EIID / Advanced Image Analysis (EIID/AIA)

Machine and Deep Learning (ML/DL)

2020-2021, 2nd semester

EIID/AIA standard project

and

Multidisciplinary project

Retinal Lesions Segmentation

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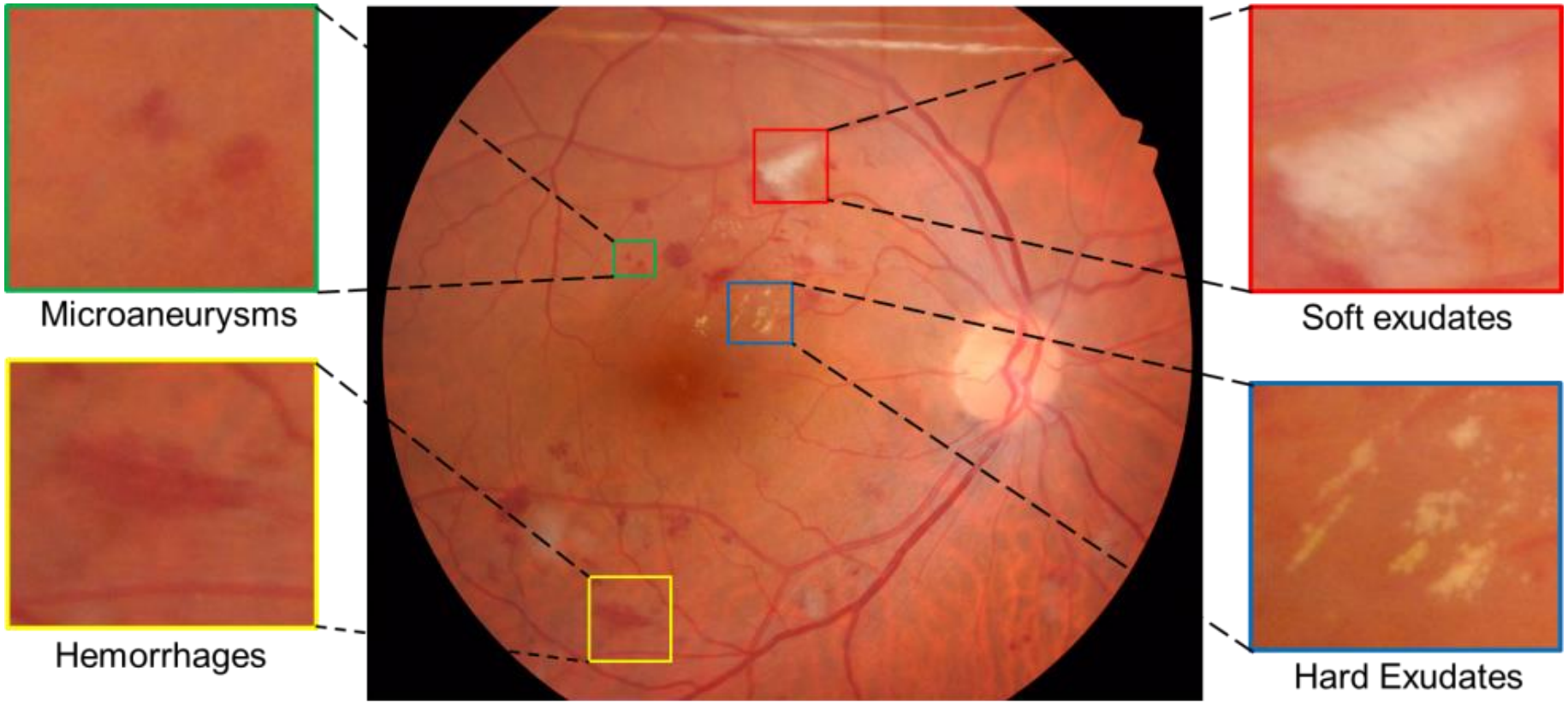
Motivations (1/2)

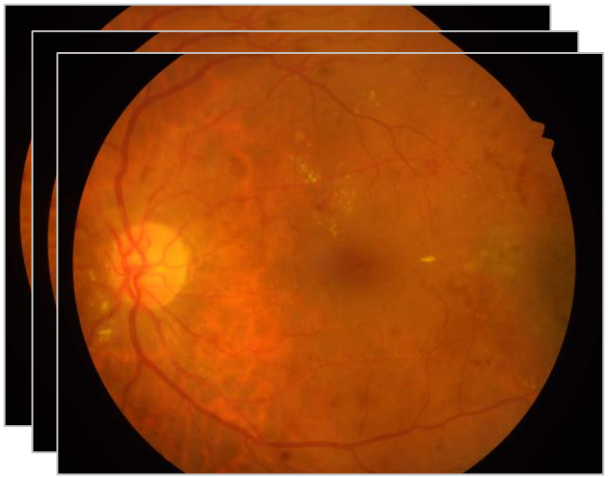
- **retinal color fundus images** are widely used for diagnosis, ***screening*** and treatment of **cardiovascular** and **ophthalmologic** diseases
- **retinal lesions segmentation** is conducive to the **early detection** of **diabetic retinopathy** that can reduce the chances of vision loss
  - four signs of diabetic retinopathy:
    - Microaneurysms (MA)
    - Hemorrhages (HE)
    - Soft Exudates (SEx)
    - Hard Exudates (HEx)

Motivations (2/2)

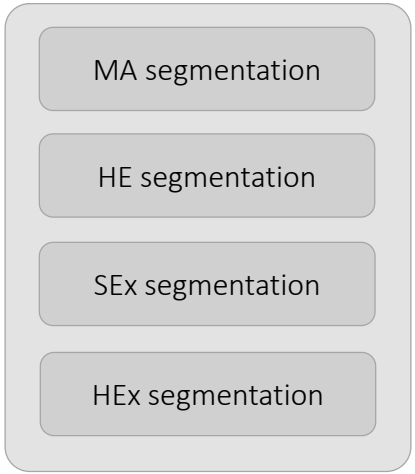


Goal

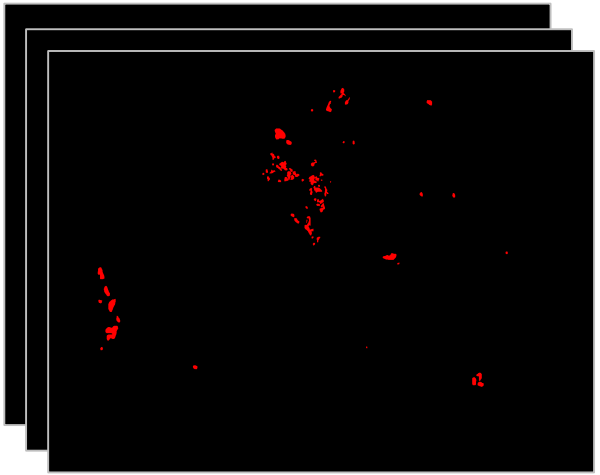
- implement automatic **segmentation** of **4 types of retinal lesions**
  - `if(EIID/AIA standard project):` segment 1 type of retinal lesion of your choice



input images



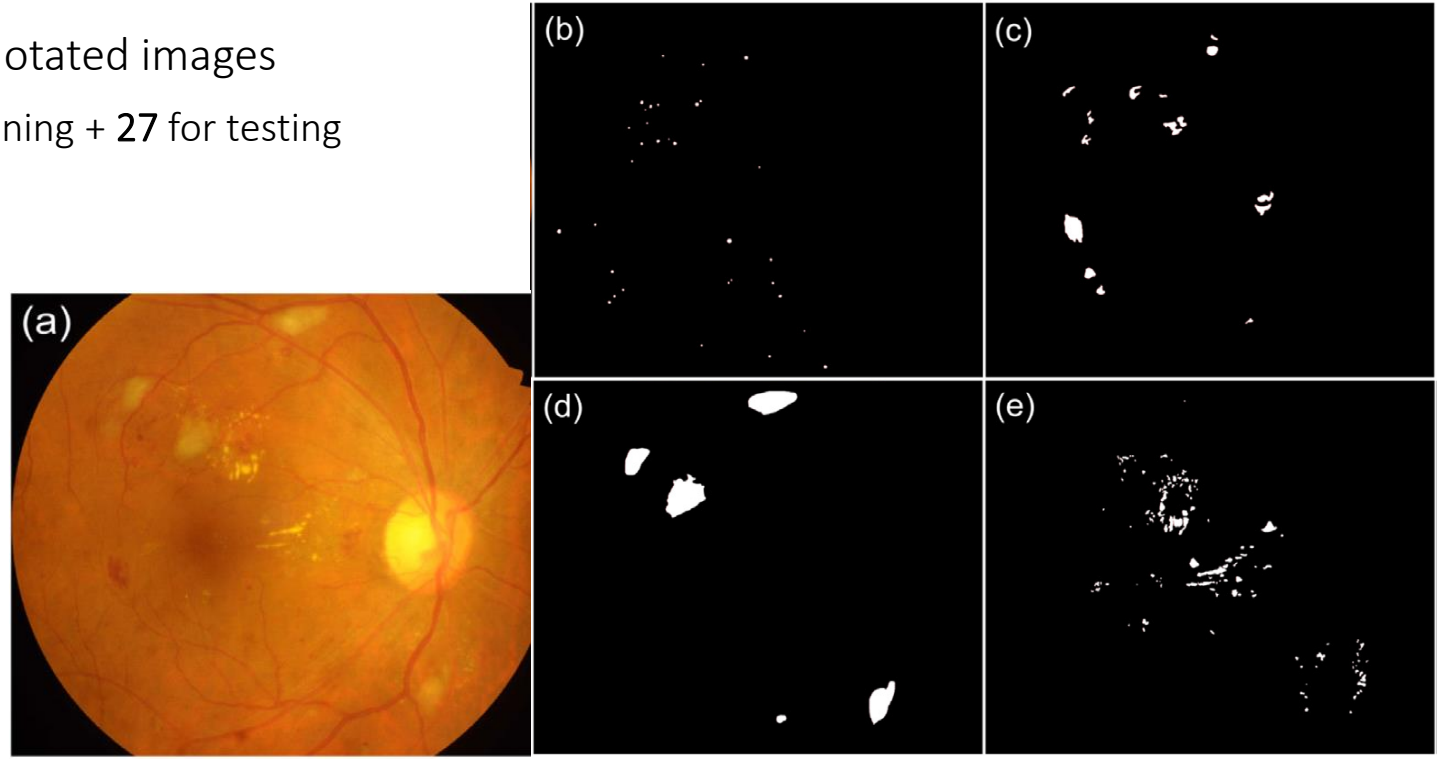
system



binary images for each lesion

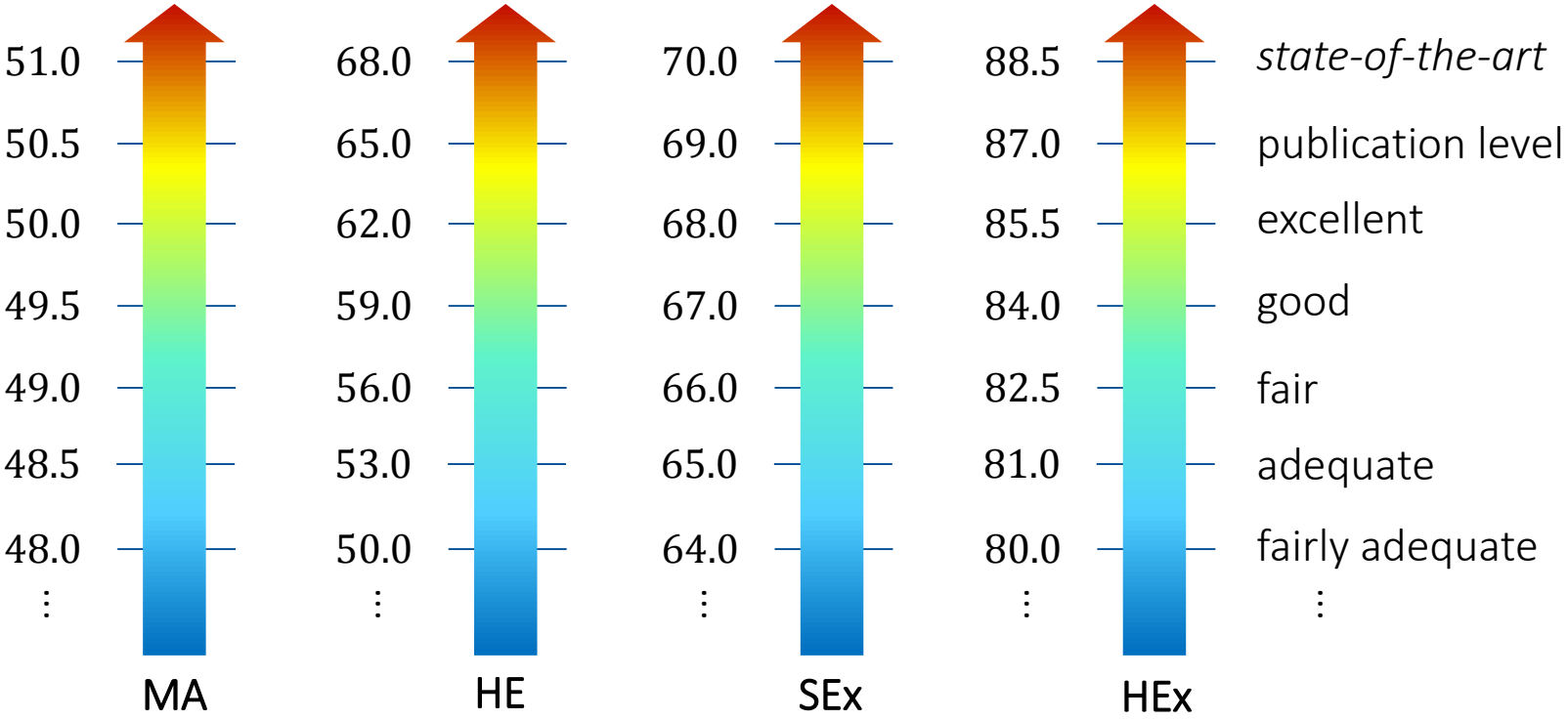
Materials

- IDRiD Challenge Dataset
  - in `/data`
  - 81 fully-annotated images
    - 54 for training + 27 for testing



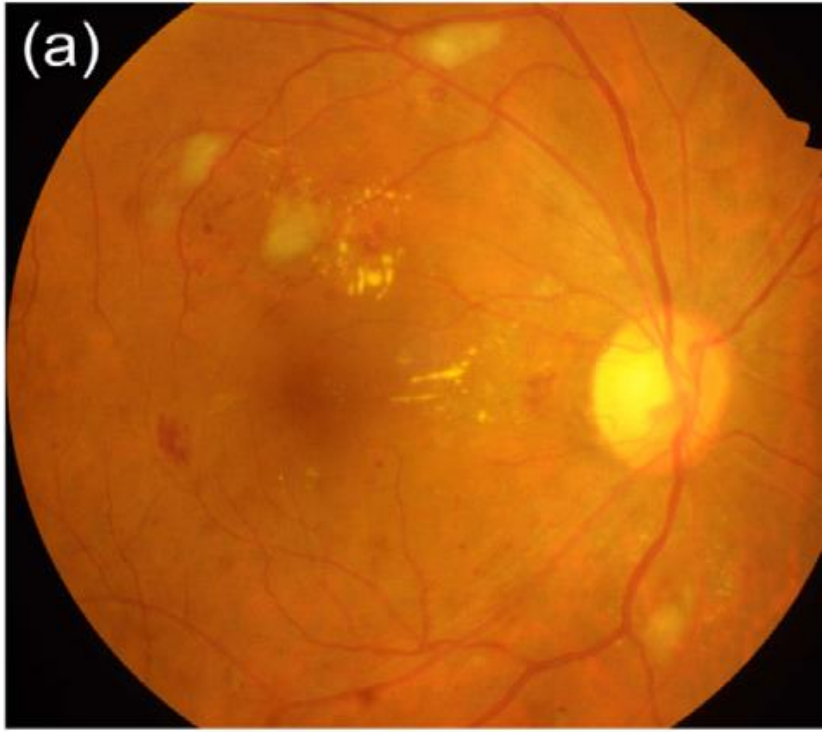
Performance evaluation

- area under the precision-recall curve ($AUPR$) for each lesion type
  - see paper "*2020 - IDRiD - Diabetic Retinopathy...*" in `/literature/`



Challenges

- unbalanced classification
- very heterogeneous lesions
- uneven illumination conditions
- few images

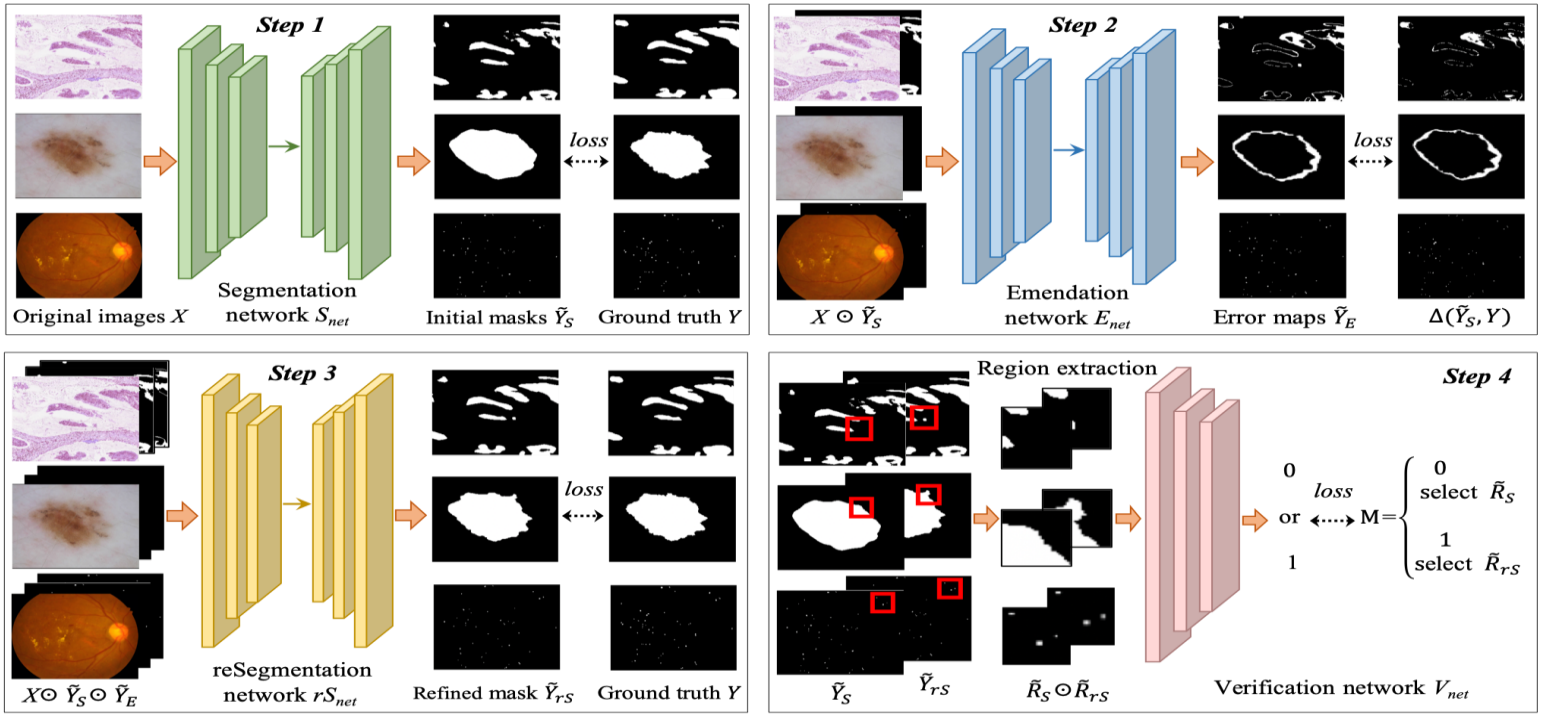


Hints

- segmentation
  - color spaces, grayscale morphology, region growing
- feature extraction
  - color features, shape features, geometrical features, texture features
- ML
  - can be used to refine the segmentation
  - 5-class classification (4 lesions + false positive) or other hierarchical/sequential classification schemes
- DL
  - see next slide and (optional) pre-train on other datasets for retinal images (e.g. eophtha-MA for MAs and eophtha-EX for HEx)
- see papers in `/literature`

Hints (DL)

- end-to-end Segmentation - Emendation - reSegmentation - Verification (**SESV**)
  - see paper "*2020 - SESV Accurate Medical Image Segmentation...*" in `/literature/`



Constraints (multidisciplinary project)

- use **training and test splits** as those proposed in the **dataset**
  - use training and test splits as those proposed in the dataset
  - train your ML/DL models on the training set, evaluate performance on the test set
- **ML**: test several models and find your own (possibly novel) method
  - ...it is *not* okay to train/test only one model (e.g. SVM) because 'it just works'
- **DL**: it is ok to implement and/or fine-tune an architecture found on the web...
  - ...if it works on the first attempt, at least try something different, like different hyperparameters and slight modifications of the architecture

If you want to do more (optional)

- compare and/or merge **handrafted features** with **deep features**
- use other datasets
  - e.g. **eophtha-MA** for MAs and **eophtha-EX** for HEx