CS512

IMAGE SEGMENTATION ON ORAL CANCER

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SUMMARY

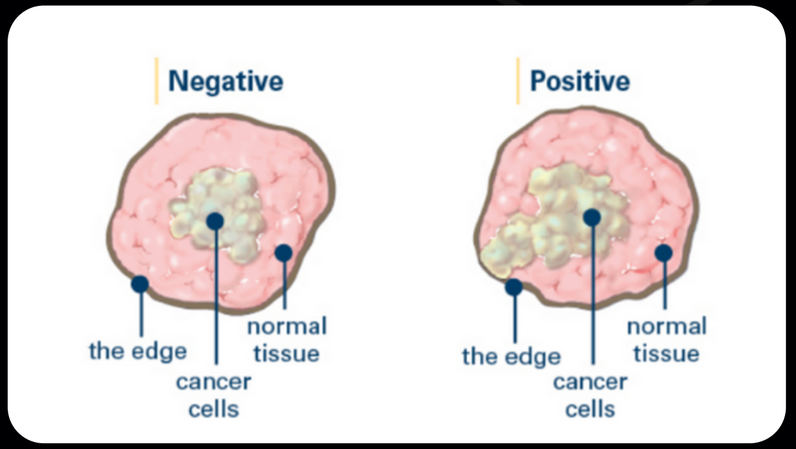
1. Approach
2. Data
3. Model architecture
4. Results
5. Conclusion

APPROACH

WHAT? Surgical Margins assess presence of tumor in tissues

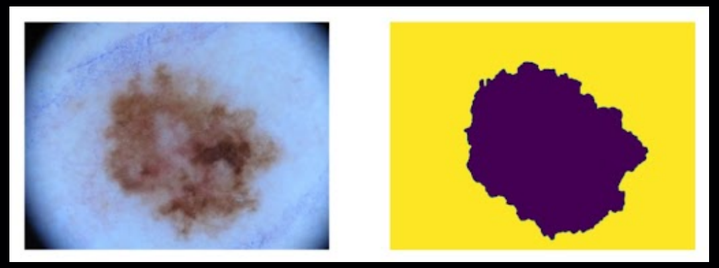
WHY? Help surgeons make faster decision

HOW? Using semantic segmentation to mask tumor regions



DATA

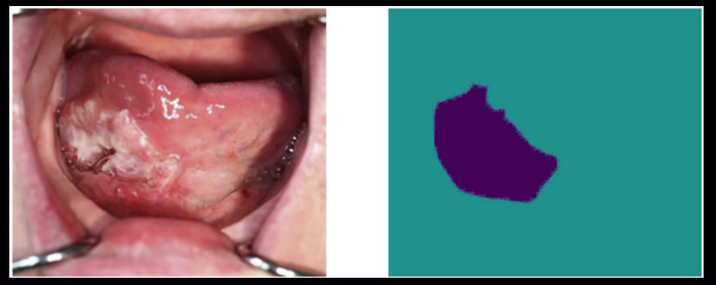
Datasets used for cross-domain approach:



ISIC 2017

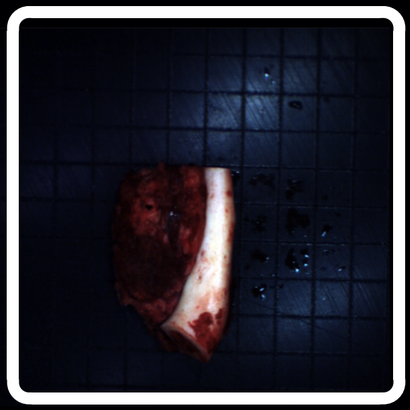
Skin Lesions

2000 images and masks of shape 200x200



Oral Cancer (Lips and Tongue)

87 images and masks of shape 200x200



MIRC data

Surgical Margins

60+ ZxZ images

DATA SPLIT

ISIC 2017 DATASET (2000 IMAGES)		
TRAIN (80% = 1600 IMAGES)		TEST (20% = 400 IMAGES)
TRAIN (80% = 1280 IMAGES)	VALIDATION (20% = 320 IMAGES)	

FINAL SPLIT		
TRAIN(64% = 1280 IMAGES)	VALIDATION(16% = 320 IMAGES)	TEST(20% = 400 IMAGES)

MODEL ARCHITECTURE

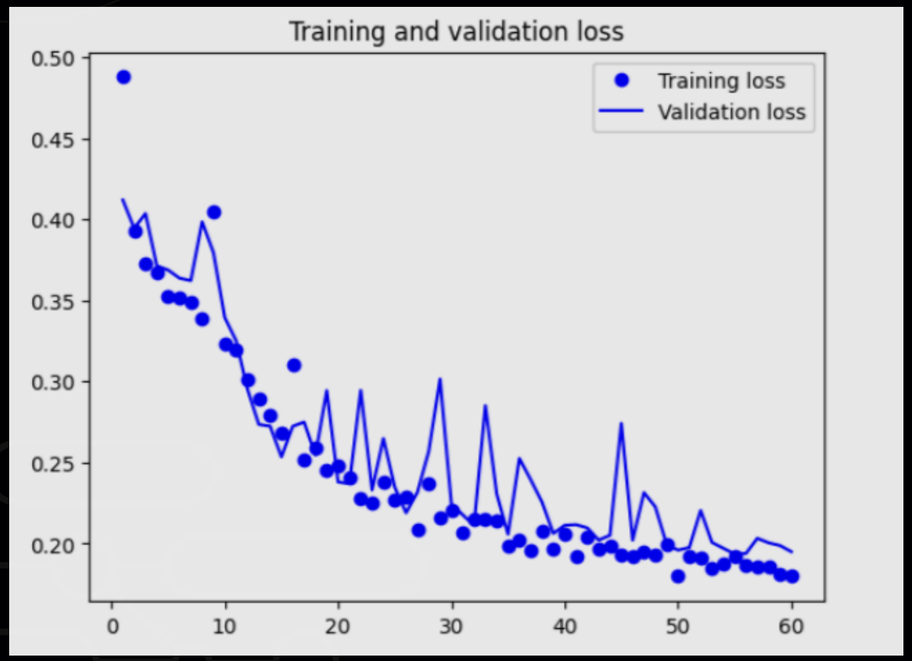
- IMAGE DIMENSION - : 200 X 200 X 3
- U-SHAPED NETWORK:
  - **INPUT LAYER** – IMAGES WITH DIMENSION 200 X 200 X 3
  - **RESCALING LAYER** – SCALES BY A FACTOR 1./255
  - **ENCODER PART:**
    - CONV2D (32 UNITS, 3 X 3), MAXPOOLING2D (2X2) , ACTIVATION – RELU, PADDING – SAME
    - CONV2D (64 UNITS, 3 X 3), MAXPOOLING2D (2X2) , ACTIVATION – RELU, PADDING – SAME
  - **BOTTLENECK LAYER -** CONV2D (128 UNITS, 3 X 3), ACTIVATION – RELU, PADDING – SAME , DROPOUT = 0.5
  - **DECODER PART:**
    - UPSAMPLING2D (2X2), CONCATENATE , CONV2D (64 UNITS, 3X3), MAXPOOLING2D (2X2) , ACTIVATION – RELU, PADDING – SAME
    - UPSAMPLING2D (2X2), CONCATENATE , CONV2D (32 UNITS, 3X3), MAXPOOLING2D (2X2) , ACTIVATION – RELU, PADDING – SAME
  - **OUTPUT LAYER –** CONV2D (NUM_CLASSES, 1 X 1), ACTIVATION – SOFTMAX
- METRIC - MEAN INTERSECTION OVER UNION (IOU)
- LOSS – SPARSE CATEGORICAL CROSS-ENTROPY
- OPTIMIZER - RMSPROP

HYPERPARAMETERS

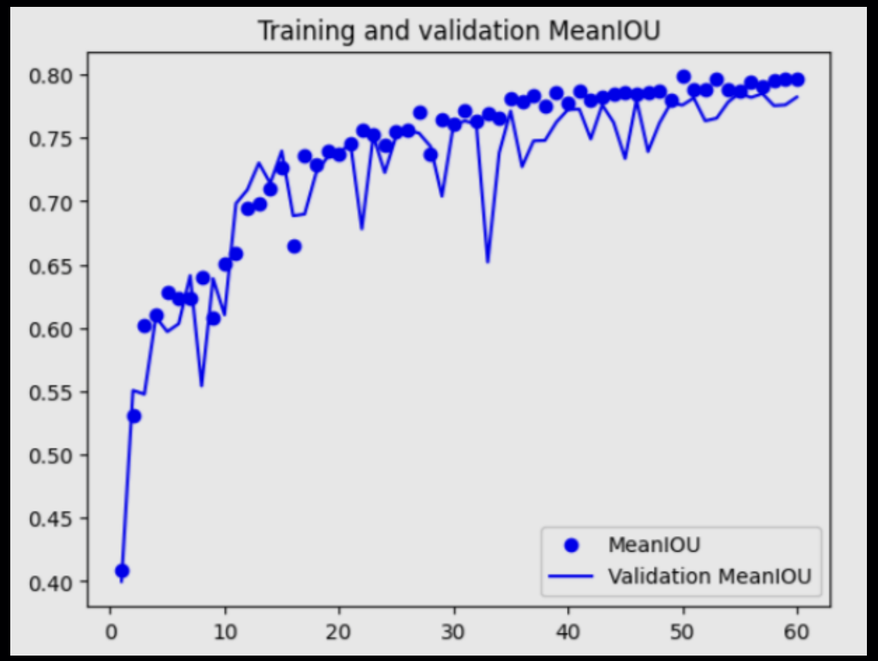
Training and Validation Metric Values					
Experiments	**Hyperparameters**	**Loss**	**Val loss**	**Mean IOU**	**Val Mean IOU**
Experiment 1	•Output activation = softmax •Loss = sparse_categorical_crossentropy •Metric = Mean_IoU •Experiment 1: Epochs = 60/60 with patience 10 •Experiment 2: Epochs = 52/60 with patience 10 •Experiment 1: Batch Size = 64 •Experiment 2: Batch Size = 30	0.17	0.19	0.76	0.78
Experiment 2		0.17	0.2	0.8	0.77

RESULTS

Experiment 1



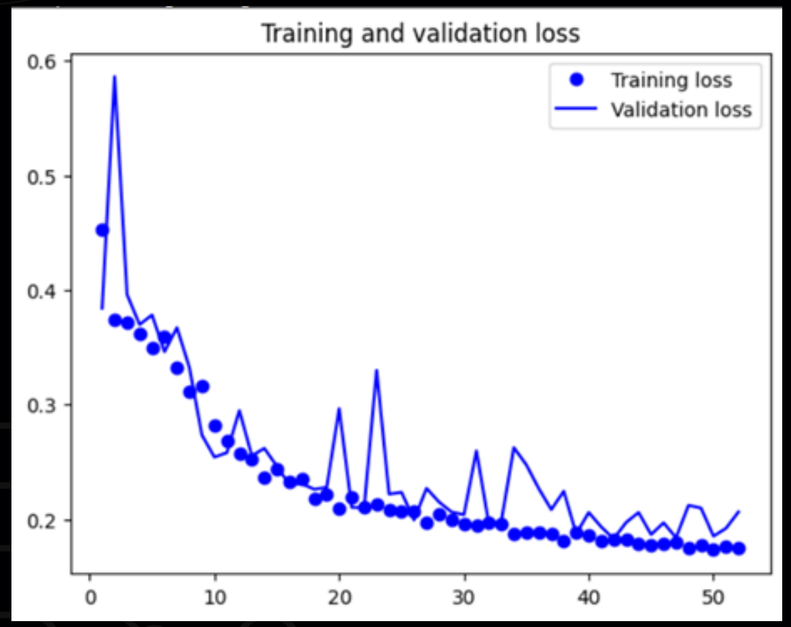
Loss curves on ISIC 2017 dataset



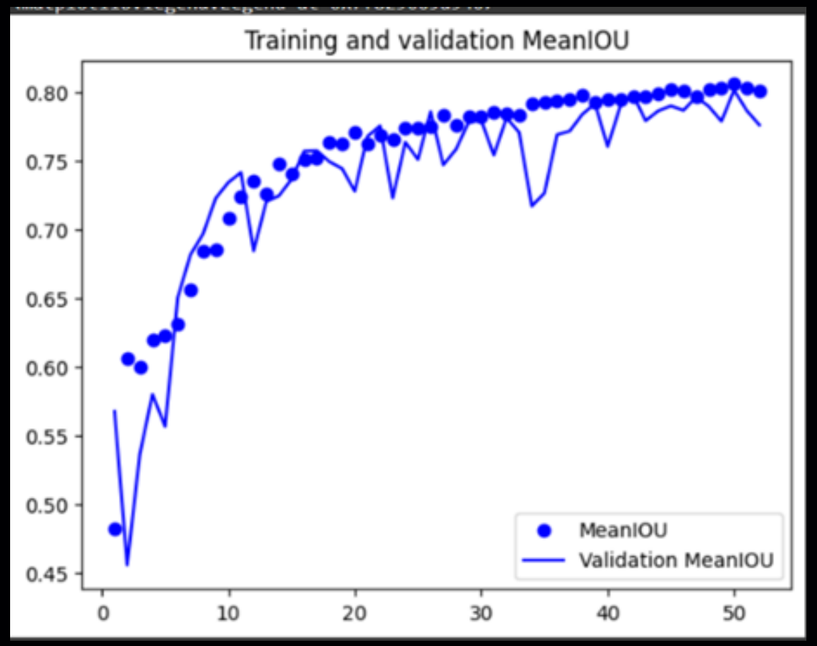
Mean IoU curve on ISIC 2017 dataset

RESULTS

Experiment 2



Loss curves on ISIC 2017 dataset



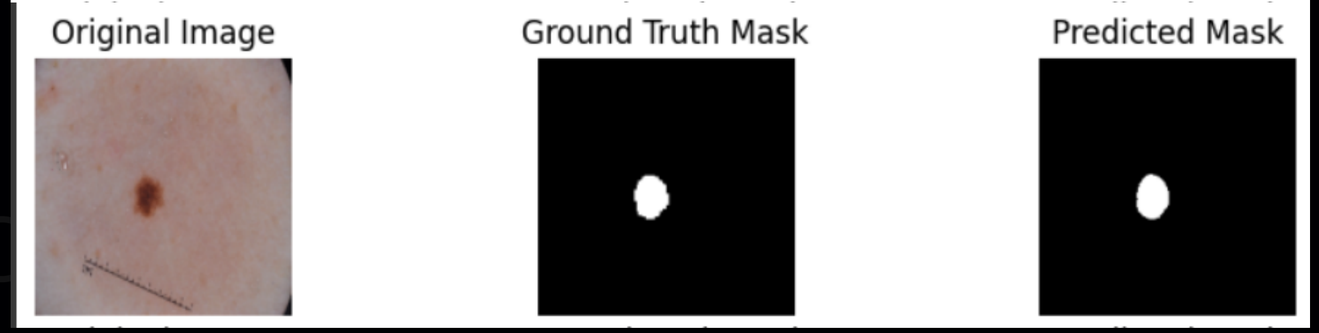
Mean IoU curve on ISIC 2017 dataset

RESULTS

Experiment 1

Validation Data

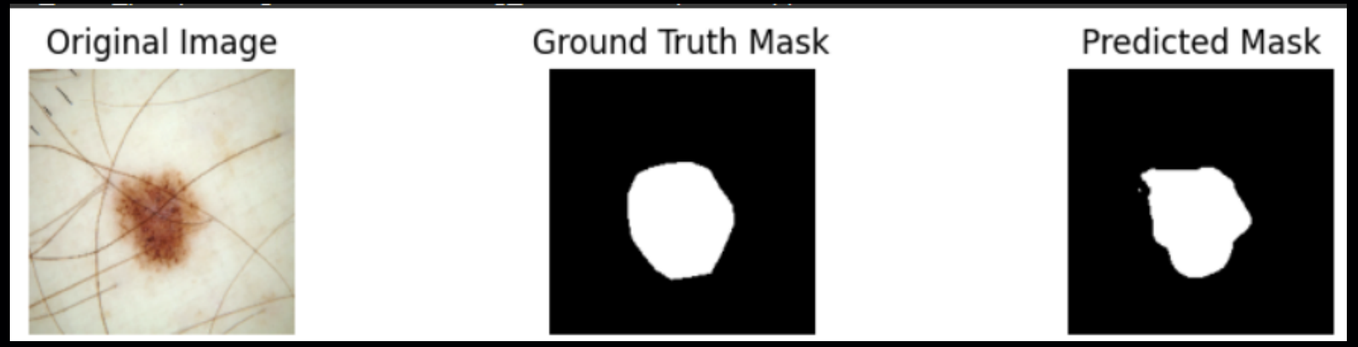
Test Data



RESULTS

Experiment 2

Validation Data



Test Data

RESULTS

Experiments	Prediction Results	precision	recall	f1-score
Experiment 1	Validation	1	0.81	0.90
	Test	1	0.97	0.99
Experiment 2	Validation	1	0.78	0.88
	Test	1	0.94	0.97

F1 scores on ISIC 2017

TEST MODEL ON ORAL CANCER DATASET

Experiment 1 model

Experiment 2 model

CONCLUSION

- Good results on ISIC 2017 model training
- Poor prediction on oral cancer because it merges skin and oral cancer detection

FURTHER IMPROVEMENTS

- Train few shot Meta-Learning algorithm on oral cancer

REFERENCES

[1] Gil Z. Shah JP. 2008. Current concepts in management of oral cancer–surgery. Oral Oncol.. In Epub 2008 Jul 31. PMID: 18674952; PMCID: PMC4130348.
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[2] L. Feller and J. Lemmer. 2012. Oral Squamous Cell Carcinoma: Epidemiology, Clinical Presentation and Treatment. https://doi.org/10.4236/jct.2012.34037
[3] Mărgăritescu C Ciucă EM Matei M Şerbănescu MS Camen A. Pătru A, Şurlin V. 2020. Analysis of the distribution and expression of some tumor invasiveness markers in palate squamous cell carcinomas. Rom J Morphol Embryol. https: //doi.org/10.47162/RJME.61.4.27
[4] Wang X Patel M Griffith CC Chen AY et al. Halicek M, Little JV. 2018. Tumor Margin Classification of Head and Neck Cancer Using Hyperspectral Imaging and Convolutional Neural Networks. https://doi.org/10.1117/12.2293167
[5] Training ISIC Dataset: https://challenge.isic-archive.com/data/#2017
[6] Liangliang Liu, Jianhong Cheng, Quan Quan, Fang-Xiang Wu, Yu-Ping Wang, and Jianxin Wang. 2020. A survey on U-shaped networks in medical image
[7] Oral Cancer (Lips and Tongue) images Dataset: https://www.kaggle.com/datasets/shivam17299/oral-cancer-lips-and-tongue-images

Resources used for implementation

Main resource we used was the course.

To fix issues while using meanIOU metric from keras:
https://github.com/tensorflow/tensorflow/issues/32875

Building U-shaped model:
https://github.com/angadbajwa23/Segmentation-of-2D-Brain-MR Images-using-Deep-Neural-Architectures/blob/master/2d/models/U-Net.ipyn

THANK YOU