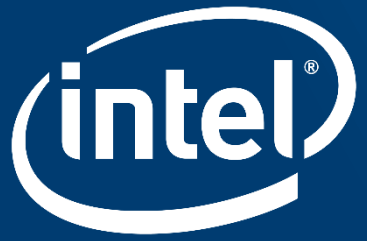

BRAIN TUMOR SEGMENTATION WITH DEEP LEARNING

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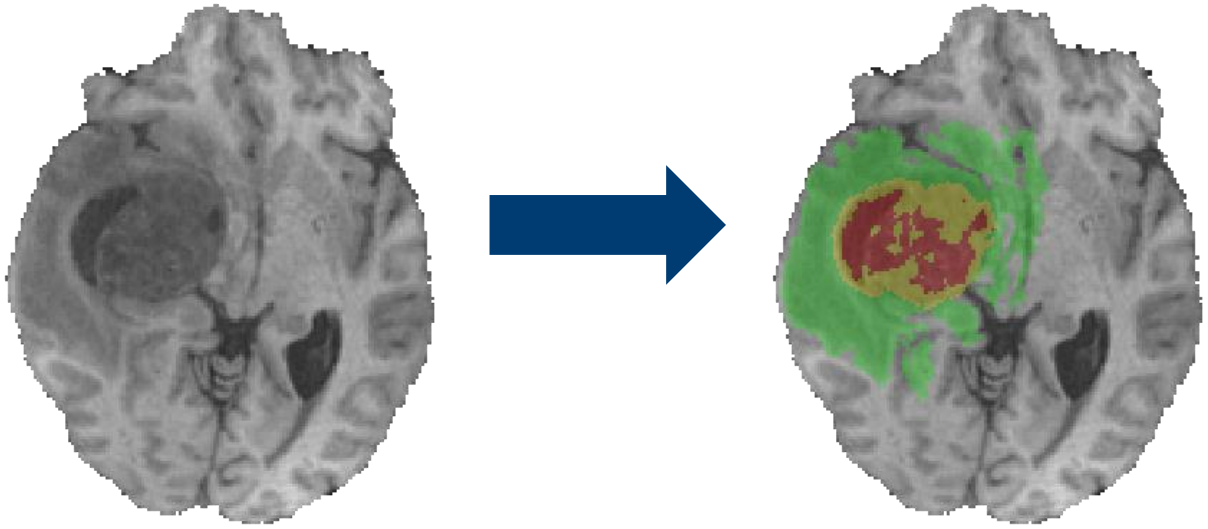
Brain tumor segmentation

- Tumor classification
- Therapy planning and control
- Pre- and Post-operative analysis
- Surgery assistance
- Etc.

https://www.youtube.com/watch?v=FuZjHnpYL_4

Goal

- Automatically label tumor regions with given multimodal MRI
  - Detect tumor core (red)
  - Enhancing tumor (yellow)
  - Peritumoral edema (green)
- Data: BraTS 2018



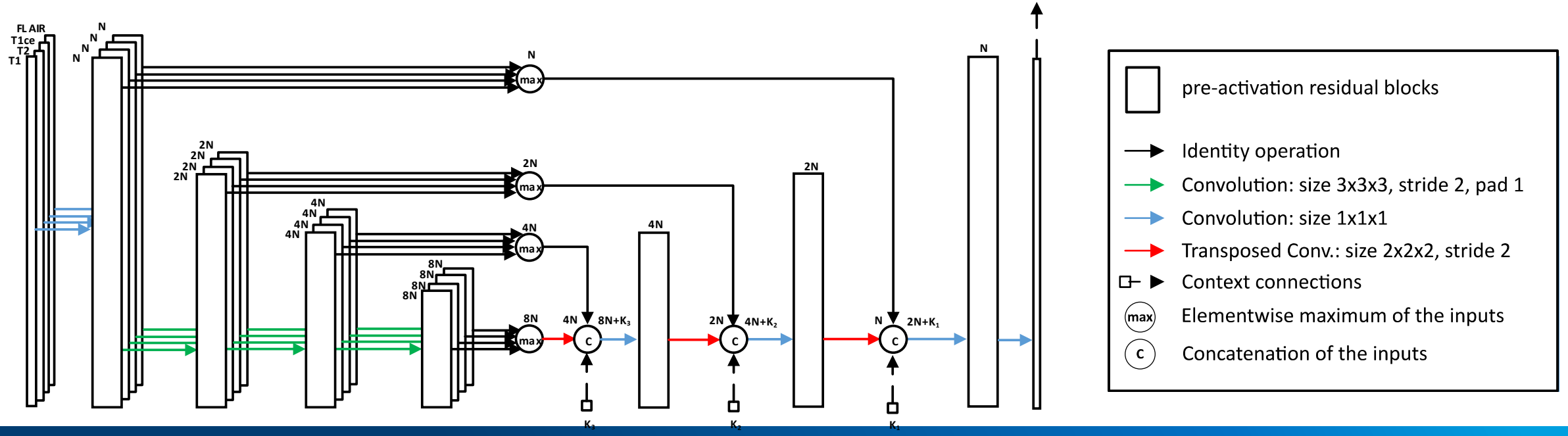
https://www.med.upenn.edu/sbia/brats2018/data.html

Contribution

- Method that can efficiently handle multimodal MRI input
- Segmentation refinement strategy

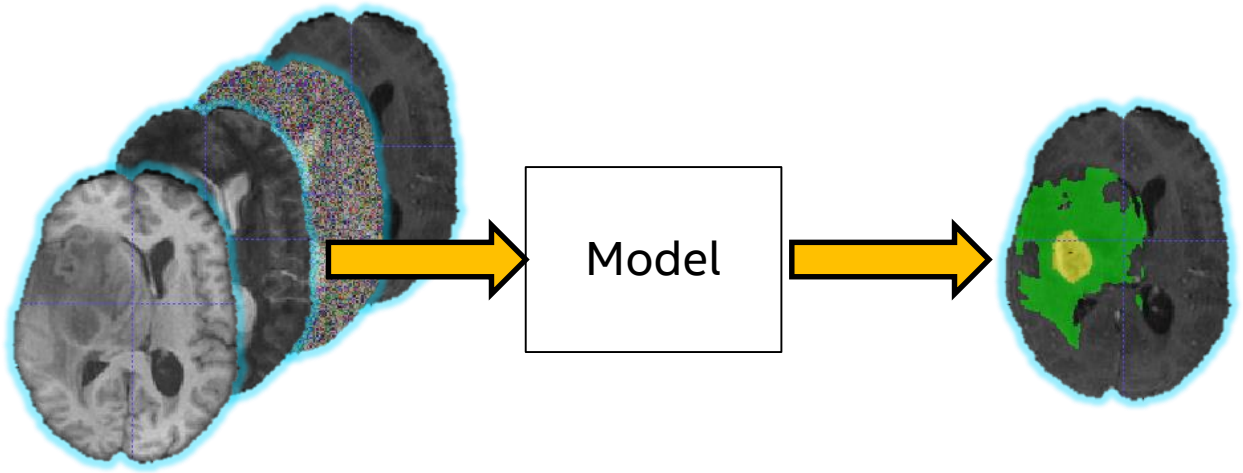
Proposed method

- Handling of multimodal input
  - Problem: Four given inputs represent heterogeneous data
  - Solution: Force model to encode unique features of each modality



Proposed method

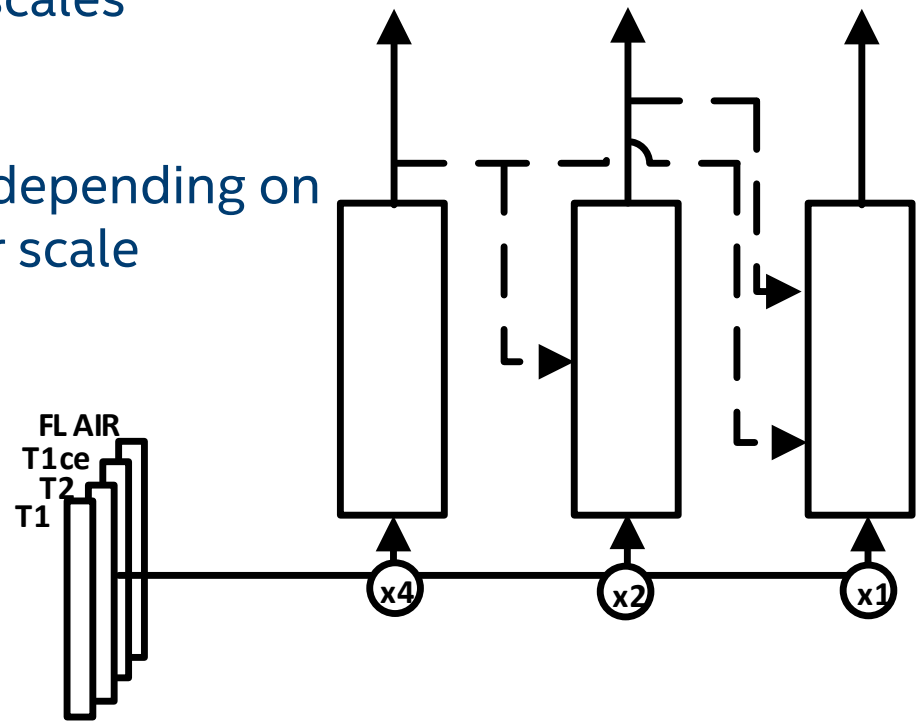
- Handling of multimodal input
  - Problem: Model prefers one of the input channels
  - Solution: Augmentation technique – channel out



Proposed method

- Segmentation refinement strategy
  - Encourages to iteratively refine results of previous iterations;
  - Fuses multiple neural networks operating at different scales

Unlike UNet architecture with decoder output at each scale i depending on encoder, here we propose to incorporate context of the lower scale networks.



Validation

Preliminary results in unseen data are obtained with validation dataset. The ground truth of the validation data isn't provided to the participants

Metric: $DSC = \frac{2TP}{2TP+FP+FN}$

ID	w/o CO			w/ CO		
	ET	WT	TC	ET	WT	TC
UNet	0.767	0.901	0.797	0.779	0.901	0.837
ME UNet	0.763	0.904	0.823	0.784	0.907	0.827
C ME UNet	0.772	0.906	0.836	0.784	0.908	0.844

CO – channel-out augmentation

ET – Enhancing tumor, WT – whole tumor, TC – tumor core

Evaluation

Final results in unseen data are obtained with test dataset.

Metric: $DSC = \frac{2TP}{2TP+FP+FN}$, $H = \max\{\sup_x \inf_y d(x,y), \sup_y \inf_x d(x,y)\}$

ID	BraTS 2018 Test.		
	ET	WT	TC
First	0.766	0.883	0.815
Second	0.778	0.878	0.806
Ours	0.720	0.878	0.795

ID	Dice			Hausdorff		
	ET	WT	TC	ET	WT	TC
Ours	24th	10th	11th	9th	12th	5th

ET – Enhancing tumor, WT – whole tumor, TC – tumor core

DISCUSSION