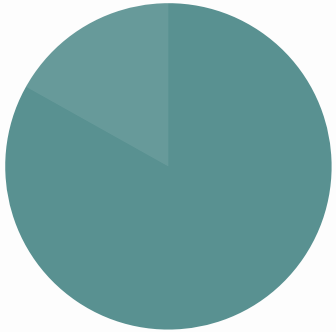
Screening of Common Retinal Diseases with Deep Learning



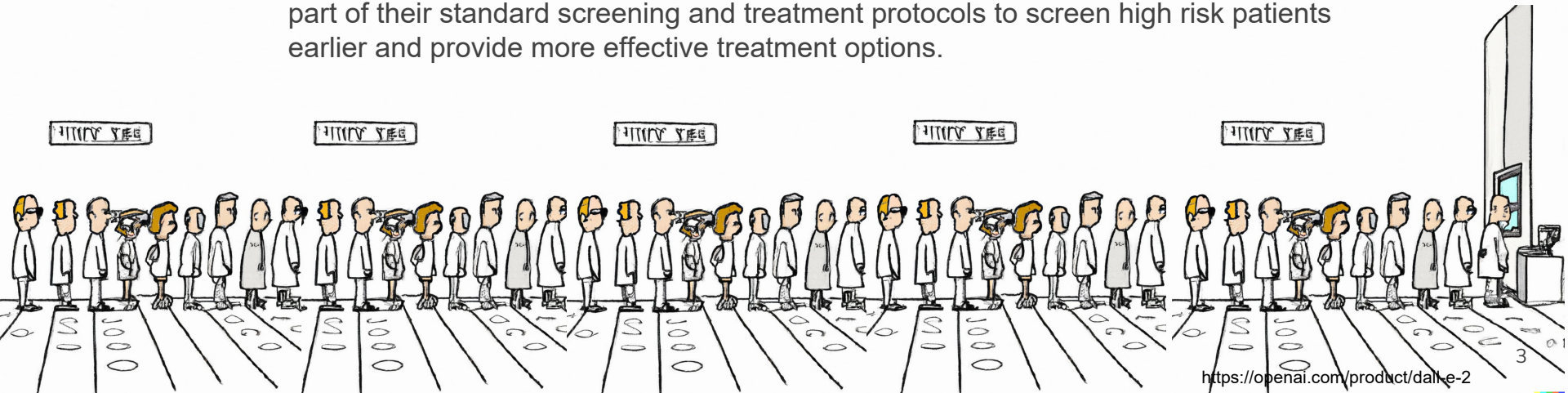
Presented by
Maryam Ghaffari

Outline

- Problem statement
- Mission
- Methodology
  - Obtain Data
  - Scrub Data
  - Explore Data
  - Model Data
  - Interpret Model
- Recommendation & Conclusion

Problem Statement

- Farabi hospital is a comprehensive center of excellence in ophthalmology.
- More that 100 patients visiting Farabi Hospital. Shortage in specialists to screen the high risk patients decrease patient outcomes and increase healthcare costs.
- OCT imaging is a standard of care for guiding the diagnosis of retinal conditions
- The hospital as a stakeholder interested in implementing the AI diagnostic tool as part of their standard screening and treatment protocols to screen high risk patients earlier and provide more effective treatment options.

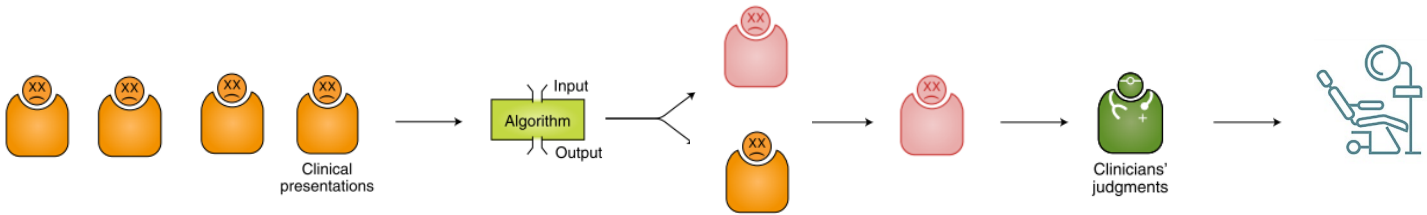


https://openai.com/product/dall-e-2

Mission

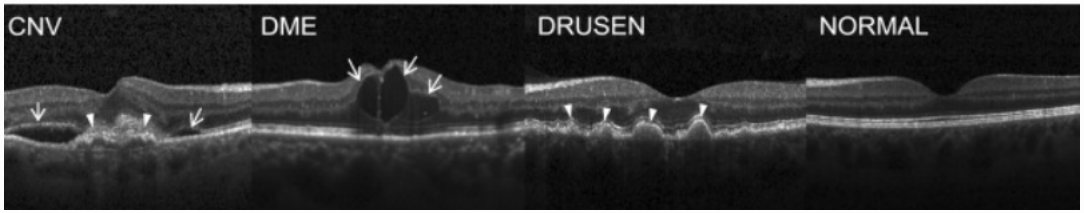
TEHRAN UNIVERSITY OF MEDICAL SCIENCES

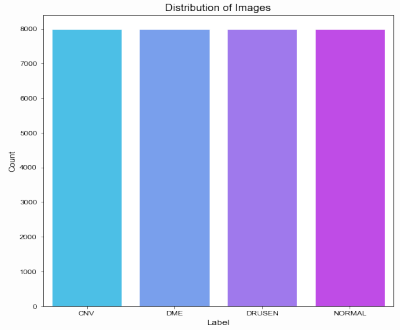
- Generate a Convolutional Neural Network (CNN) algorithm which detects high risk retinal conditions in OCT with high accuracy.
- Reveal potential indicators in the OCT in different diagnosis by highlighting regions recognized by the CNN to help ophthalmologists make more informed decisions regarding patient care, leading to better patient outcomes .



Methodology: Obtain & Scrub Data

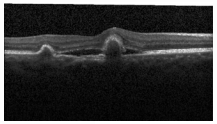
- Data collected in the University of California San Diego, Guangzhou Women and Children's Medical Center.
- There datasets include 33000 OCT images. The images are split into a training set (32000) and a testing set (1000) of independent patients. Images are labeled as and split into 4 directories: CNV, DME, DRUSEN, and NORMAL
- CNV and DME are generally considered more serious and require more aggressive treatment.

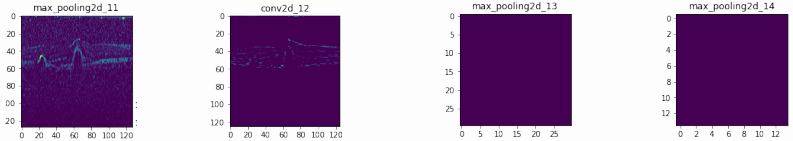


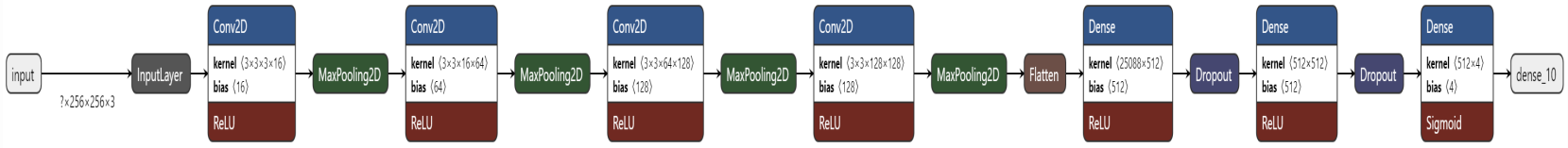


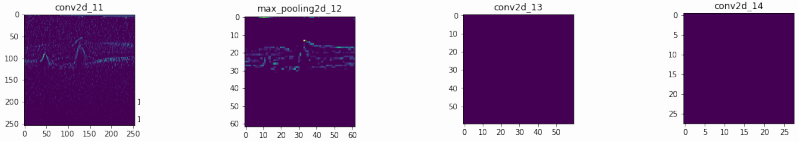
Kermany, Daniel S., et al. "Identifying medical diagnoses and treatable diseases by image-based deep learning." *cell* 172.5 (2018): 1122-1131.

Methadology: Model Data







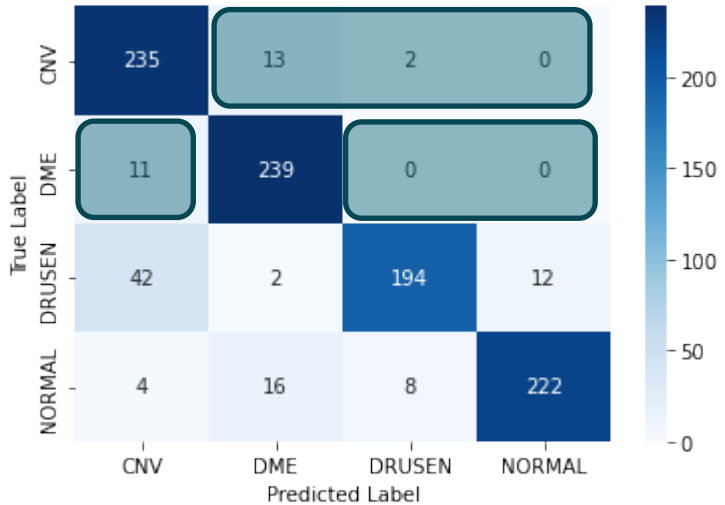


Output

CNV
DME
DRUSEN
NORMAL

Methadology: Model Interpretation

Confusion Matrix



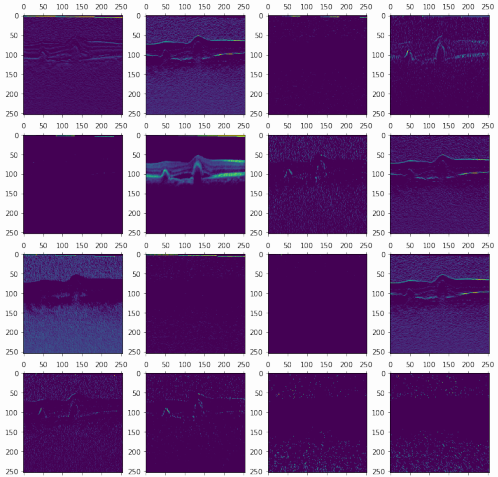
False Negative

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives + False Negatives}}$$

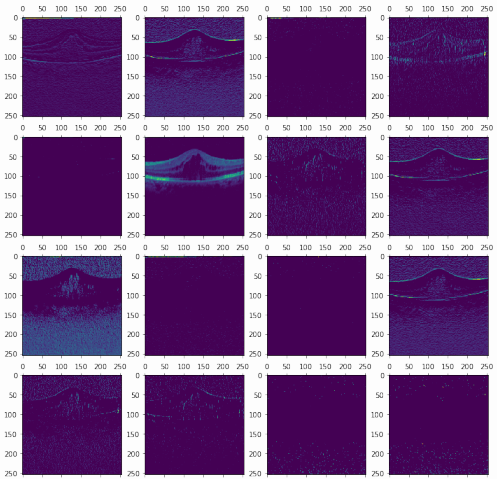
		precision	recall	f1-score	support
CNV	0	0.80	0.94	0.87	250
DME	1	0.89	0.96	0.92	250
DRUSEN	2	0.95	0.78	0.85	250
NORMAL	3	0.95	0.89	0.92	250
accuracy				0.89	1000
macro avg		0.90	0.89	0.89	1000
weighted avg		0.90	0.89	0.89	1000

Feature Visualization

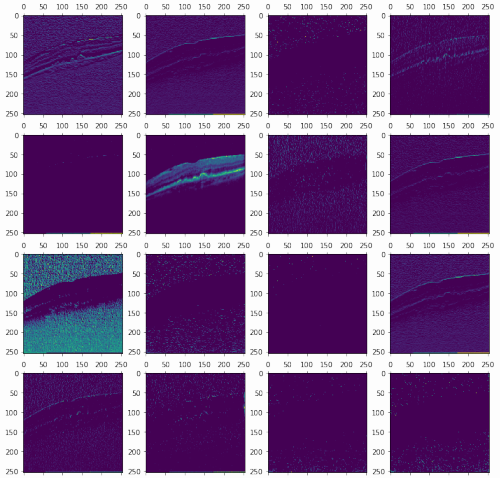
CNV



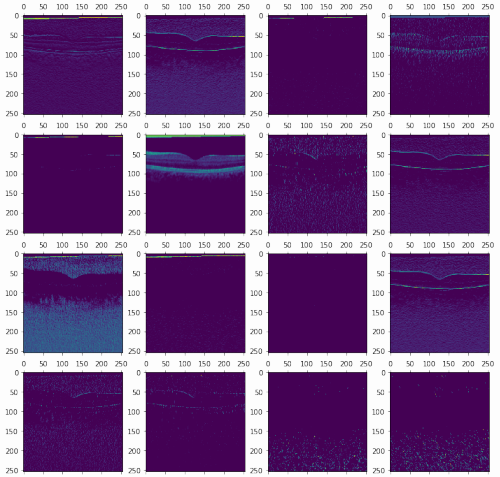
DME



DRUSEN



Normal



Conclusion & Recommendation

Conclusion:

- The proposed model distinguish between four potential classes (CNV, DME, DRUSEN, and NORMAL) with a high accuracy rate of 0.89.
- The main focus of the project was to achieve a high recall rate for the more serious conditions, CNV and DME, with a goal of above 0.9. The model achieved a recall of 0.94 and 0.96 for CNV and DME, respectively.
- this project suggest that implementing deep learning -based diagnostic tools for screening and diagnosis of retinal diseases can significantly improve patient outcomes and reduce healthcare costs by enabling early detection and personalized treatment

Recommendation:

- Implementation of the developed CNN model
- Integration with existing protocols
- Ongoing monitoring and evaluation.

Future work

- Exploration of different deep learning architectures and pretrained models: Although the CNN model used in this project achieved high accuracy and recall rates, other deep learning architectures may be more suitable for this task.

- Incorporating other imaging modalities: OCT is just one type of imaging modality used in ophthalmology. Future work could explore the use of deep learning - based models to analyze other imaging modalities such as fundus photography or fluorescein angiography.

- Clinical validation: While the developed CNN model achieved high accuracy and recall rates on the test dataset, it is important to validate the model in a clinical setting. Future work could involve a prospective study to evaluate the performance of the model in a clinical setting and compare it to the performance of human experts.

Thank You!

Email: mar.ghaffari@gmail.com
GitHub: https://github.com/MarGhaf/Screening-of-Common-Retinal-Diseases-with-Deep-Learning