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WHITING SCHOOL of ENGINEERING SURGICAL®

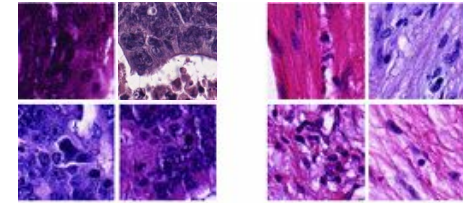
EN.601.482/682 Deep Learning

Modeling A Transferable Histopathological Image Analysis System

Hadley VanRenterghem, Matt Figdore, Max Xu, Taha Baig

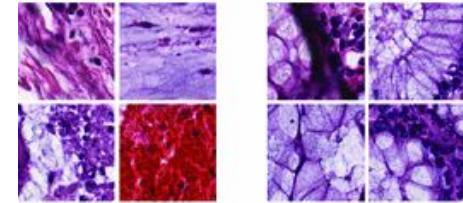
Problem

Colorectal Cancer Histology



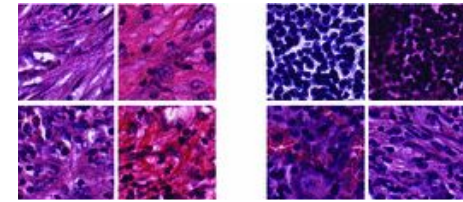
Tumor

Stroma Simple



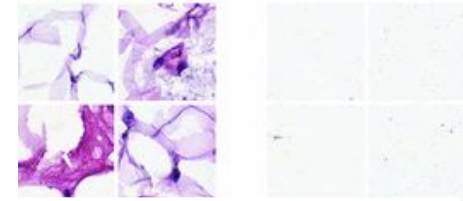
Debris

Mucosa



Stroma Complex

Lymphocytes

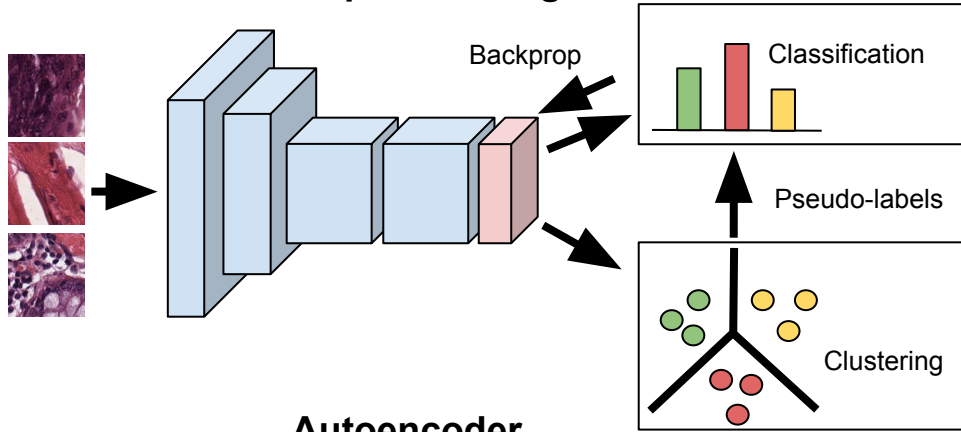


Adipose

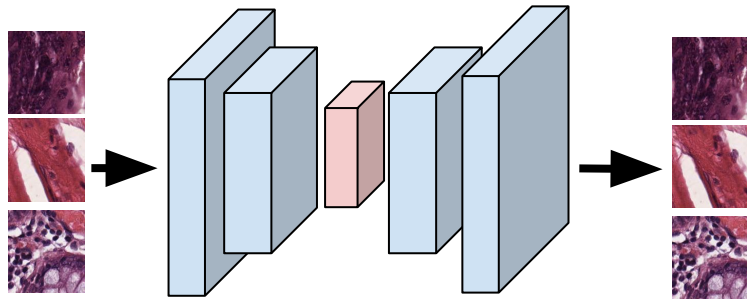
Empty

Unsupervised Approach

Deep Clustering

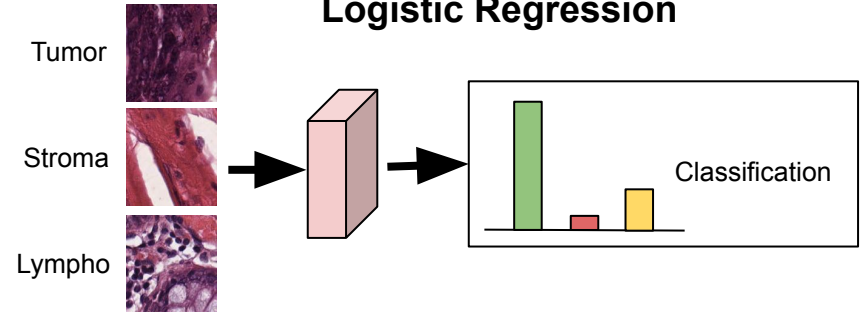


Autoencoder

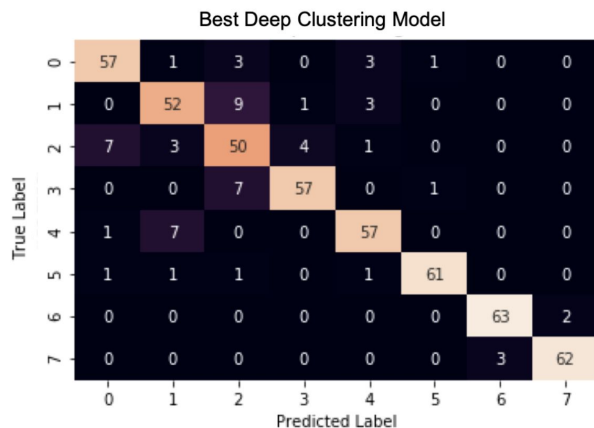
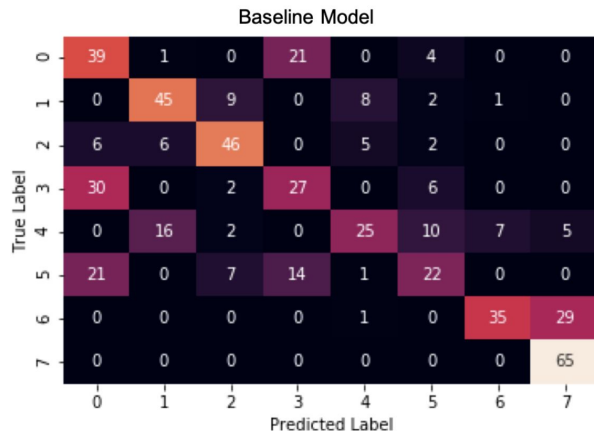


Evaluation Approach

Logistic Regression



Confusion Matrix

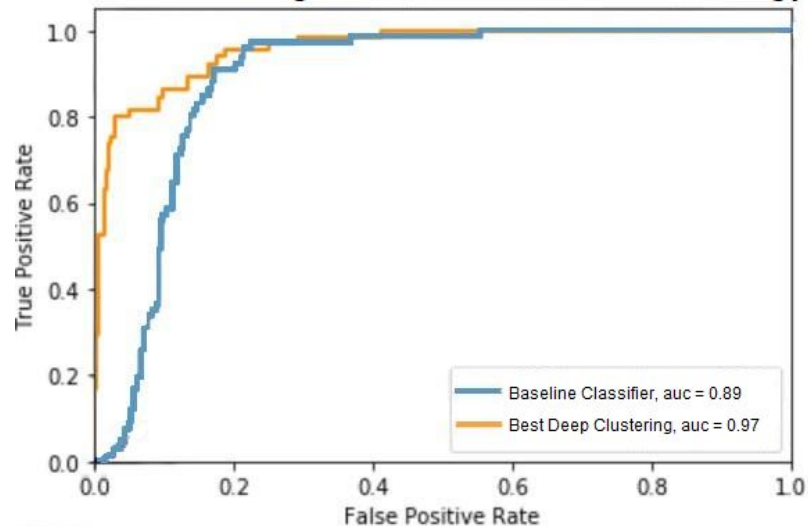


Legend

- 0 : Tumor
- 1 : Stroma
- 2 : Complex
- 3 : Lympho
- 4 : Debris
- 5 : Mucosa
- 6 : Adipose
- 7 : Empty

ROC Curve

Tumor Recognition for Colorectal Histology



Classification Accuracy

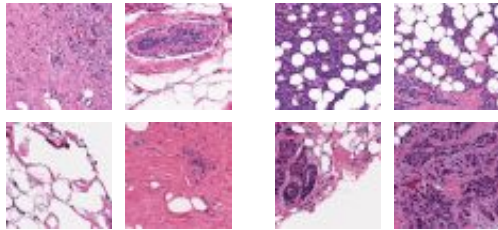
Baseline Classifier: 58%

Best Deep Clustering: 88%

Best Autoencoder: 35%

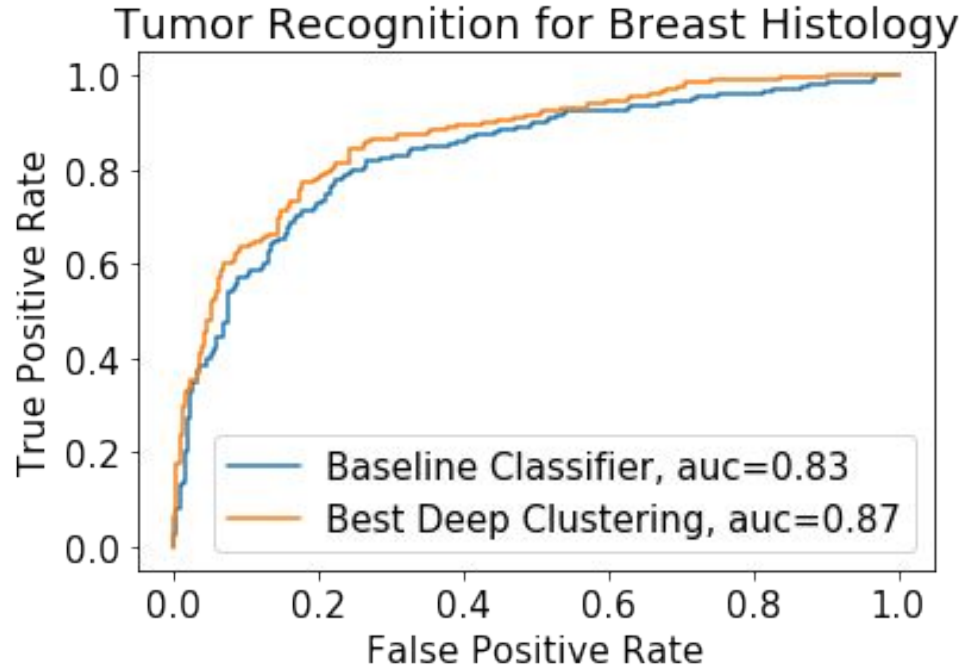
Transfer Learning Results

Breast Cancer Histology



No Tumor

Tumor



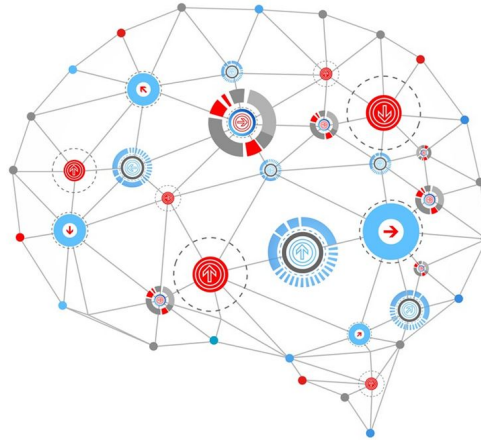
Next Steps

Deep Clustering

- **Scale** up training dataset
- **Combine** k-means loss and cluster prediction loss
- Explore various CNN architectures (e.g. **VGG16**)

Autoencoder

- Integrate **deep clustering** technique



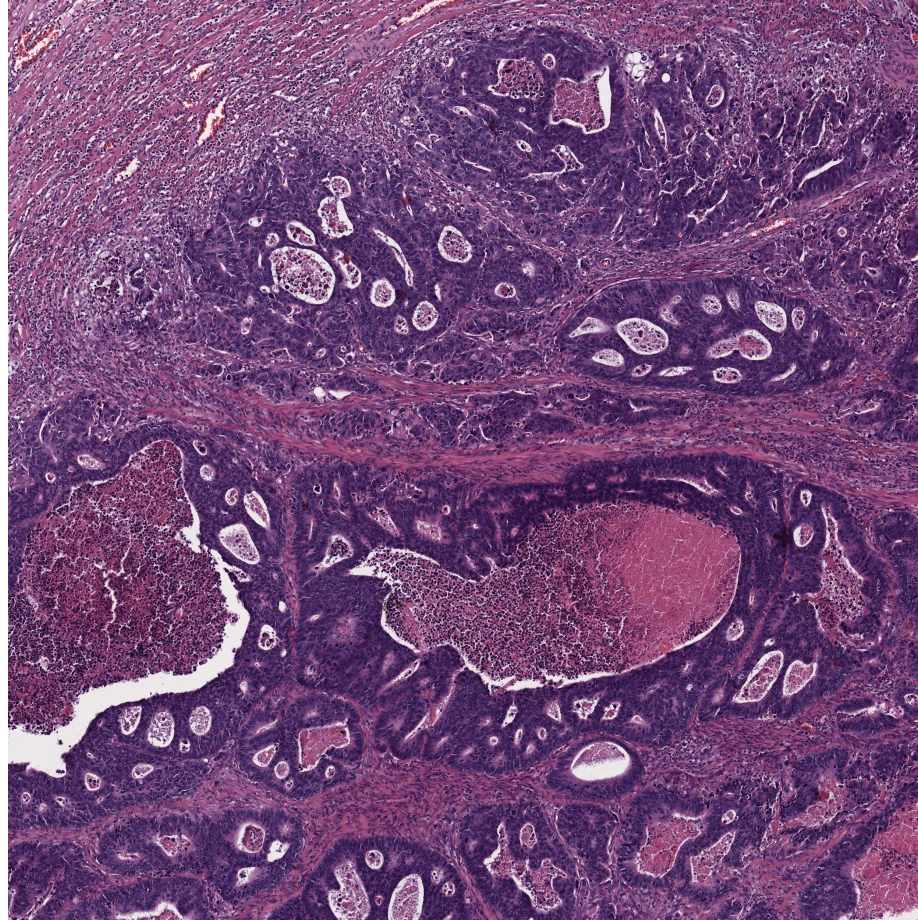
Domain Transfer

- Include greater **variety** of histology images
- Introduce better **stain normalization**

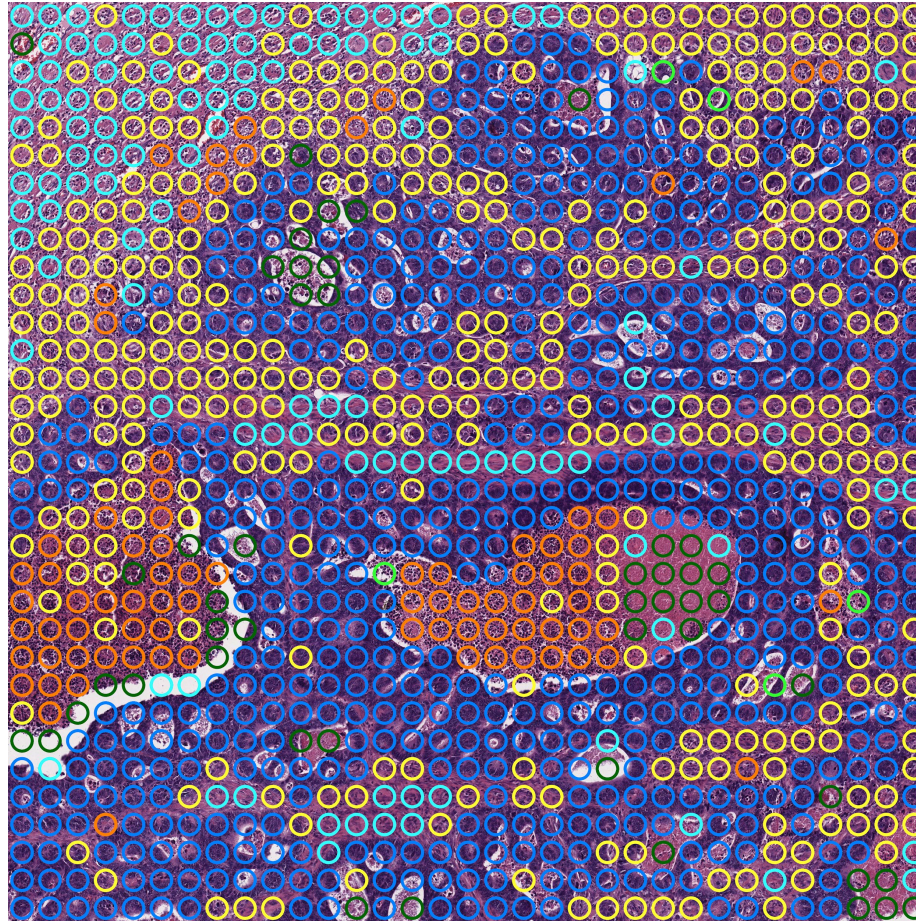
Whole Slide Demo



Original Image

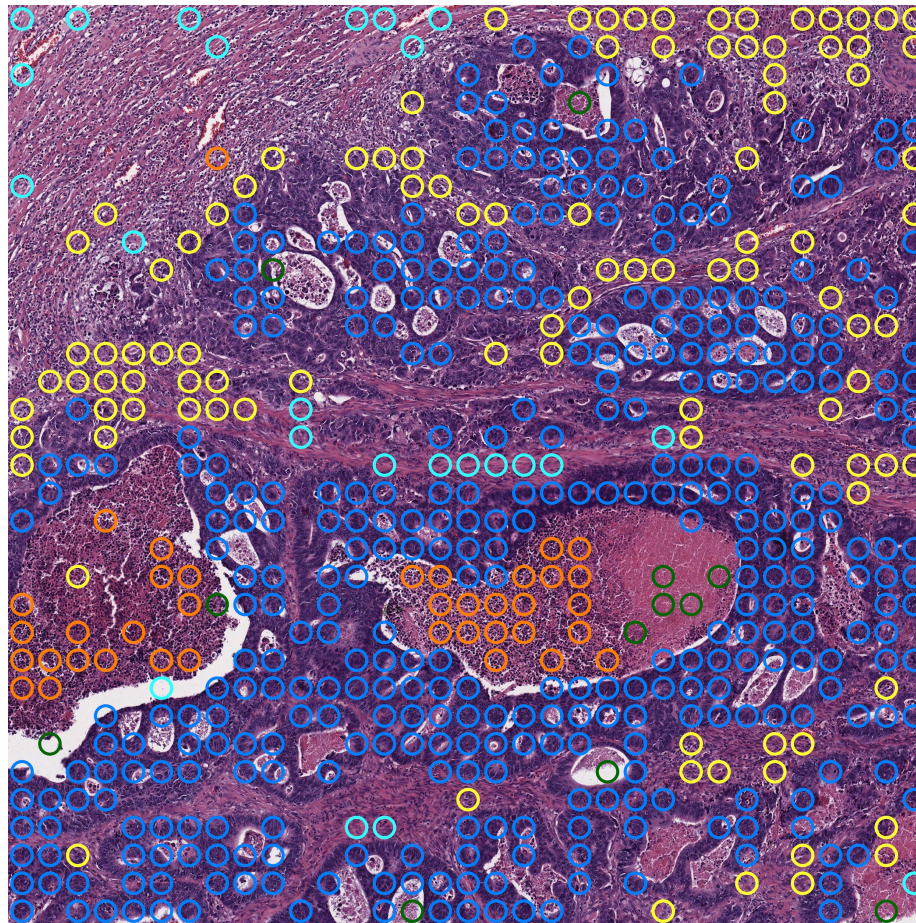


Classification



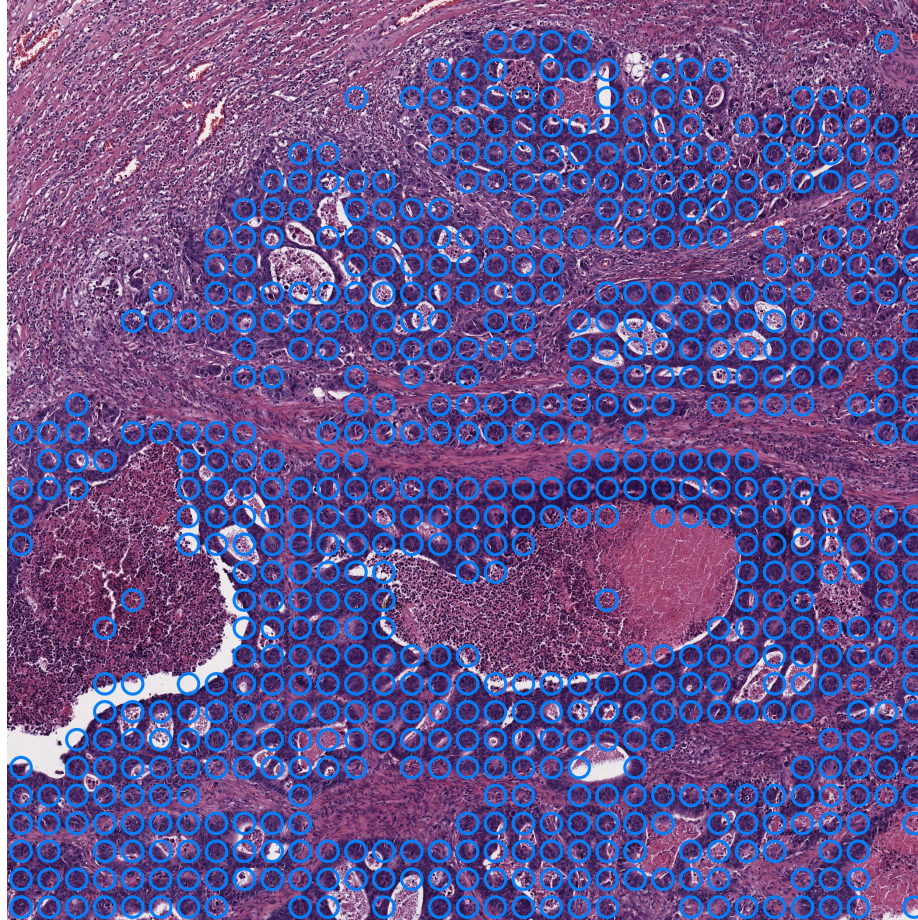
tumor	blue
stroma	cyan
complex	yellow
lympho	orange
debris	green
mucosa	light green
adipose	red
empty	black

.80+ Score

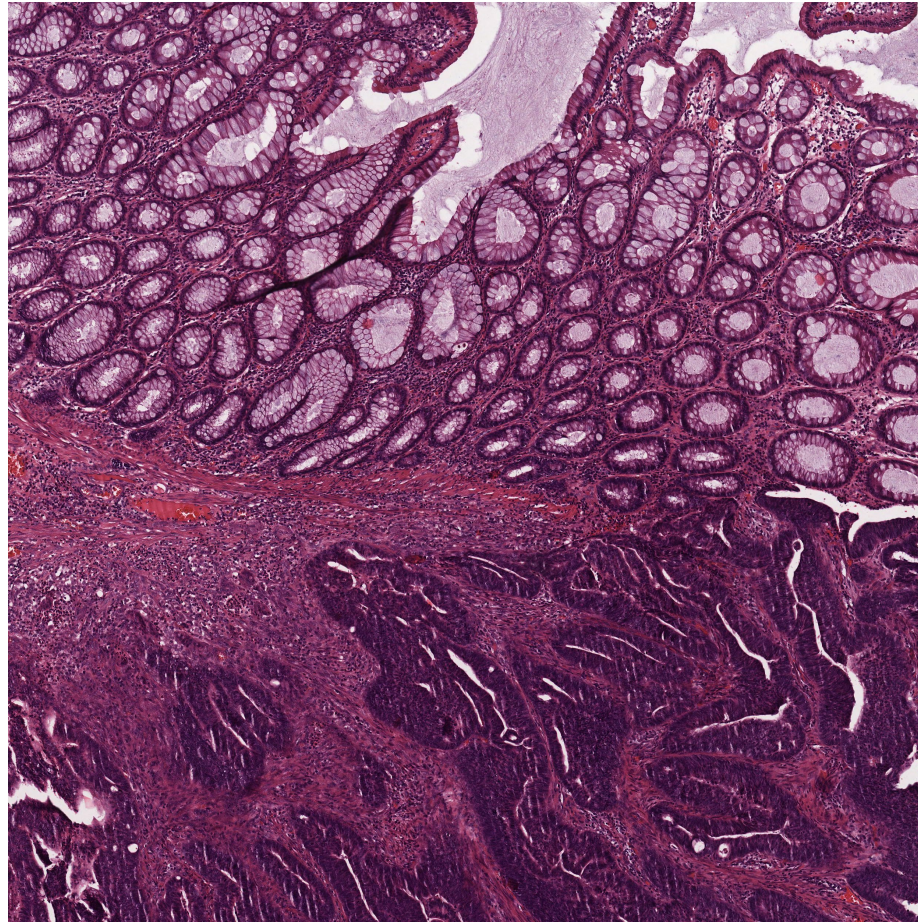


tumor	Blue
stroma	Cyan
complex	Yellow
lympho	Orange
debris	Green
mucosa	Light Green
adipose	Red
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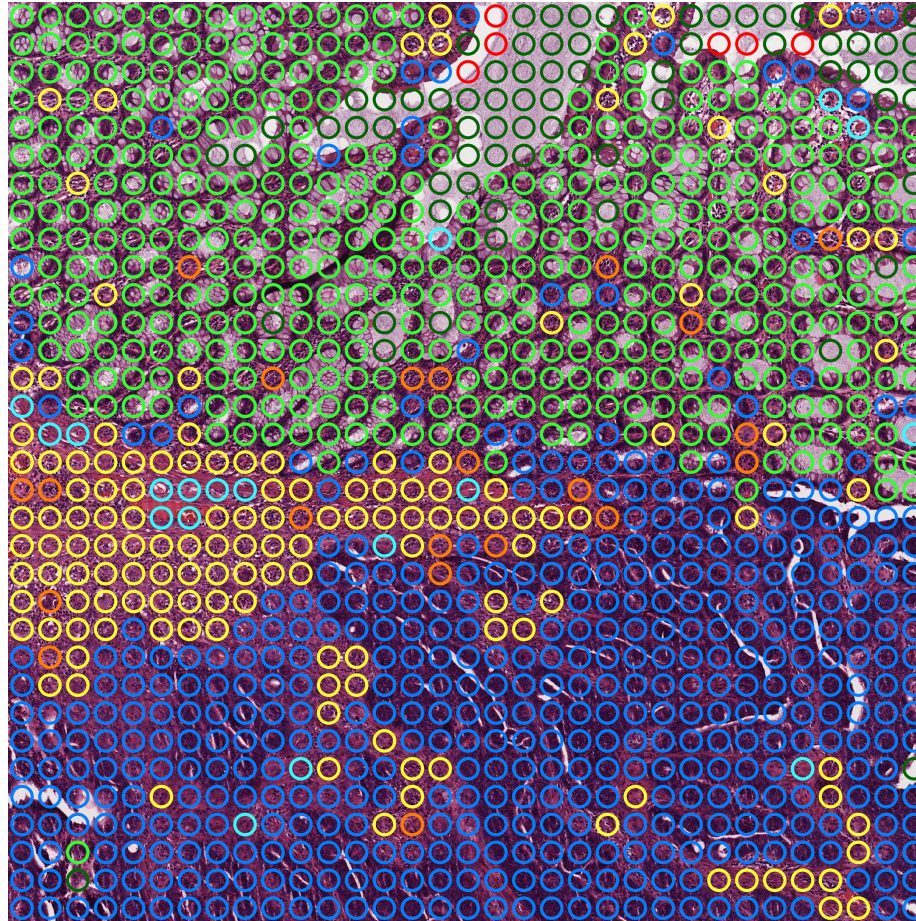
.125+ Tumor



Original Image

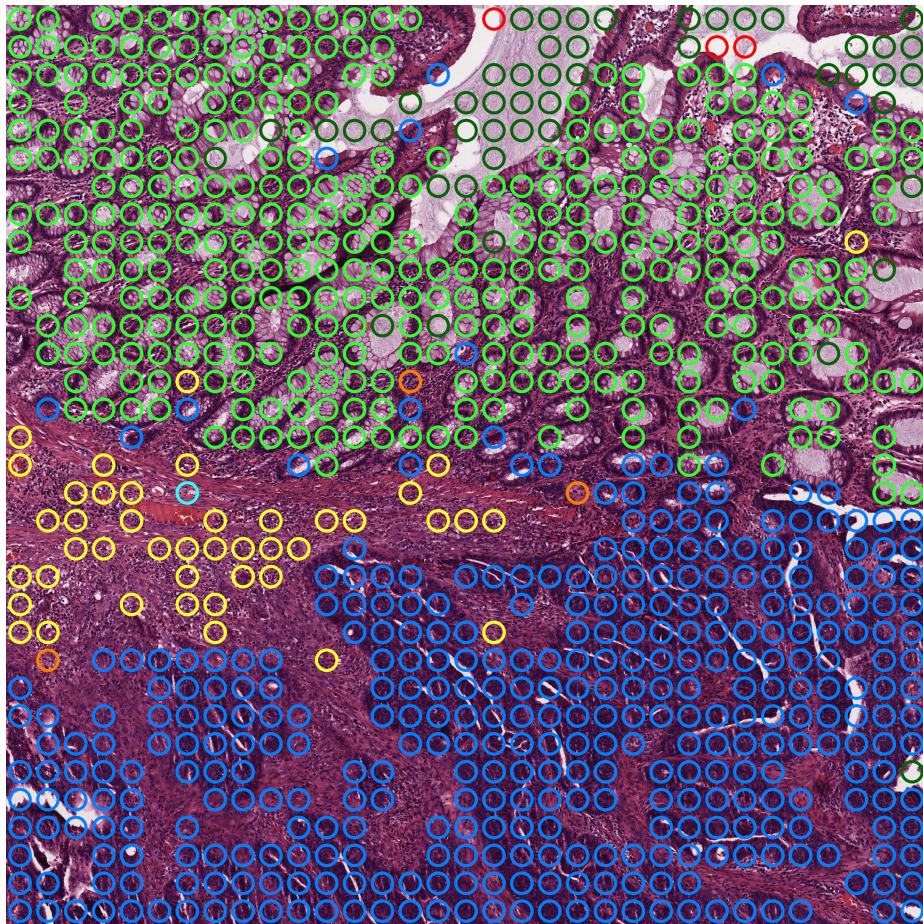


Classification



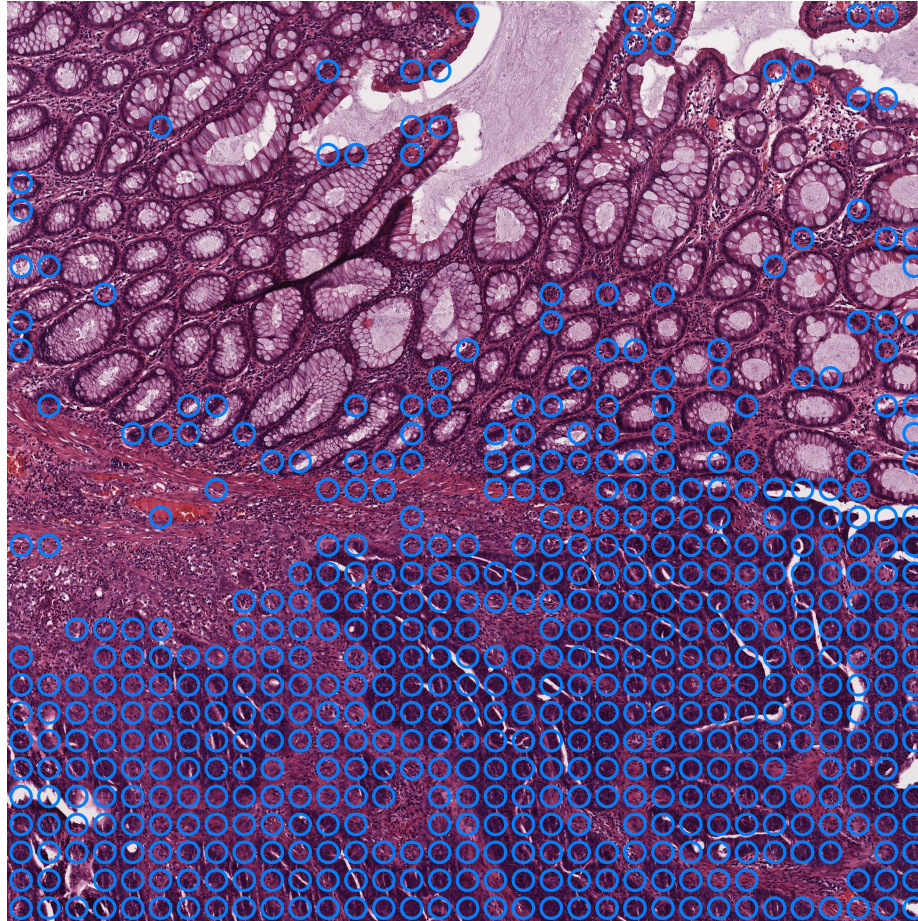
tumor	Blue
stroma	Cyan
complex	Yellow
lympho	Orange
debris	Dark Green
mucosa	Bright Green
adipose	Red
empty	Black

.80+ Score

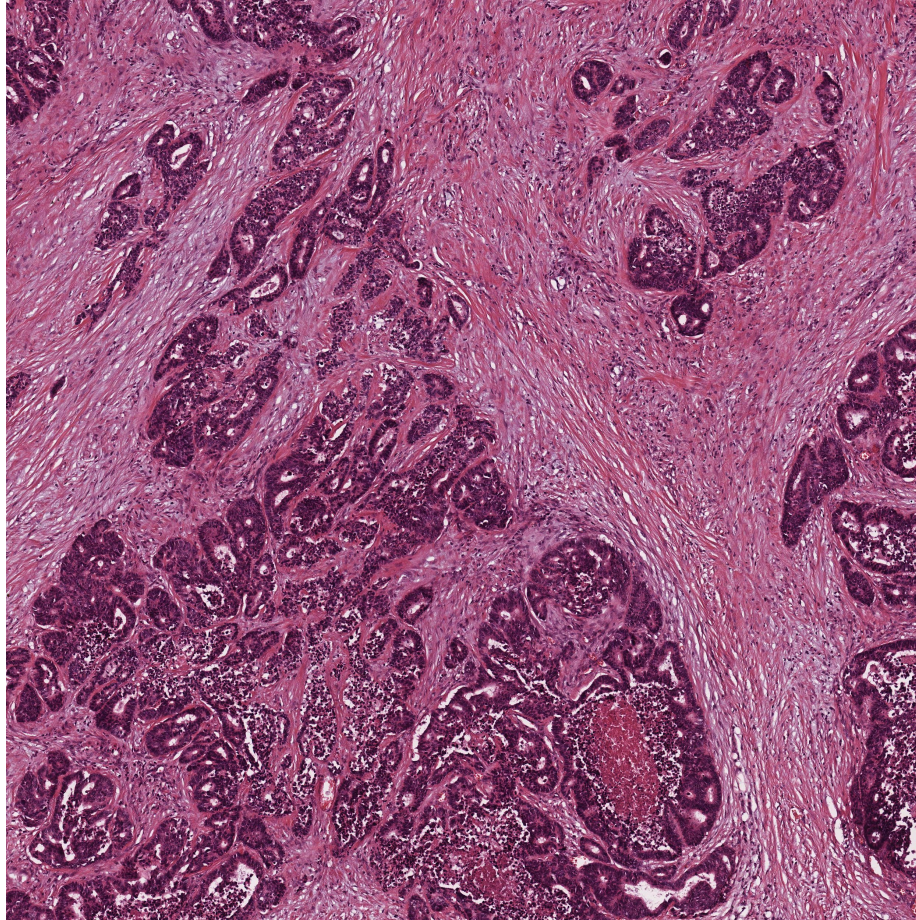


tumor	Blue
stroma	Cyan
complex	Yellow
lympho	Orange
debris	Dark Green
mucosa	Light Green
adipose	Red
empty	Black

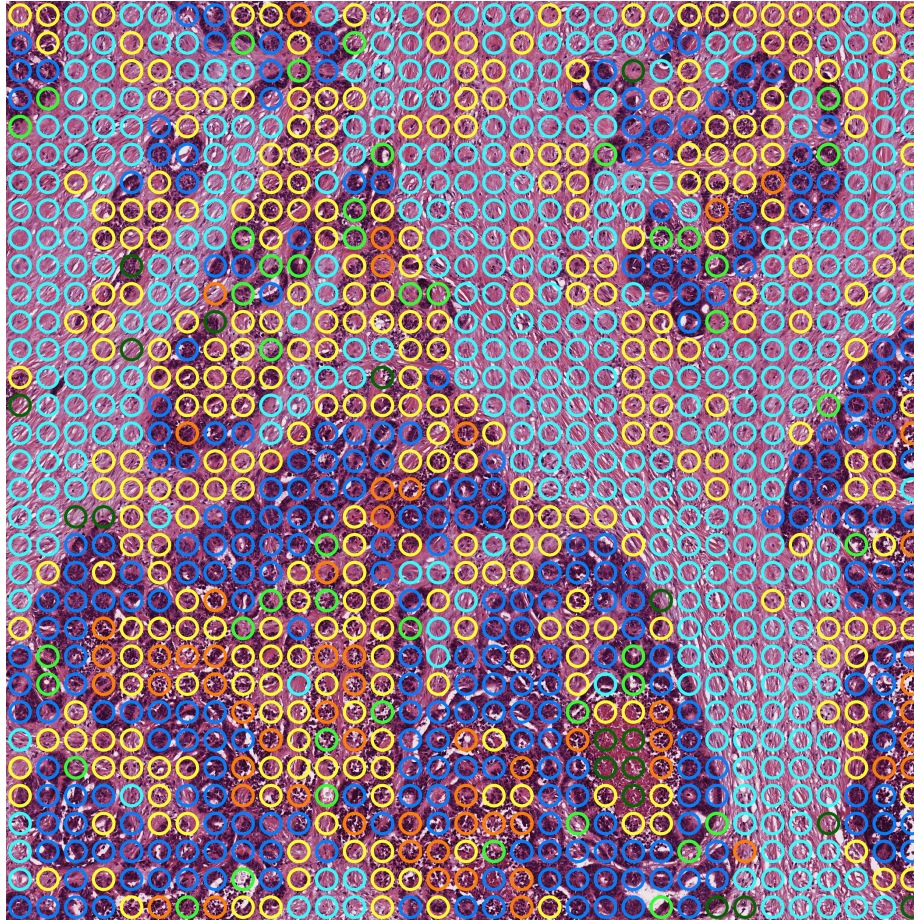
.125+ Tumor



Original Image

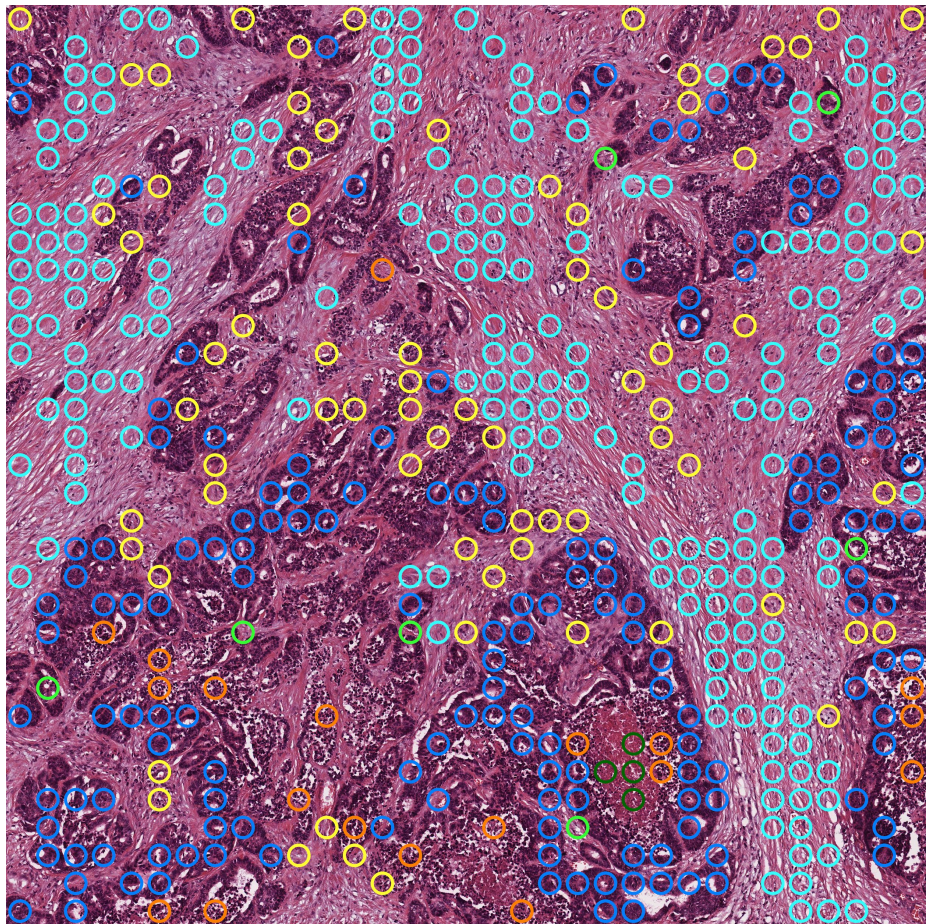


Classification



tumor	Blue
stroma	Cyan
complex	Yellow
lympho	Orange
debris	Green
mucosa	Bright Green
adipose	Red
empty	Black

.80+ Score



tumor	Blue
stroma	Cyan
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.125+ Tumor

