



Metastatic Region Segmentation in Lymph Node Biopsy

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Challenge

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ISBI challenge on cancer metastasis detection in lymph node

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The data in this challenge contains a total of 400 whole-slide images (WSIs) of sentinel lymph node from two independent datasets collected in Radboud University Medical Center (Nijmegen, the Netherlands), and the University Medical Center Utrecht (Utrecht, the Netherlands).

The training dataset

The first training dataset consists of 170 WSIs of lymph node (100 Normal and 70 containing metastases) and the second 100 WSIs (including 60 normal slides and 40 slides containing metastases).

The ground truth data for the slides containing metastases is provided in two formats:

- .xml files containing vertices of the annotated contours
- WSI binary Masks

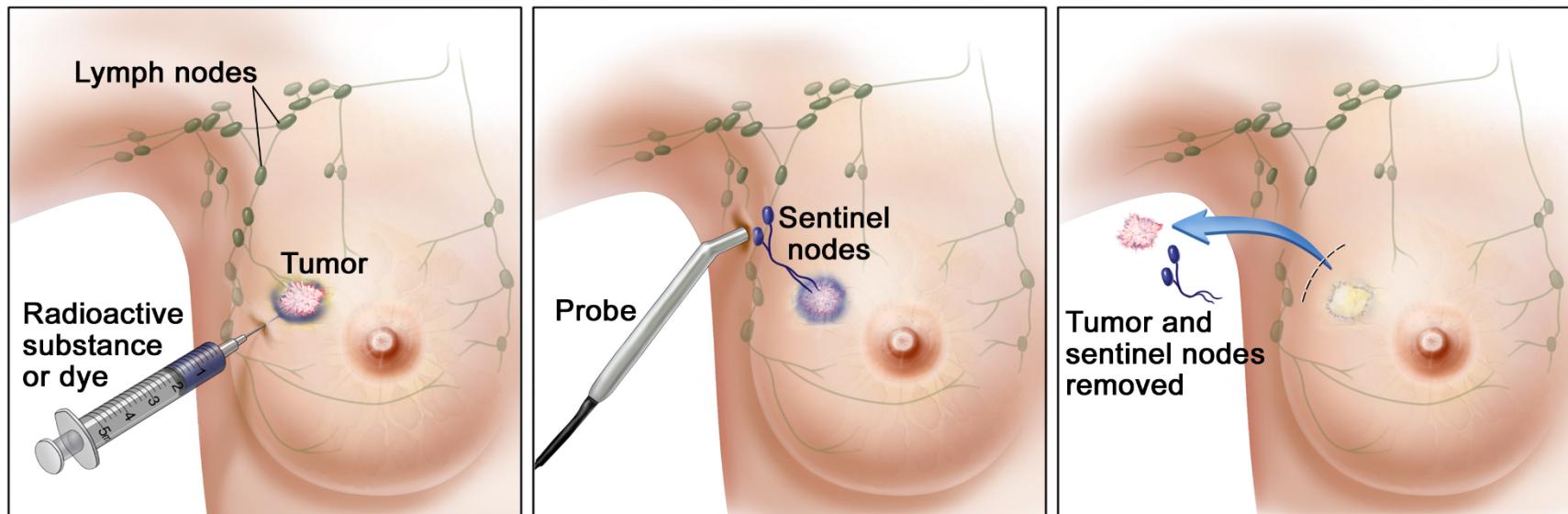
<https://camelyon16.grand-challenge.org/data/>

The test dataset

Open "<https://camelyon16.grand-challenge.org/data/>" in a new tab



Rational



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Traditional Histopathology

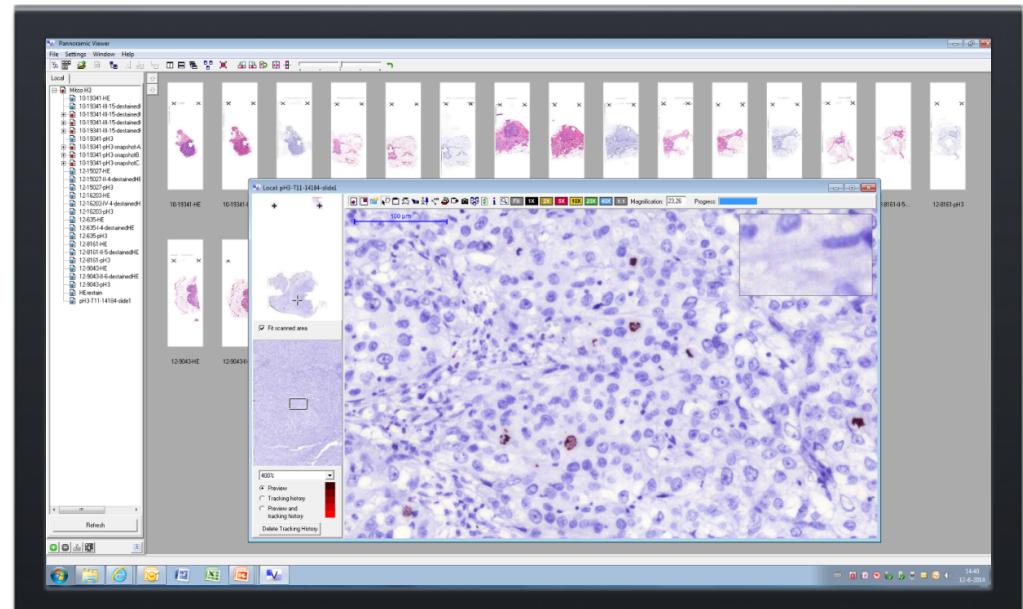




Modern Practice



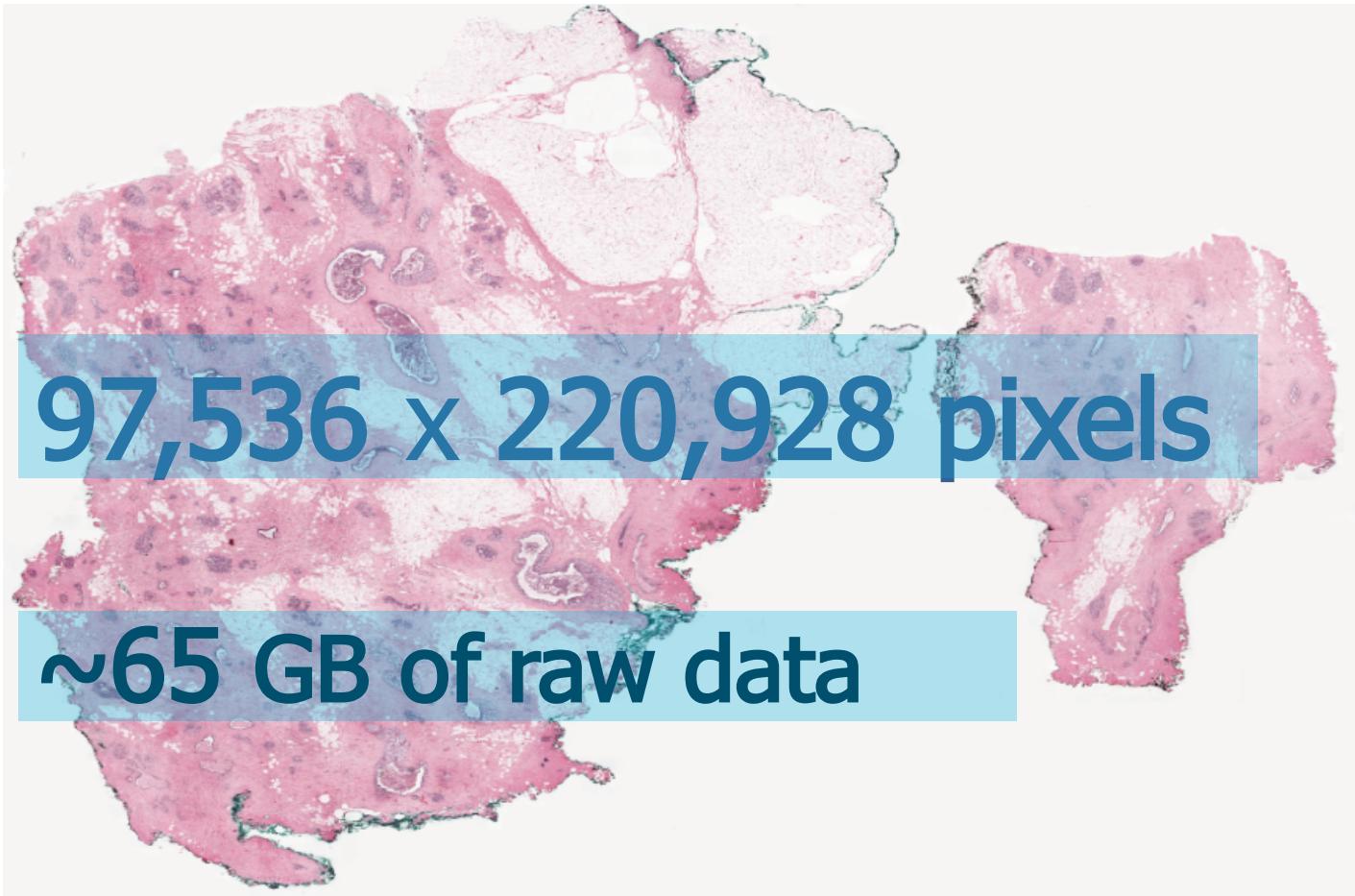
Whole Slide Digitizer



Whole Slide Viewer

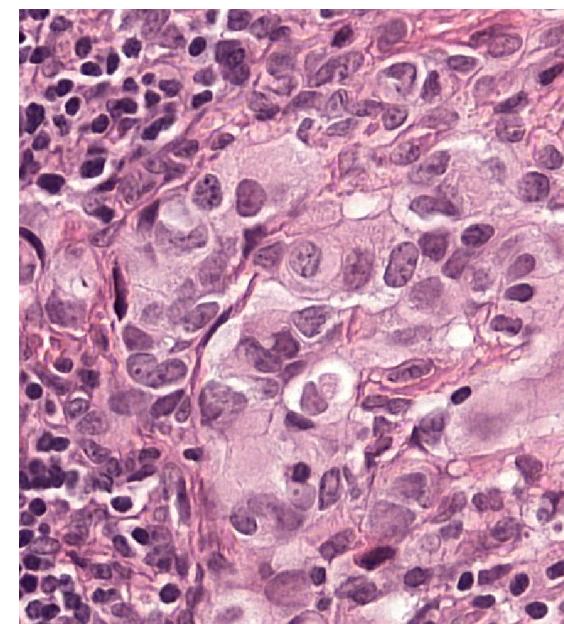
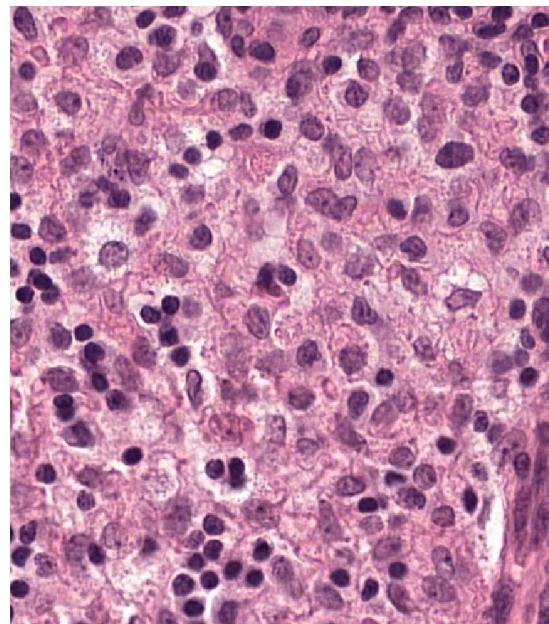
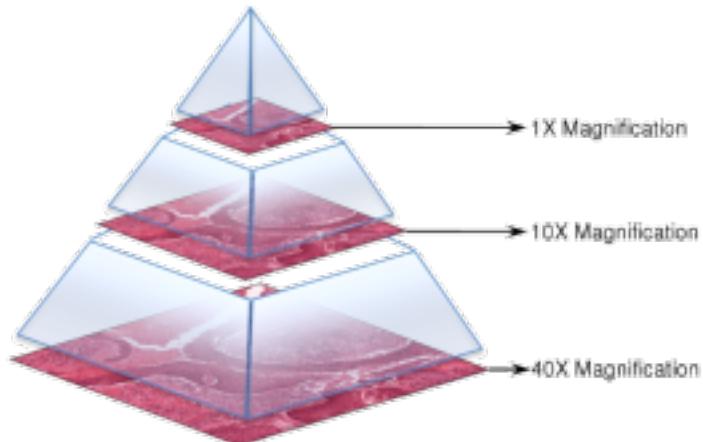


Big Data Deluge



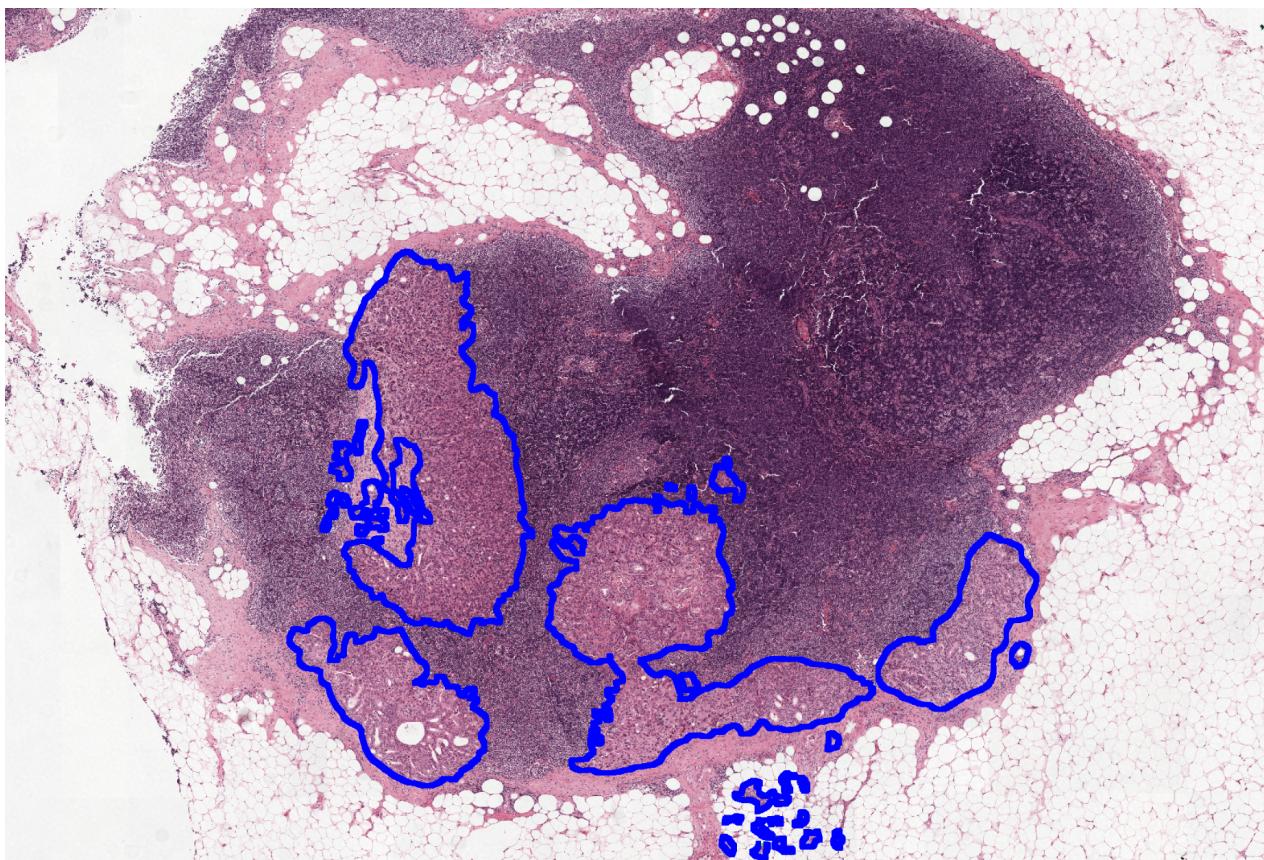


Multi-magnification Image Data



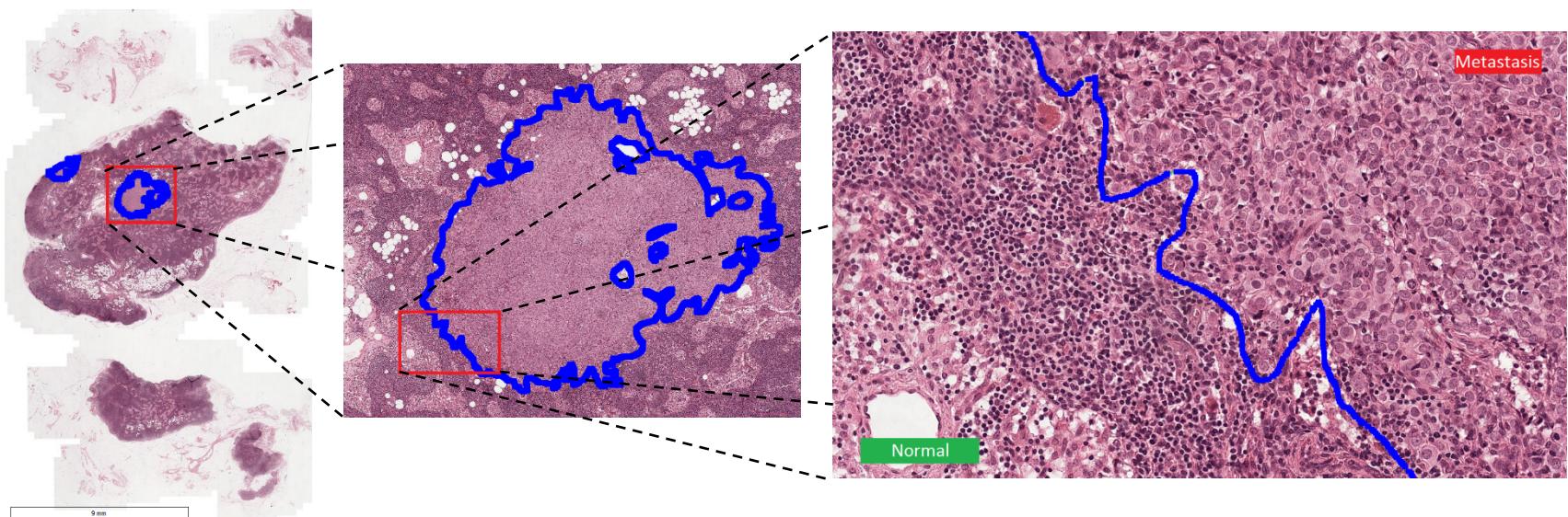


Sample WSI





Goal of the Challenge





Contributors

Rank	Team	AUC	Description
01	Harvard Medical School (BIDMC) and Massachusetts Institute of Technology (CSAIL), USA	0.9250	
02	ExB Research and Development co., Germany	0.9173	
03	Independent participant, Germany	0.8680	
04	Health Sciences Middle East Technical University, Turkey	0.8669	
05	NLP LOGIX co., USA	0.8332	
06	University of Toronto, Electrical and Computer Engineering, Canada	0.8181	
07	The Warwick-QU Team, United Kingdom	0.7999	
08	Radboud University Medical Center, Diagnostic Image Analysis Group, Netherlands	0.7828	
09	HTW-BERLIN, Germany	0.7717	
10	University of Toronto, Electrical and Computer Engineering, Canada	0.7666	

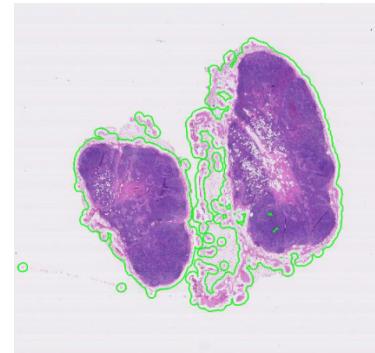


Winning Team

Deep Learning based Cancer Metastases Detection.

Training set construction:

- Pre-processing:
 - Otsu method based tissue region segmentation from background non tissue regions.
- Randomly extracted patch of size 256 x 256 from the tissue regions.
 - 1K positive and 1K negative patches from each tumour slide.
 - 1K negative patches from normal slides.



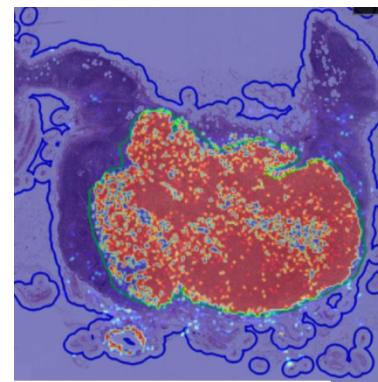
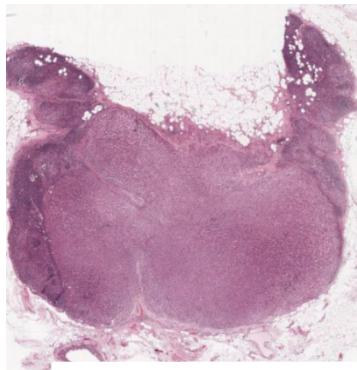
Remove 82% of WSI region on an average.



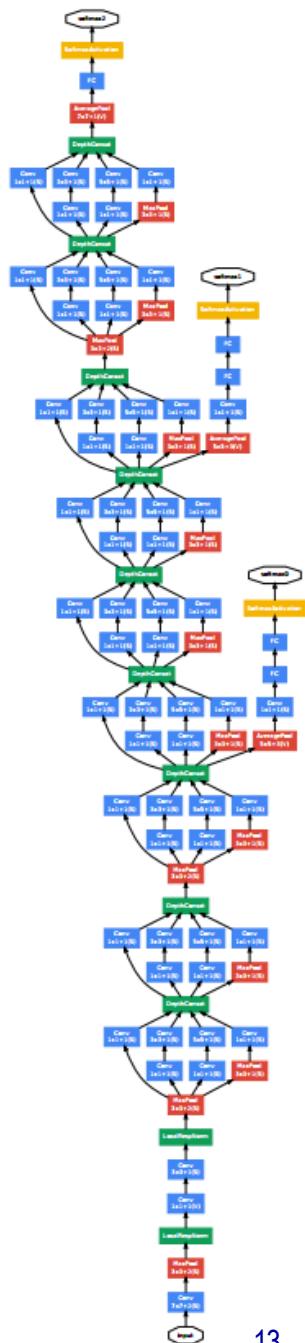
Network Architecture

Performed state-of-art GoogLeNet for generating heat-map

- Architecture of GoogLeNet:
 - 27 layers in total.
 - Nearly 6 millions of parameters.
 - Three loss layers.



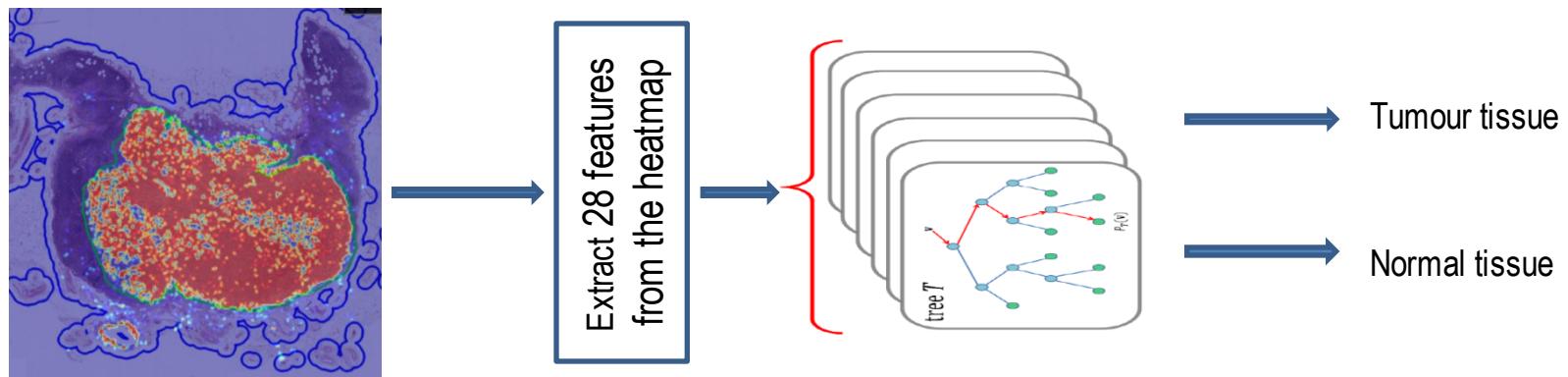
Visualization of heat-map of the whole slide image.





Post-processing for slide based tumour classification

- Extract 28 higher level features from the heat-map of the whole slide image.
- Use Random Forest (RF) classifier bag of 50 trees for classifying the whole slide as tumour or normal.





Take Home Messages

Public Leaderboard 1 - Whole-slide-image classification

- The results are computed on the independent test set.
- Evaluation 1: Teams are ranked based on area under ROC curve (AUC).

Top-five ranked teams until the challenge event deadline (Apr 1, 2016):

Rank	Team	AUC	Submission date	Description
01	Harvard Medical School and MIT, Method 1	0.9234	01 Apr 2016	
02	EXB Research and Development co., Germany	0.9156	01 Apr 2016	
03	Independent participant, Germany	0.8654	01 Apr 2016	
04	Middle East Technical University, Departments of EEE, NSNT and HS, Turkey	0.8642	01 Apr 2016	
05	NLP LOGIX co., USA	0.8298	01 Apr 2016	

Leaderboard including all submissions (updated after each new entry):

* Indicates that the team has achieved an AUC value that surpasses the AUC of the pathologist in our study.

Rank	Team	AUC	Submission date	Description
01 *	Harvard Medical School and MIT, Method 2 (updated)	0.9935	06 Nov 2016	
02 *	Harvard Medical School, Gordon Center for Medical Imaging, MGH, Method 3	0.9763	24 Oct 2016	