

The re-evaluation of Brain Tumor Segmentation using Cascaded Anisotropic Convolutional Neural Network

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Task & Result background

Brain Tumour Segmentation Challenge is an annual competition held by multiple universities and organizations. The first competition is BRATS 2012 in France. Most of the dataset that the competition uses is from the previous year with some modifications and expansions. The year that our team chose was BRATS 2017, in the previous year, the dataset had a mixture of pre and post-operative scans. They only included pre-operative scans in 2017. There were 285 patients included in the training dataset with 210 HGG and 75 LGG. There were two tasks in the competition, task 1 was the segmentation of gliomas in the MRI scans and task 2 was predicting the patient's overall survival from the pre-operative. Our target is task 1, segment whole tumor, tumor core, and enhanced tumor for every patient. We decided to use 3 views, axial view, sagittal view, and coronal view for each part, combine the results to segment the image. Therefore, we need 9 different models.

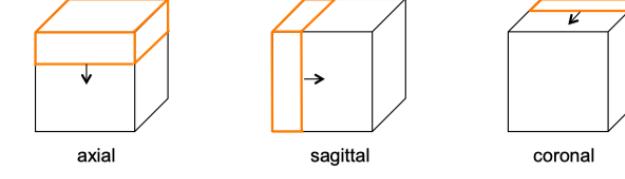


Fig 2. Multi-view fusion[1,2]

Jobs in the team

- Browse, train, evaluate, analyze author's model
- Model evaluation code
- Help with model implementation, debug data loader
- Training, Testing dataset selection
- Adjust training configs
- Supervise on going model training progress

Problem facing

1. Tensorflow 1 no longer supported, not compatible on Colab & ComputeCanada.

- Solution: Minor change to the code in order to run and understand how codes works.

2. Multi-dimension shapes on model implementation

- Solution: Analyze original code, reshape matrix.

3. ComputeCanada environment setup.

- Solution: Find working packages, write scripts, adjust training config

4. Evaluate the model's performance

- Solution: Wrote evaluation code, use dice score to measure performance.

5. Don't have official testing dataset.

- Solution: Use 2020's dataset for model evaluation.

6. Validation dataset don't have ground truth labels.

- Solution: Communicate with the organization, gain access to the portal and get the model's performance on validation dataset.s

Result

Dice score on validation dataset

	Dice_WT	Dice_TC	Dice_ET
CRF + DA model	89.6	79.2	75.1
Paper	88.9	82.5	74.1

Dice score on training dataset

	Dice_WT	Dice_TC	Dice_ET
CRF + DA model	89.1	81.7	77.2
Paper	87.4	77.4	74.1

Ground Truth

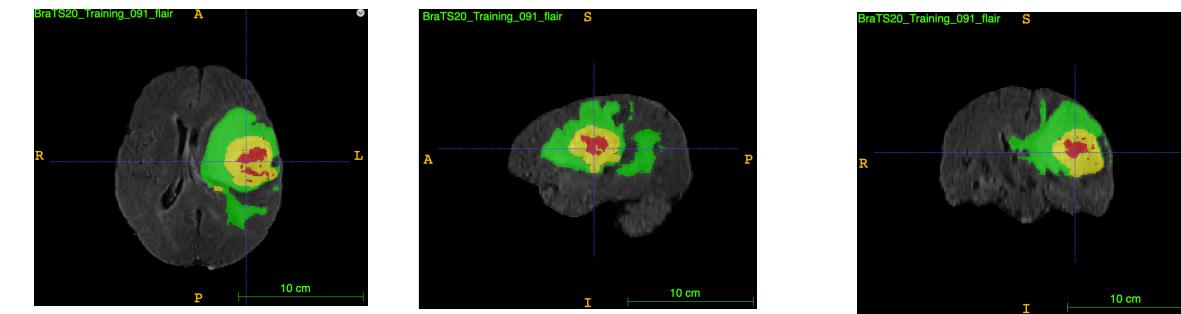
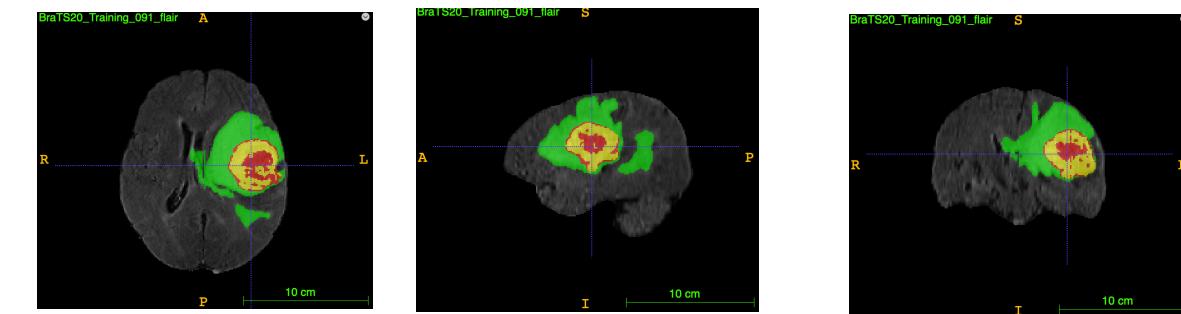


Fig 1. Model flow [1,2]

Trained Model with CRF and Data augmentation



Evaluation formula

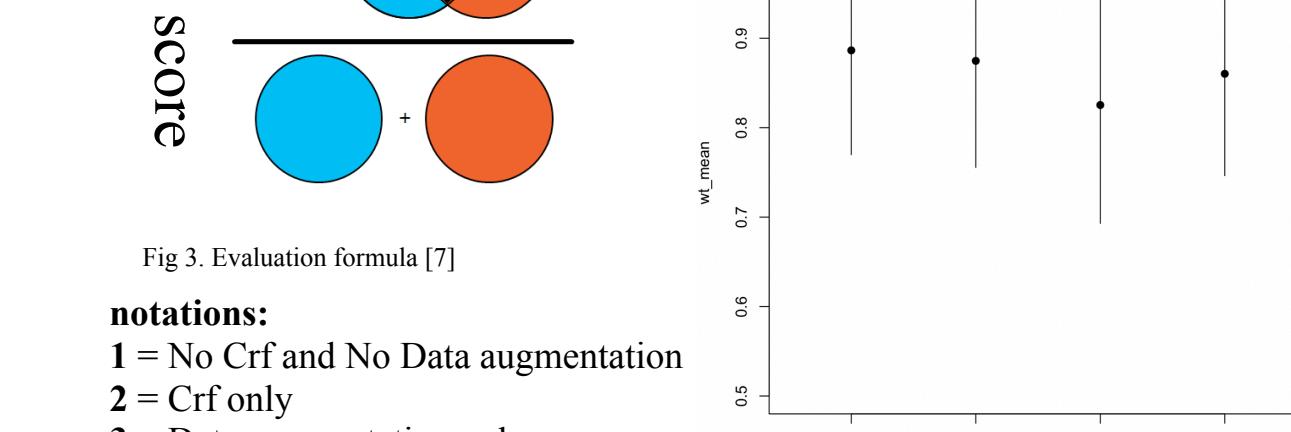
$$\text{Dice score} = \frac{2 \times \text{A} \cap \text{B}}{\text{A} + \text{B}}$$

Fig 3. Evaluation formula [7]

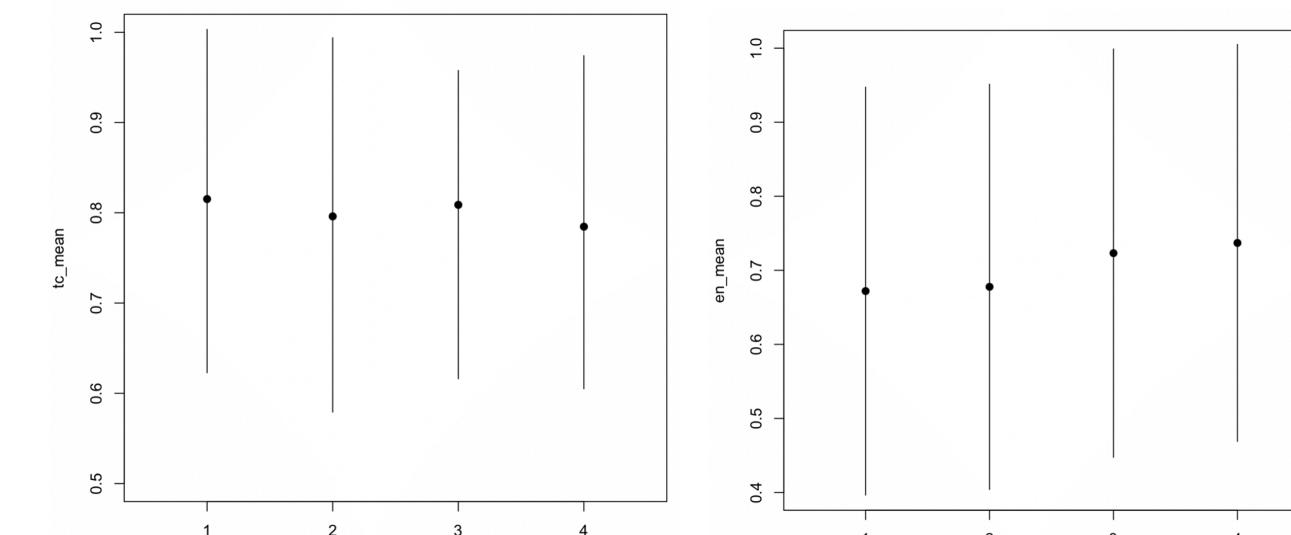
notations:

- 1 = No Crf and No Data augmentation
- 2 = Crf only
- 3 = Data augmentation only
- 4 = Both Crf and Data augmentation

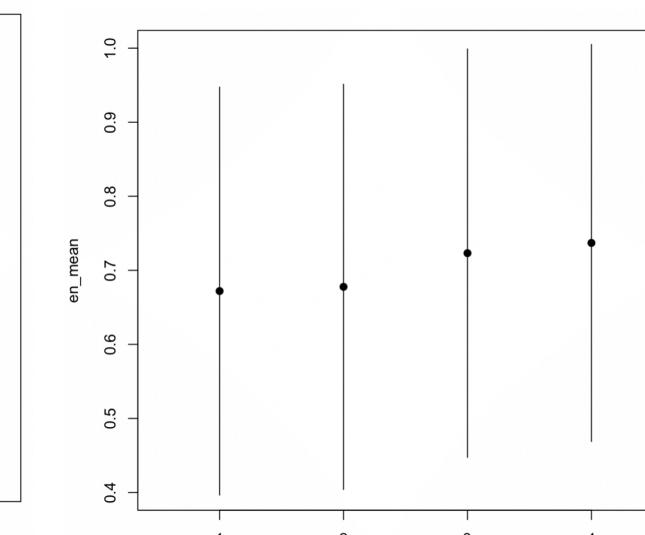
Dice: Whole tumour



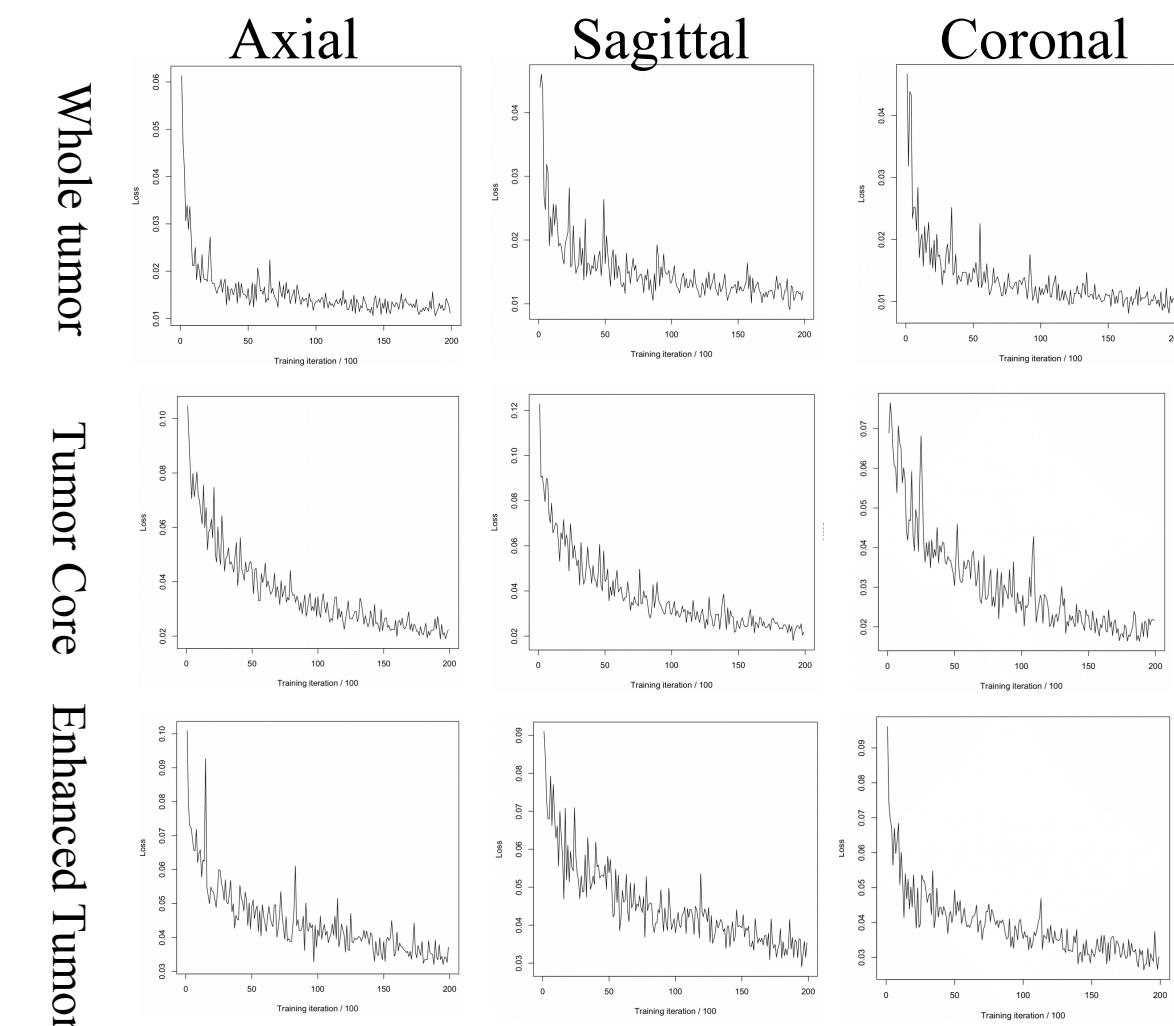
Dice: Tumour core



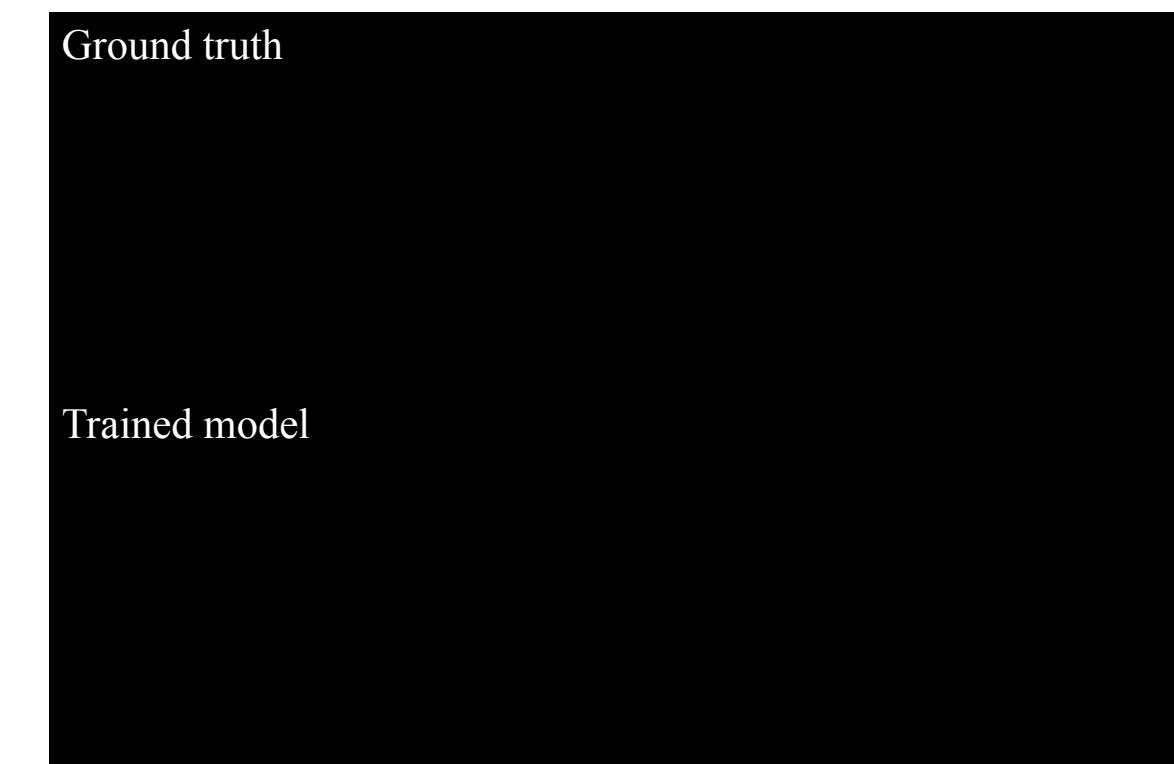
Dice: Enhanced tumour



Training Loss graphs



Animated Segmentation Result



References

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