

# Graph Based Classification of Glands in Colorectal Cancer

*Master Thesis Presentation  
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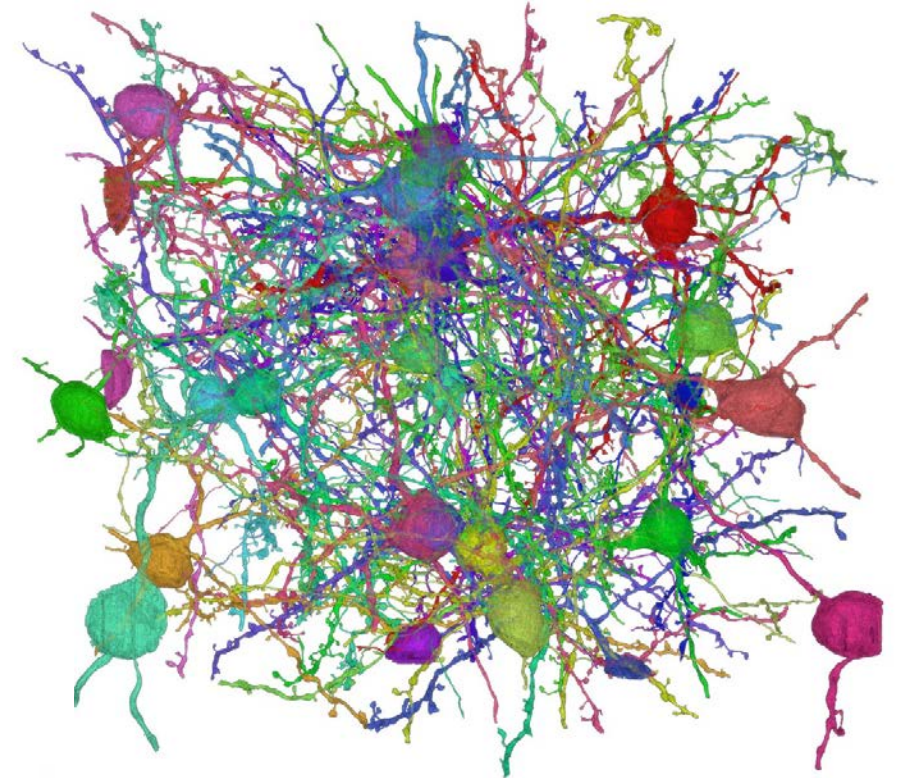
# Project aim

- ▶ Classify normal and dysplastic glands in pT1 WSIs
- ▶ Input graphs instead of images to the classifier

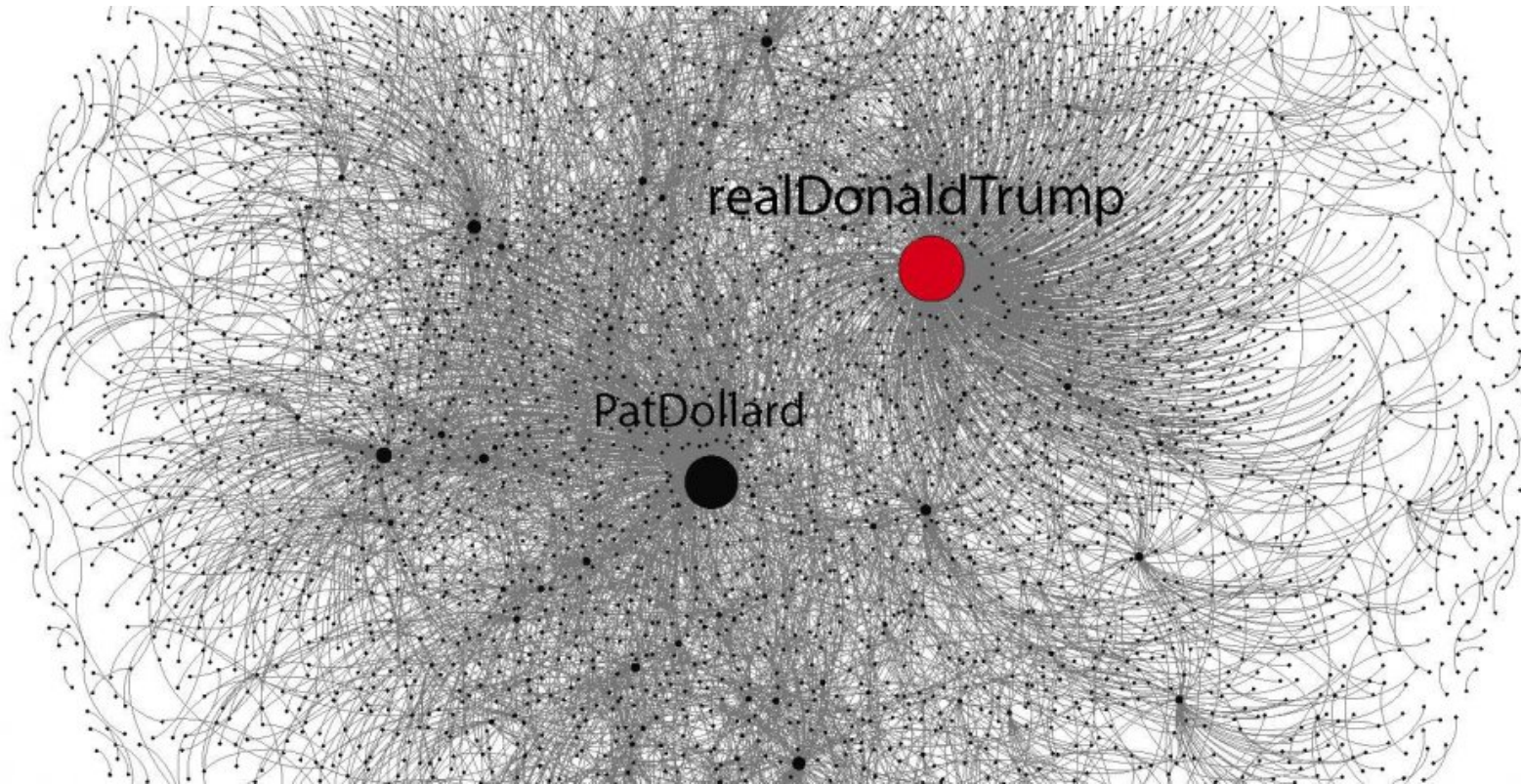


# What are graphs?

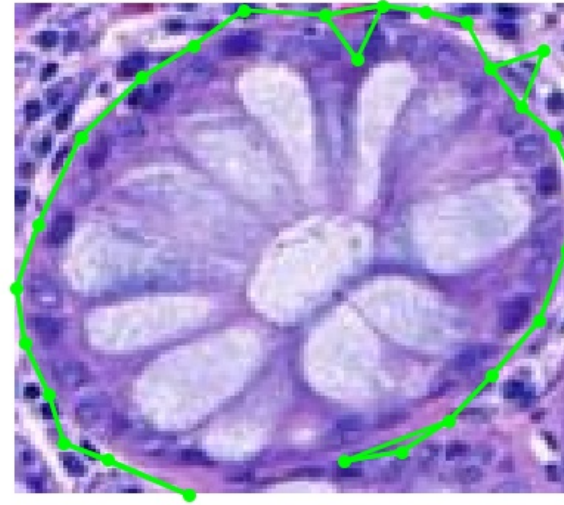
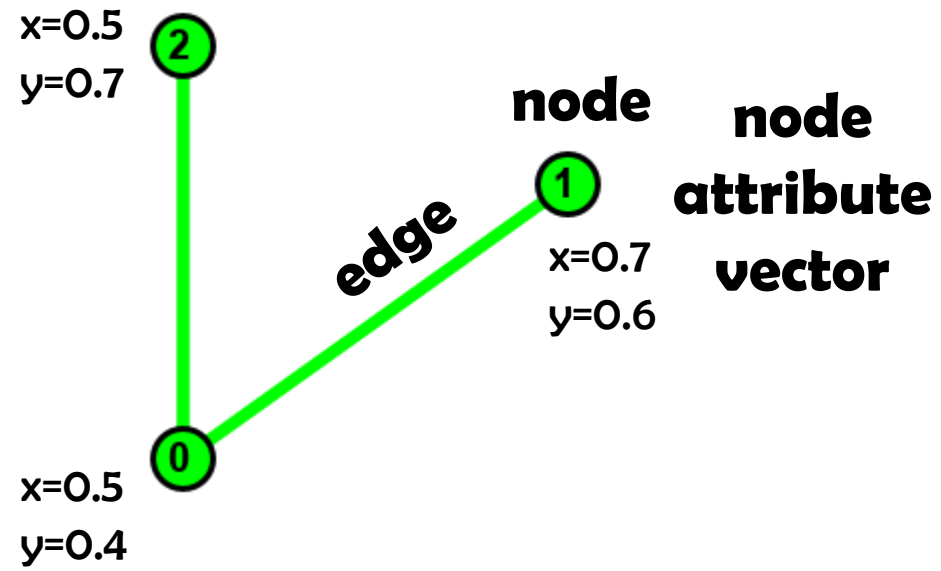
Connectomics



Social network analysis

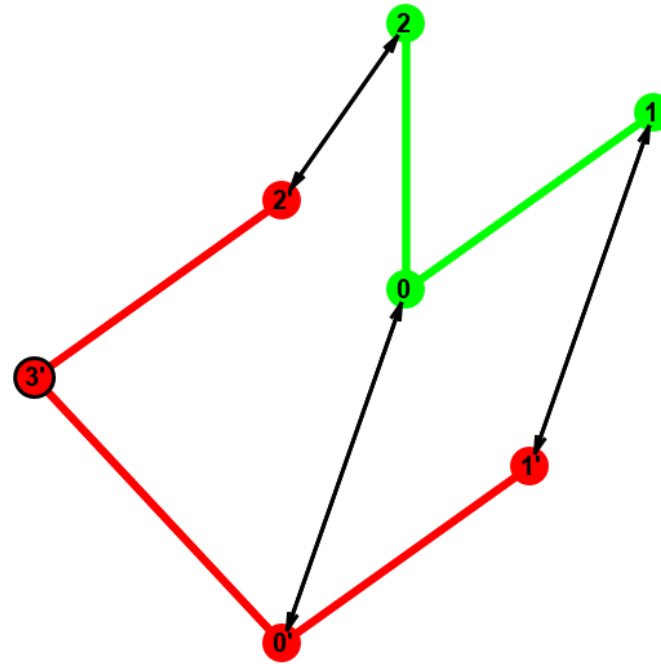


# What are graphs?



# Graph based classification

- ▶ Computation of graph edit distance - a metric of graph similarity
- ▶ Feeds the distance matrix to a classifier



# Node Attribute Selection

- ▶ 6 candidate features:
  - ▶ Circularity
  - ▶ Eccentricity
  - ▶ Nucleus: Hematoxylin mean
  - ▶ Nucleus: Hematoxylin standard deviation
  - ▶ Cytoplasm: Eosin mean
  - ▶ Cytoplasm: Eosin standard deviation
- ▶ *Baseline:*
  - ▶ *Not labelled graph*



# Node Attribute Selection

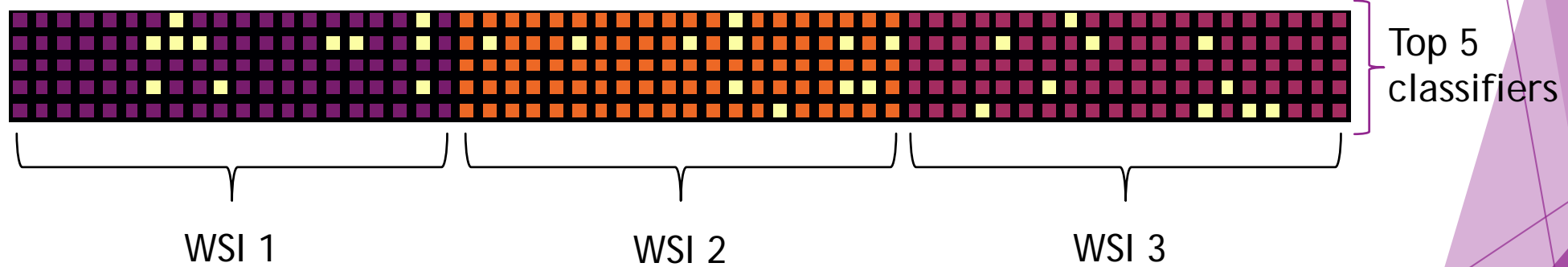
- ▶ 6 candidate features:
  - ▶ Circularity
  - ▶ Eccentricity
  - ▶ **Nucleus: Hematoxylin mean**
  - ▶ Nucleus: Hematoxylin standard deviation
  - ▶ Cytoplasm: Eosin mean
  - ▶ **Cytoplasm: Eosin standard deviation**
- ▶ *Baseline:*
  - ▶ *Not labelled graph*
- ▶ Feature selection with sequential forward search

**82.5% accuracy**



# Misclassifications of the best graph setups

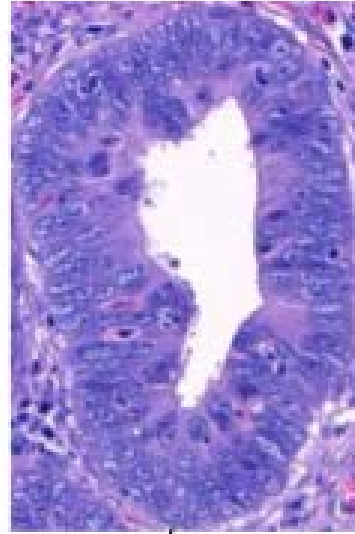
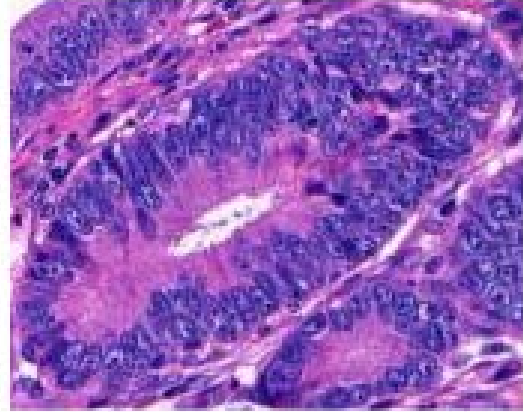
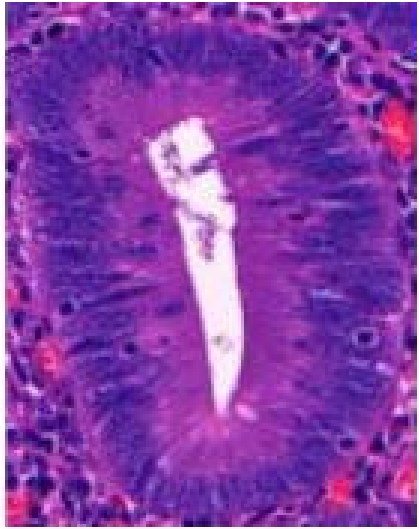
Normal glands



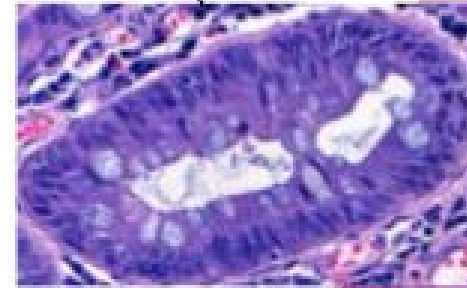
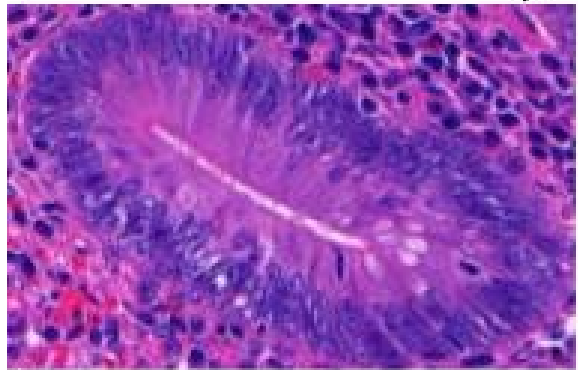
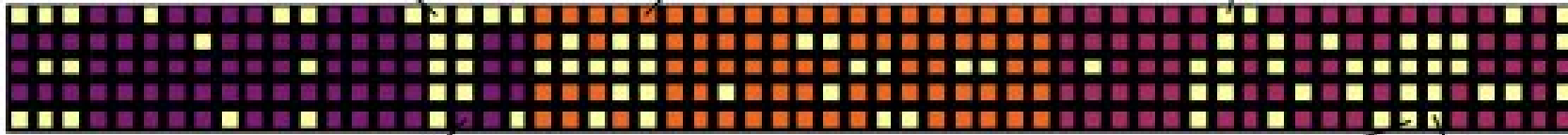
Yellow = misclassification



# Misclassifications of the best graph setups

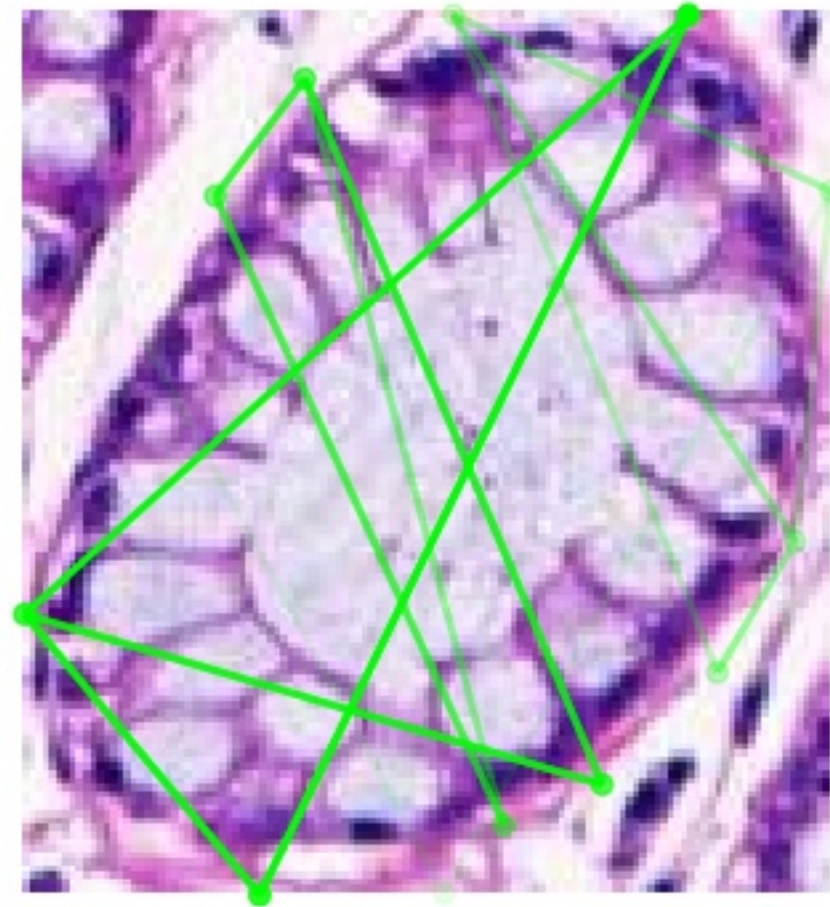


Dysplastic glands

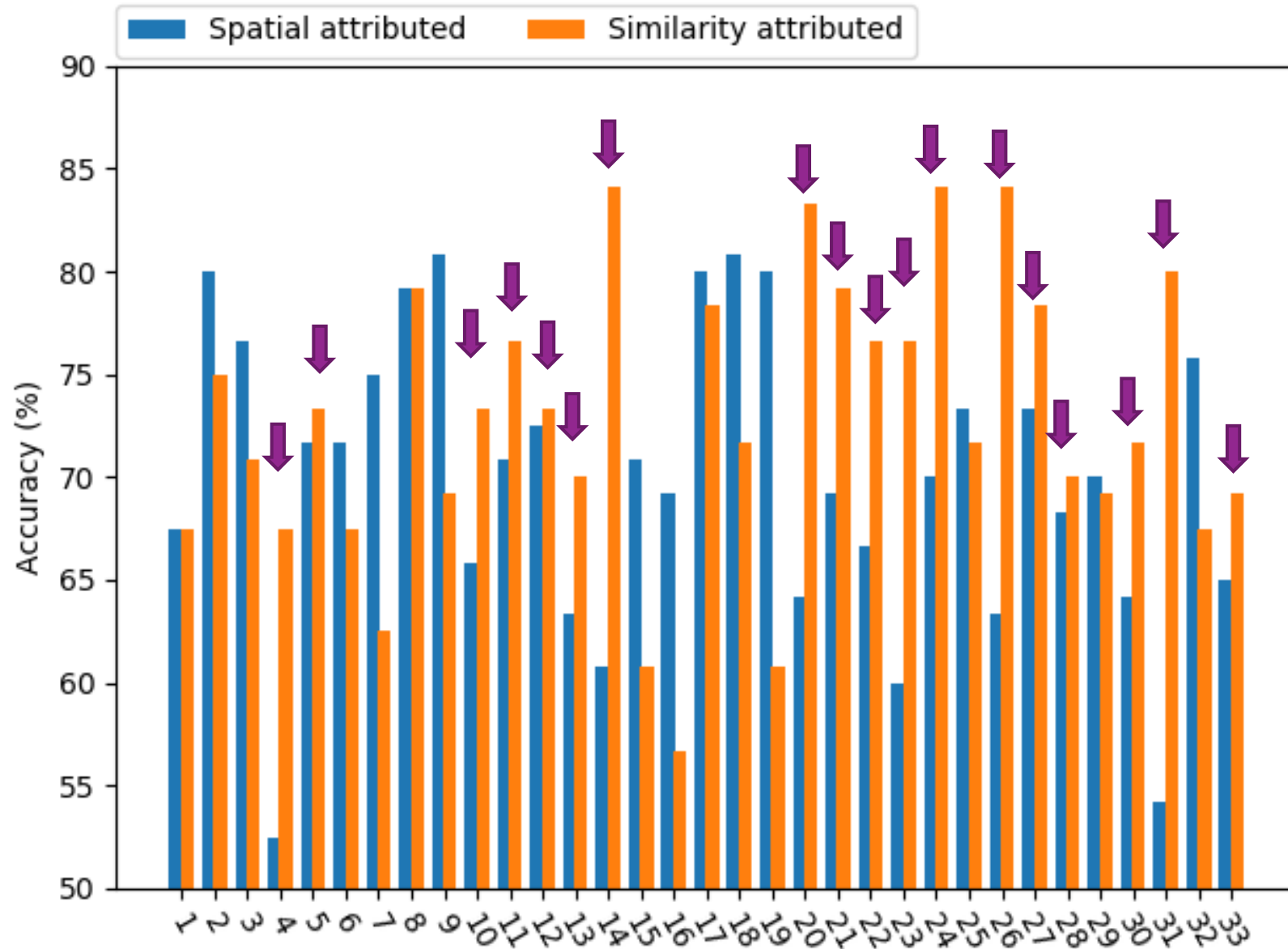


**Thank you for your attention!**

# Spatial VS Similarity graphs



# Spatial VS Similarity graphs



# 1 attribute per node

Node attribute	Accuracy
Circularity	77.5%
Eccentricity	65.8%
Hematoxylin mean	71.7%
Hematoxylin sd	72.5%
Eosin mean	67.5%
<b>Eosin sd</b>	<b>79.2%</b>
<i>Baseline</i>	76.6%



## 2 attributes per node

Node attributes	Accuracy
Eosin sd, Circularity	78.3%
Eosin sd, Eccentricity	78.3%
<b>Eosin sd, Hematoxylin mean</b>	<b>82.5%</b>
Eosin sd, Hematoxylin sd	78.3%
Eosin sd, Eosin mean	56.7%

## 3 attributes per node

Node attribute	Accuracy
Eosin sd, Hematoxylin mean, Circularity	80.0%
Eosin sd, Hematoxylin mean, Eccentricity	71.7%
Eosin sd, Hematoxylin mean, Hematoxylin sd	78.3%
Eosin sd, Hematoxylin mean, Eosin mean	80.8%

Features selected:  
Eosin sd and  
Hematoxylin mean

# Best graph confusion matrix

Spatial graph attributed with cytoplasm eosin SD and nucleus hematoxylin mean

