

## Translational Pathology Program



Beatrice S. Knudsen MD PhD  
(pathologist)

**Molecular &  
Computational  
Pathology**



Arkadiusz Gertych PhD  
(biomedical engineer)

**Biolmage Informatics,  
Image Analysis**

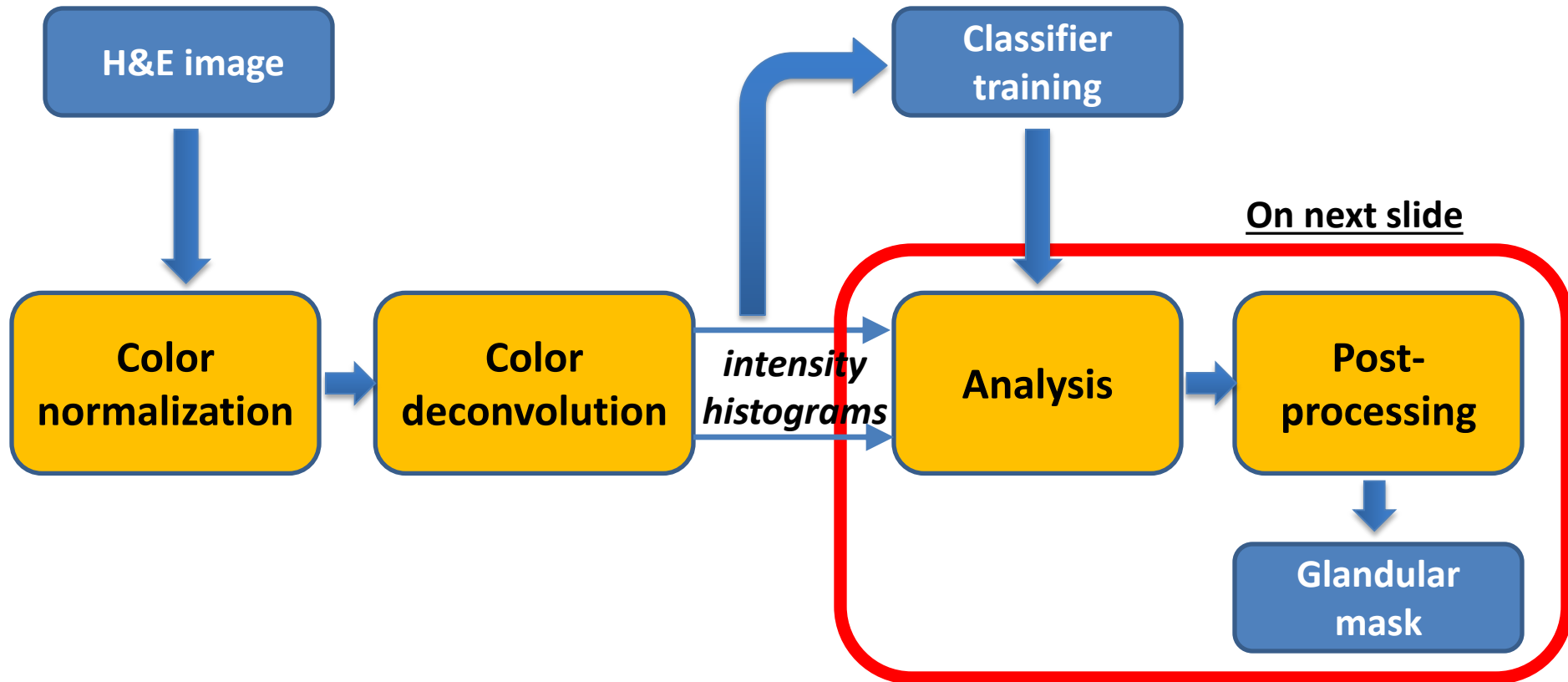


Nathan Ing BS



Zhaoxuan Ma MS

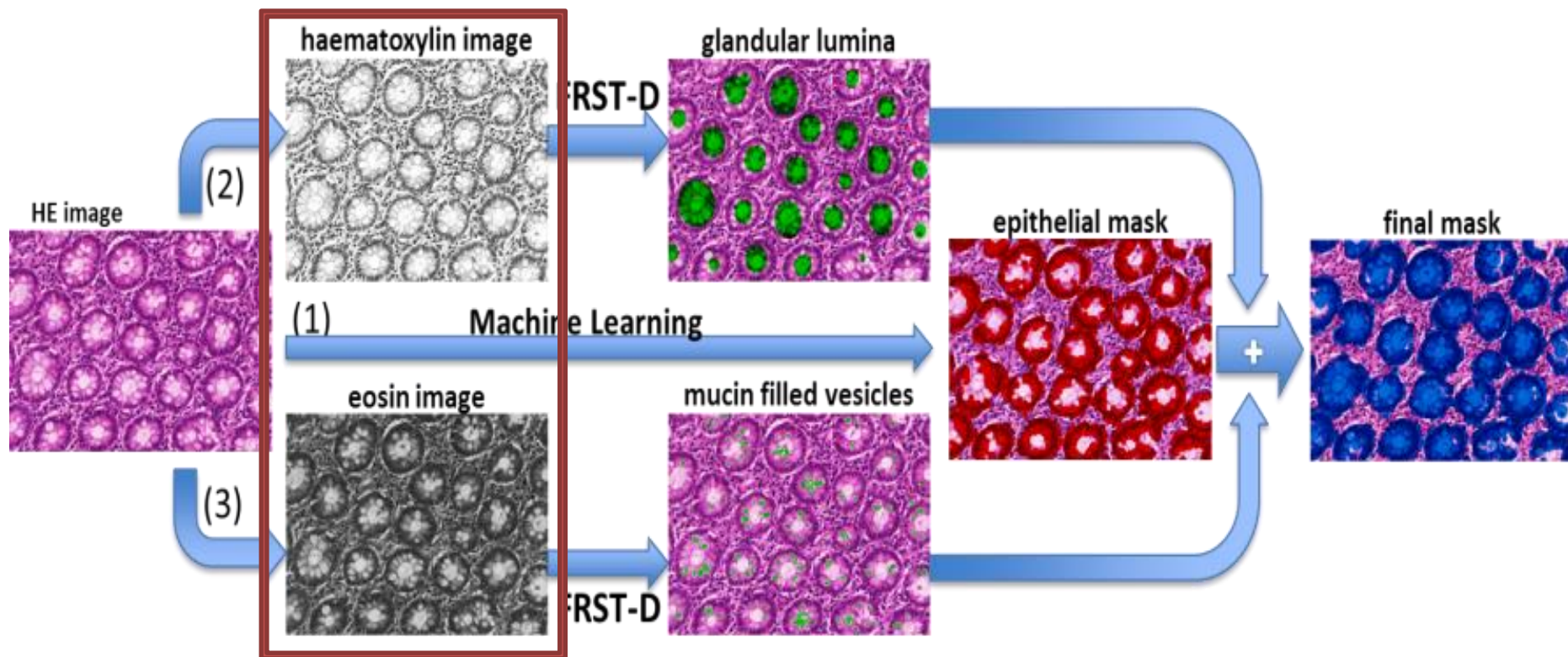
# Segmentation of epithelial components in complex HE images of the colon



## Analysis:

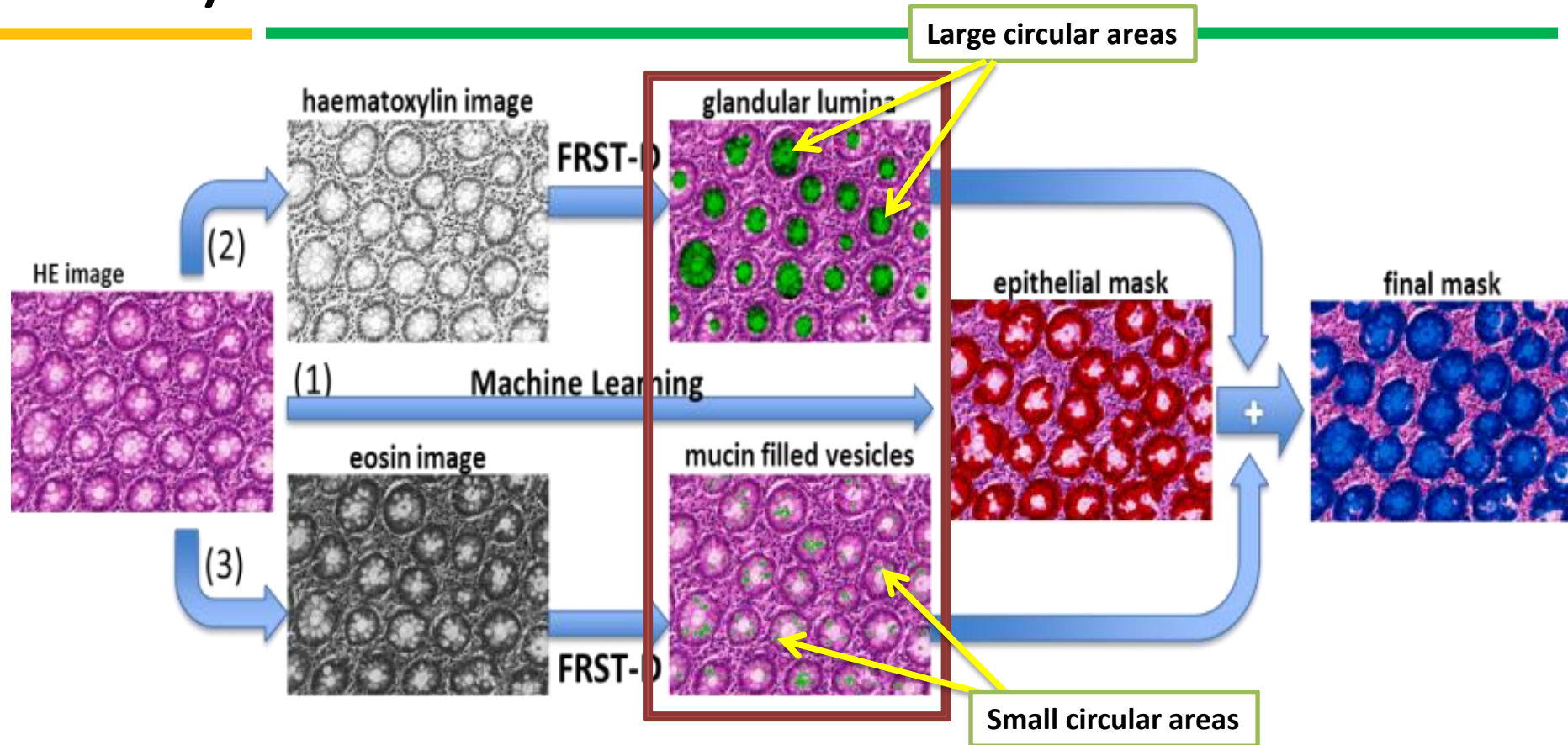
- Machine Learning (ML) to detect epithelium (pixel classification)
- Fast radial symmetry transform (FRST-D) to detect circular structures
- Post-processing: watershed-based post processing to split glands

# Analysis workflow - Preprocessing

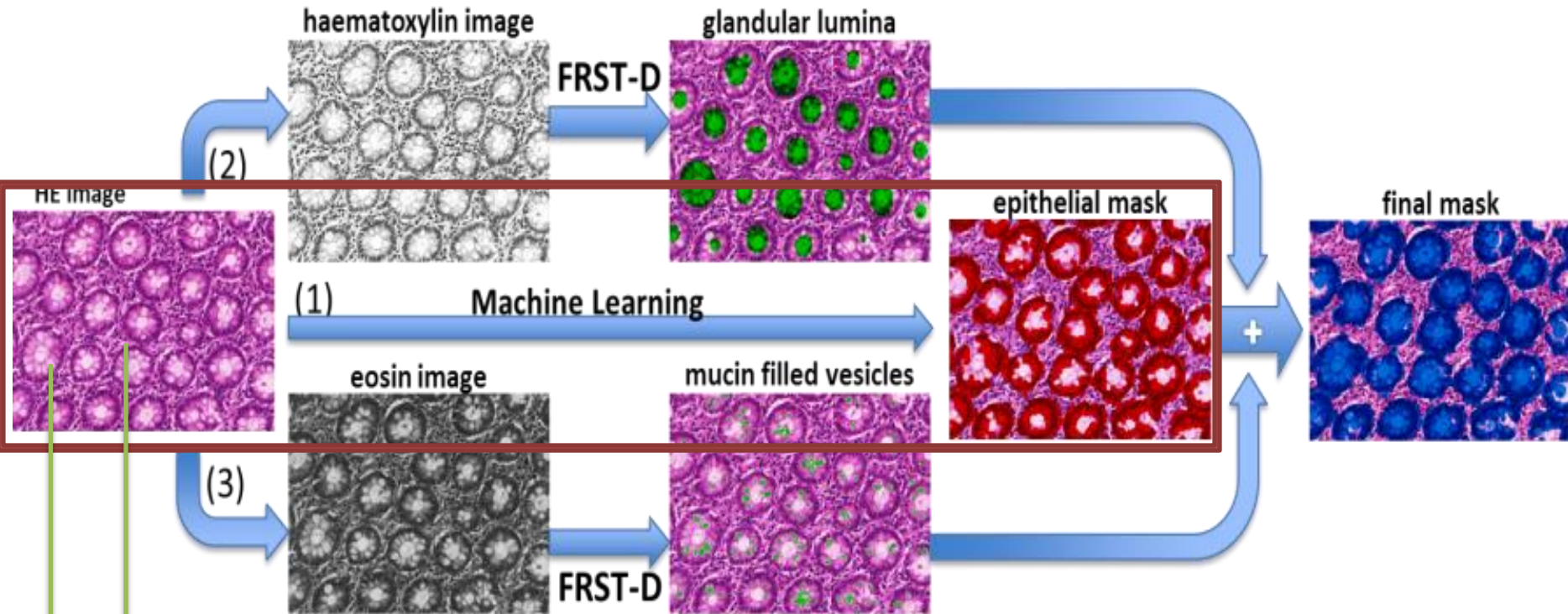


1. Color normalization
2. Color deconvolution to obtain separate Haematoxylin & Eosin intensity images

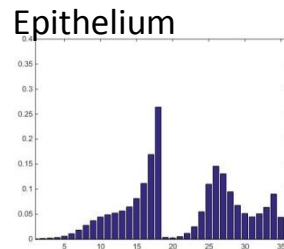
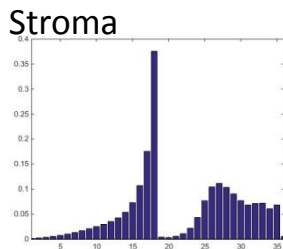
# Analysis workflow - FRSTD



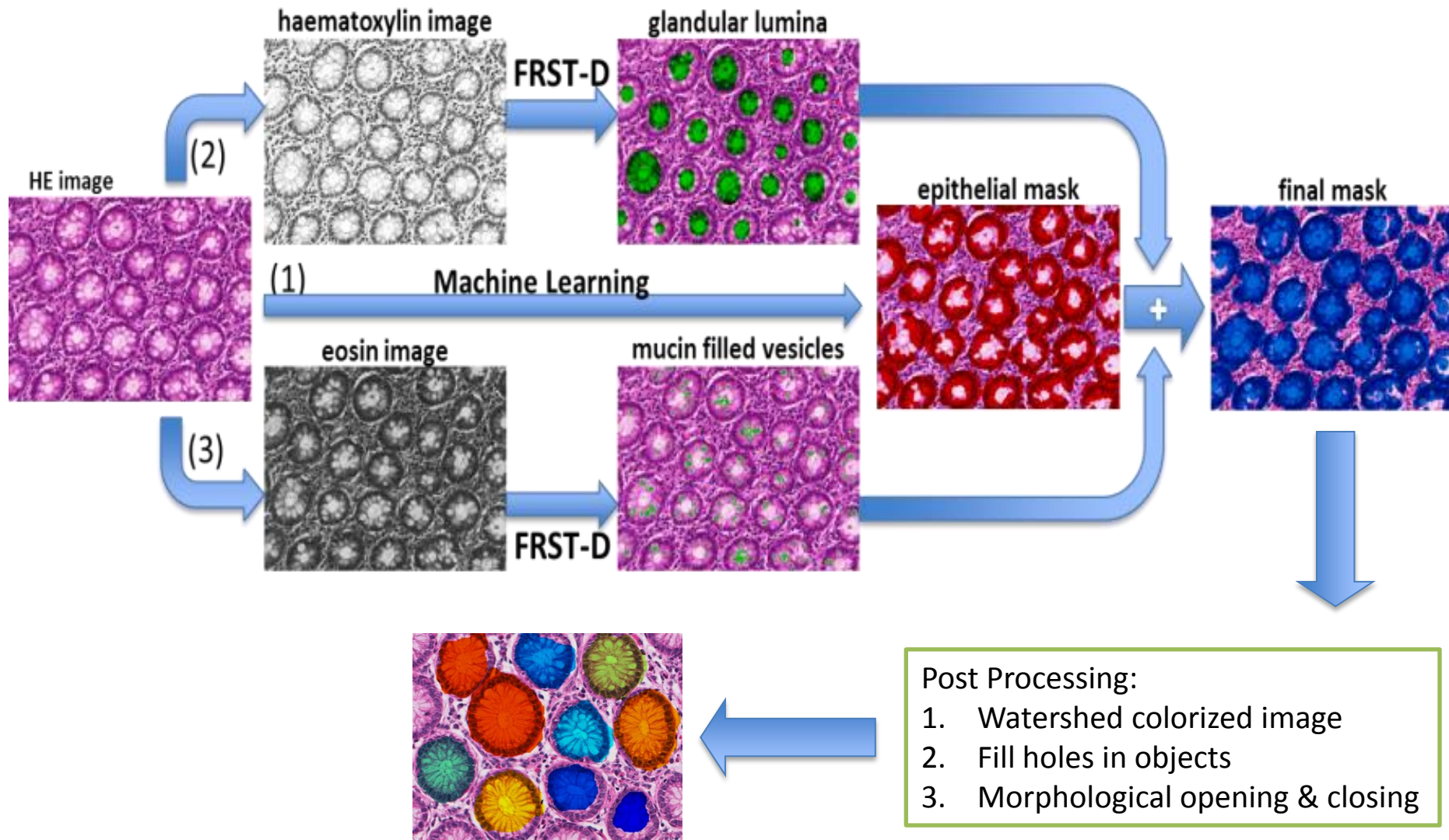
# Analysis workflow – Machine Learning



## H&E Intensity Histograms for Machine Learning



# Analysis workflow - Postprocessing



# Performance Measures

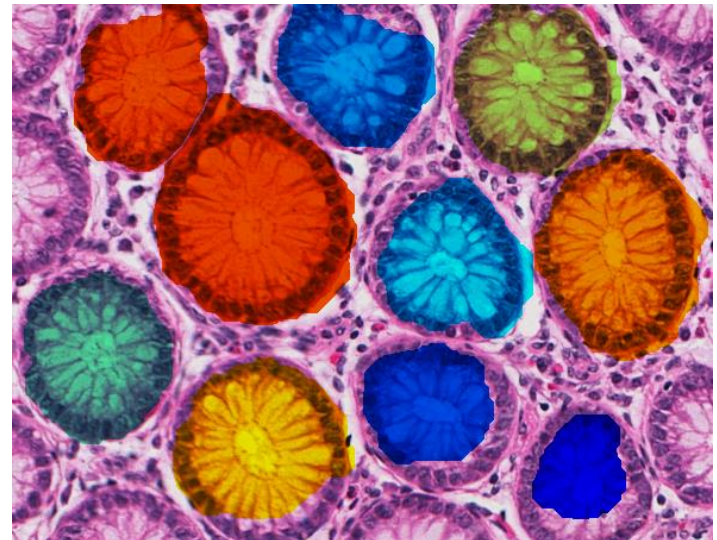
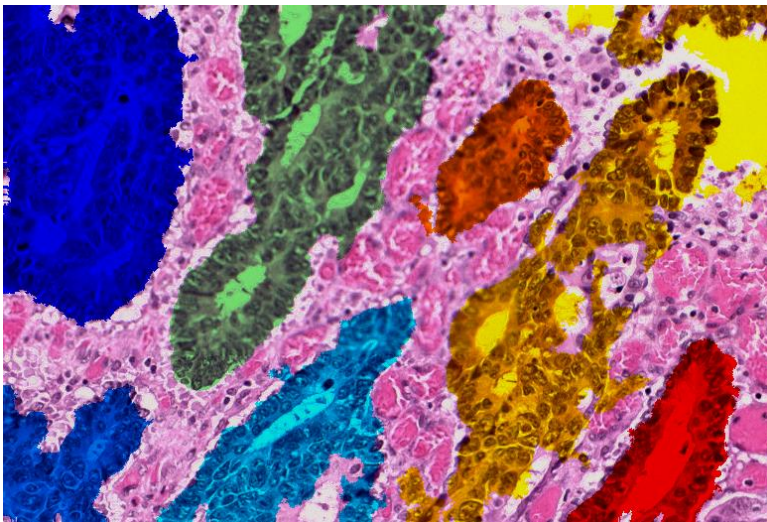
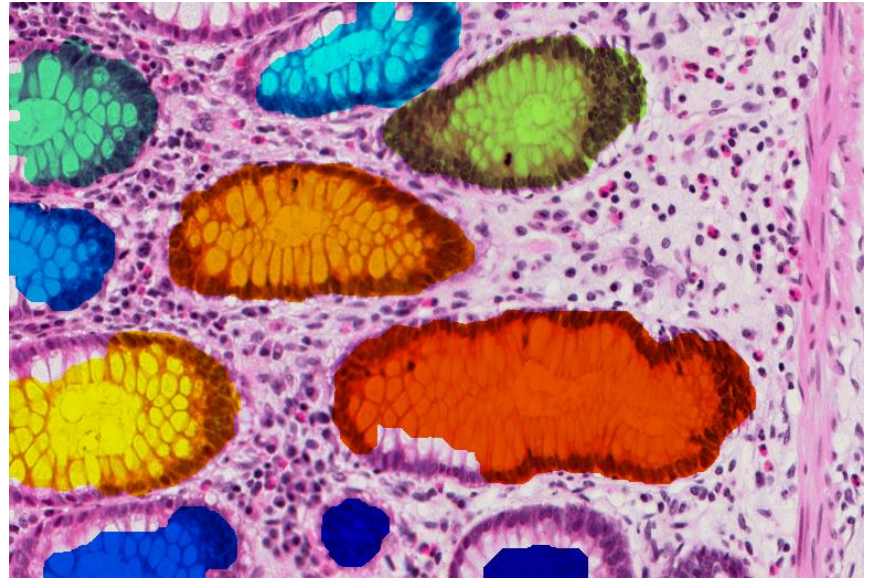
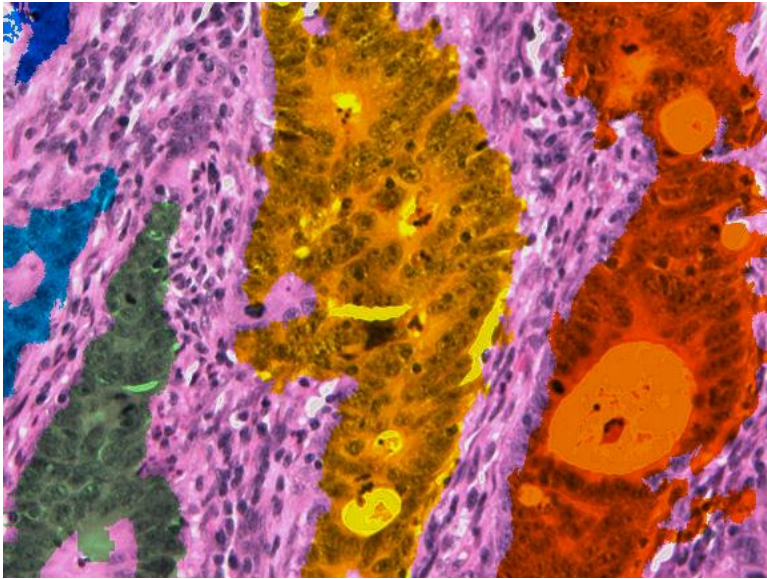
	Training set (n=85)	Training subset* (n=24)	Part A*** (n=60)
Hausdorff	128.14±99.78	122.3±73	152.48±84.78**
Dice Coefficient	0.70±0.16	0.69±0.17	0.71±0.16**
F1	0.59±0.22	0.55±0.26	0.78 (47/60)
Jaccard Index**	0.67±0.17	0.65±0.17	0.57±0.17
Overlap**	0.73±0.19	0.72±0.19	0.65±0.21
Run Time	~11 minutes	~3.5 minutes	~7.5 minutes

\* Images from the training set not used in classifier training

\*\* Pixel-level, considering the “epithelial mask” as one object

\*\*\* On annotations made by a team member

# Example Result Images (Dataset A)





# References

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Ruifrok, AC., Johnston, DA., **Quantification of histochemical staining by color deconvolution.** *Anal Quant Cytol Histol* (2001), pp.291-299.

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Loy, G.; Zelinsky, A., **Fast radial symmetry for detecting points of interest.** *Pattern Analysis and Machine Intelligence, IEEE Transactions on* , vol.25, no.8, pp.959-973, Aug. 2003

Gertych, A., et al., **Machine learning approaches to analyze histological images of tissues from radical prostatectomies.** *Comput Med Imaging Graph.* 2015 (in press)