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Technical Project (Medical Imaging): Building AI-based Brain Tumour Classification/Segmentation Models

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Project Lead: Chengliang Dai
Supervisors: Mengyun Qiao, Yifeng Mao, Shuojie Fu

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Project Overview

Our computer vision (CV) technical project in Medical Imaging focuses on building AI-based models for Brain Tumour Classification/Segmentation.

The primary aim is to design reliable models to classify/segment gliomas, the most common malignant brain tumours, using what you will learn in this winter school. You will collaborate in small groups to develop Convolutional Neural Network (CNN) based AI models that can identify gliomas from brain MR images.

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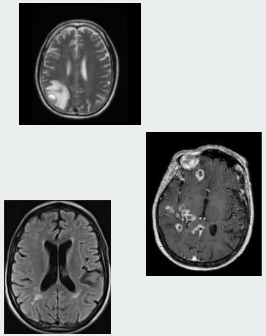
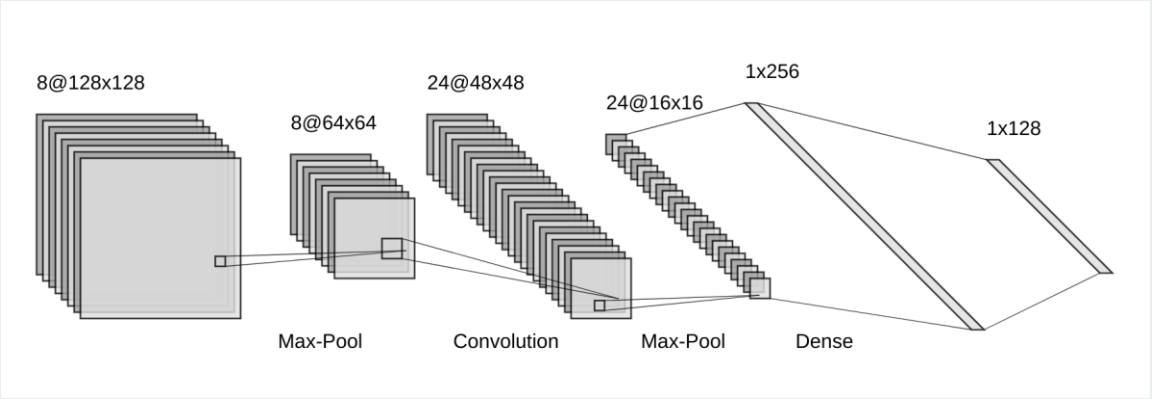
CNN-based Framework for Brain Tumours Classification

- The goal for you is to design a CNN-based framework for brain tumour classification as depicted in the provided figure.



Input



CNN-based model for feature extraction

With tumour or without tumour?

Output

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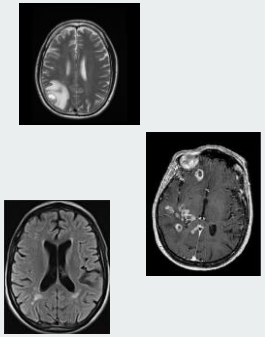
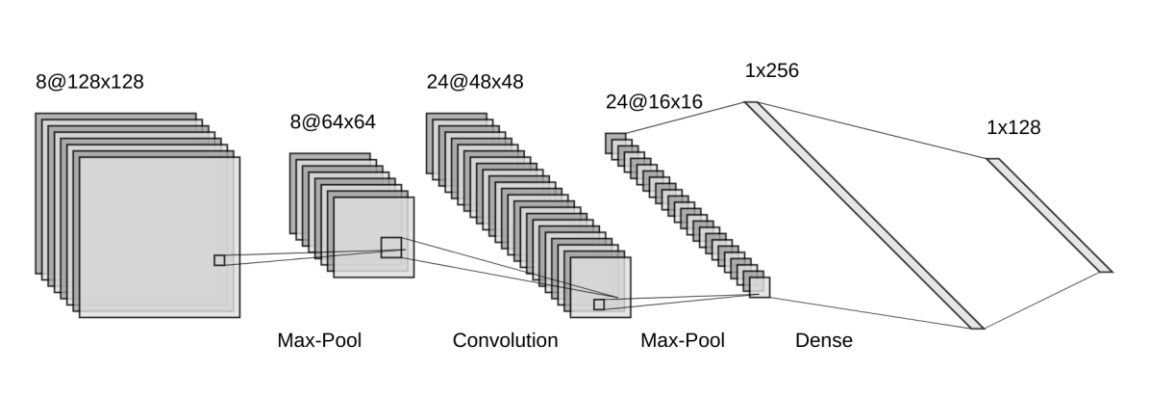
CNN-based Framework for Brain Tumours Segmentation

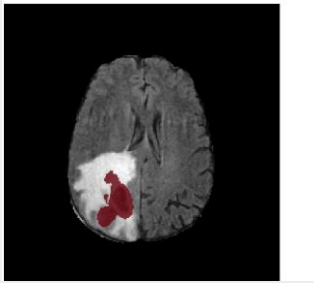
- You are also expected to design a similar CNN-based framework for brain tumour segmenta as shown in the figure.



Input



CNN-based model for feature extraction



Output

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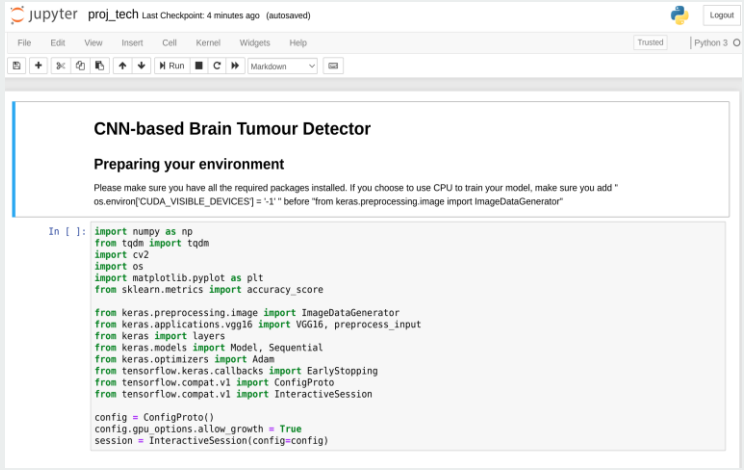
CNN-based Framework for Brain Tumours Classification

You will be provided with a dataset and sample code to realise the brain tumour classification framework. The sample code will be provided in a Jupyter notebook. You are encouraged to modify the code to adopt different deep learning models, tune hyperparameters, and implement data augmentation methods to achieve the best classification accuracy.



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CNN-based Framework for Brain Tumours Segmentation

Data preprocessing

Images in the original dataset are usually in different sizes, so sometimes we need to resize and normalise (z-score is commonly used in preprocessing the MRI images) them to fit the CNN model. Depending on the images you choose to use for training your model, some other preprocessing methods. If preprocessing methods like cropping is applied, remember to convert the segmentation result back to its original size.

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Train-time data augmentation

Generalizability is crucial to a deep learning model and it refers to the performance difference of a model when evaluated on the seen data (training data) versus the unseen data (testing data). Improving the generalizability of these models has always been a difficult challenge.

Data Augmentation is an effective way of improving the generalizability, because the augmented data will represent a more comprehensive set of possible data samples and minimizing the distance between the training and validation/testing sets.

There are many data augmentation methods you can choose in this projects including rotation, shifting, flipping, etc.

You are encouraged to try different augmentation method to get the best segmentation result.

Get the data generator ready

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Define a metric for the performance of the model

Dice score is used here to evaluate the performance of your model. More details about the Dice score and other metrics can be found at https://towardsdatascience.com/metrics-to-evaluate-your-semantic-segmentation-model-6bcb99639aa2

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Evaluation Criteria

- Medical imaging project: 40%
  - Accuracy of the final **segmentation** model on the test set: 25%
  - Rationale of the experimental design and final report: 15%
- Natural language processing project: 40%
  - Completeness of the project: 30%
  - Final report: 10%
- Presentation skills and **teamwork**: 20%

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Result Submission

You will be provided with the test set for the brain tumour segmentation task before the last tutorial session. Use your trained model to generate the predicted segmentation map and send your results in a .zip file via email by noon the next day. The performance of your model will be shared with you by 9PM.

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Technical Report

The technical report should include the following sections:

- Literature review (no more than 3 pages on AI-assisted medical images analysis)
- Experimental design
- Results

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Important Dates

- Literature review submission: 10th Feb
- Test dataset release: 13th Feb
- Test result submission: By 6 PM on 13th Feb
- Technical report submission: By 6 PM on 13th Feb
- Final presentation: 14th Feb

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Questions?