Final Project for ELEC4010N

1 Overall

For the final project, each group can choose one task from Project 1 and one from Project 2(**In total, you need to implement two algorithms**) or Project 3. You need complete the following tasks: 1) run a baseline model on the provided dataset (you may use the code from Assignment 2), 2) propose or implement one method to improve performance, 3) write a summary report, and 4) give a presentation in the last class (on May 23). The specific requirements for each project are detailed in the problem statement.

1.1 Submission requirement

1.) Report (.pdf, no more than **4 pages**) to give a brief literature review, introduce the baseline and your implemented methods, and summarize the experimental results. 2.) Presentation slides (.pdf). 3.) Code with the readme file.

1.2 Deadline for presentation and submission

PPT submission deadline: May 23, 11:59 pm
Report submission deadline: May 26, 11:59 pm
Presentation time: May 23, 12:00 pm - 3:00 pm

1.3 Grades

Grading policy: Presentation (30%) + Report (70%)
Presentation (30%):

20% for attendance

5% for well-prepared PPT, including (1) background introduction, (2) method developments, (3) results analysis, and (4) conclusion.

5% for well-scheduled presentation: Each group member should present half of the work.

Report (70%):

30%+30% for reproducing satisfactory results. There are two algorithms.

10% for a well-written report, including (1) background introduction (2) method developments (3) results analysis, and (4) conclusion.

An additional 20 score will be given for any **novel** ideas and improvements you have made to improve the performance. To get it, please clearly indicate what you have tried and what results you have achieved in your report.

2 Project 1: Semi-Supervised Learning

There are two tasks, and you must choose one of them (either 2.1 or 2.2) to solve using the knowledge taught in class.

2.1 Semi-Supervised Classification

Dataset splitting. The dataset for this task is identical to the one used in question 1 of homework 2. To download the data and baseline codes, please refer to the resources provided on Canvas. Your task is to randomly partition the original training set, which consists of 900 images, into three subsets: a labeled training set (270 images), an unlabeled training set (540 images), and a validation set (90 images). The validation set will be used to assess the performance of your model during training. To ensure the reliability of your results, you must repeat the random data splitting and experiment at least four times.
Algorithm implementation. This course covers several semi-supervised learning methods, including Pseudo-Label [3], π model [2], temporal ensembling [2], mean teacher [4], UA-MT [8], UMCT [6], and CPS [1]. For this assignment, you are required to choose and implement **one** of these methods.
Optional requirement. Try to propose some **new** ideas to improve the performance.

2.2 Semi-Supervised Segmentation

Dataset splitting. The dataset for this task is the same as the one used in question 2 of homework 2. However, in that assignment, only a subset of the complete dataset was used, consisting of 30 patients out of the original 110. For this task, you should use the remaining 70 patients as the unlabeled training set, and 10 patients as the validation set.
Algorithm implementation. In this course, many semi-supervised methods are taught, like Pseudo-Label [3], π model [2], temporal ensembling [2], mean teacher [4], UA-MT [8], UMCT [6], and CPS [1]. You must select **one** method to implement.
Optional requirement. Try to propose some **new** ideas to improve the performance.

3 Project 2: Domain Generalization

There are two tasks on fundus and MRI images in this problem, respectively. **You must solve one (either 3.1 or 3.2) based on the taught knowledge**.

3.1 Domain Generalization on fundus images

Data splitting. The optic cup and disc (OC/OD) segmentation dataset comprises four distinct data sources. For this task, you are required to perform four

separate experiments, testing your models on each of the four data sources in turn. Specifically, you should train your models on combinations of three data sources, leaving out one for testing. The four experiments are: train on 1,2,3 and test on 4; train on 1,2,4 and test on 3; train on 1,3,4 and test on 2; train on 2,3,4, and test on 1.
Algorithm implementation. Implement the naive baseline and **one** domain generalization (DG) methods(It can be FACT [7], Dofe [5] or other methods); report the segmentation performance on the optic cup and optic disc (dice and average surface distance); analyze the advantages and disadvantages of different DG methods.
Optional requirement. Try to propose some **new** ideas to improve the performance.
Reference: dataset baseline code FACT Dofe

3.2 Domain Generalization on MRI images

Data splitting. The SCGM (spinal cord gray matter segmentation) dataset contains single-channel Spinal Cord MRI data with gray matter labels from four different centers. Data is collected from four centers (UCL, Montreal, Zurich, Vanderbilt) using three different MRI systems (Philips Acheiva, Siemens Trio, Siemens Skyra) but with institution-specific acquisition parameters. Domains are therefore grouped by institution, giving four domains in total.
Algorithm implementation. Implement the naive baseline and compare **one** domain generalization (DG) methods(It can be FACT [7], Dofe [5] or other methods); report the segmentation performance (dice and average surface distance); analyze the advantages and disadvantages of different DG methods.
Optional requirement. Try to propose some **new** ideas to improve the performance.
Reference: The dataset, Code for dataset, paper

4 Project 3: Choose your own topic

You can choose your own **two** topics related to medical imaging and the content taught by this course. But you need to make sure that the workload of your own topic is close to the previous project 1 and 2.

References

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2. Laine, S., Aila, T.: Temporal ensembling for semi-supervised learning. arXiv preprint arXiv:1610.02242 (2016)
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4. Tarvainen, A., Valpola, H.: Mean teachers are better role models: Weight-averaged consistency targets improve semi-supervised deep learning results. Advances in neural information processing systems **30** (2017)
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