Georgia Institute of Technology
School of Electrical and Computer Engineering
ECE 8803 - Spring 2023
Term Project

DRSS Severity Classification on OCT images

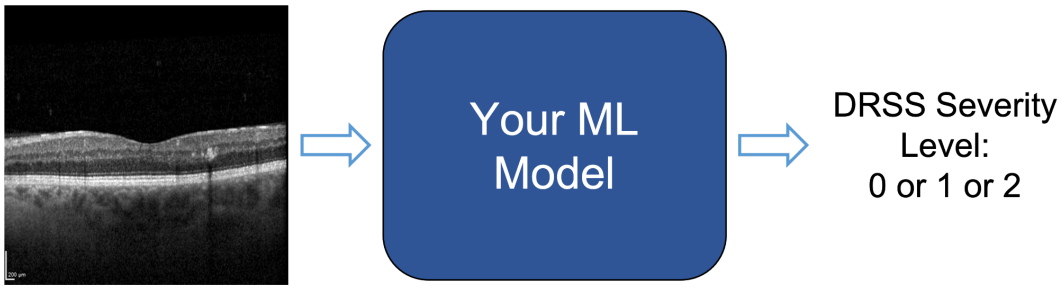
INSTRUCTIONS

- Teams: Students can work on the project in teams of TWO students. You may utilize Piazza to team up. Students from the Atlanta section and the DL section could team up.
- Data required for this project is available for download as detailed below.
- Your project must contain at least four different methods that perform the task. These methods must be different conceptually. For example, using two CNNs with different architectures count as one methodology.
- You have to conduct a comprehensive performance evaluation using, at least, all metrics we discuss in class and provide a detailed analysis.
- Your codes must be readable. You have to comment on your codes.
    - Students are expected to submit their codes with the instructions in a README file.
- Final reports and progress reports should be well-organized. In the final report, you will clearly explain your methods, and results.
    - One team member will submit all materials on behalf of the team.
- On Canvas, you have to submit the following for the progress report:
    - One-page pdf.
- On Canvas, you have to submit the following for the term paper:
    - one PDF of the term paper report. The report must include a link to a PUBLIC github repo. The Github repo must contain the report, the presentations, and the codes;
    - one PDF of the presentation; and
    - a zip file of your codes and the README file.
- If you have a research problem you would like to use for the project, then you have to perform this project in its entirety and then use the outcomes from this project to your research problem. You are welcome to add that as an extra page in your report. That will be used as a test of generalizability of your methods to other data modality.

PROBLEM

In this project, you will conduct Diabetic Retinopathy Severity Scale (DRSS) severity classification on the OCT images from the OLIVES [1] dataset. Data exists for each patient visit across a defined period of time, leading to the various severity levels.

You will develop classification methods that take only the OCT images as input samples, and output the associated DRSS severity levels. The following diagram illustrates the high-level goal of this project.



DATA

The full OLIVES dataset is derived from the PRIME and TREX-DME trials. In this project, we aim to classify OCT images only from the PRIME data into three severity levels. In summary, there are 32,337 samples taken from 658 volumes in the PRIME data. The samples from the same volume have the same DRSS scores.

OCT Data: You are provided with the Zenodo link HERE to download the data. Once you download and unzip the data file, you will find two zip files including “Prime_FULL.zip” and “TREX_DME.zip”. You will only use the “Prime_FULL.zip” for this project.

Annotations: You are provided with the pre-defined training and test split of Prime_FULL data HERE, which contains two .csv files including “df_prime_train.csv” and “df_prime_test.csv”. The paths to the training and test data and associated annotations can be found in the “df_prime_train.csv” and “df_prime_test.csv”, respectively. You will find the following fields of the two .csv files useful.

- “File_Path”: the paths to the OCT images under “Prime_FULL.zip”.
- “DRSS”: the discrete raw DRSS scores for reference.
- … etc.

Creating the severity levels for classification: You should create the Severity Level of DRSS using the following table, by grouping the values of the above “DRSS” field in the .csv files. You will use the row named “Severity Level” in the following table as the classification labels, i.e., {0,1,2}. We group the DRSS scores according to Table 3 of [7].

Severity Level	0	1	2
DRSS Scores	35, 43	47, 53	61, 65, 71, 85

USEFUL SCRIPTS and TUTORIALS

Click HERE for a script named "dataloader.py" that contains an example of PyTorch dataloader for this project.

Useful tutorials for creating PyTorch datasets and dataloaders can be found HERE, if you will train deep learning models.

DELIVERABLES and GRADES DISTRIBUTION

The following deliverables are expected from every team.

- **Progress Report** (25% of the project grade): On March 10, 2023, teams are expected to submit a one-page progress report that includes: (1) names of the team members, (2) lists the completed tasks such as dataloading, classification algorithms, …etc., (3), details of the individual's work, and (4) a list of the remaining tasks.
- **Term Paper** (40% of the project grade): The term paper is due on April 14, 2023. The term paper must follow an *IEEE* Double-column, single-space, 11-pt font size format. Use a Letter size template. A template can be found HERE. The term paper cannot be more than 4 pages in length. References and appendices are not included in the 4-page limit.
- **Poster Presentations** (35% of the project grade): Teams are expected to present their project on April 24 or April 28 during lecture. Every team has 7 minutes (plus 3 minutes for Q&A).

REFERENCES

[1] M. Prabhushankar, K. Kokilepersaud*, Y. Logan*, S. Trejo Corona*, G. AlRegib, C. Wykoff, "OLIVES Dataset: Ophthalmic Labels for Investigating Visual Eye Semantics," in *Advances in Neural Information Processing Systems (NeurIPS 2022) Track on Datasets and Benchmarks*, New Orleans, LA,, Nov. 29 - Dec. 1 2022 [PDF][Code]

[2] K. Kokilepersaud, M. Prabhushankar, and G. AlRegib, "Clinical Contrastive Learning for Biomarker Detection," in *NeurIPS 2022 Workshop: Self-Supervised Learning - Theory and Practice*, Oct. 16 2022.

[3] K. Kokilepersaud, M. Prabhushankar, G. AlRegib, S. Trejo Corona, C. Wykoff, "Gradient Based Labeling for Biomarker Classification in OCT," in *IEEE International Conference on Image Processing (ICIP)*, Bordeaux, France, Oct. 16-19 2022.

[4] Y. Logan, R. Benkert, A. Mustafa, G. Kwon, G. AlRegib, "Patient Aware Active Learning for Fine-Grained OCT Classification," in *IEEE International Conference on Image Processing (ICIP)*, Bordeaux, France, Oct. 16-19 2022. [PDF][Code]

[5] Y. Logan, M. Prabhushankar, and G. AlRegib, "DECAL: DEployable Clinical Active Learning," in *International Conference on Machine Learning (ICML) Workshop on Adaptive Experimental Design and Active Learning in the Real World*, Jun. 17 2022. [PDF][Code]

[6] Y. Logan, K. Kokilepersaud, G. Kwon and G. AlRegib, C. Wykoff, H. Yu, "Multi-Modal Learning Using Physicians Diagnostics for Optical Coherence Tomography Classification," in *IEEE International Symposium on Biomedical Imaging (ISBI)*, Kalkota, India, Jan. 7 2022. [PDF]

[7] Singer, Michael, et al. "Predictors of Early Diabetic Retinopathy Regression with Ranibizumab in the RIDE and RISE Clinical Trials." *Clinical Ophthalmology (Auckland, NZ)* 14 (2020): 1629.