Tencent AI Lab

RSNA19 Challenge
Intracranial Hemorrhage Detection
First Place Solution

Team: Tencent AI Lab

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Tencent MIAIS(腾讯觅影) solutions to facilitate end-to-end clinical workflow

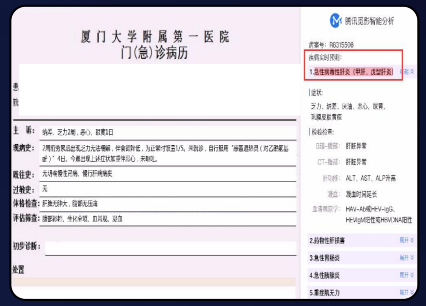
1 Medical consultation

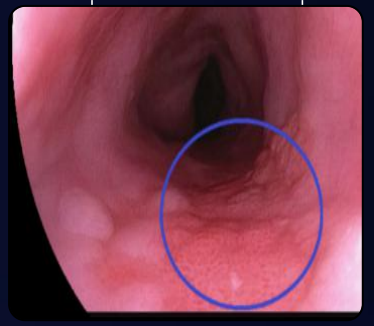
2 Image diagnosis

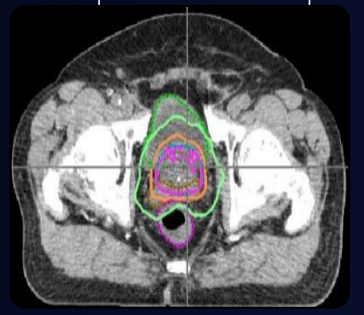
3 Pathology

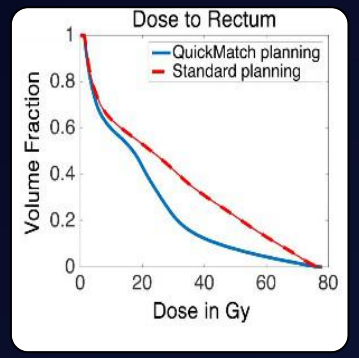
4 Treatment planning

5 Therapy

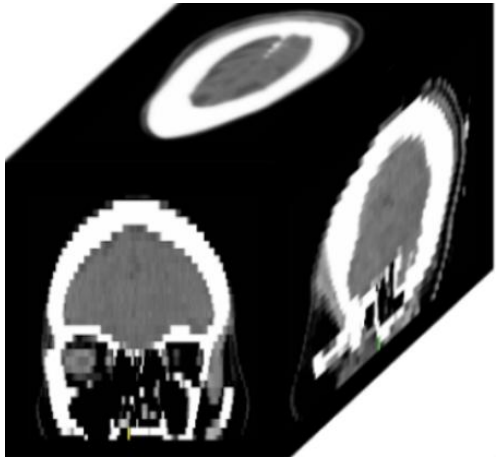




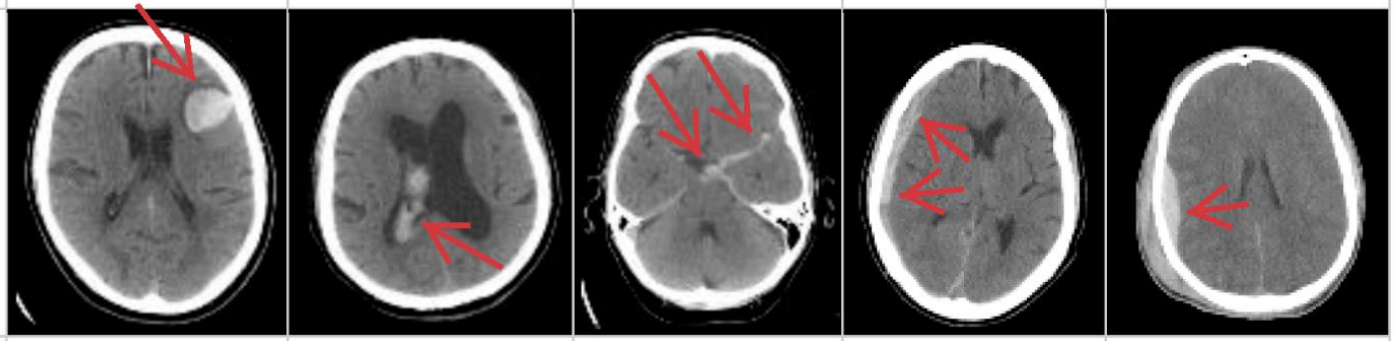




Challenge Task



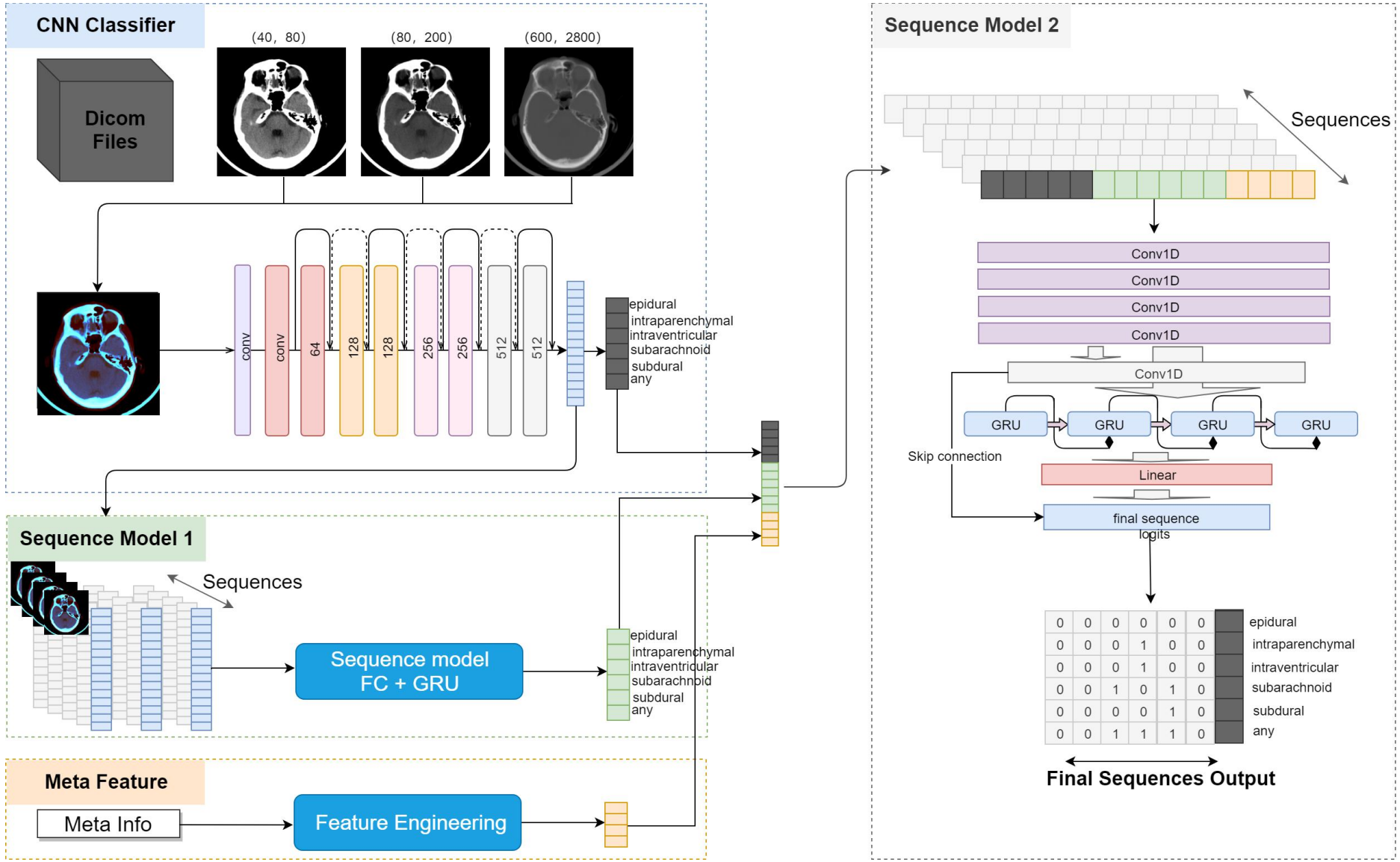
- Brain CT
- Intracranial Hemorrhage
- Evaluation: Log loss

	Intraparenchymal	Intraventricular	Subarachnoid	Subdural	Epidural
Location	Inside of the brain	Inside of the ventricle	Between the arachnoid and the pia mater	Between the Dura and the arachnoid	Between the dura and the skull
Imaging					
Mechanism	High blood pressure, trauma, arteriovenous malformation, tumor, etc	Can be associated with both intraparenchymal and subarachnoid hemorrhages	Rupture of aneurysms or arteriovenous malformations or trauma	Trauma	Trauma or after surgery
Source	Arterial or venous	Arterial or venous	Predominantly arterial	Venous (bridging veins)	Arterial
Shape	Typically rounded	Conforms to ventricular shape	Tracks along the sulci and fissures	Crescent	Lentiform
Presentation	Acute (sudden onset of headache, nausea, vomiting)	Acute (sudden onset of headache, nausea, vomiting)	Acute (worst headache of life)	May be insidious (worsening headache)	Acute (skull fracture and altered mental status)

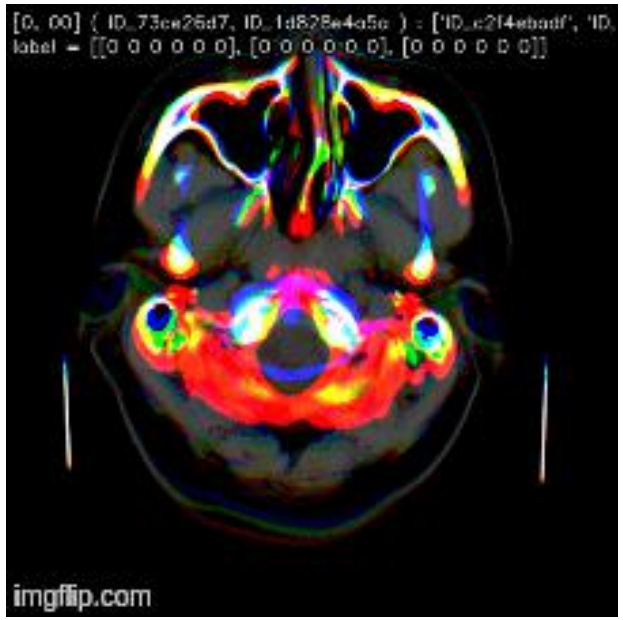
Solution Overview

Key Modules :

- 2D CNN Classifier
- Sequence Models
- Meta Features



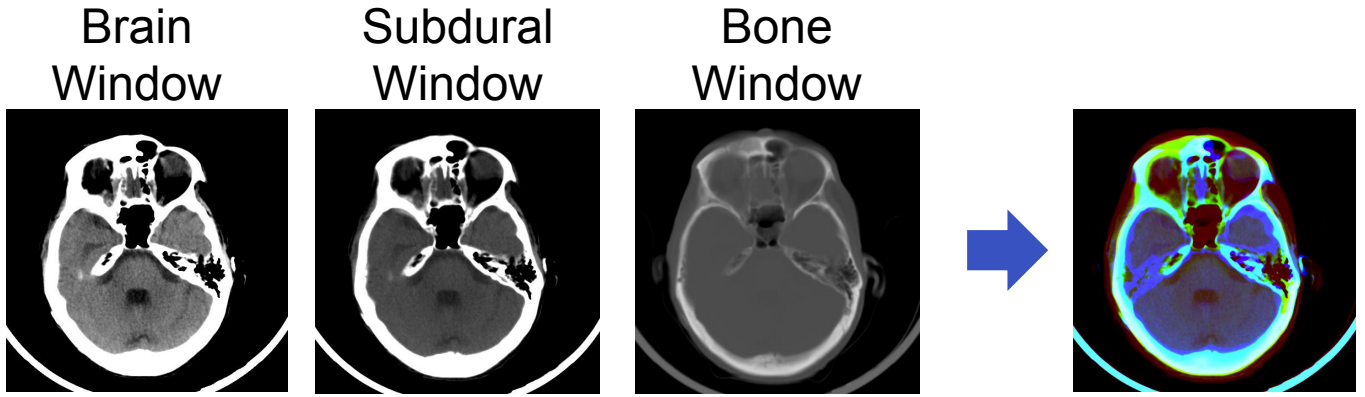
Preprocessing



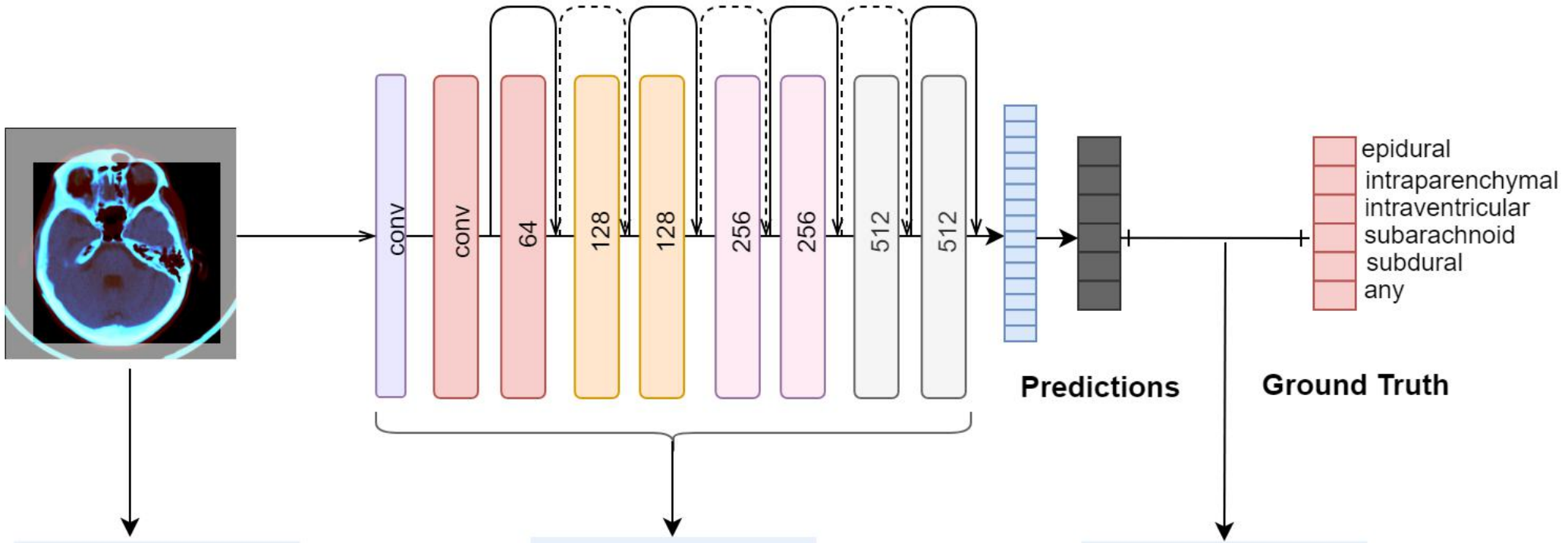
- Three channel input
- Image size512*512

Three windows

- Brain window (40-80)
- Subdural window (80-200)
- Bone window (600-2800)



2D CNN Modeling



Augmentation

- Random Crop
- Random Erase
- Left-Right Flip

BackBone

- SE-Resnext101
- Densenet169
- Densenet121

Loss Function

- Log Loss

2D CNN Modeling

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Optimization

- 5 fold cross validation
- Randomly sample images form different studyIDs
- Each epoch was trained on 4 times studyIDs
- Adam optimiser with cycle learning rate (5e-4~1e-5)

Performance

Backbones	stage1 score
densenet121	0.064
densenet169	0.064
seresnext101	0.062

Sequence Modeling

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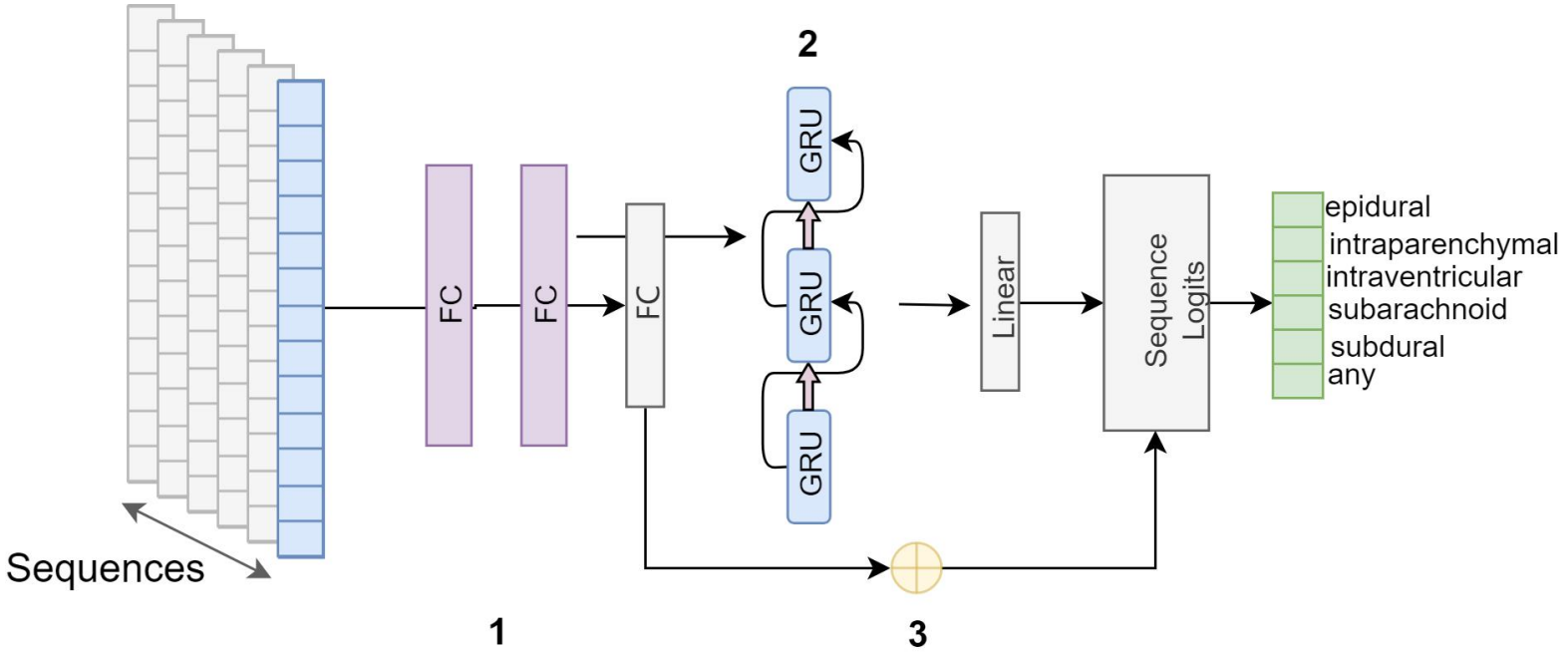
Sequence model 1:



Elementwise Sum

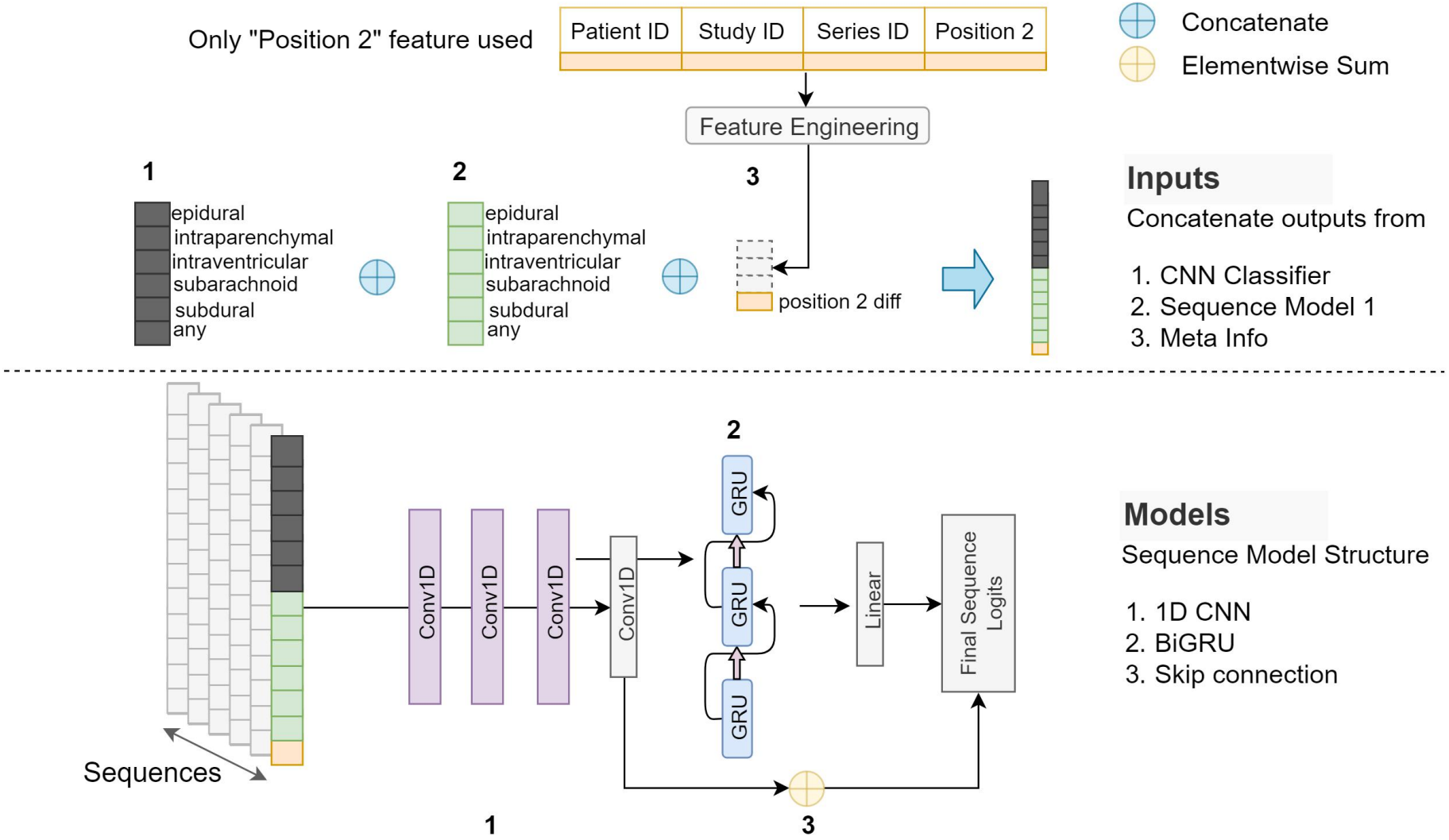
Models

Sequence Model Structure

1. Full Connected Layer
2. BiGRU
3. Skip connection

Sequence Modeling

Sequence model 2:



Sequence Modeling

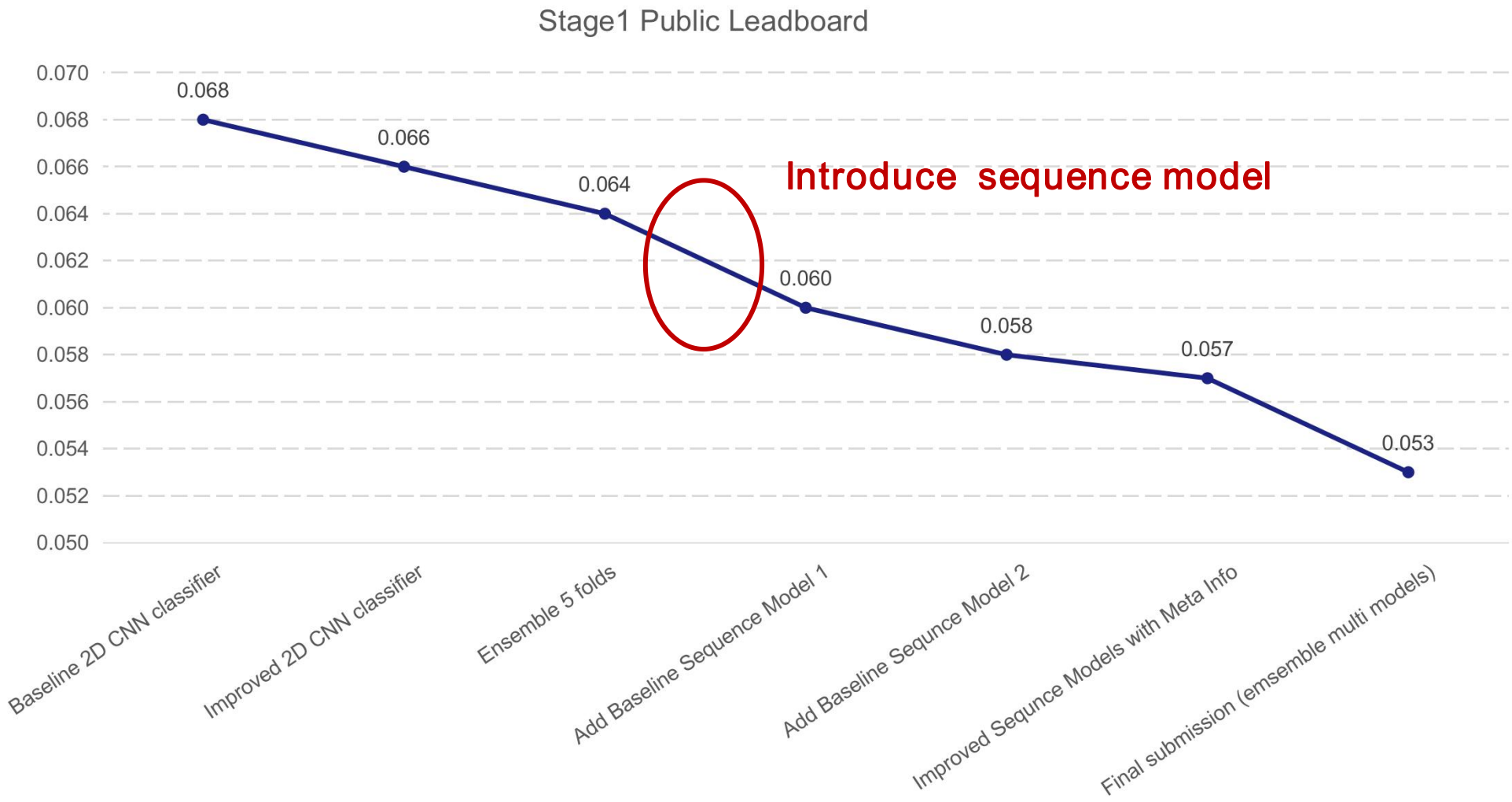
Optimization

- 10 fold cross validation
- Sequence subsampling augmentation
- Adam optimiser with step learning rate
- 50 epochs

Performance

Model	stage1 score
Best 2D CNN	0.062
Seq Model 1	0.058
Seq Model 2	0.057
Seq Model 2 (ensemble)	0.054

Score Growth Chart



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Thank you

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Code:
https://github.com/SeuTao/RSNA2019_1st_place_solution