Brain Metastasis Segmentation Network Trained with Robustness to Annotations with Multiple False Negatives

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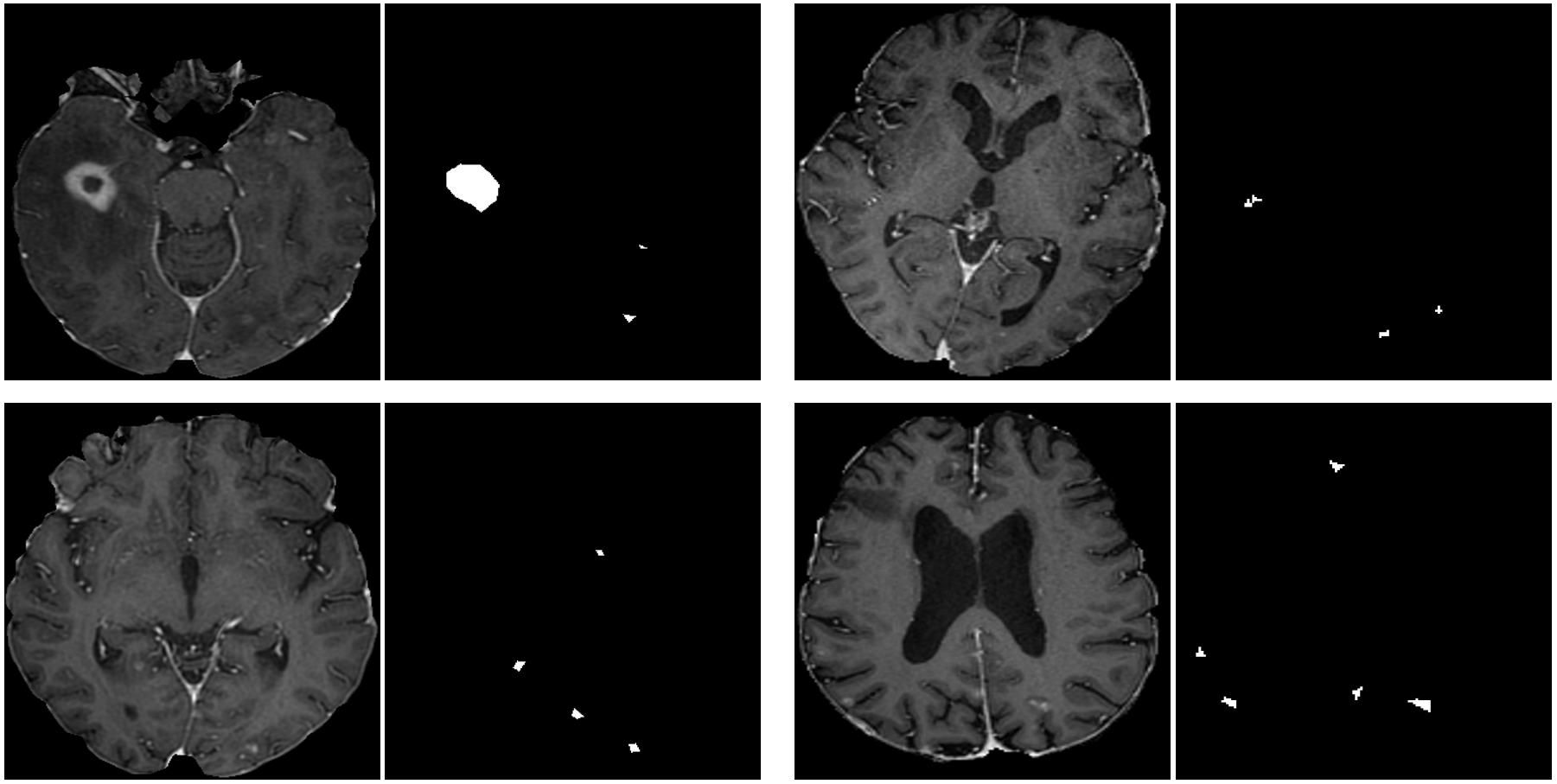
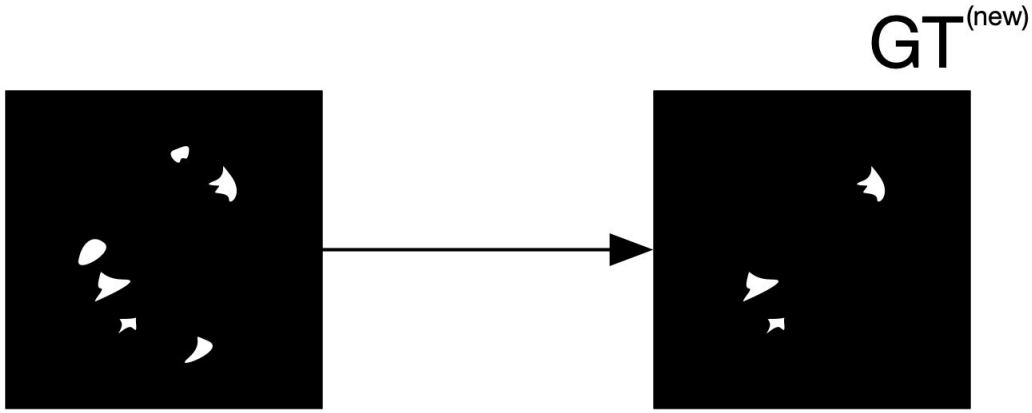
Brain Metastases Segmentation



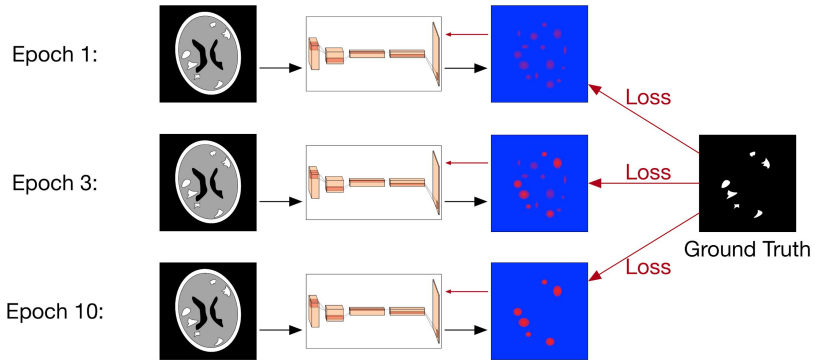
Inducing False Negative Annotations

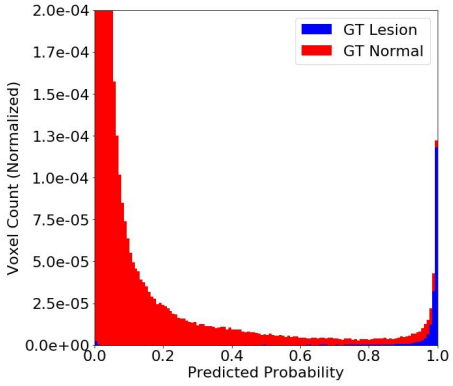
Stochastic 50% Censoring

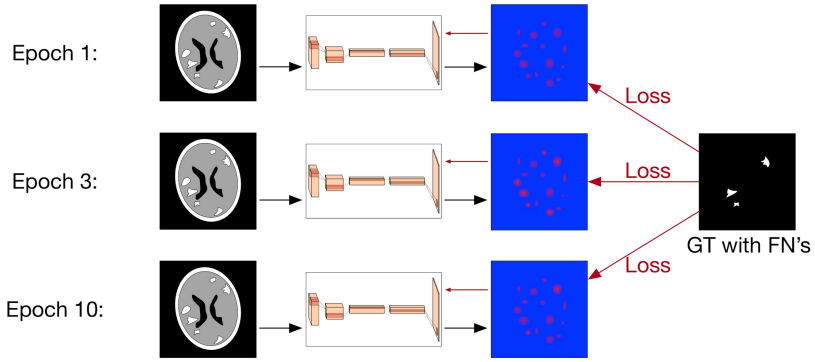


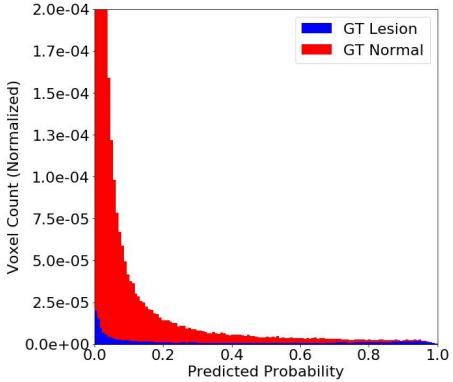
Original
Ground Truth
Annotation

Training on False Negatives

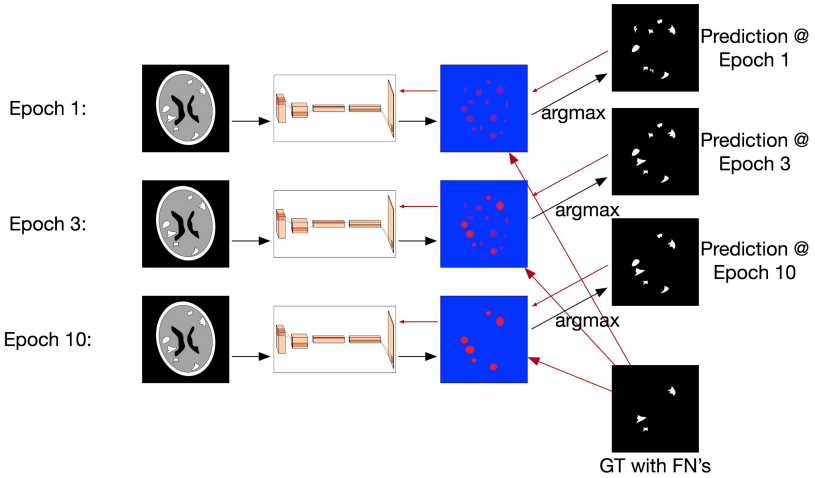


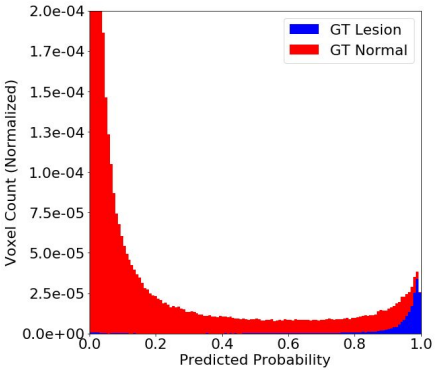






Lopsided Bootstrap Loss





Lopsided Bootstrap Loss:

$$\mathcal{L}(Y,\hat{Y}) = \begin{cases} \beta * CE(Y,\hat{Y}) + (1-\beta) * CE(\text{argmax}(\hat{Y}),\hat{Y})) & \text{if } Y == 0 \\ \alpha * CE(Y,\hat{Y}) & \text{if } Y == 1 \end{cases}$$

Quantitative Results

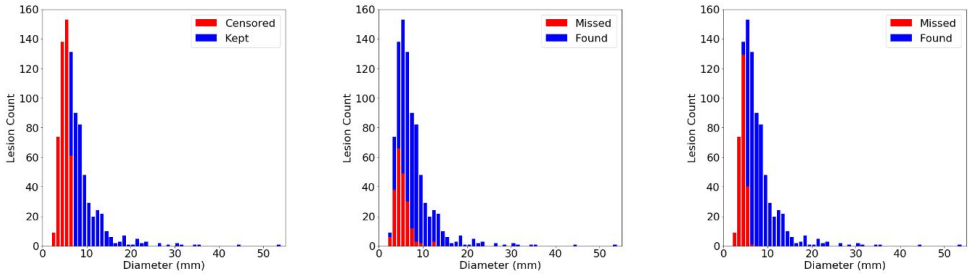
Table 1: Stochastic Lesion Censoring with FN Rate 50%

Training Data	**Loss** (α, β)	**mAP (95% CI)**	**Max Sensitivity**	**TP DICE**
Full	3, 1	46 (44,47)	80	72
1/2 Censored Data	3, 1	20 (15,22)	8	54
1/2 Censored Data	10, 1	6 (2,9)	15	48
1/2 Censored Data	3, 0.5	39 (36,41)	76	75
1/2 Censored Data	10, 0.5	29 (25,32)	53	69
1/2 Censored Data	3, 0.1	42 (40,44)	78	73
1/2 Censored Data	10, 0.1	35 (31,37)	63	71

Size-Based Censoring

Table 2: Size-Based Lesion Censoring with FN Rate 50%

Training Data	**Loss** (α, β)	**mAP (95% CI)**	**Max Sensitivity**	**TP DICE**
Full	3,1	46 (44,47)	80	72
1/2 Censored Data	3, 1	22 (19,24)	14	61
1/2 Censored Data	10, 1	18 (14,20)	9	51
1/2 Censored Data	3, 0.5	32 (19,34)	68	71
1/2 Censored Data	10, 0.5	18 (15,20)	50	68
1/2 Censored Data	3, 0.1	39 (37,41)	71	71
1/2 Censored Data	10, 0.1	19 (17,21)	51	69



(a) Target Annotations (b) Random Censoring (c) Size-based Censoring

Figure 5: **Prediction accuracy sorted by lesion size.**

Thank you...

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