Dyslexia Classification based on MRI images

Objective:
This project requires students to design and implement a deep learning classification algorithm to diagnose dyslexia based on patient's brain MRI images.

Background:
According to the International Dyslexia Association (https://dyslexiaida.org/), Dyslexia is defined as a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and the reduced reading experience that can impede growth of vocabulary and background knowledge.

In past years, researchers have tried to predict dyslexia from the 3D brain MRI images of young children using various classification methods. For instances, Tamboer et al. used an SVM classifier to differentiate between MRI images with/without dyslexia (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4832088/). Cui et al. describes a SVM + logistic regression aproach that predict dyslexia based on structural magnetic resonance imaging (MRI) and diffusion tensor imaging (https://pubmed.ncbi.nlm.nih.gov/26787263/). Recently researchers tried to use deep learning methods to study MRI images for diagnosing various brain related diseases, such as Alzheimer disease (AD) and Mild Cognitive Impairment (MCI). However, we have not seen any attempt to classify Dyslexia using deep learning approaches.

Project requirement:
In this project, students are required to design and implement a deep learning classifier to identify dyslexia patients by analyzing their brain MRI images. In addition to developing the deep learning method for classification, a traditional classification method such as SVM, should also be implemented to serve as a baseline for performance comparison. The project deliverables include:
1. A technical report to discuss your proposed method and research results. This report should at least include an introduction of the problem, a survey of the recent development in the area, the motivation of your study, the discussion of your proposed method, the experimental study, and concluding remarks.
2. The source code, the trained deep learning classifier (if applicable), the referenced libraries or packages (if applicable), and an instruction on how to compile, execute, and run your code.

Dataset:
The data were originally collected by Dyslexia Data Consortium, an initiative to collaboratively develop methods for retrospective multi-site dyslexia study. These data were contributed by members of the Dyslexia Data Consortium and included data from studies of reading disability group differences and dimensional studies of reading development (https://www.nature.com/articles/s41598-017-05691-5). The dataset is collected from eight different sites, consisting of 192 images, with 96 images labelled as controls and 96 images as (dyslexia) cases. There are 116 male (58 cases) and 76 females (38 cases) with a mean average of 9.78 years with a standard deviation of 1.55 years. The brain images are represented by 121 x 145 x 121 voxels. These brain MRI images are Jacobian transformed images, which can capture the whole brain volume without distorting the regions of interests and can therefore generalize and characterize the brain shape differences among the data. The dataset can be found at:

http://www.cs.clemson.edu/~jzwang/ustc20/jac_files.tar.gz

Project Policy:

- Each student must finish the project independently. Any form of cheating (including copying or reusing code from any source) will result in **0 (zero)** point for the project. However, you can use existing deep learning frameworks if you properly cite the original sources in your report.

- Students must submit their project deliverables at the specified due dates. Late submission will not be accepted without the prior approval of the instructor.

Questions and Concerns:

If you have any questions or concerns regarding this project, or if you feel any part of the project description is confusing, please talk to the instructor. Making false assumptions about the project may result in a low grade. The instructor can be reached at jzwang@clemson.edu.