Image Processing and Analysis / Advanced Image Analysis

2022-2023, 2nd semester

IPA/AIA standard project

Retinal Lesions Segmentation

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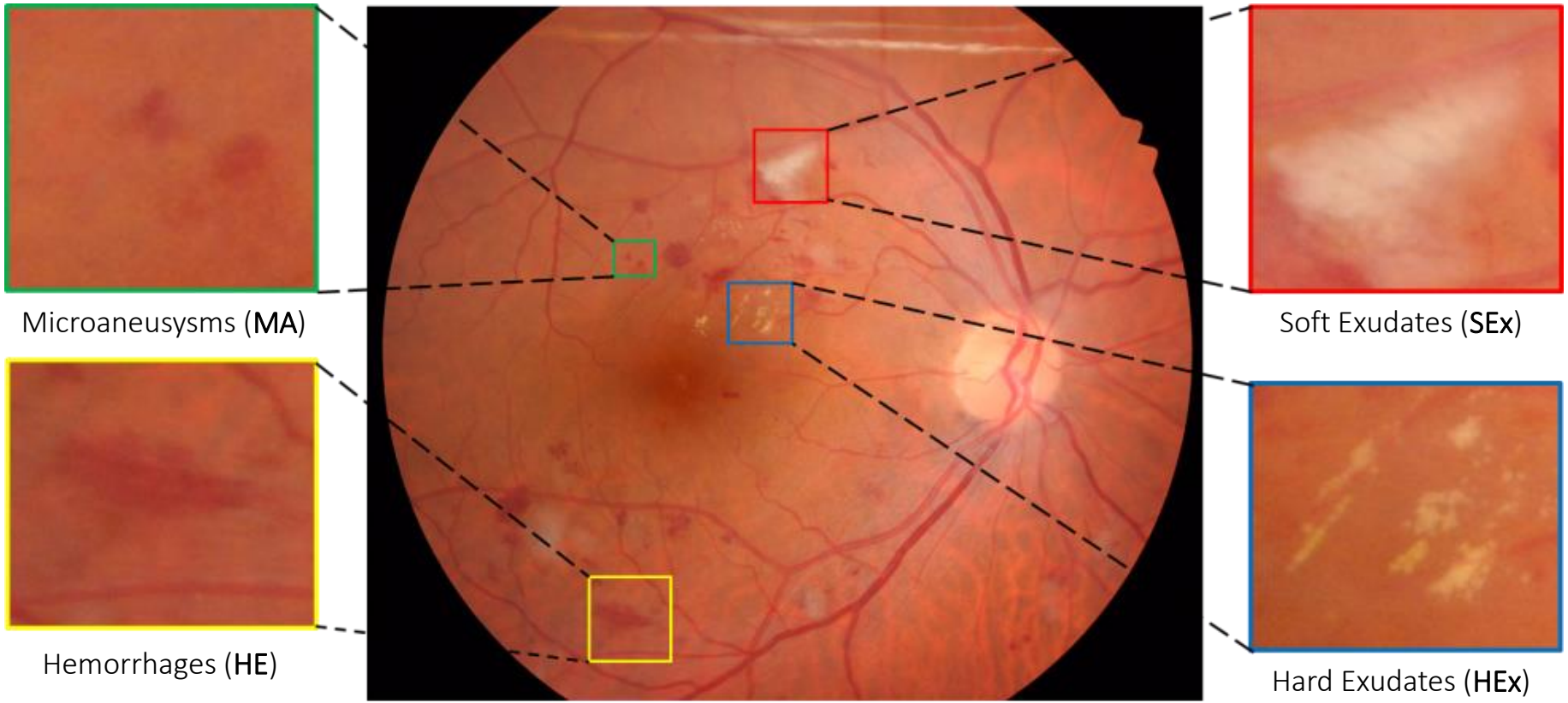
Motivations (1/2)

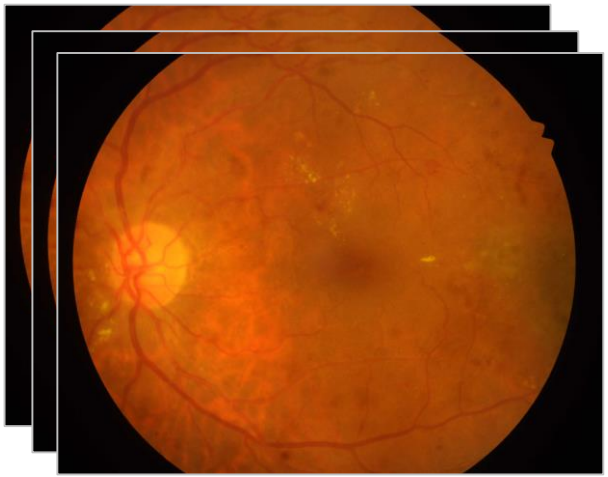
- **retinal color fundus images** are widely used for diagnosis, ***screening*** and treatment of **cardiovascular** and **ophthalmologic** diseases
- **retinal lesions segmentation** is conducive to the **early detection** of **diabetic retinopathy** that can reduce the chances of vision loss
  - four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

Motivations (2/2)

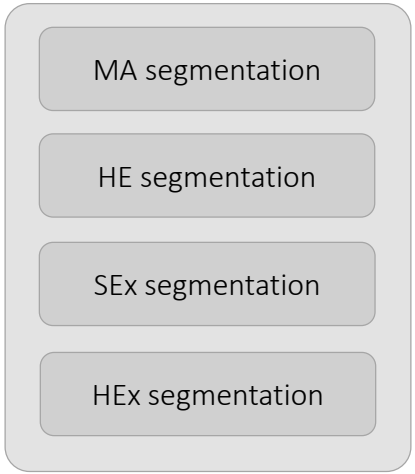


Goal

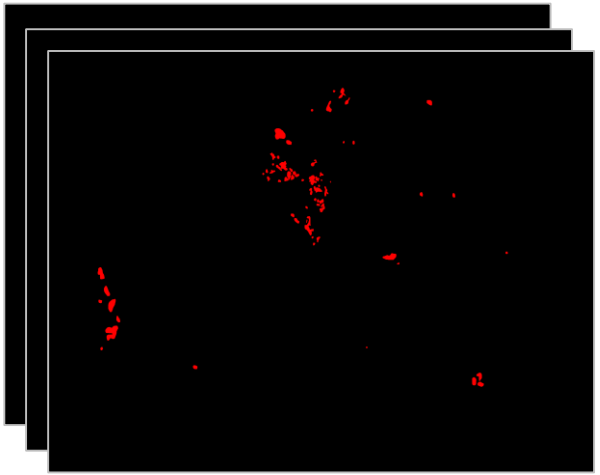
- implement automatic **segmentation** of **1 type** (of your choice) of **retinal lesion**
  - choosing this project requires choosing the lesion to be segmented in advance



input images



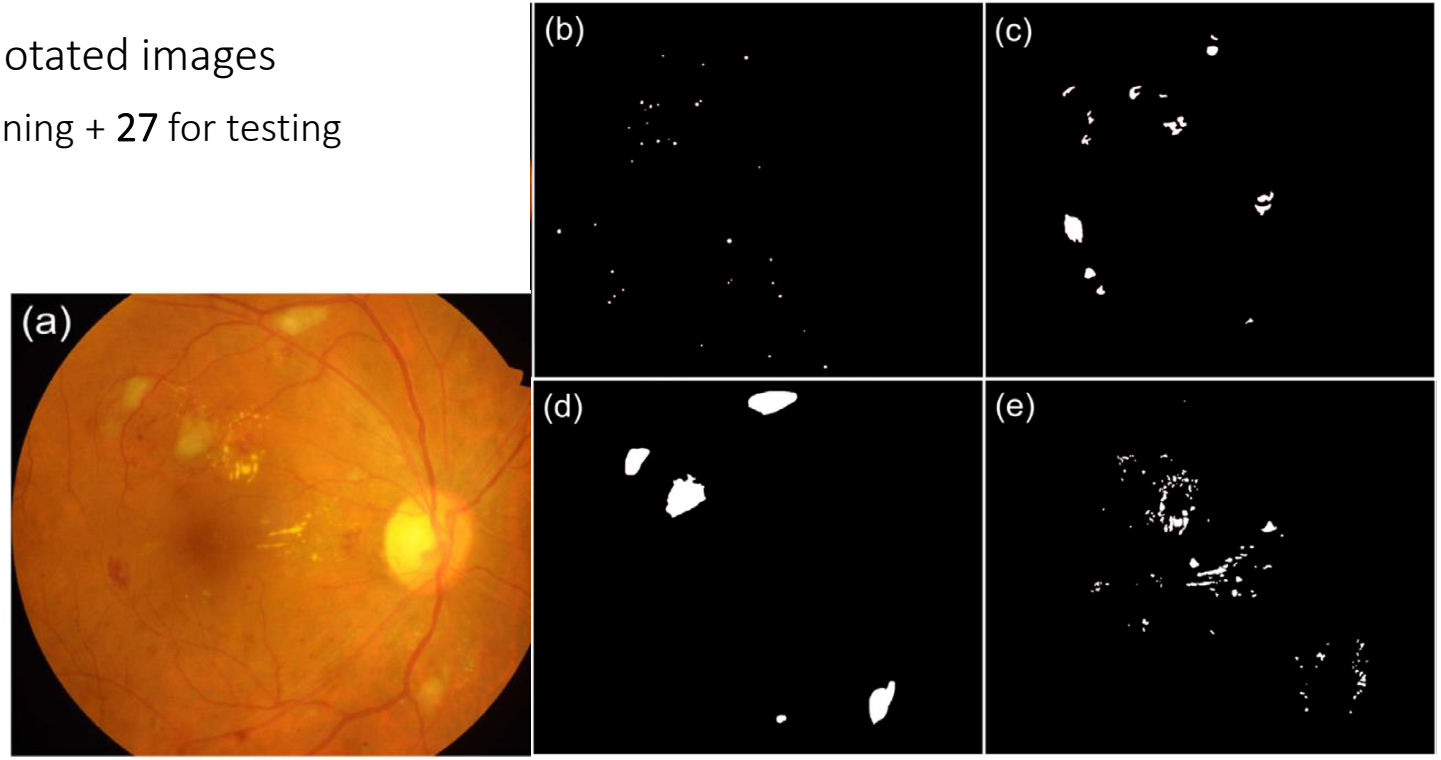
system



binary images for chosen lesion

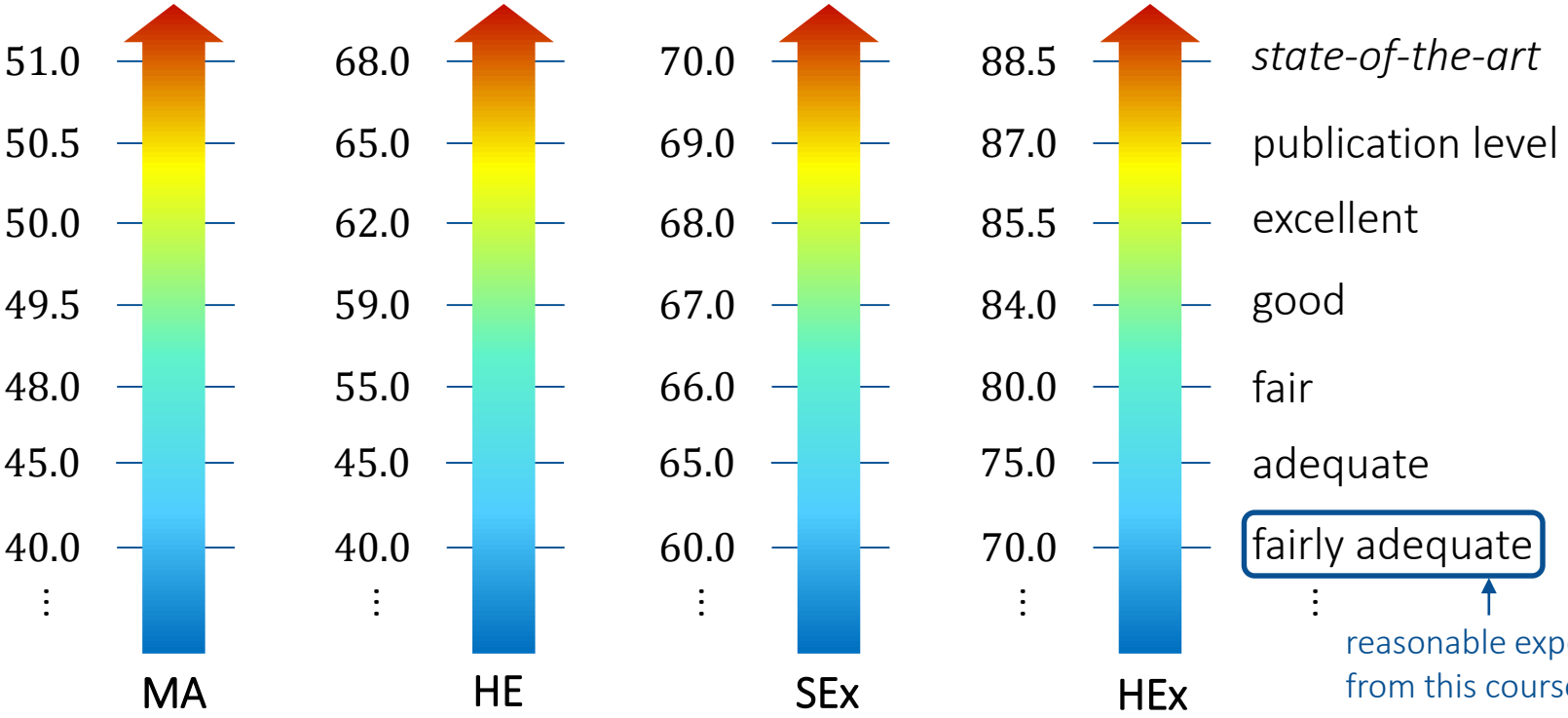
Materials

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



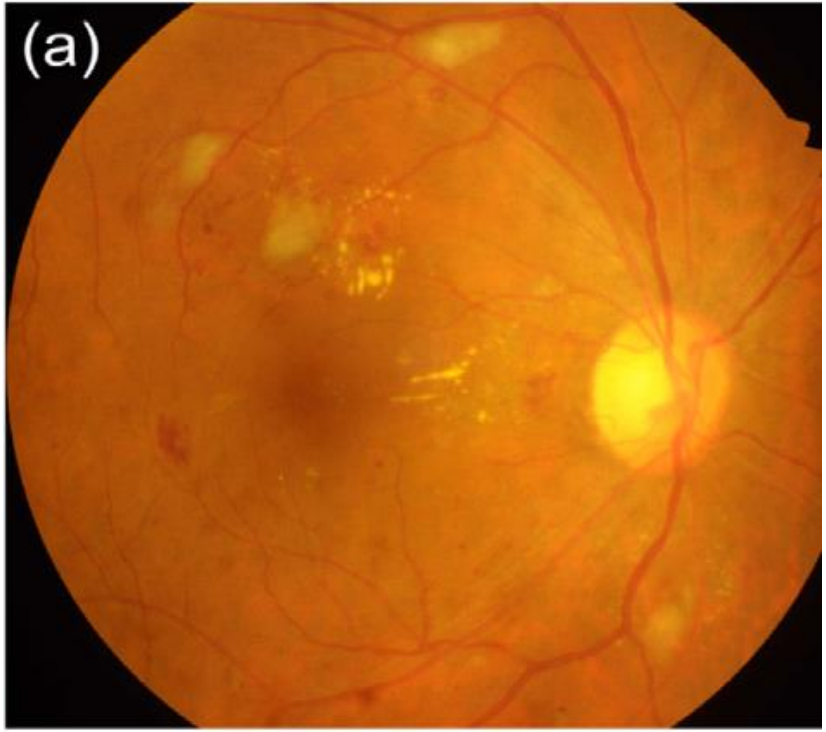
Performance evaluation

- area under the precision-recall curve ($AUPR$) for each lesion type
  - see Appendix in Traffic Sign Detection project and paper in `/literature`



Challenges

- unbalanced data
  - it is likely you will obtain a true-positive-false-positive ratio of 1:100 or higher in your candidate lesions set
    - this will be handled by **`ucasML`**
- very heterogeneous lesions
- uneven illumination conditions
- big high-res images (4000×3000)



Hints

- candidate extraction / segmentation
  - color spaces, grayscale morphology, region growing, …
  - sensitivity is more important than specificity, ML will do the false positive reduction
    - it's ok to have a 1:100 or even 1:1000 class imbalance
    - it's ok to test sensitivity on groundtruth regions
- feature extraction
  - color features, shape features, geometrical features, texture features, …
  - large feature sets (Haar, Gabor, etc.) might need feature reduction/engineering
- ML
  - strongly suggested to use **`ucasML`** tool, it is robust to class imbalance
  - training set definition is crucial and should be based on IoU
    - the higher, the purer the positive samples, the easier the learning task, but the less generalizable is the classifier….this is clearly a trade-off

Constraints

- decision with machine learning (**`ucasML`**)
- use **training and test splits** as those proposed in the **dataset**
  - train the ML model on the training set, evaluate performance on the test set
- groundtruth data in the test folder can only be used for performance evaluation
  - of course!
- performance evaluation must be performed on **original** groundtruth images
  - i.e. do not resize – performances will be biased if you do it