מסמך אפיון פרויקט כהכנה לפגישת הזנקת הפרוייקט

שם הפרויקט:_____Foreground Tissue Segmentation in H&E Whole Slide Images_____

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מנחה:_____טל נהורן, רועי וליץ'

סטודנטים:

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שנה:_____2022/2023

המסמך נועד להכין את הצגת הפתיחה של הפרוייקט ויש להגישו במועד הפגישה (שבוע שני או שלישי) המסמך יכתב לאחר פגישה עם המנחה והבנת מטרת הפרוייקט ע"י הסטודנטים.

במהלך פגישת פתיחת הפרוייקט הסטודנטים יסבירו :

1. מטרת הפרוייקט

The aim of this Project is building a deep learning-based robust model for automatic foreground segmentation of tissue (against background) within a Whole Slide Image (WSI) of a biopsy - taken from breast cancer patients. The biopsy is stained with H&E method.

We aim to outperform the classic method –Otsu's method- that is used today, without making any further adaptations for each different dataset.

2. סקר ספרות (רשימת מאמרים או רקע תאורטי)

Artificial Intelligence Algorithms to Assess Hormonal Status From Tissue Microarrays in Patients With Breast Cancer:

https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2739045

Deep learning-enabled breast cancer hormonal receptor status determination from base-level H&E stains:

https://www.nature.com/articles/s41467-020-19334-3

WSI foreground segmentation with CNNs:
https://arxiv.org/abs/1703.05990

The traditional method for the Segmentation:
https://web.archive.org/web/20200321091229id_/https://www.lfb.rwth-aachen.de/bibtexupload/pdf/BUG15fesi.pdf

WSI tumor segmentation:
https://www.nature.com/articles/s41598-021-90444-8

Deep learning segmentation architectures

U-Net:
https://arxiv.org/abs/1505.04597

FCN:
https://openaccess.thecvf.com/content_cvpr_2015/papers/Long_Fully_Convolutional_Networks_2015_CVPR_paper.pdf

SegNet:
https://arxiv.org/abs/1511.00561

3. כלי פיתוח ושימוש בספריות

- python
- pytorch and other computer vision's libraries

4. אביזרים או חומרה הדרושים לפרוייקט

- Access for the GIP lab servers and using the GPUs for the training purposes
- Accessing the Data sets of the WSI

5. דרכים ושיטות לבדיקת תוצר הפרוייקט

Comparison between the labeled pixels of the WSI (the groundtruth that was produced by the otsu's thresholding algorithm) and the results of the deep-learning based model. the main criteria would be:

- Visual evaluation
- Jaccard index / IOU ("intersection over union")
- Pixel accuracy
- mean accuracy
- frequency weighted IU

Metrics We report four metrics from common semantic segmentation and scene parsing evaluations that are variations on pixel accuracy and region intersection over union (IU). Let n_{ij} be the number of pixels of class i predicted to belong to class j, where there are n_{cl} different classes, and let $t_i = \sum_j n_{ij}$ be the total number of pixels of class i. We compute:

- pixel accuracy: $\sum_i n_{ii} / \sum_i t_i$
- mean accuraccy: $(1/n_{\text{cl}}) \sum_i n_{ii}/t_i$
- mean IU: $(1/n_{\text{cl}}) \sum_i n_{ii} / \left(t_i + \sum_j n_{ji} - n_{ii}\right)$
- frequency weighted IU: $(\sum_k t_k)^{-1} \sum_i t_i n_{ii} / \left(t_i + \sum_j n_{ji} - n_{ii}\right)$

6. תכולת אמצע הפרוייקט (שבוע שביעי שמיני) וסופו (שבוע 14)

By the Mid-Semester, we expect to have a U-net model with a performance non inferior to the traditional method.

By the end of the semester, we expect to have:

a. Suggested and implemented improvemnets to the initial model, such as:
b. Experimenting with different methods of handling WSIs - thumbnails, random small patches, etc.
c. Data augmentation methods
d. Comparing with other models such as ensemble models or other pretrained models (fine tuned to our task).

7. משימות לכל הפרוייקט ברמה שבועית או דו שבועית:

משימה	תאור	שבוע	הערות
1	• literature review • choosing a model for initial implementation • discussing the methods for handling the WSIs - thumbnails/small patches? • preparing the kickoff document • getting familiar with the GIP server	1+2	
2	• review the format of the data and the annotations. • reviewing the OTSU's method. • starting the implementation of the chosen model.	3+4	
3	• finishing the initial implementation of the model	5+6	
4	• training and tuning the model • modifying the existing model with a pretrained weights, and fine tuning it. And make a comparison with the initial one	7+8	

5	• applying data augmentation methods for improving robustness of the model. e.g:
	  ○ mirroring
	  ○ rotating
	  ○ blurring with gaussian filter
	  ○ gamma correction
		9	

6	• Inserting Dropout layers, and comparing the improvement of our model upon the validation set • Suggesting handling the WSI with a different way and check the results??	10+11	

7	,trying to implement an ensemble model and checking if it enhances performance	12+13	
8	Working on the report		