Digital Image Processing Final Project

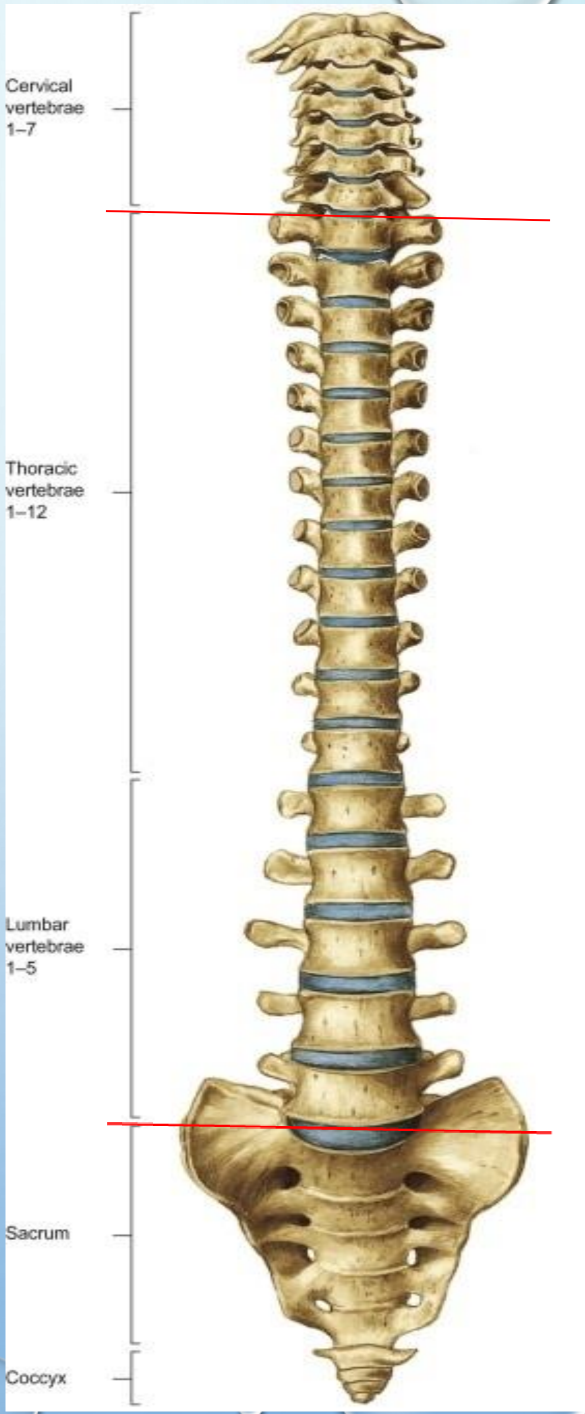
Vertebra Segmentation

Outline

- Background
- Objective
- Data
- Reference
- Evaluation
- Other information

Background

- Vertebral column
  - Cervical : 1~7
  - Thoracic : 1~12
  - Lumbar : 1~5
  - Sacral
  - Coccyx



S. Standring, 2016

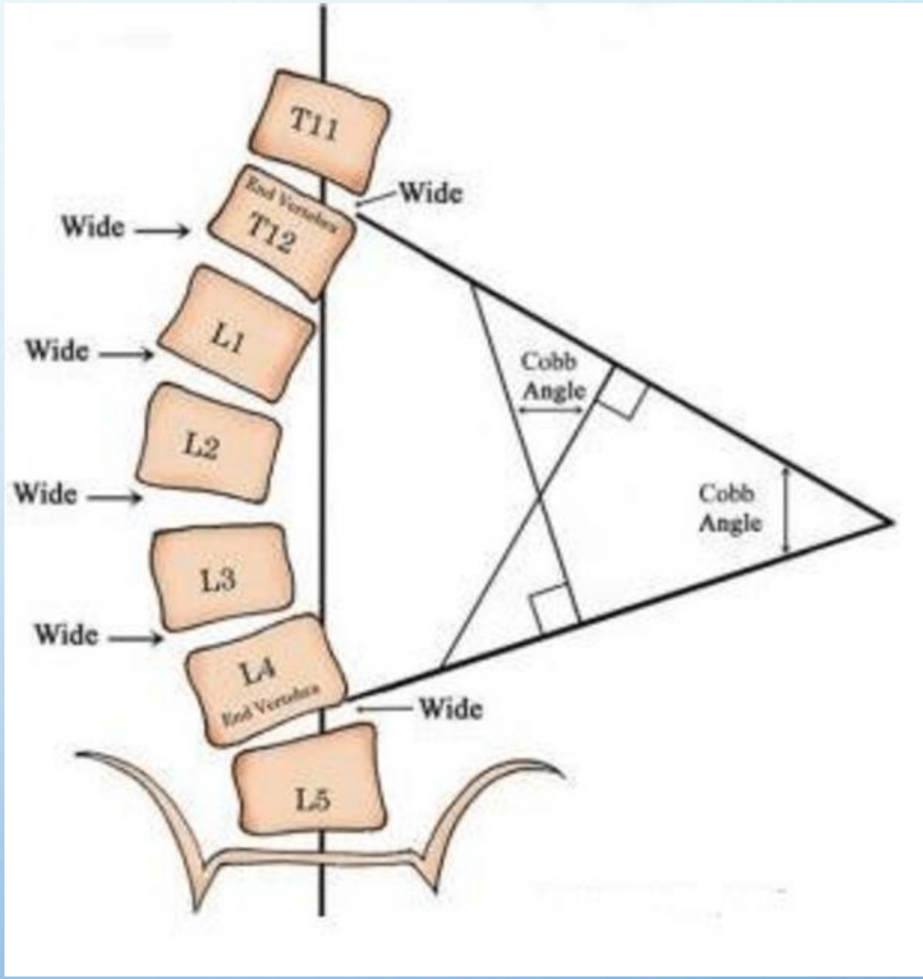
Background

- Scoliosis
  - Scoliosis is an abnormal curve in the spine.
  - Diagnosis is done by the physical exam and by imaging techniques such as X-rays, CT scans or MRI.

https://www.medicinenet.com/scoliosis/article.htm

Background

- Cobb angle
  - Cobb angle is a commonly used measurement of scoliosis.
  - Grading :
    - <10° : not scoliosis
    - 10 ° ~30 ° : mild
    - 30 ° ~45 ° : moderate
    - >45 ° : severe



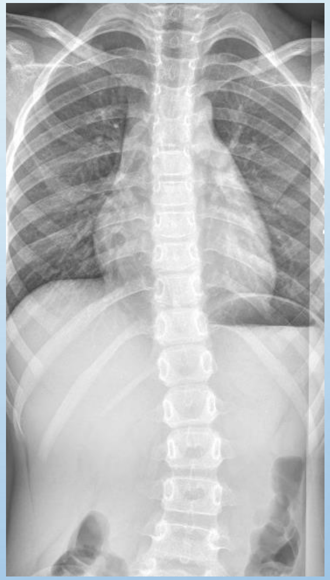
Ameneh Safari, et al. 2019

Objective

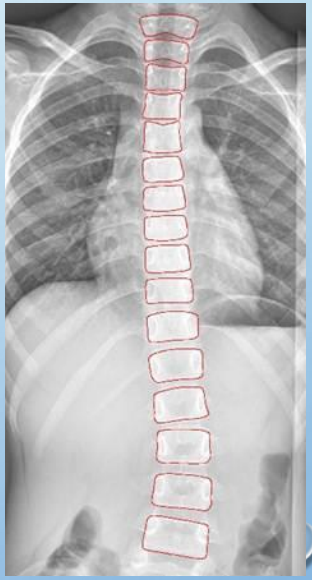
Cobb angle can be measured from spinal X-ray images.

An accurate segmentation of vertebra is very important.

Target :
Automatic segment the vertebra from an anterior-posterior (AP) view spinal X-ray images (grey level).



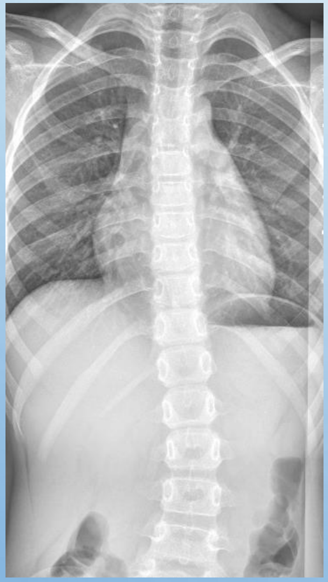
Input



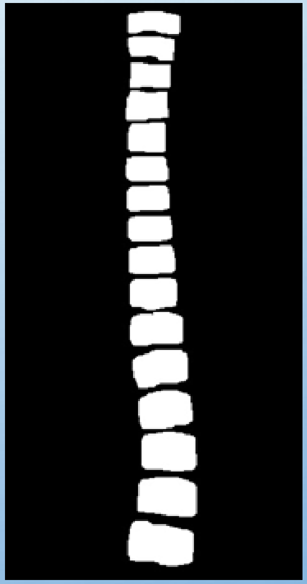
Output

Data

- 60 grey level X-ray vertebral digital images with ground truth.
- Size : 500x1200 pixels.
- The ground truths are drawn by an expert.



Source image



Ground truth image

References

- L. Vese and T. Chan, “A multiphase level set framework for image segmentation using the mumford and shah model,” *International Journal of Computer Vision*, vol. 50, no. 3, pp. 271–293, December 2002.
- Ronneberger, O., Fischer, P., & Brox, T. (2015, October). U-net: Convolutional networks for biomedical image segmentation. In International Conference on Medical image computing and computer-assisted intervention (pp. 234-241). Springer, Cham.
- Zamora, G., Sari-Sarraf, H., and Long, L. R. 2003. Hierarchical segmentation of vertebrae from x-ray images. In Medical Imaging 2003: Image Processing (San Diego, California, United States, May 15, 2003). International Society for Optics and Photonics Vol. 5032, 631-643. [Hough transform, ASM]
- Z. Zhang, Q. Liu, and Y. Wang, “Road extraction by deep residual u-net,” IEEE Geoscience and Remote Sensing Letters, 2018, http://arxiv.org/abs/1711.10684.
- S. J´egou, M. Drozdzal, D. Vazquez, A. Romero, and Y. Bengio, “The one hundred layers tiramisu: fully convolutional densenets for semantic segmentation,” in Proceedings of IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp. 1175–1183, Honolulu, HI, USA, July 2017.
- Horng, M. H., Kuok, C. P., Fu, M. J., Lin, C. J., & Sun, Y. N. (2019). Cobb Angle Measurement of Spine from X-Ray Images Using Convolutional Neural Network. Computational and mathematical methods in medicine, 2019.
- Pan, Y., Chen, Q., Chen, T., Wang, H., Zhu, X., Fang, Z., & Lu, Y. (2019). Evaluation of a computer-aided method for measuring the Cobb angle on chest X-rays. European Spine Journal, 28(12), 3035-3043.
- Lessmann, N., van Ginneken, B., de Jong, P. A., & Išgum, I. (2019). Iterative fully convolutional neural networks for automatic vertebra segmentation and identification. Medical image analysis, 53, 142-155.
- Li, Y., Liang, W., Zhang, Y., & Tan, J. (2018). Automatic Global Level Set Approach for Lumbar Vertebrae CT Image Segmentation. BioMed research international, 2018.

Evaluation

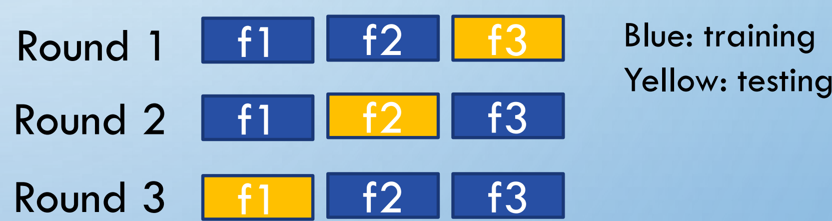
- Use the Dice Coefficient(DC) to evaluate your segmentation result with the ground truth

$$\text{DC} = \frac{2(A \cap B)}{(A + B)}$$

Where A is the ground truth region, B is the segmentation result,
$A \cap B$ is the intersect region, A+B is the sum of the regions;

Evaluation

- You can use the image processing method or deep learning method to segment the subject.
- You should clearly show the number of training, validation and testing images of your evaluation.
- If you are using training based methods, 3 fold cross-validation is required.



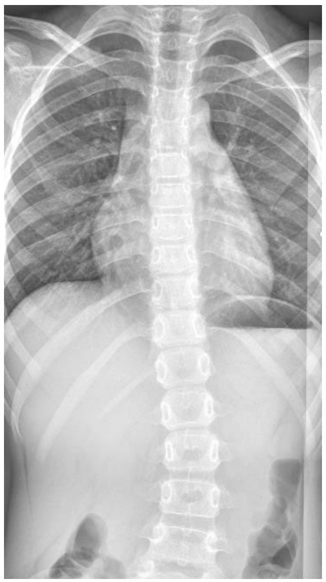
- *You should evaluate the segmentation result of each vertebra individually of a vertebral* column and show the average of them. (Both methods need to do evaluation)

Requirement

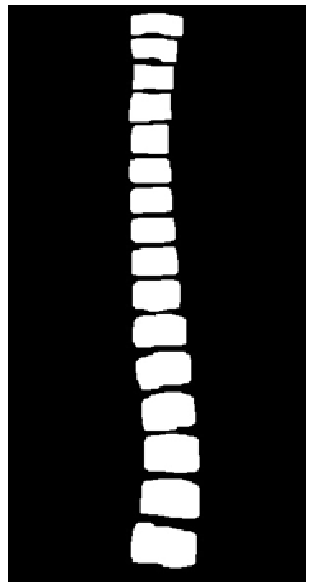
- 1) Read an input image and its ground truth from your program interface (GUI).
- 2) Run your program and show the overlapping of segmentation result(red) on the original input image in the program interface.
- 3) Show the evaluation result (DC).

GUI LAYOUT SAMPLE

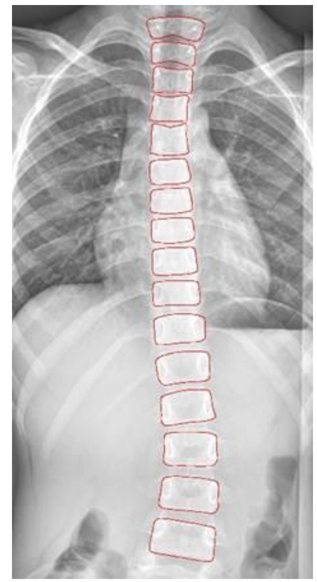
Select Image | Select Model | Run



Source



Ground truth



Result

DC :

V0 : 0.85

V1 : 0.87

V2 : 0.83

…

V15 : 0.83

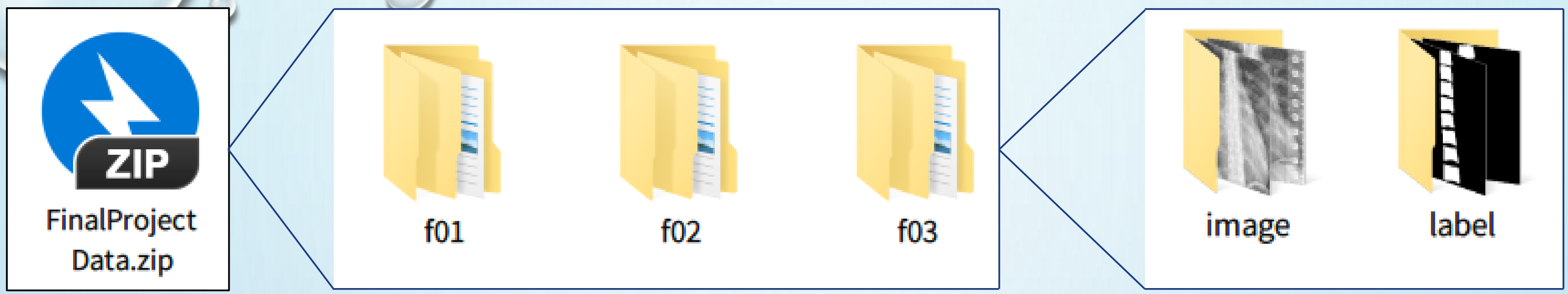
Avg : 0.84

You can free to design the interface.

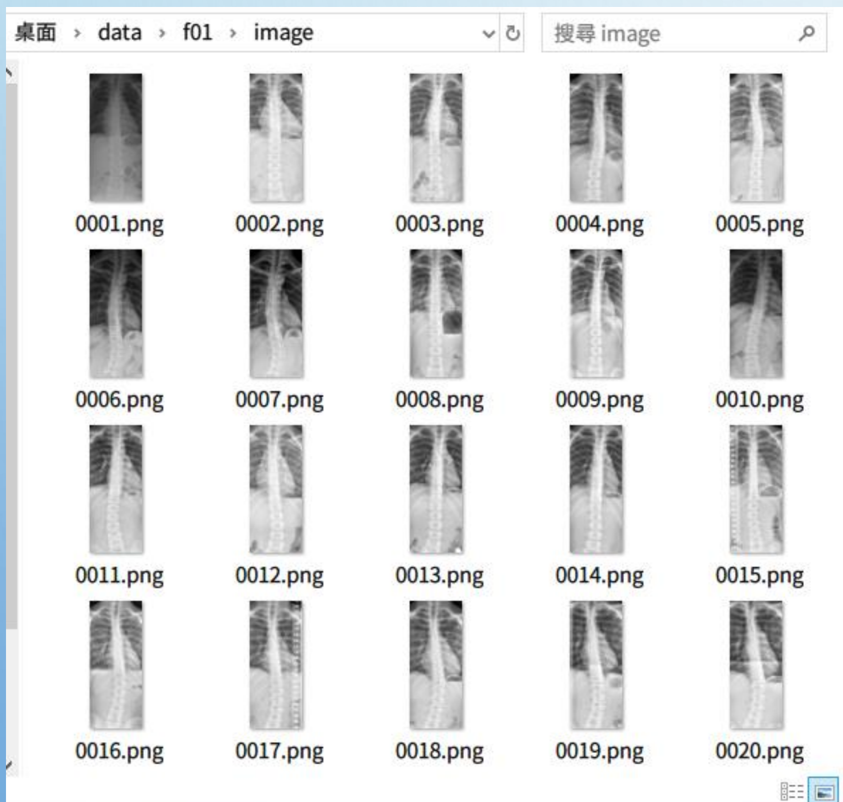
At least show source, ground truth, result, DC of each vertebra, DC of average.


1081_影像處理 IMAGE PROCESSING
成功大學
數·位·學·習·平·台
National Cheng Kung University
您以 郭振鵬登入 (登出)
正體中文 (zh_tw)
首頁 ► 1081_P755000
導覽
首頁
個人化首頁
個人歷程檔案
個人資料
目前課程
1081_P755000
課程大綱
成員
一般
主題 1
主題 2
主題 3
主題 4
主題 5
主題 6
主題 7
主題 8
您的進度
公佈欄
主題 1
FinalProject PPT
FinalProject Data
主題 2
[上課投影片] Ch 1
[上課投影片] Ch 2
[上課投影片] Ch 3
主題 3
作業一PPT

3 fold cross-validation



Each fold has 20 images and labels



Notice

- The report should be written in Chinese or English, and 4 pages at least. The report should include the questions, methods, results, discussion and conclusion. Please print it and hand it in at the demonstration.
- The demonstration will be held in Room 65702 during 2019/01/14,15,16. The schedule will be announced in advance on the course web side.
- If you cannot attend the scheduled demonstration, please inform the teaching assistant one week earlier for changing demo time.
- If you are not EE or CSIE student, you are allowed to use the matlab 2019 to do this project. EE or CSIE students should use Visual Studio C# or C++ (VS2017) (note: Python 3.6 with tensorflow 1.15 / pytorch 1.3 can be used when you are using deep learning methods).
- For deep learning methods, if you have to use any special library or version, please contact TA in advance. Basically an executable file of your project is required when doing demonstration. However, when you need to run it from source code, it is better to test your program first before the demonstration (contact TA if needed).
- It is not allowed to copy homework from other classmates, but discussions are encouraged.

File Upload

- Please compress the program source code, execution file(release mode) and report as a zip file and upload it to FTP before 11:59 p.m. of 2019/01/09(Thu).
  - ftp://140.116.247.97 port:102
  - id: imagehw
  - password: imagehw
- The format of the zip file name (all lowercase):
  - [student id]_[vs/py/matlab].zip
    - e.g. p78901234_py.zip
    - e.g. p78901234_matlab.zip
  - Please add your version number if you have any new update
    - e.g. p78901234_vs_v02.zip

VISION SYSTEM LAB (ROOM 65702)

Information

- NCKU moodle

- TA:
- shinyakuok@gmail.com
- hugikun999@gmail.com
- nick850810@gmail.com