深度學習於醫學影像分析—Deep learning in medical image analysis
Fall 2024

Homework 4, due on 2024/12/9

1. This homework is for analyzing sonography images obtained from scanning up from the lower neck. The goal is to **segment the carotid artery** from the image, which is a typical **semantic segmentation** problem.

2. We had taken sonography videos from left and right necks of three volunteers. We randomly extracted 100 image frames from each volunteer's video to from in total 300 training sonography images. The test data were taken from another volunteer and 100 test sonography images were created. We had asked several radiologists to label carotid artery area from each image frame.

3. The zipped file "**hwk04_data.zip**", which can be downloaded from e3 (https://e3.nycu.edu.tw/) under "Homework 4", contains all datasets for this homework.

   All training data are in the folder "**train**". Under the training data folder, there are two sub-folders "**pre**" and "**post**", which contains original sonography images and carotid artery labels, respectively. File names of training sonography images and their corresponding carotid artery labels can be found in the file "**train.csv**".

   Original sonography images of test data can be found under the folder "**test\pre**", and the file "**test.csv**" has the file names of test data.

4. This homework aims to develop predictive models to **label carotid artery areas of input sonography images**. You are ask to:

   a. Use the fully convolutional network (FCN) to build up your prediction model. Try out FCN-8s (with skip connections) schemes to upsample the coarse feature maps into a full-resolution segmentation map.

   b. Use U-Net to build up your prediction model.

5. For each prediction model, load test sonography images into your prediction

model to generate their predicted carotid artery labels.

a. Save predicted carotid artery labels as "(test_file_name)_ROI.bmp", e.g., the out label for the test data "**frame301.bmp**" is "**frame301.bmp_ROI.bmp**".

b. Collect all predicted carotid artery labels from FCN-8s and U-Net under folds "FCN-8s" and "U-Net", respectively, and create "**FCN-8s.zip**" and "**U-Net.zip**" for results. Please also upload the Python codes of your solution (saved as a .ipynb file) and its compiled html file.

c. Select a ***best*** model from b. for the Kaggle competition.

6. Kaggle submission
   a. Kaggle link: https://www.kaggle.com/t/0df92b91ea57469abb7b8935a8536b63
   b. Display team name: <studentID>
   c. The scoring metric is dice coefficient.
   d. You can submit at most 5 times each day.

7. Report submission
   a. Reproductivity of the results (6 pts)
   b. Number of parameters: Please write the parameter count of your final selected model to the Kaggle competition (4 pts)
   c. The difficulty during training (8 pts)
   d. Briefly explain the structures of the models you are using: You are required to do analyses using FCN-8s and "U-Net (12 pts)
   e. You should submit compile HTML file and ipynb notebook with name prefix to e3 platform.
      - {studentID}.ipynb, {studentID}.html, {studentID}.pdf, FCN-8s.zip, and U-Net.zip

8. Grading policy
   a. Kaggle (70 pts): Based on your final selected model
      The public leaderboard is calculated with approximately 50% of the test data. The final score will be based on the other 50% (private leaderboard), so the final scorings may be different.
      - Basic score (40 pts):

Over baseline: 40 pts

- Ranking score (30 pts):

  Dice: $\left(1 - \frac{\text{rank}-1}{\text{num\_participated}}\right) \times 20$ pts (the larger the dice, the higher the ranking)

  Number of parameters: $\left(1 - \frac{\text{rank}-1}{\text{num\_participated}}\right) \times 10$ pts (the smaller the number of parameters, the higher the ranking)

b. Report (30 pts)

9. Error submission

   If you submit the wrong format of files to e3, your score may be reduced.

   a. Name typo error 0 pts

   b. Late submission -10 pts per days