HeLP Challenge

Stroke onset time

File format

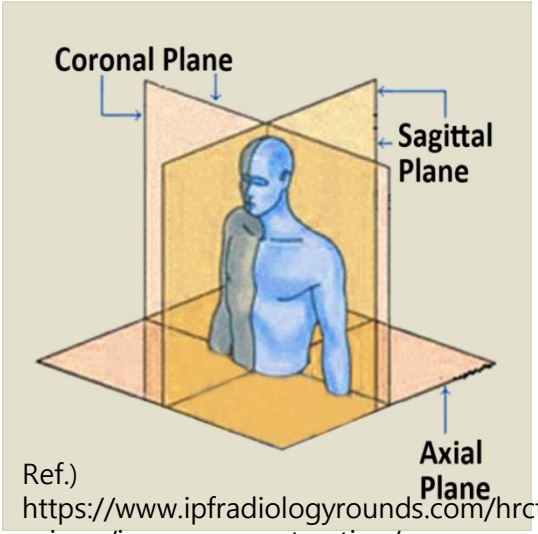
- **Medical Image**
  - DCM(Digital Imaging and Communications in Medicine)
    - is the international standard for medical images and related information
    - raw data
    - 2D slice 를 여러 장으로 쌓은 형태
    - Included patient and image info
    - .DCM
  - NIFTI(Neuroimaging Informatics Technology Initiative)
    - 3D Volume
    - .NII
  - Analyze
    - hdr file for metadata, img file for image data

ref
https://www.dicomstandard.org/
https://nifti.nimh.nih.gov/nifti-1

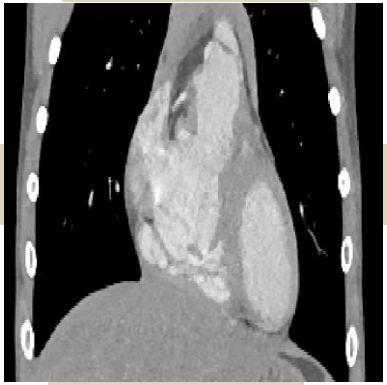
의료영상처리 라이브러리 (python)

- **Medical Imaging**
  - SimpleITK: 전반적인 의료영상처리 관련 함수 제공 라이브러리
  - opencv-python
  - Pydicom
  - medpy
- **Neuroimaging (http://nipy.org/index.html)**
  - NiBabel: 의료영상 파일 읽고 쓰기 지원 라이브러리
  - NiLearn: 영상 시각화, 머신러닝 등의 영상처리 라이브러리
  - NiPype
  - NiWidgets
- **기타**
  - Numpy
  - Scipy
  - matplotlib
  - Pandas
  - scikit-learn

Radiographic Presentations

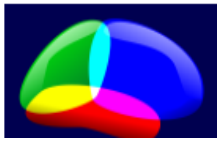


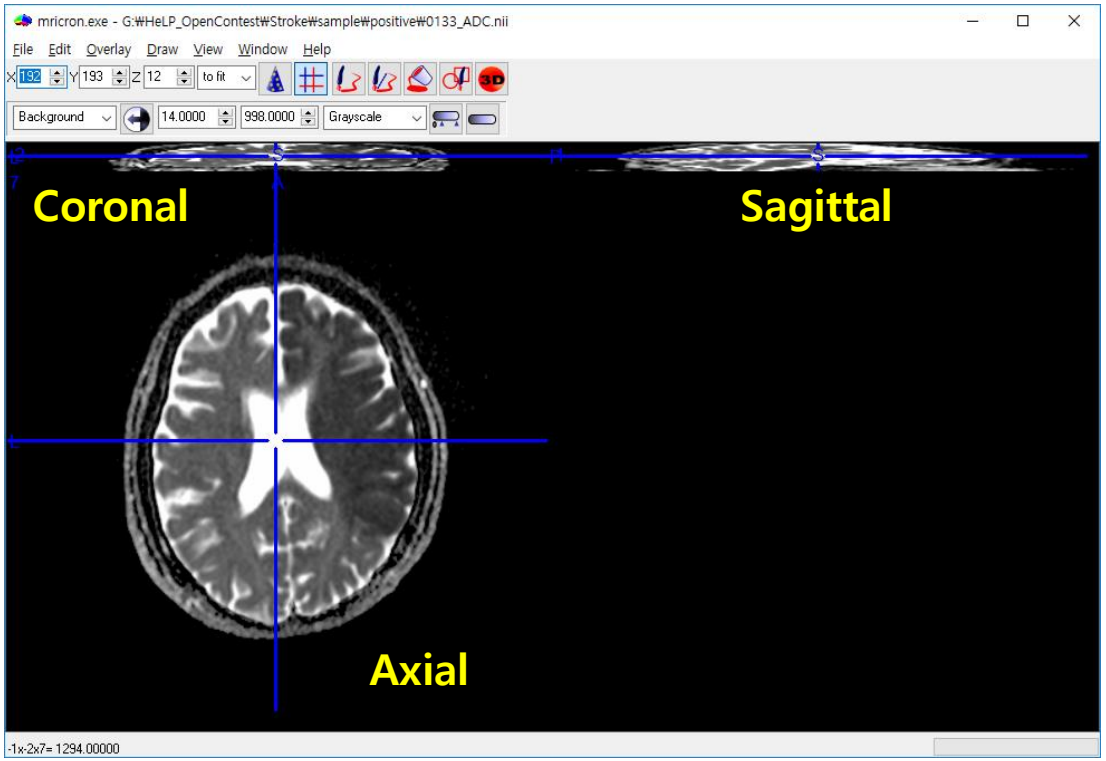
Ref.)
https://www.ipfradiologyrounds.com/hrct-primer/image-reconstruction/



Medical image viewer

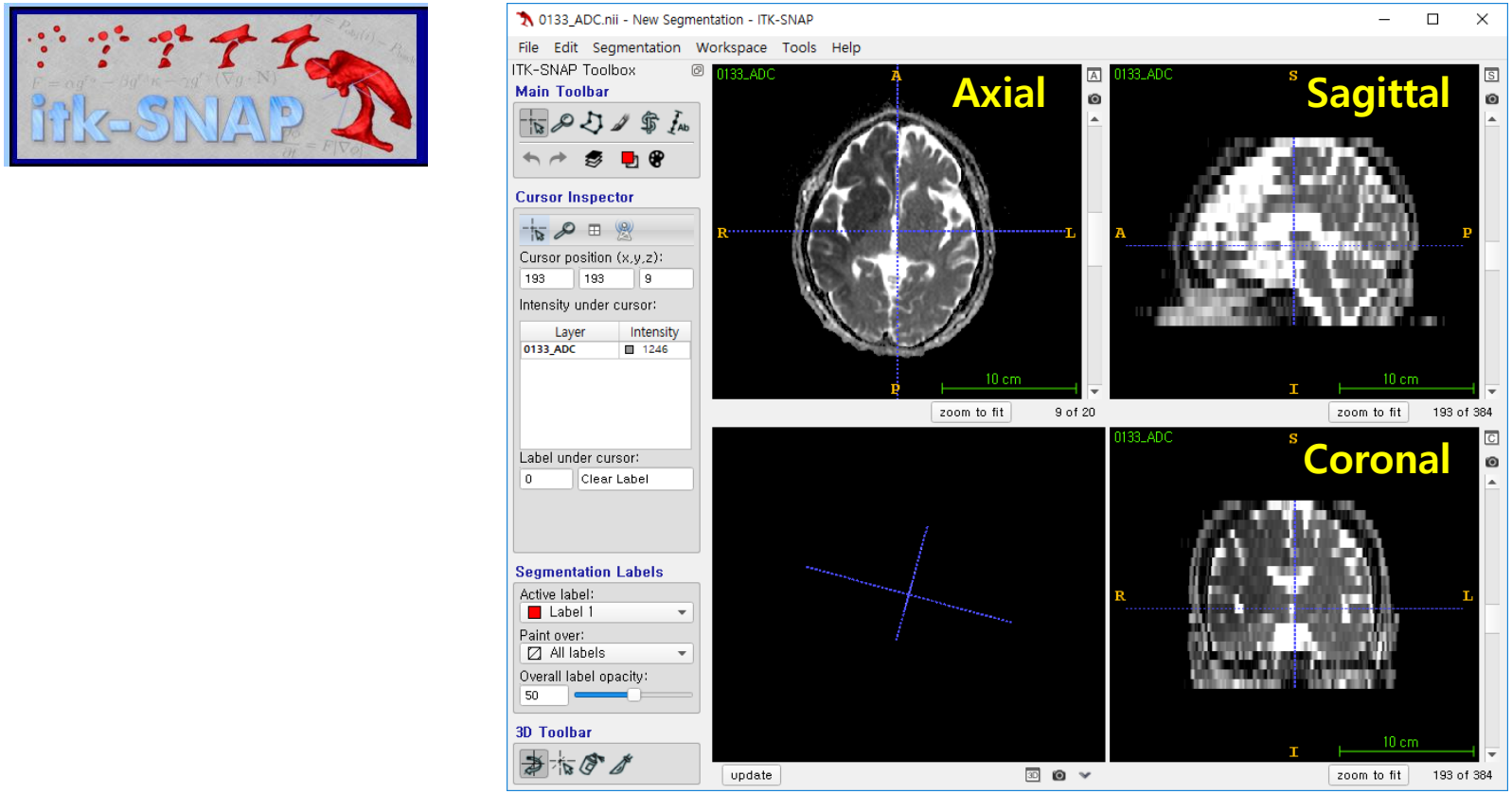
- **MRICron**





Medical image viewer

- **ITK-SNAP**



NIfTI (.nii) file in python (using simpleITK)

- **Read image**

```
import SimpleITK as sitk
imageInput = sitk.ReadImage(file_name_imageT1[n])
```

- **Get size, origin, spacing, direction**

```
imageInput =sitk.ReadImage(file_name_imageT1[0])

origin3d = imageInput.GetOrigin()
spacing3d =imageInput.GetSpacing()
size3d =imageInput.GetSize()
direction3d =imageInput.GetDirection()
```

- **Convert itk image to array**

```
imageT = sitk.GetArrayFromImage(image) # covert itk image to Array
model.train_on_batch(imageT,LabelT1)
```

- **Write image**

```
model1.load_weights(path_model1)
result11 = model1.predict(imageT)
result1 = result11.reshape((img_rows,img_cols,img_dep))
ResultImg11 = sitk.GetImageFromArray(result1)
final_Img1.SetSpacing(originalImg.GetSpacing())
final_Img1.SetOrigin(originalImg.GetOrigin())
sitk.WriteImage(final_Img1,output_filename)
```

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NIfTI (.nii) file in python (using simpleITK)

- http://insightsoftwareconsortium.github.io/SimpleITK-Notebooks/
- **IntensityWindowing**

```
isocubic_img_ww = sitk.Cast(sitk.IntensityWindowing(isocubic_img, LowT,HighT,0,255), sitk.sitkUInt8)
```

- **Extract**

`ExtractImageFilter()` - Crops an image to the selected region bounds using vectors; Collapses dimensions unless dimension is two

```
# Collapse along the x axis
extractSliceFilter = sitk.ExtractImageFilter()
size = list(mr_image.GetSize())
size[0] = 0
extractSliceFilter.SetSize( size )

index = (x, 0, 0)
extractSliceFilter.SetIndex(index)
sitk_xslice = extractSliceFilter.Execute(mr_image)
```

- **Compose**

`ComposeImageFilter()` - Combines several scalar images into a multicomponent vector image

```
# Recompose image (should be same as joined_image)
compose = sitk.ComposeImageFilter()
composed_image = compose.Execute(channel1_image, channel2_image, channel3_image)
```

Stroke data

- **MRI**
  - Multi-modal image
    - DWI (diffusion-weighted image) & ADC (apparent diffusion coefficient) map
      - “XXXX_b1000.nii”
      - “XXXX_ADC.nii”
    - FLAIR (fluid attenuated inversion recovery)
      - “XXXX_FLAIR.nii”
      - Coregistered (rigid-transformed) into DWI
    - Brain & infarct masks
      - “XXXX_brain.nii”
      - “XXXX_infarct.nii”
      - Coregistered (rigid-transformed) into DWI

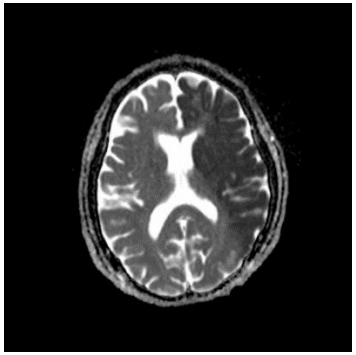
Stroke data

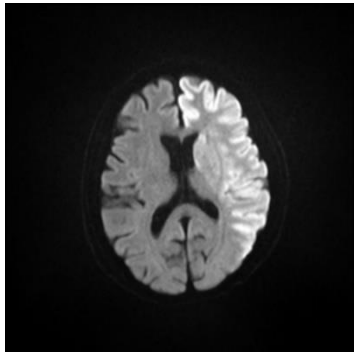
- **MRI**
  - Binary classification
    - Positive (1): within 4.5 hours from symptom onset
    - Negative (0): beyond 4.5 hours from symptom onset

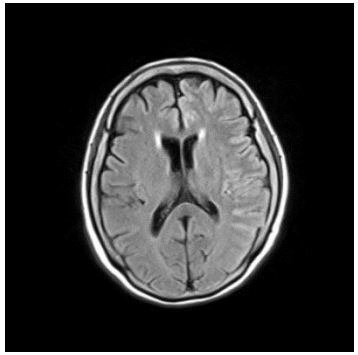
	Positive class	Negative class
Train	123	132
Validation	26	18
Test	33	23

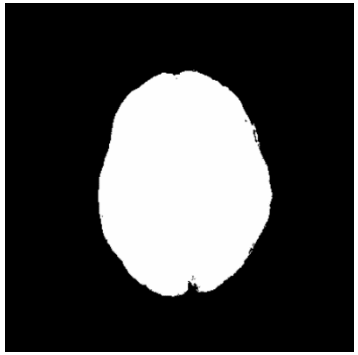
Stroke data

Positive case


ADC

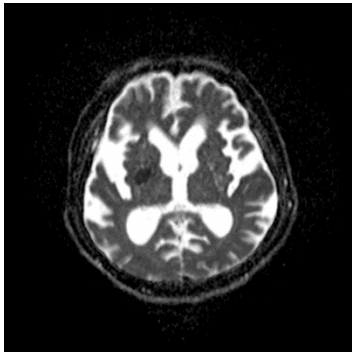

b1000

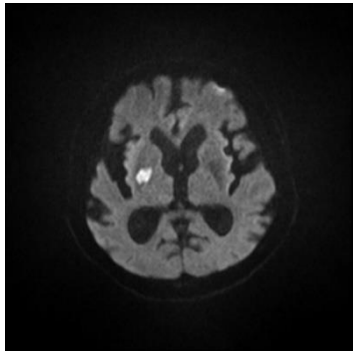

FLAIR

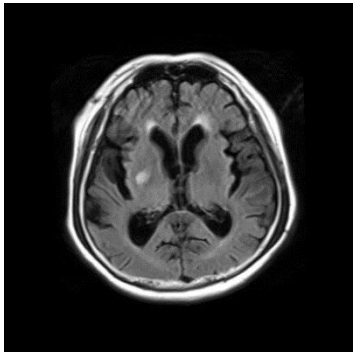

brain


infarct

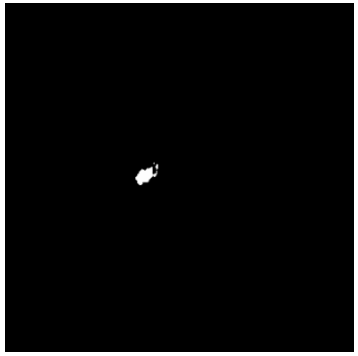
Negative case


ADC


b1000


FLAIR

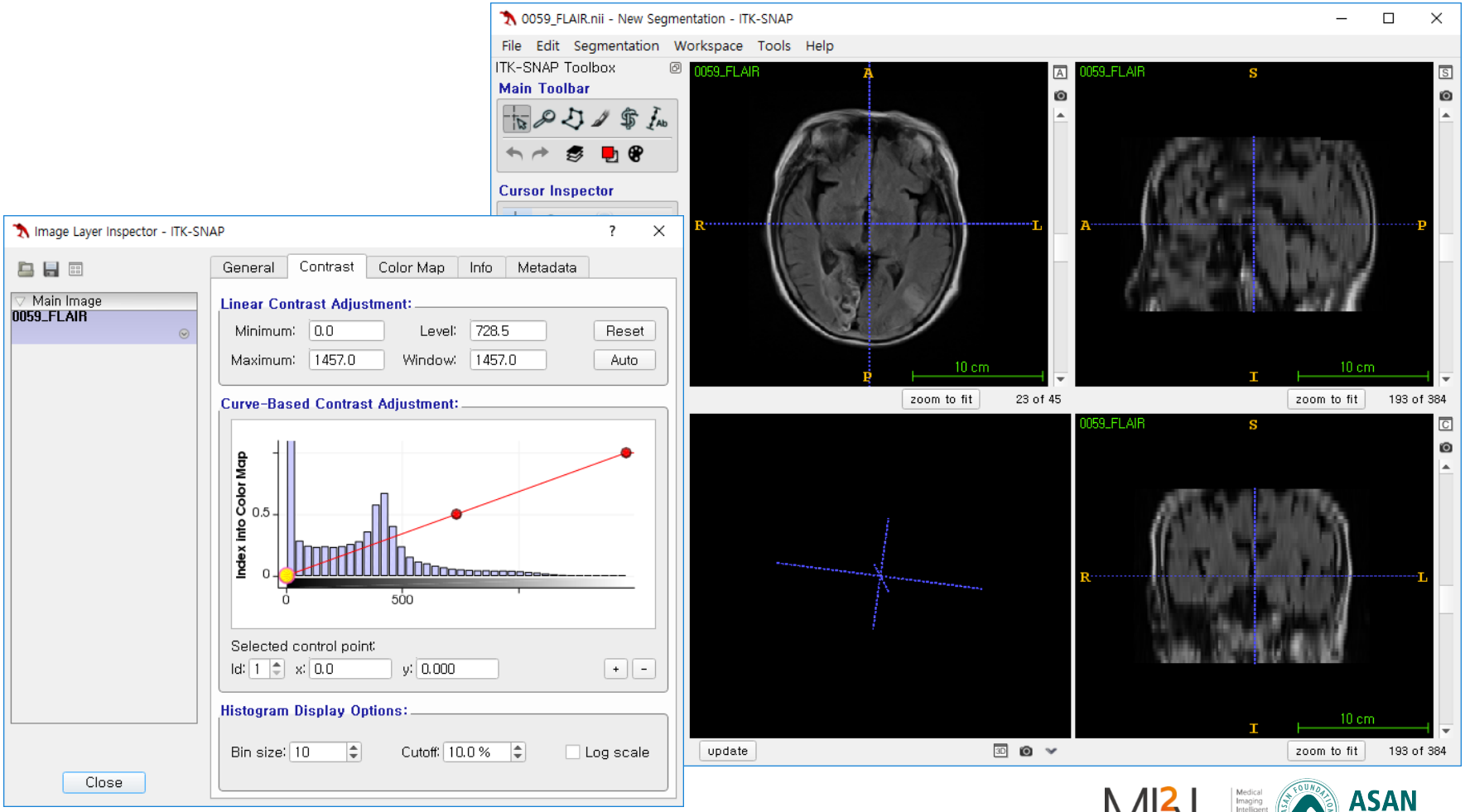

brain


infarct

Stroke data

➢ Preprocessing

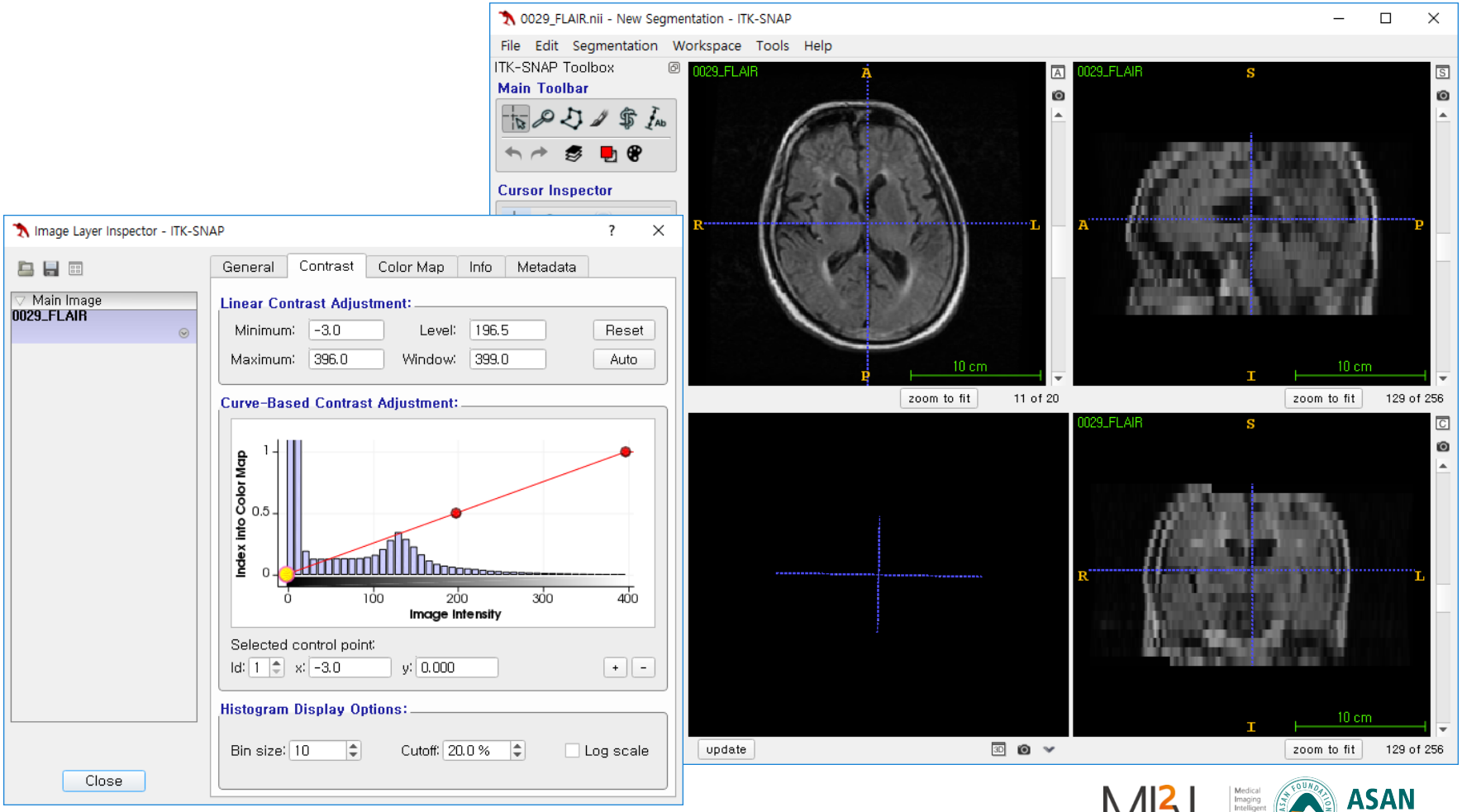
- Intensity normalization



Stroke data

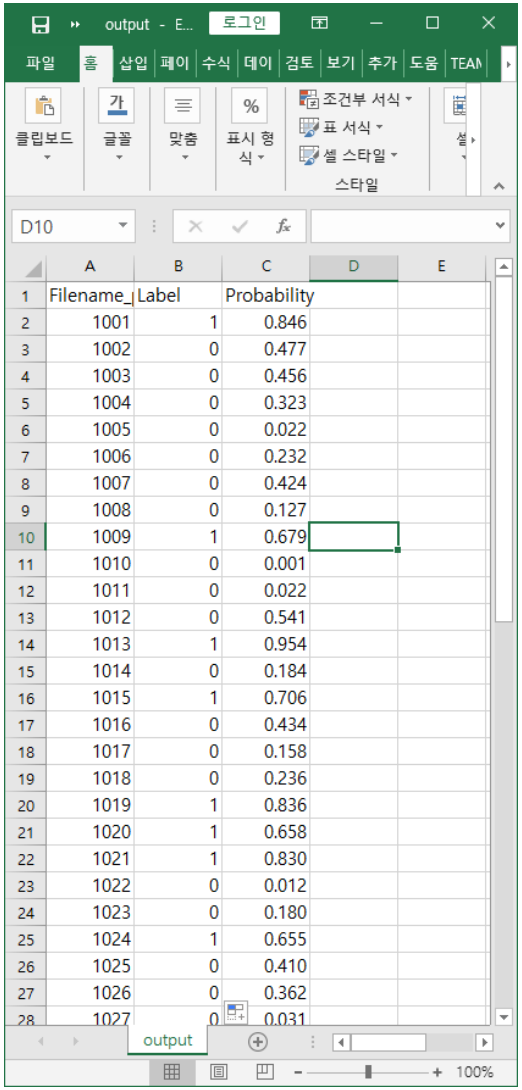
➢ Preprocessing

- Intensity normalization



(Predicted) Output

- “output.csv”



output - E... 로그인

파일 홈 삽입 페이 수식 데이 검토 보기 추가 도움 TEAM

클립보드 글꼴 맞춤 표시 형식 조건부 서식 표 서식 셀 스타일 스타일

D10

	A	B	C	D	E
1	Filename_	Label	Probability		
2	1001	1	0.846		
3	1002	0	0.477		
4	1003	0	0.456		
5	1004	0	0.323		
6	1005	0	0.022		
7	1006	0	0.232		
8	1007	0	0.424		
9	1008	0	0.127		
10	1009	1	0.679		
11	1010	0	0.001		
12	1011	0	0.022		
13	1012	0	0.541		
14	1013	1	0.954		
15	1014	0	0.184		
16	1015	1	0.706		
17	1016	0	0.434		
18	1017	0	0.158		
19	1018	0	0.236		
20	1019	1	0.836		
21	1020	1	0.658		
22	1021	1	0.830		
23	1022	0	0.012		
24	1023	0	0.180		
25	1024	1	0.655		
26	1025	0	0.410		
27	1026	0	0.362		
28	1027	0	0.031		

output

100%

Ranking scheme

➢ Evaluation

- $F_{0.5}$ score
  - Weighs recall lower than precision (by attenuating the influence of false negatives)
  - https://en.wikipedia.org/wiki/F1_score

$$F_\beta = (1 + \beta^2) \cdot \frac{\mathrm{precision} \cdot \mathrm{recall}}{(\beta^2 \cdot \mathrm{precision}) + \mathrm{recall}}.$$

- Accuracy

$$\text{Accuracy} = (TP+TN)/(TP+TN+FP+FN)$$

- AUC (Area Under the Curve)
  - https://en.wikipedia.org/wiki/Receiver_operating_characteristic

MI2RL

Medical
Imaging
Intelligent
Reality
Lab

Clinical Collaborators @ Asan Medical Center

Radiology

Joon Beom Seo, SangMin Lee[A,B], Dong Hyun, Yang, Hyung Jin Won, Ho Sung Kim, Seung Chai Jung, Ji Eun Park, Jeong Hyun Lee, So Jung Lee, Gilsun Hong, Hyoung Jung Kim

Pathology

Hyunjeong Go, Gyuheon Choi, Gyungyub Gong, Dong Eun Song

Cardiology

Jaekwan Song, Jongmin Song, Young-Hak Kim

Anesthesiology

Sung-Hoon Kim, Eun Ho Lee

Neurology

Dong-Wha Kang, Chongsik Lee, Jaehong Lee, Sangbeom Jun, Misun Kwon, Beomjun Kim

Surgery

Beom Seok Ko, JongHun Jeong, Songchuk Kim, Tae-Yon Sung

Emergency Medicine

Dong-Woo Seo

Internal Medicine

Jeongsik Byeon, Kang Mo Kim

HYUNDAI HEAVY INDUSTRIES LG CGBio OSSTEM IMPLANT kakaobrain VUNO CORELINE SOFT ANYMEDI 울산대학교 UNIVERSITY OF ULSAN 서울아산병원 Asan Medical Center