



# Detecting Cancer Metastases on Gigapixel Pathology Images

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# Outline

- Motivation
- Method
  - Data generation
  - Image Augmentation
  - Model
  - Evaluation & Heatmap Generation
- Results
- Future works

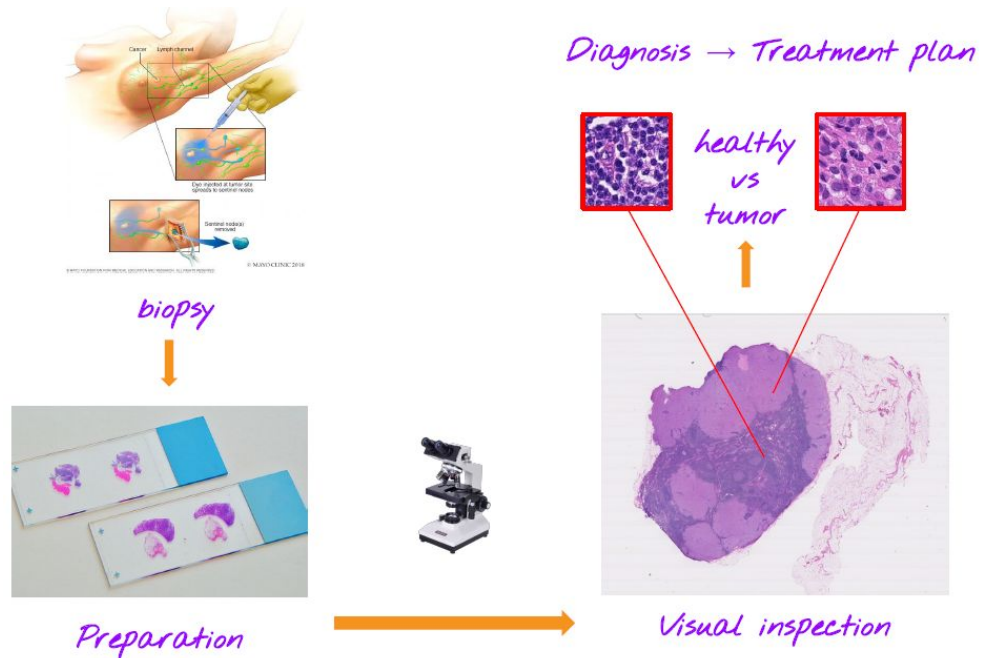
# Motivation

## Tumor examination

- Require expertise
- Time consuming
- Error prone

## Deep learning can improve

- Speed, accuracy





## Method - Dataset Generation

Data point: image patch at level 0 and 1, size 299x299

Label: if tumor cell exists in 128x128 center

Choose “normal” and “tumor” with equal probability (balanced dataset)

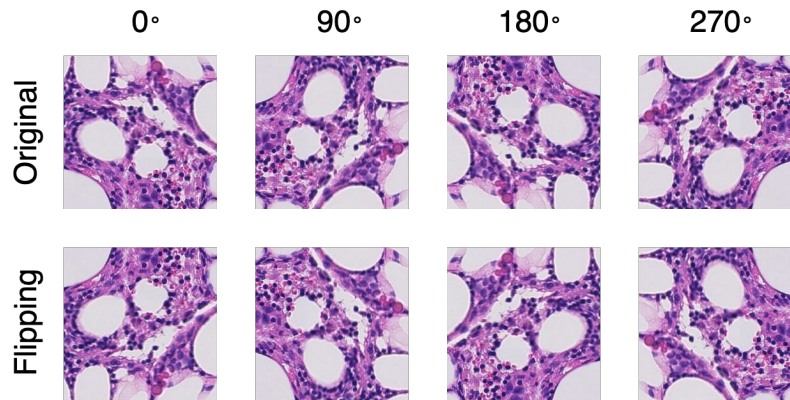
Select slide containing chosen class of patch uniformly

Sample patch from the slide with >50% tissues

# Method - Image Augmentation

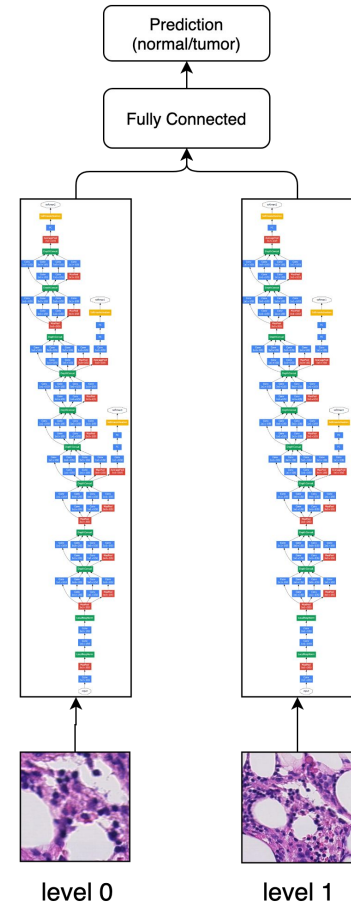
Rewrite ImageDataGenerator to ensure two input images get the same preprocessing

- Rotation 90 degrees
- Flipping (vertical & horizontal)
- Shift (8 pixels)



# Method - Model

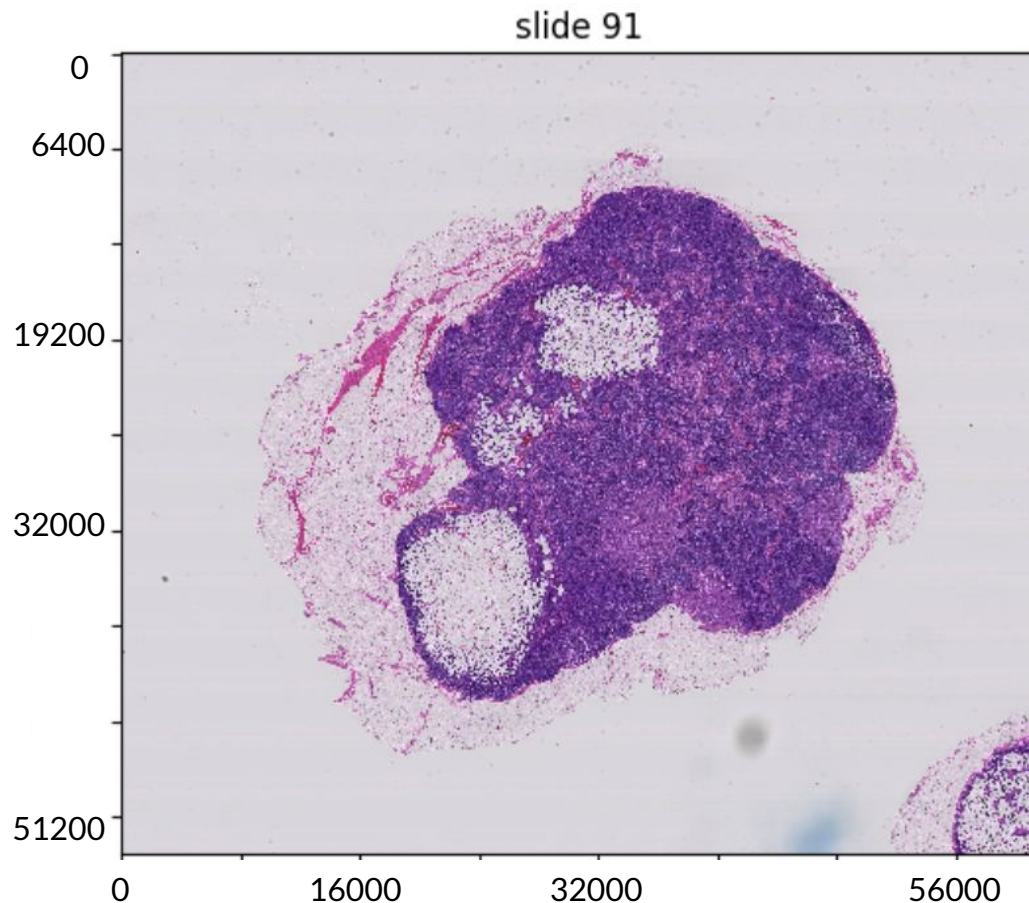
- Inception as base
- Input are two images at level 0 and 1 respectively
- Concatenate final layer from Inception
- Predict label with fully connected layer



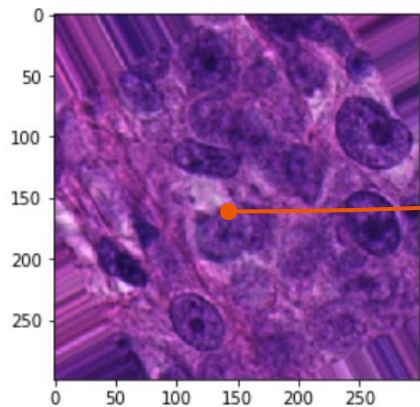


## Prediction

- Generate  $299 \times 299$  patches for each row
- Skip patches with tissue percentage  $< 50$
- Get predicted probabilities from trained model
- Choose a threshold to determine if a patch has tumor

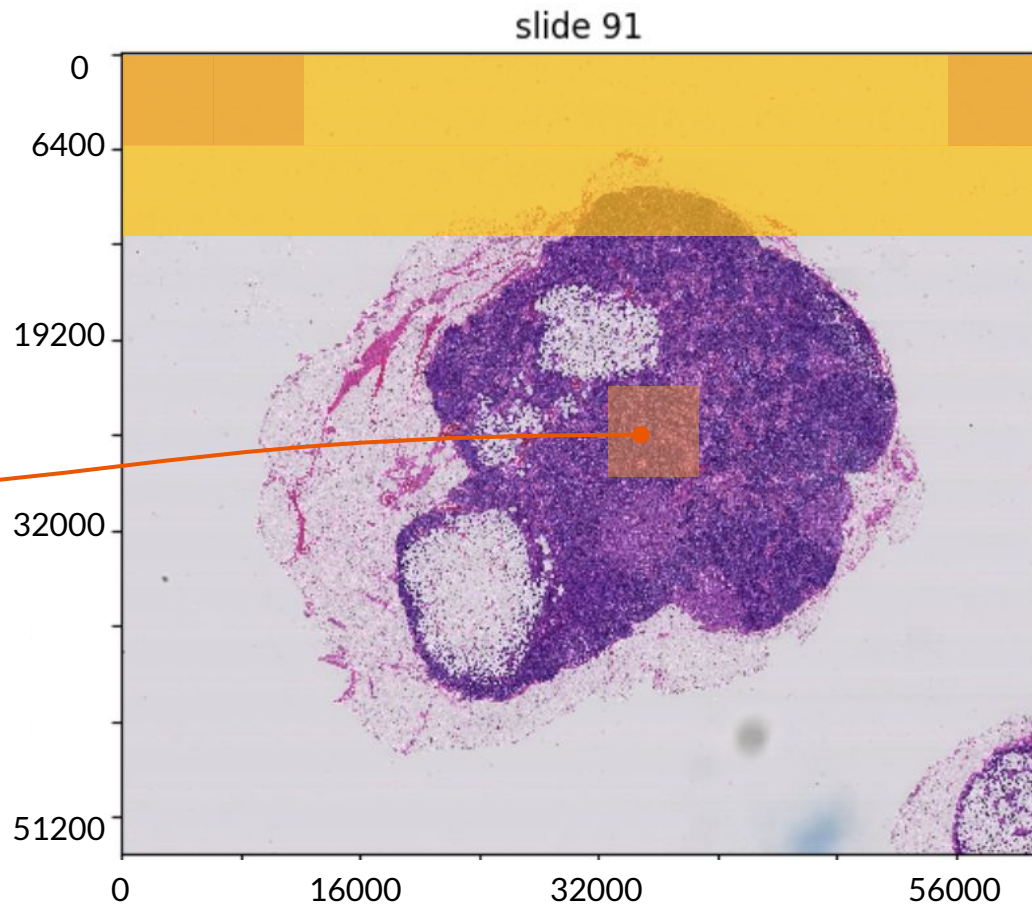


# Prediction



Patch size: 299 \* 299

Level 0 : 53760 \* 61440







# Evaluation

Precision

$$\text{Precision} = \frac{\text{true positive}}{\text{true positive} + \text{false positive}}$$

Recall

$$\text{Recall} = \frac{\text{true positive}}{\text{true positive} + \text{false negative}}$$

F1 score

$$\text{F1 score} = 2 * \frac{\text{precision} * \text{recall}}{\text{precision} + \text{recall}}$$

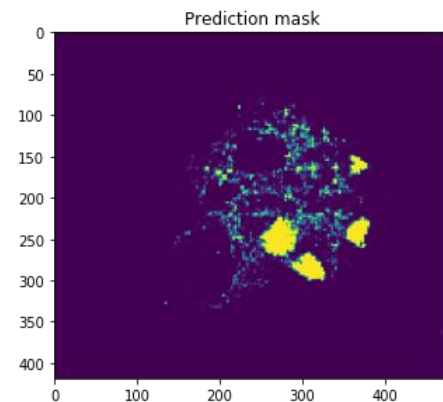
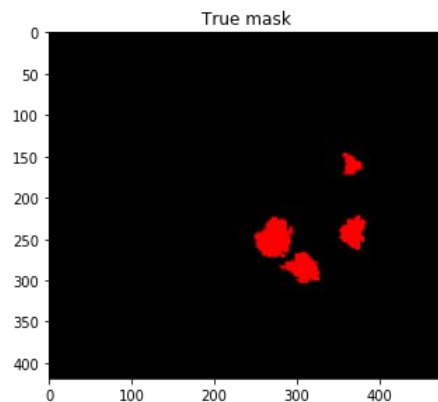
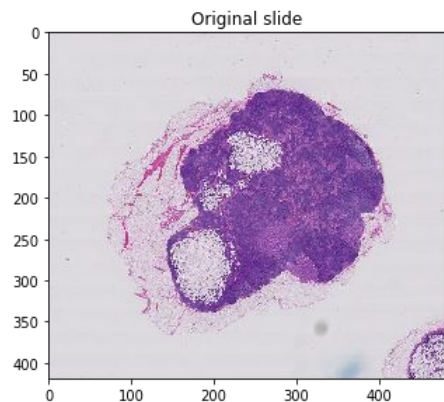
		<i>Predicted</i>	
		<b>Negative</b>	<b>Positive</b>
<i>Actual</i>	<b>Negative</b>	True Negative	False Positive
	<b>Positive</b>	False Negative	True Positive

Positive: Tumor  
Negative: Normal

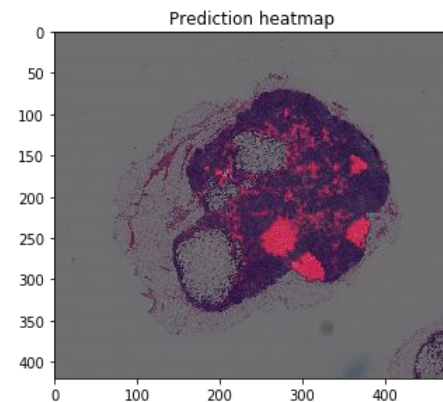
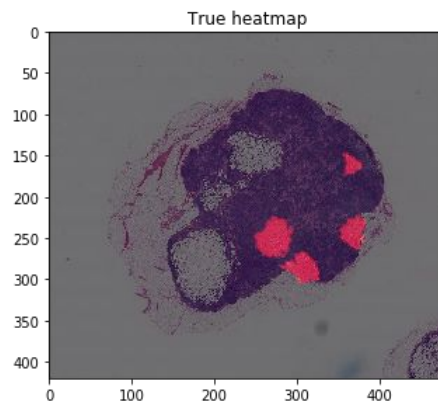


## Results

Threshold	Precision	Recall	F1 score
0.5	0.54	0.94	0.69
0.7	0.71	0.90	0.80
0.9	0.90	0.83	0.86



  
**Heatmap**



Heatmaps for true mask and prediction (slide 91)



## Future Work

- Generate more training data to improve the accuracy using GCP
- Compare the performance of multi-scale model with the single-scale model

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# Code Walkthrough