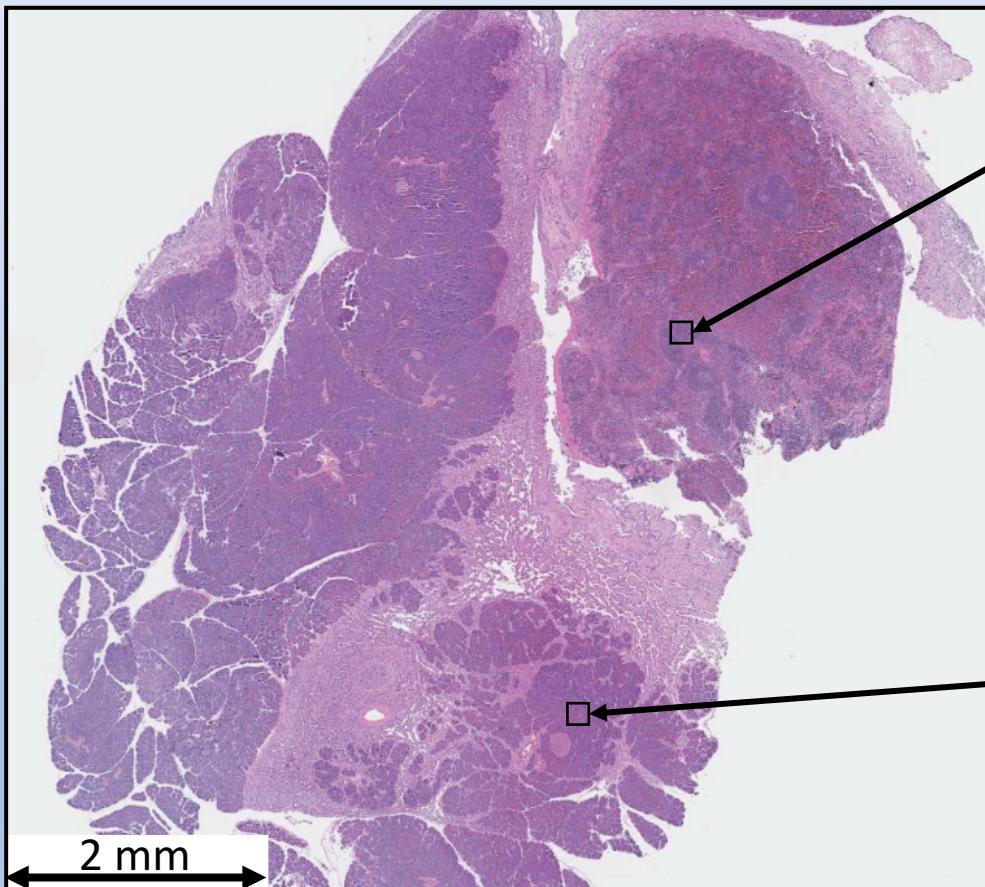


www.IsThisMetastasis.info

<https://github.com/pwrose21/TissueClassifier>

Histology is repetitive

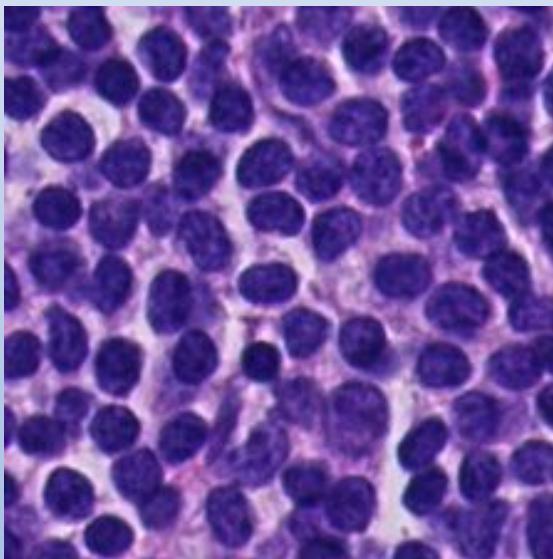
(but it doesn't have to be)



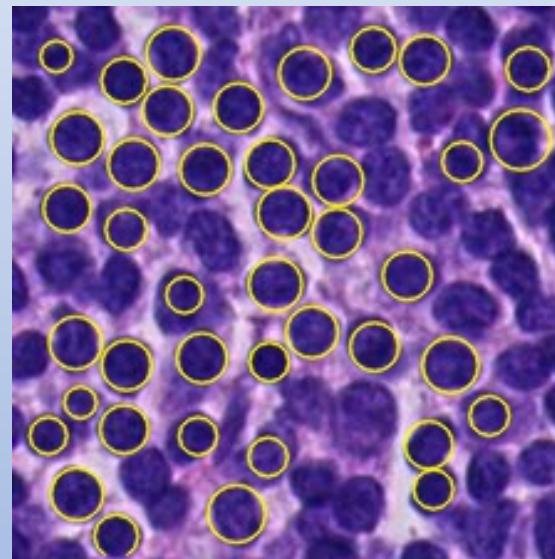
<https://histowiz.com/app/slides/10286/viewer/>

Computer vision techniques identify key image features

Original



Nuclei Density



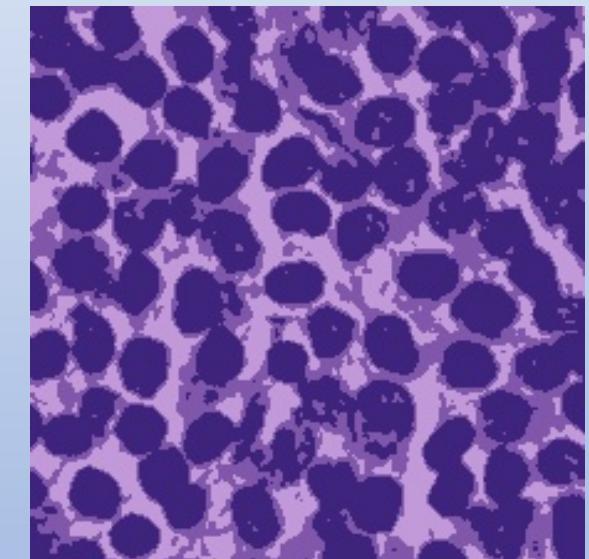
Blob Detection

Tissue Discontinuity



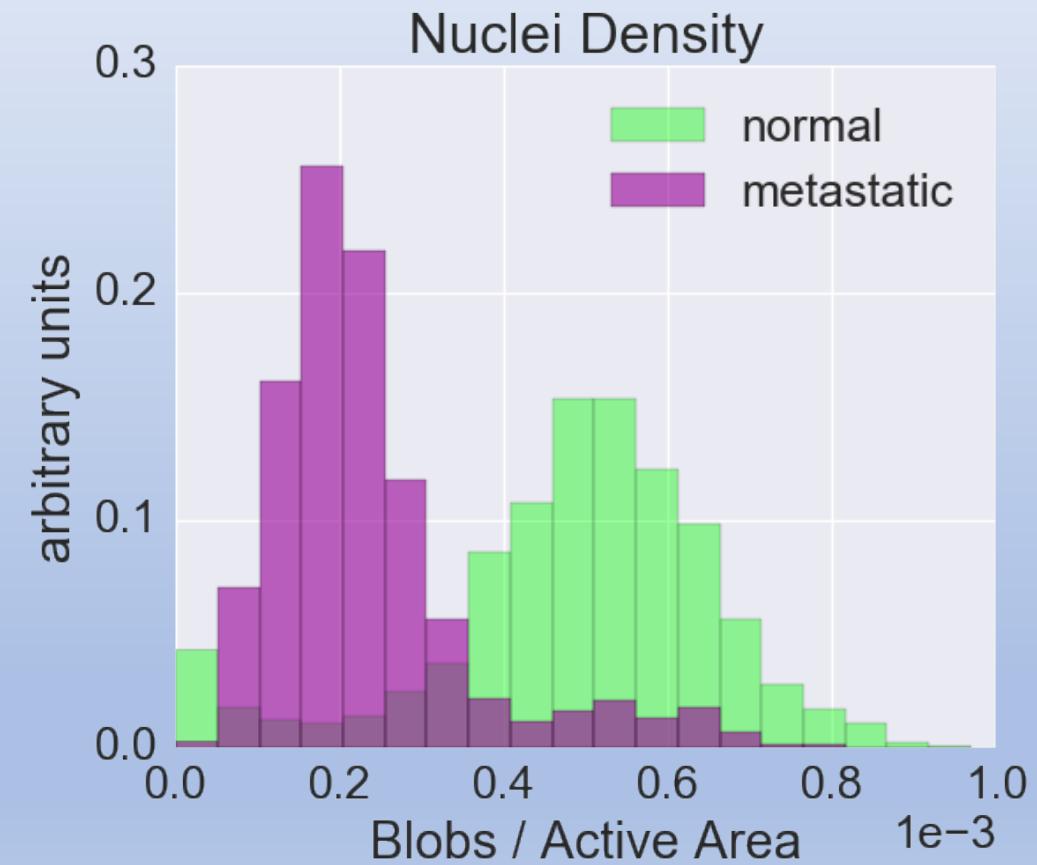
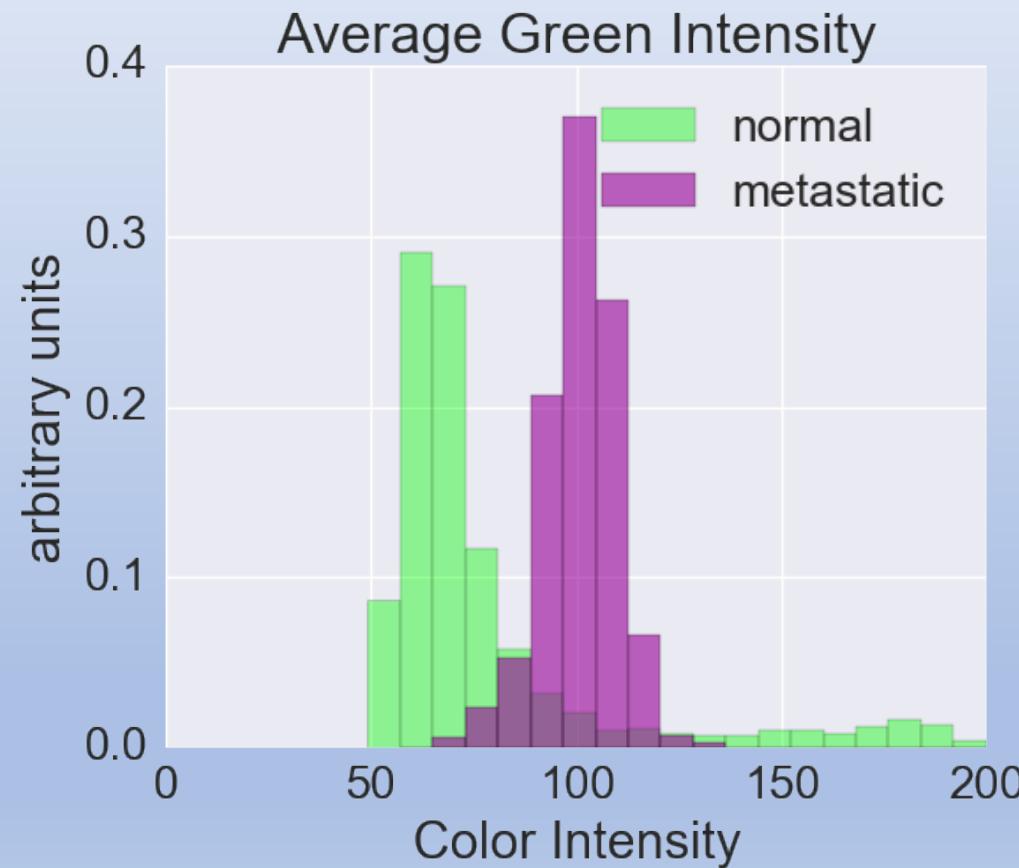
Edge Finding

Color Compactness



k-means Clustering

Normal and metastatic tissue classes are well separated



Logistic regression provides a simple approach plus model interpretability

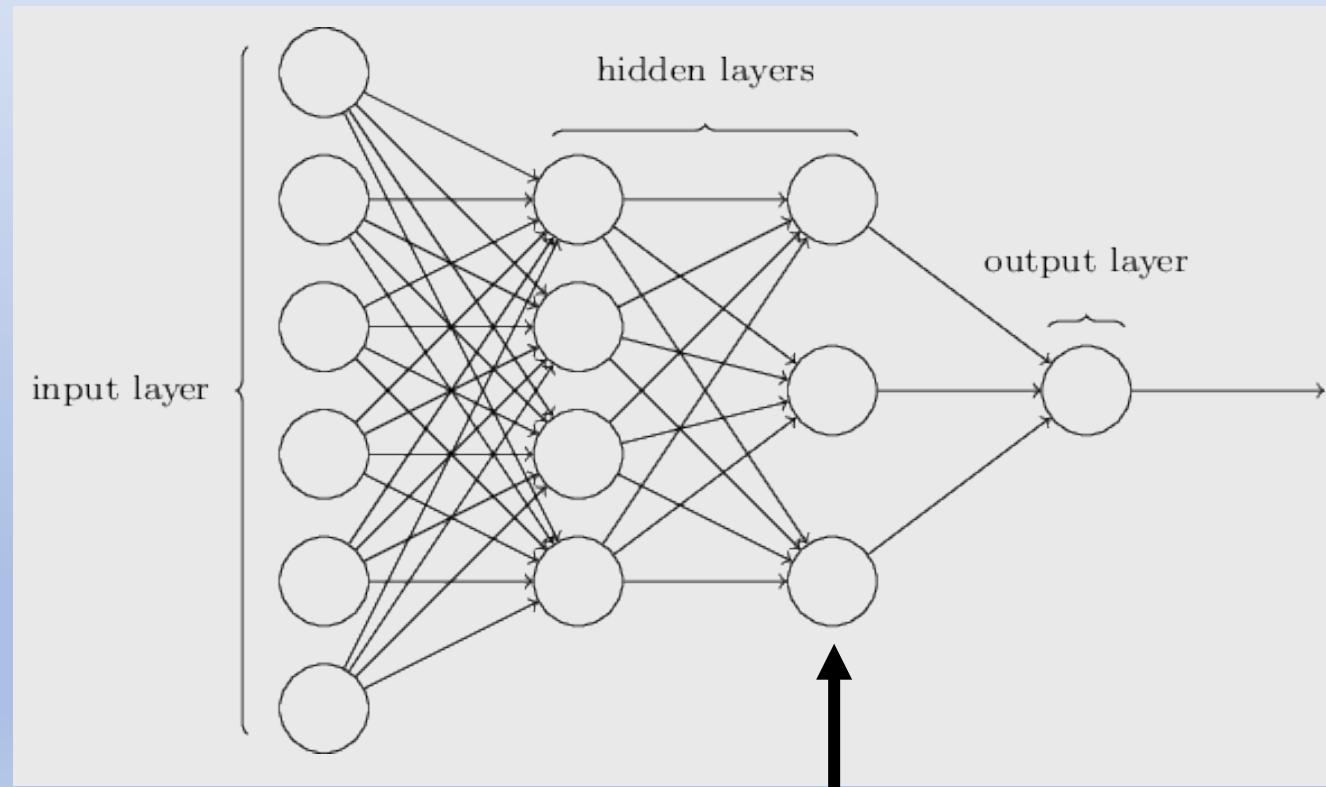
Feature Importance	
Rank	Feature
1	Avg. Red
2	Avg. Green
3	Avg. Blue
4	Tiss. Disc.
5	Color comp.
6	Nuclei density

Cross validation accuracy: 94.6%

Transfer learning offers an alternative approach

Inception-v3

Pre-trained on 1 million images across 1000 categories



“pool_3” layer outputs 2048 features which can be used as inputs to a new classifier

Cross validation accuracy

- Computer vision + logistic regression: 94.6 %
- **Transfer learning with Inception: 96.9 %**

Peyton Rose, PhD



BACKUP

IsThisMetastasis

isthismetastasis.info

Classifier How It Works Get In Touch

Upload Your Image

Choose a file Classify

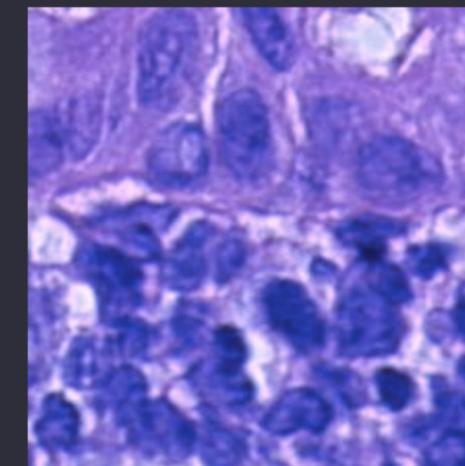
Or

Select From Sample Images

metastasis1.jpeg Classify

IsThisMetastasis.info

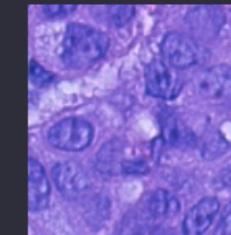
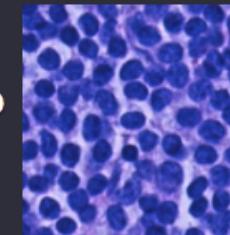
[Classifier](#) [How It Works](#) [Get In Touch](#)



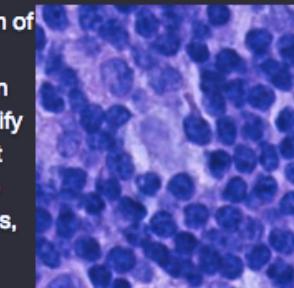
**This tissue has been classified as metastatic.
The probability of metastasis is 81.8%.**

To learn about the classifier, please [click here](#).

Is this metastasis?



If you're not a pathologist, you have a 50/50 chance of correctly identifying which of the two images above contains metastatic tissue -- the same probability that an untrained computer could correctly classify the two types of tissue. The image on the left is healthy tissue, and the other is metastatic tissue. How would you classify this other image to the right? It has a similar color and structure to the tissue that you learned was healthy, so you'd probably guess (correctly) that this image also contains healthy tissue. Is it possible to train a computer to identify these features, and why is this important?



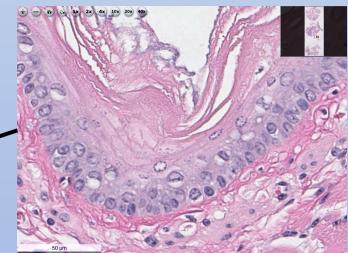
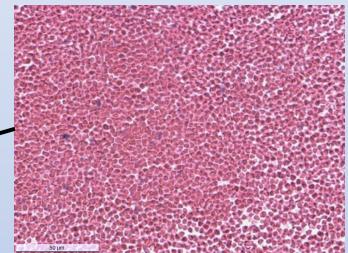
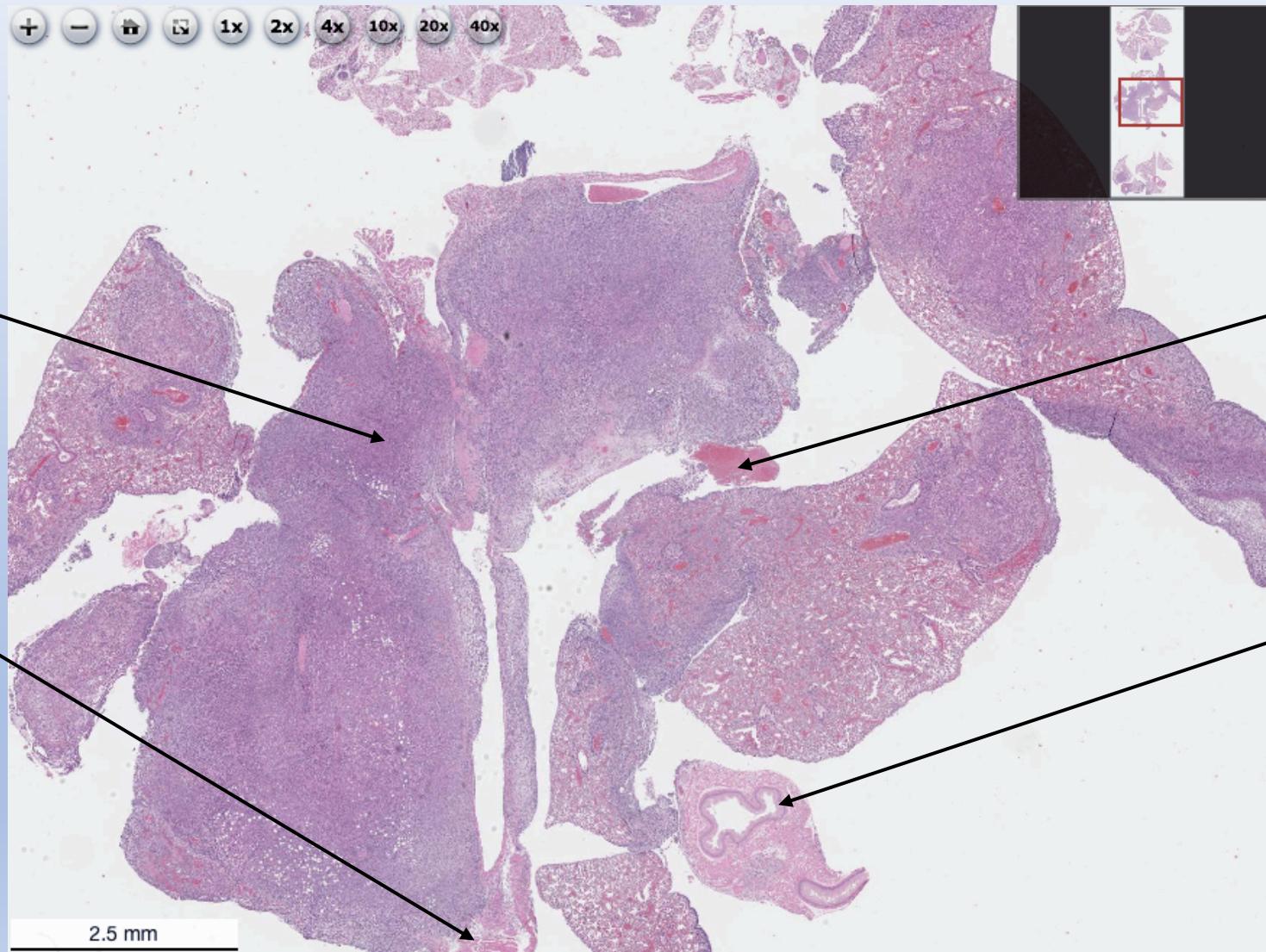
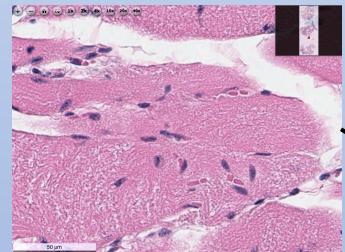
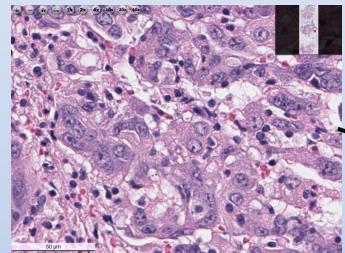
Histology is repetitive

Histology is the study of the microscopic structure of tissue. It is often used to accurately diagnose cancer and other diseases, and is an essential tool for researchers evaluating new potential cures for these diseases. There are many steps involved in preparing a histological slide before it can be examined by a histopathologist -- fixing, processing, embedding, sectioning, and staining.

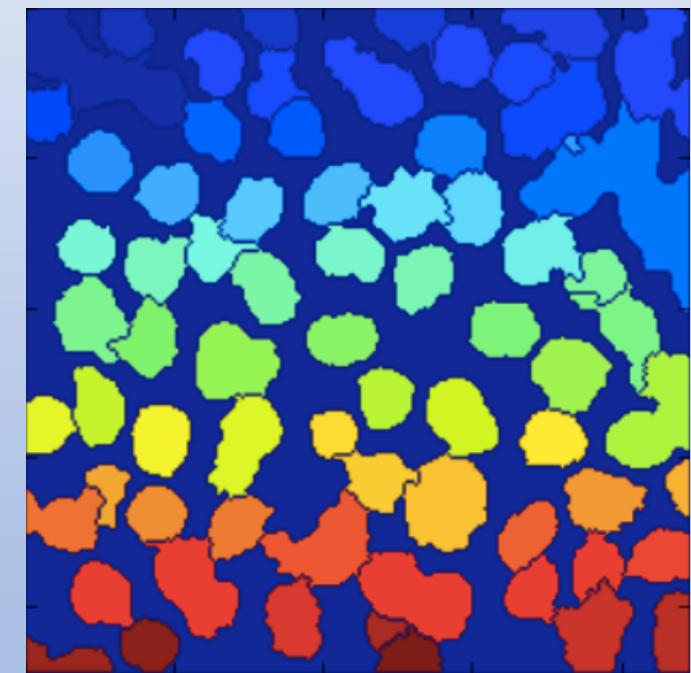
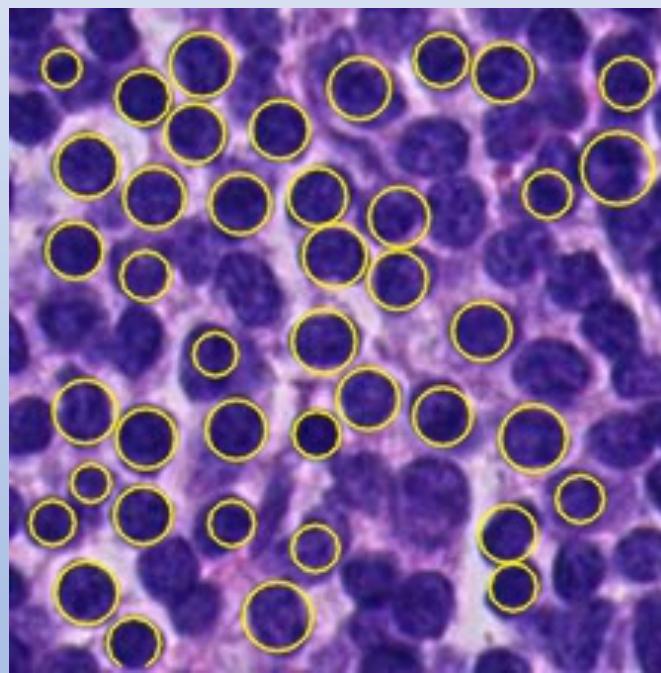
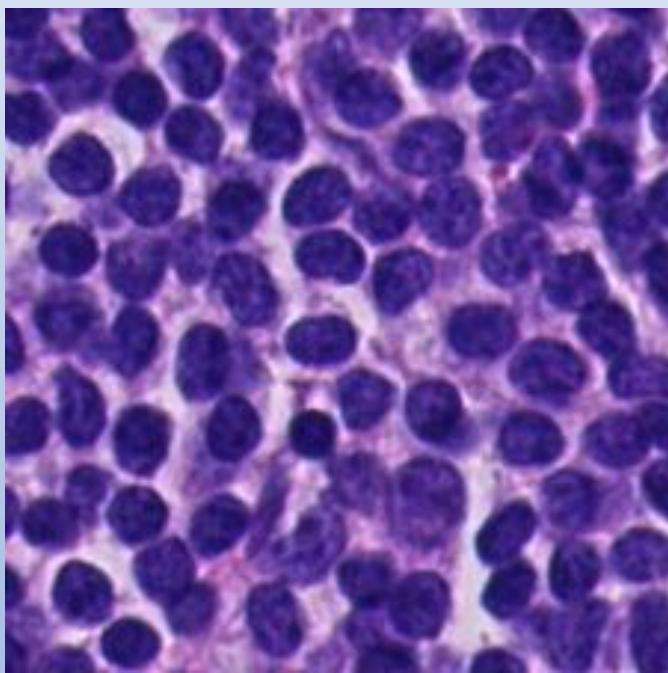
The automation of these steps has already been solved by a company called HistoWiz that offers automated histology for biomedical researchers, where tissue samples can be processed in as little as 3-days. HistoWiz returns a DZI (Deep Zoom Image) file to these researchers, allowing them to zoom in up to 40x and resolve tissue features on the micron level.

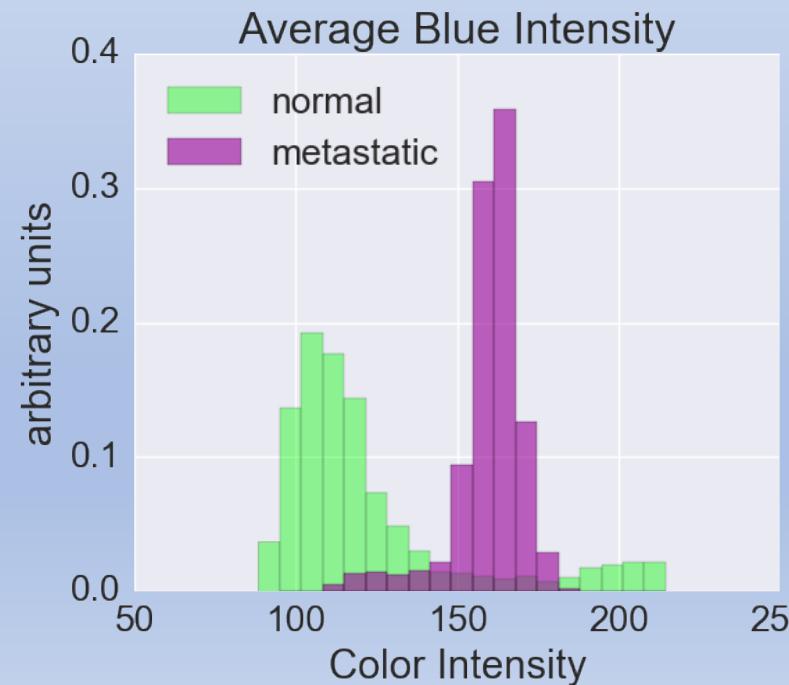
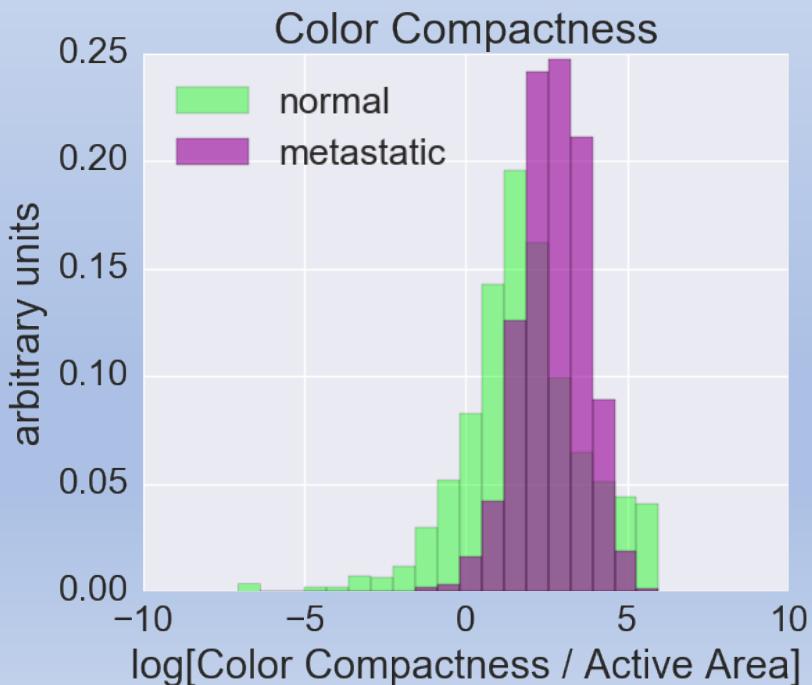
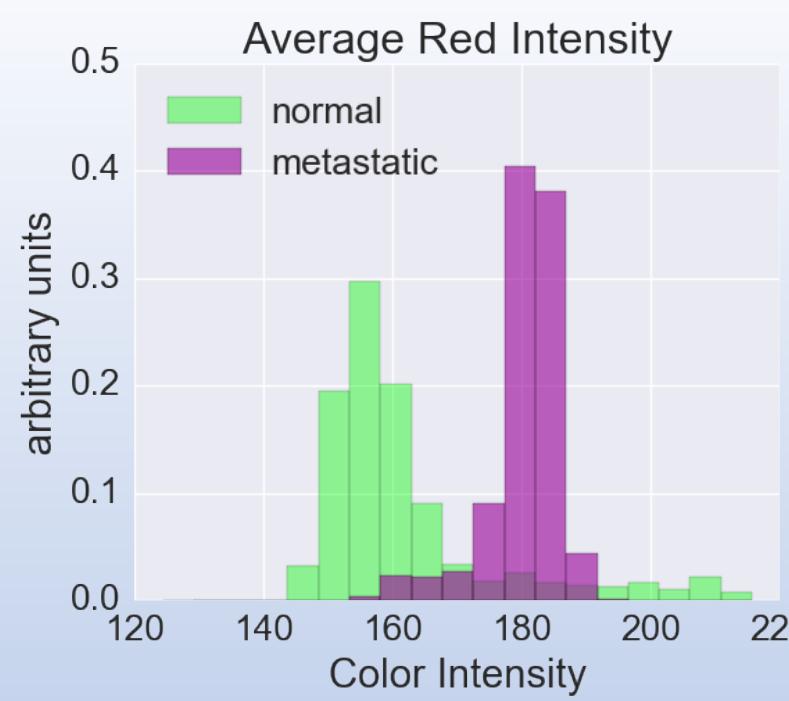
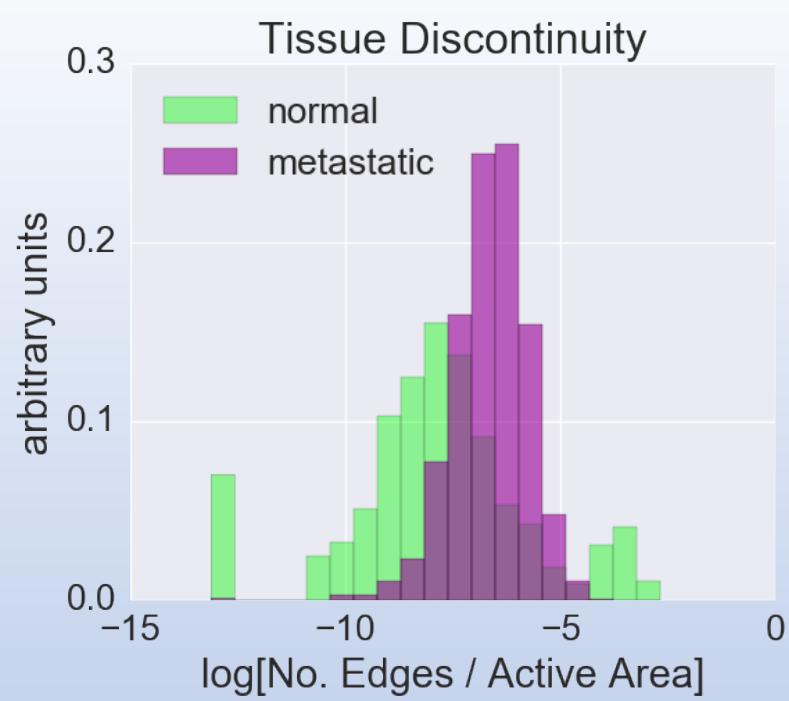
It can take a considerable amount of time for researchers to pour over these images and identify regions of interest. A computer trained to identify these regions would save researchers substantial time and effort, enabling them to accelerate their groundbreaking research. Companies that offer this service would be the go-to for these researchers, so investment in these techniques is a worthwhile pursuit.

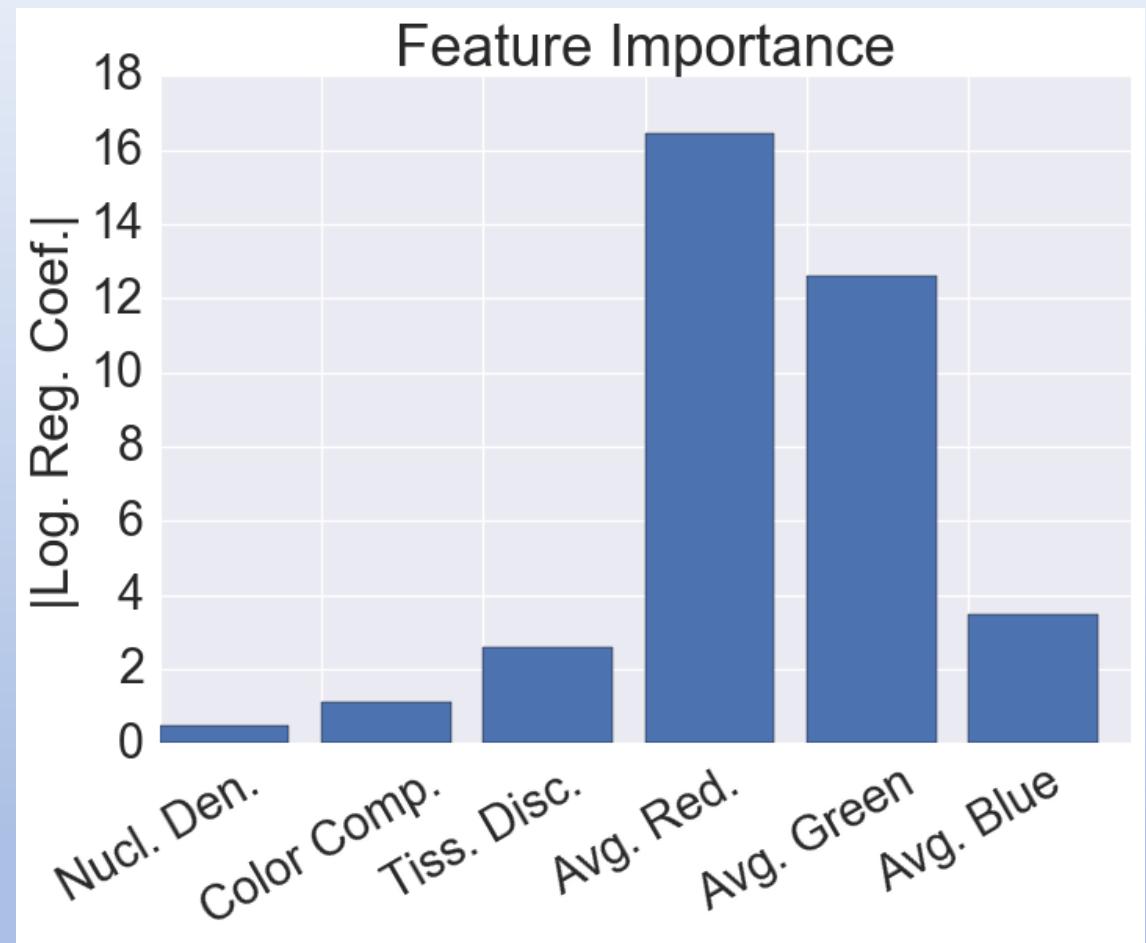
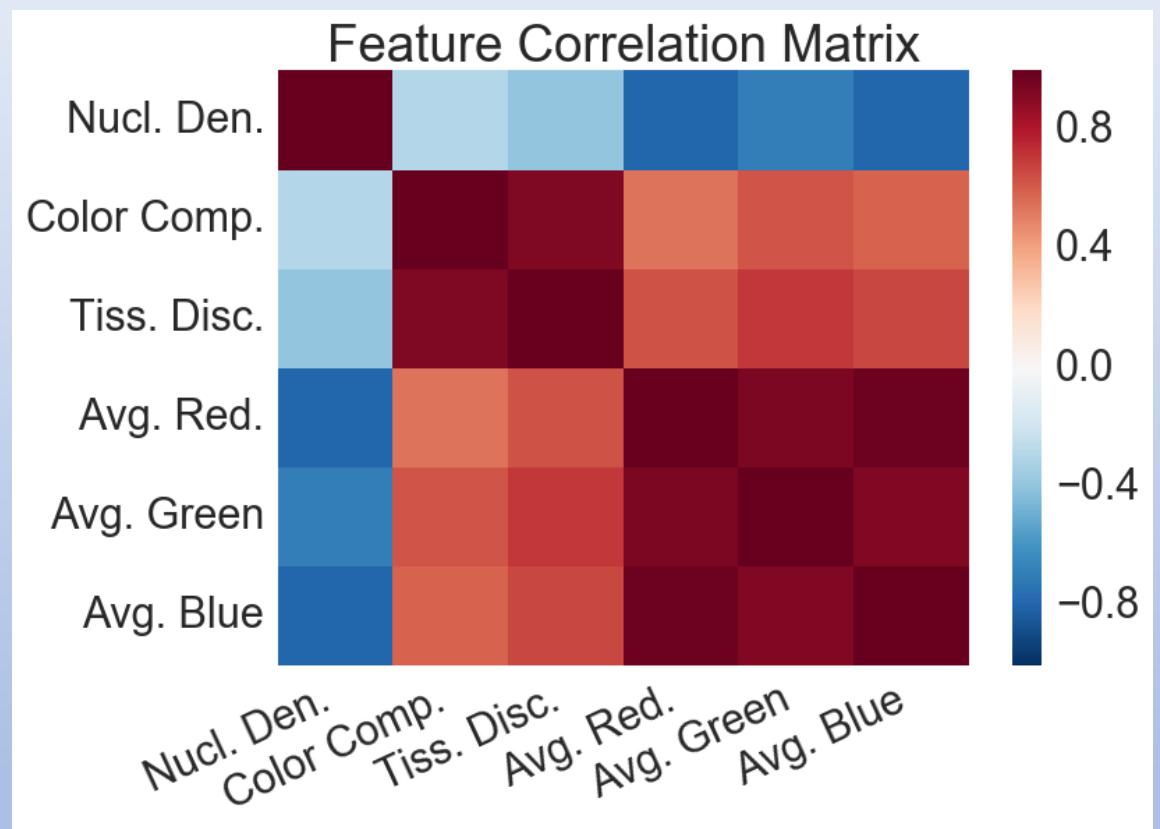
Unsupervised learning!

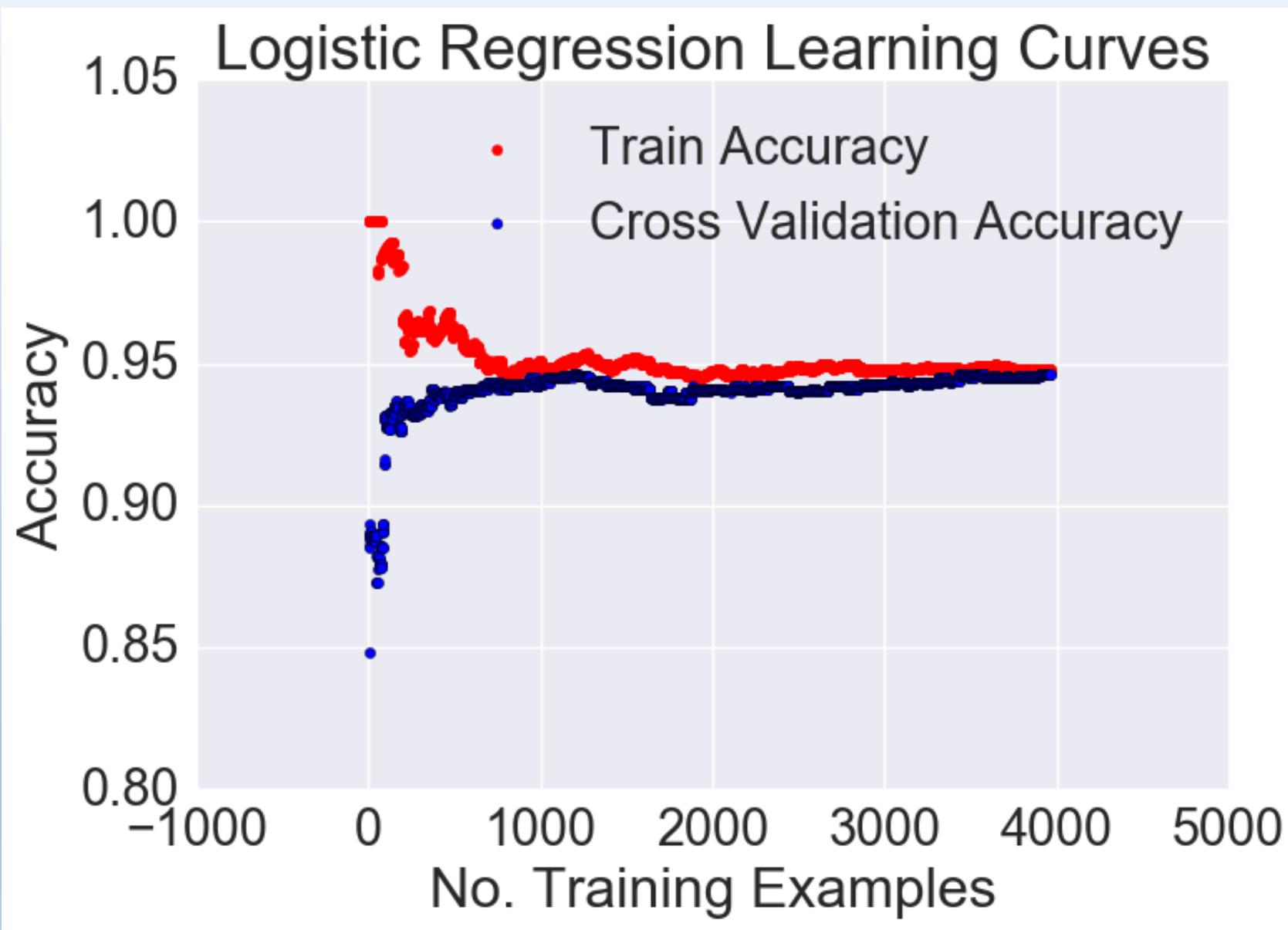


Blob detection vs watershed



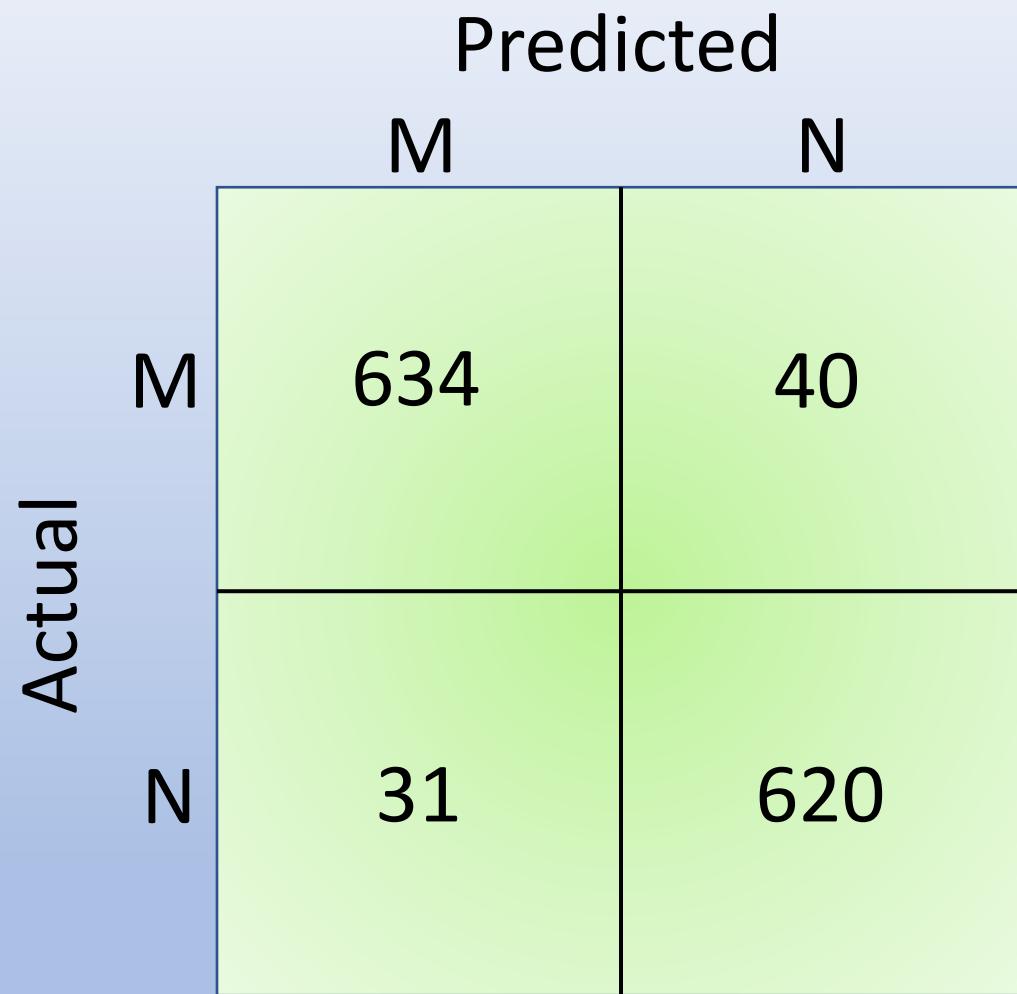




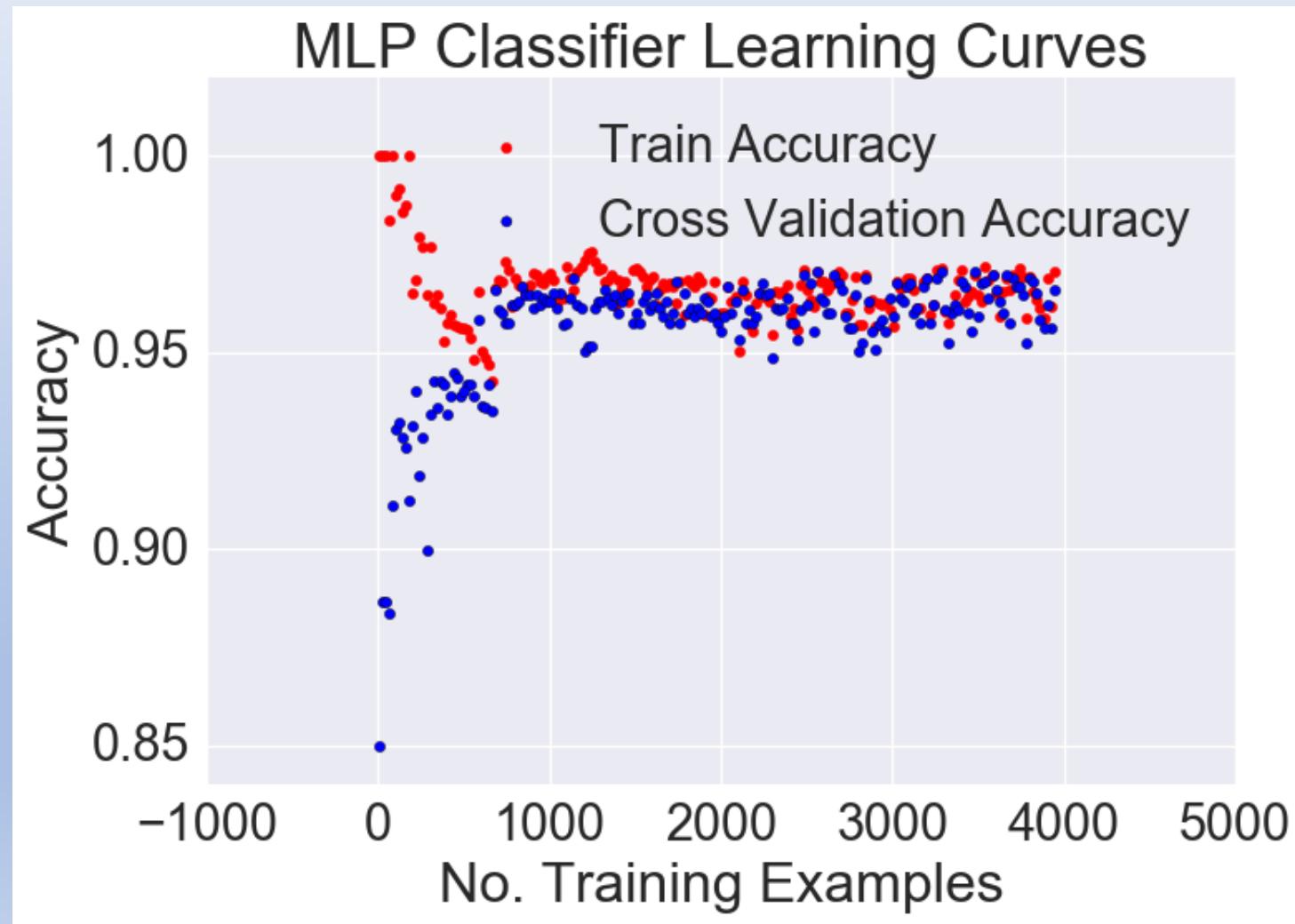


Logistic regression

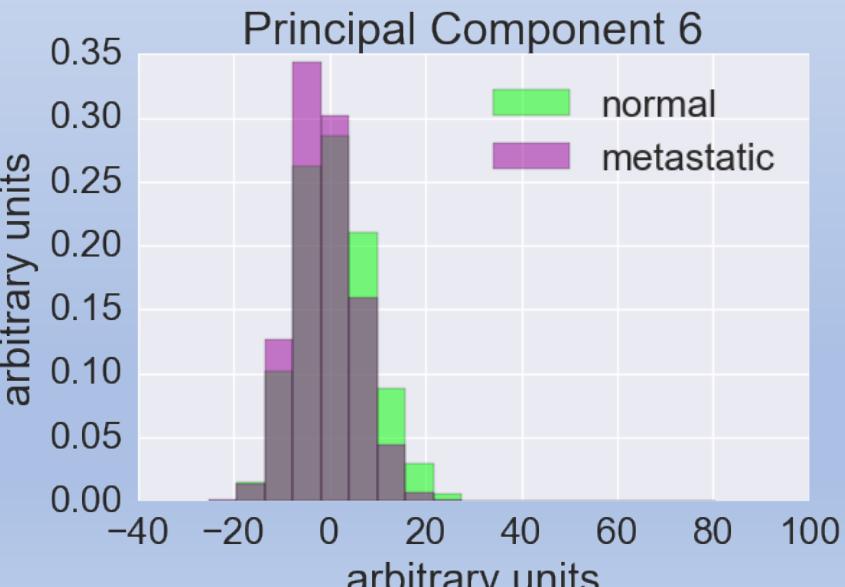
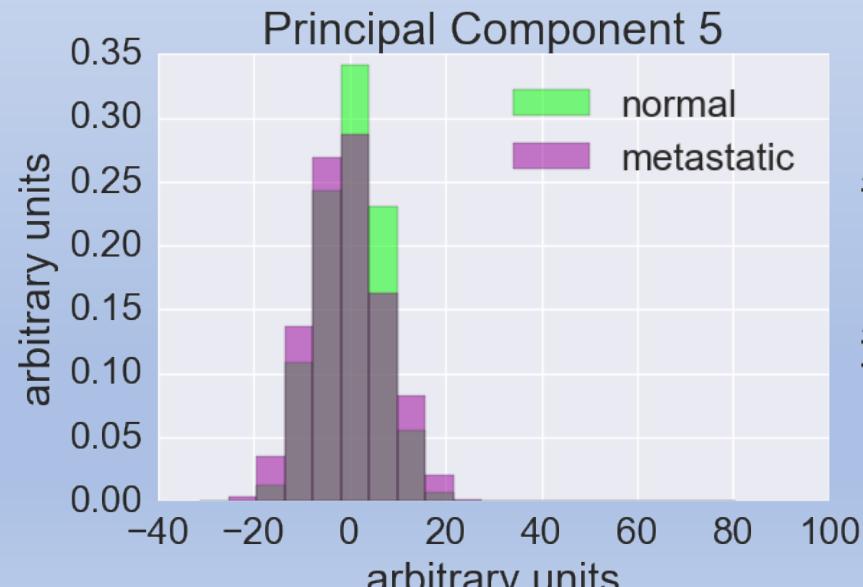
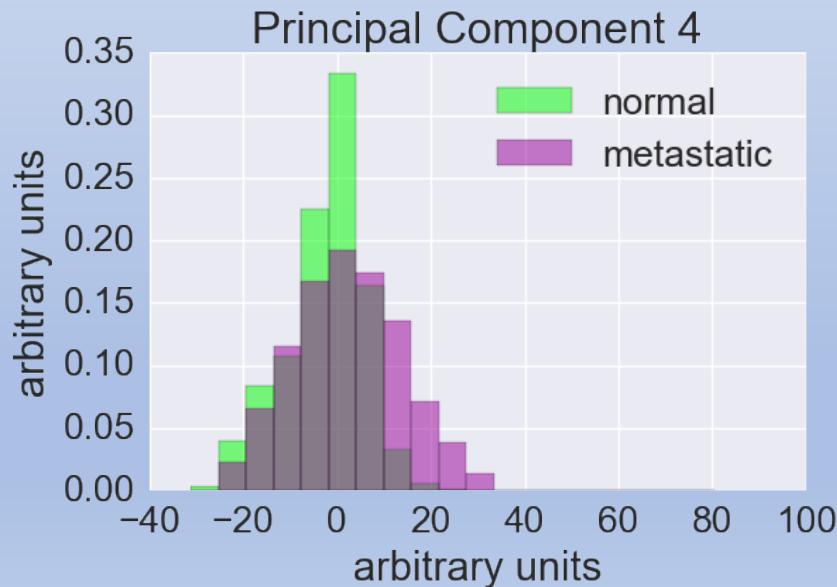
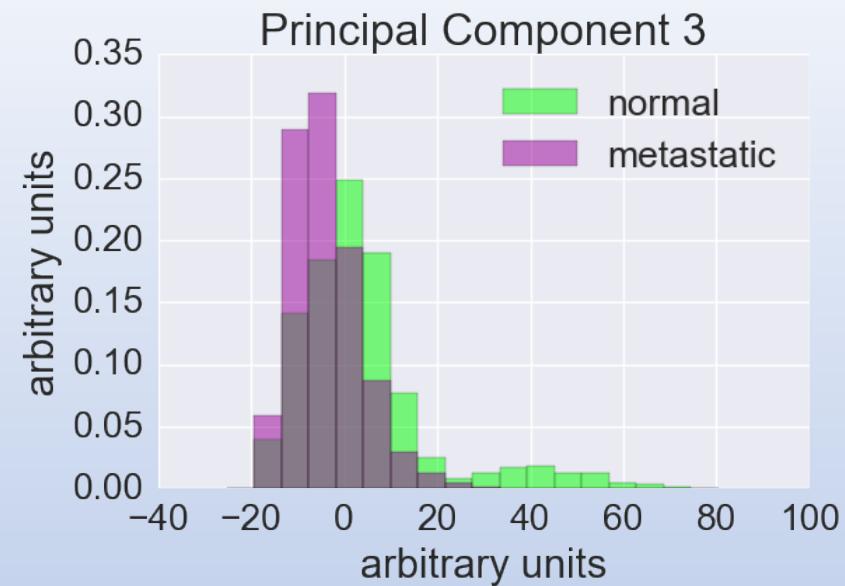
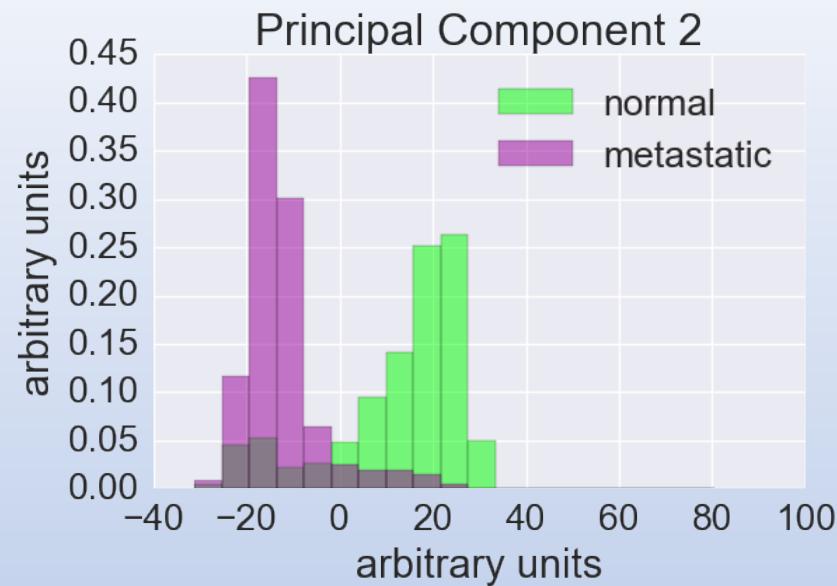
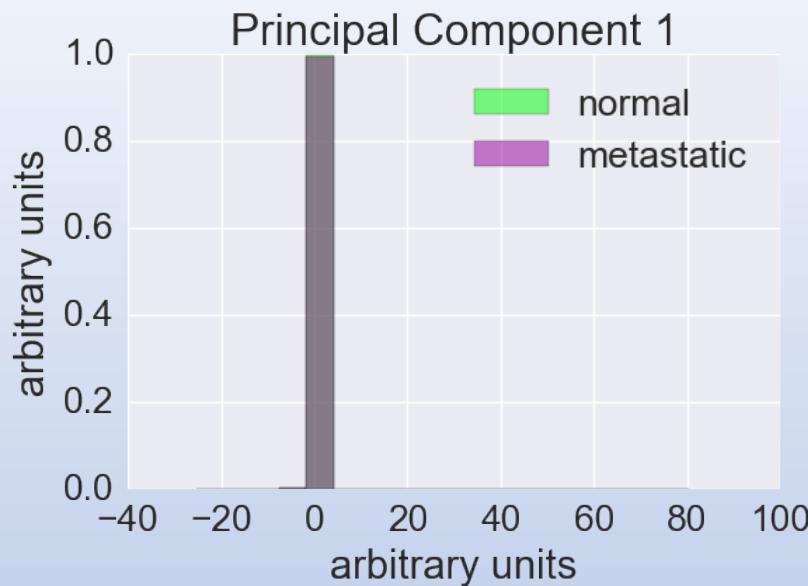
Metric	Score
Accuracy	0.946
Precision	0.953
Recall	0.941
F1	0.947

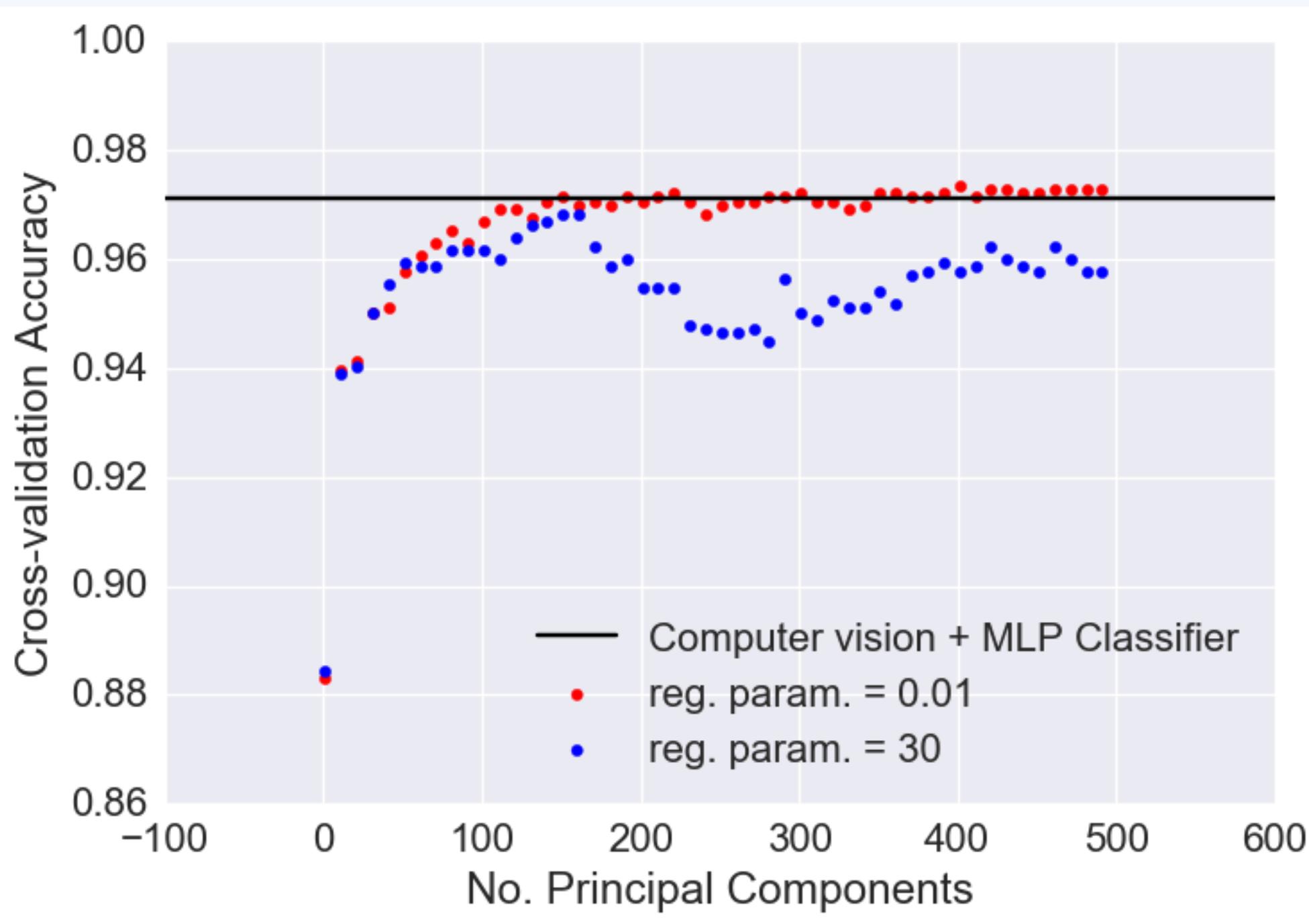


MLP Classifier with CV features



Transfer learning







Transfer learning

Metric	Score
Accuracy	0.969
Precision	0.966
Recall	0.973
F1	0.970

