
Algorithm 1 Zero-Shot Cross-Domain Evaluation with Label Harmonization

Require: Source model M_{src} trained on BraTS 2021; Target dataset $\mathcal{D}_{\text{africa}} = \{(X_i, Y_i)\}_{i=1}^N$ ($N = 146$)

Ensure: Stratified evaluation metrics (Dice, HD95) with 95% Confidence Intervals

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1: for each subject  $i = 1$  to  $N$  do
    // Step 1: Label Harmonization
2:    $Y_{i,\text{converted}} \leftarrow \text{ConvertBraTSLabels}(Y_i)$   $\triangleright$  Re-map ET label 4  $\rightarrow$  3
3:    $Y_{i,\text{binary}} \leftarrow \text{CreateMultiChannelMasks}(Y_{i,\text{converted}})$   $\triangleright$  5-channel masks
    // Step 2: Modality Normalization
4:   for each MRI modality  $m \in \{\text{T1, T1c, T2, FLAIR}\}$  do
5:      $X'_{i,m} \leftarrow (X_{i,m} - \mu_{i,m})/\sigma_{i,m}$   $\triangleright$  Z-score on brain voxels
6:   end for
    // Step 3: Single-Pass Central Crop Inference
7:    $X_{i,\text{crop}} \leftarrow \text{CentralCrop}(X'_i, \text{shape} = (128, 128, 128))$ 
8:    $P_{i,\text{crop}} \leftarrow M_{\text{src}}(X_{i,\text{crop}})$   $\triangleright$  Model forward pass
9:    $\hat{Y}_i \leftarrow \mathbb{I}(P_{i,\text{crop}} > 0.5)$   $\triangleright$  Direct logit thresholding
    // Step 4: Metric Calculation
10:   $\text{Dice}_i \leftarrow \text{ComputeDice}(\hat{Y}_i, Y_{i,\text{binary}})$ 
11:   $\text{HD95}_i \leftarrow \text{ComputeHD95}(\hat{Y}_i, Y_{i,\text{binary}})$ 
12: end for
    // Step 5: Pathology Stratification & Statistical Aggregation
13: Group subjects into  $\mathcal{C}_{\text{Glioma}}$  ( $n = 95$ ) and  $\mathcal{C}_{\text{Non-Glioma}}$  ( $n = 51$ )
14: for each cohort  $\mathcal{C} \in \{\text{Full, Glioma, Non-Glioma}\}$  do
15:    $\mu_{\text{Dice},\mathcal{C}} \leftarrow \text{Mean}(\{\text{Dice}_i \mid i \in \mathcal{C}\})$ 
16:    $\text{CI}_{95,\mathcal{C}} \leftarrow \mu_{\text{Dice},\mathcal{C}} \pm 1.96 \cdot (\sigma_{\text{Dice},\mathcal{C}}/\sqrt{|\mathcal{C}|})$ 
17: end for

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