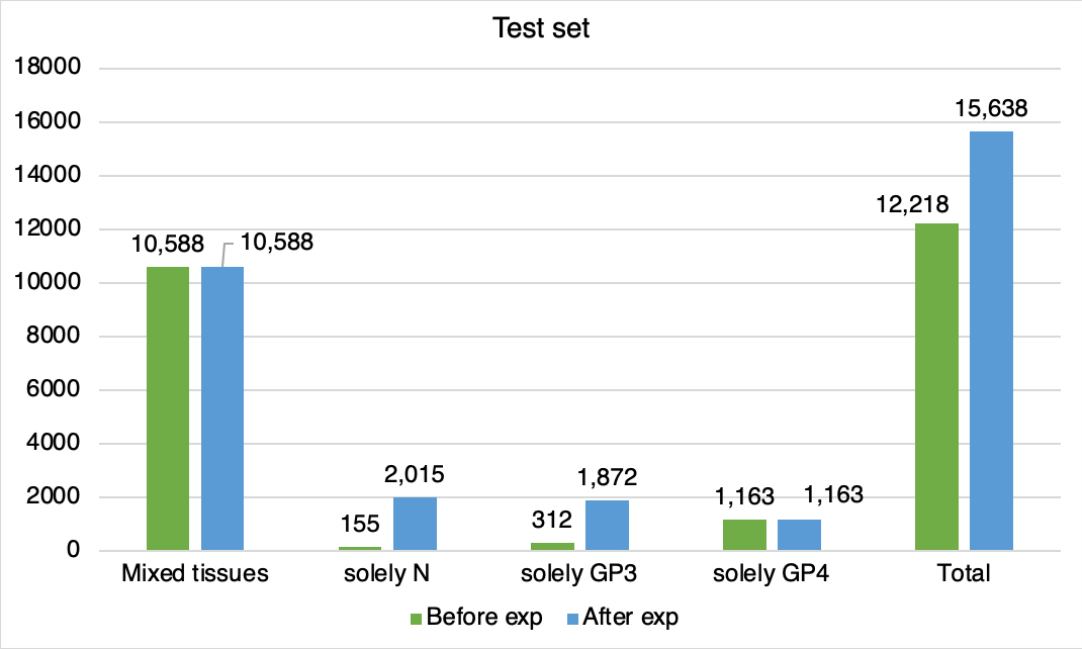
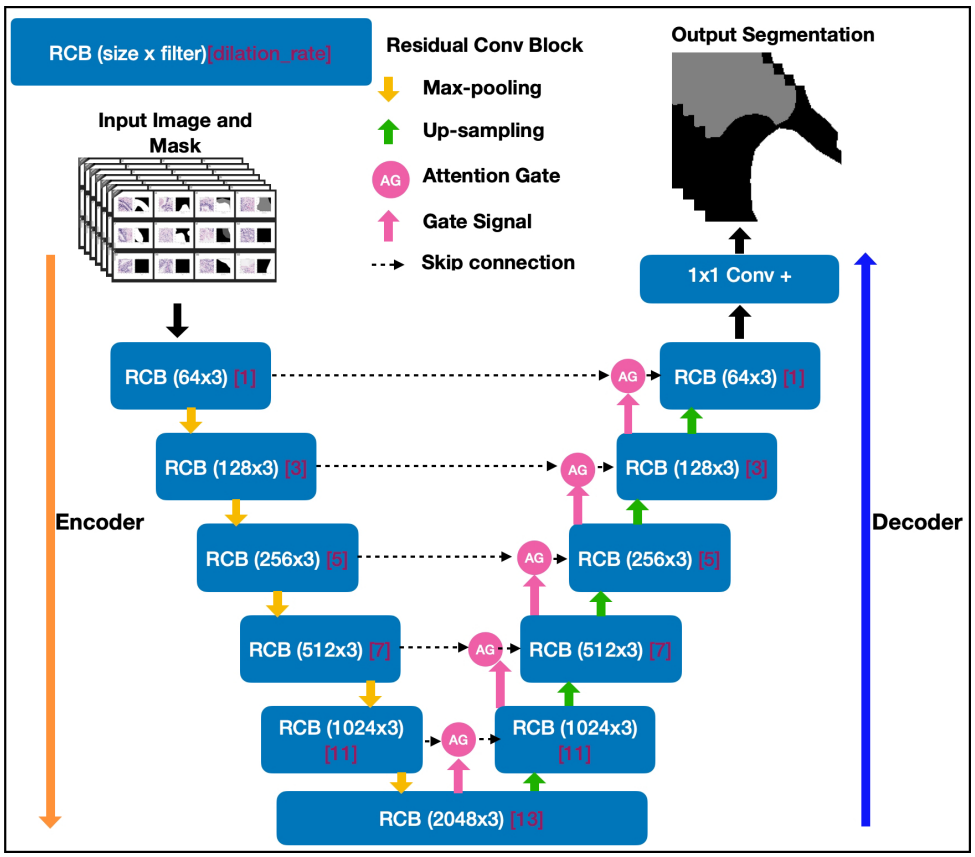
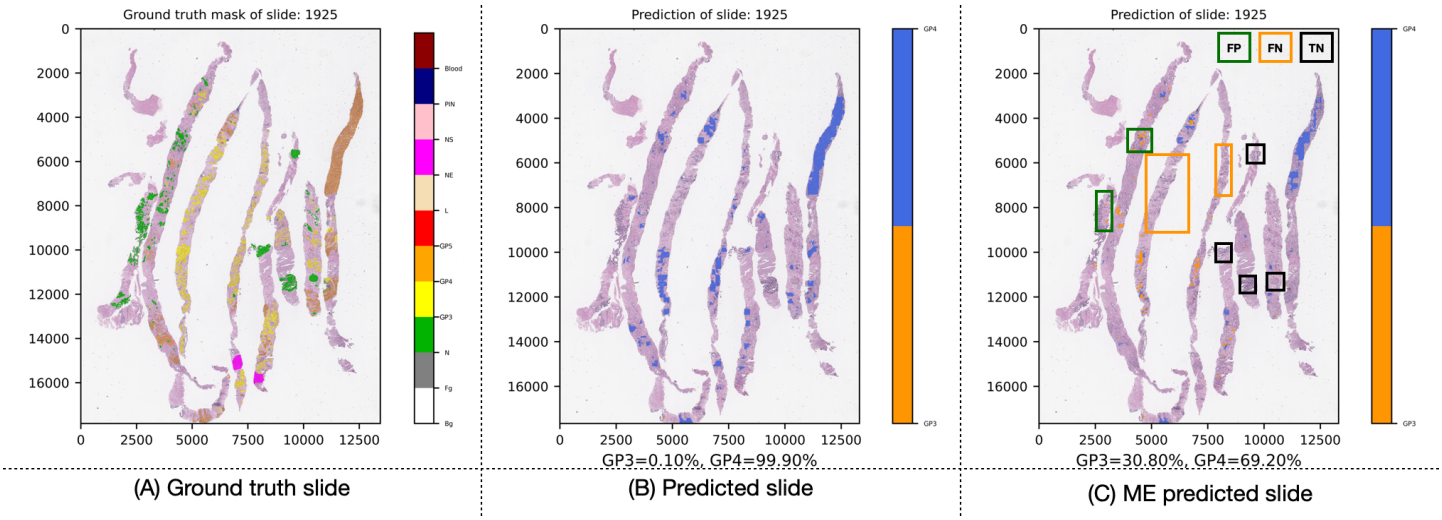
Supplementary Material



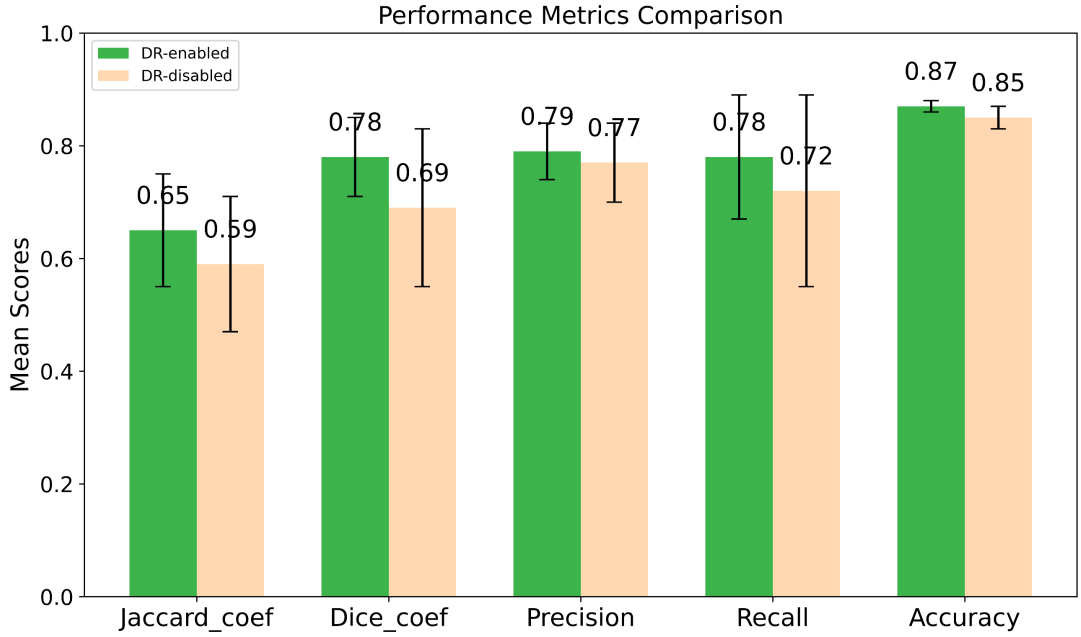
S1 Fig. Patch pair counts in the test set before and after expansion



S2 Fig. Enhanced model architectural design of the proposed DARUN model



S3 Fig. Adenocarcinoma segmentation prediction and GP percentages for slide ID 1925 of Fold-4 validation set; black indicates TN for benign, orange indicates FN for GP3, and green indicates FP for benign.



S4 Fig. Comparison of performance metrics: DR-enabled vs. DR-disabled models for the Fold-1 dataset. The DR-enabled model performed significantly better across all metrics, with a p-value of 0.039 (t-value = 2.145).

S1 Table. Hyperparameters and their configurations for the proposed DARUN model

Parameter	**Configuration**
Image patch preprocessing	Utilized the SEResNet50 of Segmentation Models version 1.0.1
Patch size	256 x 256
Kernel size	3 x 3
Dilation rate	1, 3, 5, 7, 11, 13
Batch size	8
Epochs	120
Dropout rate	0.25
Activation function	ReLu for all CNN-based layers and Softmax for the prediction layer
Loss function	Defined in the Equation 8 where alpha=0.25, beta=1.0, gamma=2.0
Optimizer	Adam with initialized learning rate
Learning rate (LR)	1e-4
Class weights	Computed
Data augmentation	Horizontal flip (selection probability of 0.5) and vertical flip (selection probability of 0.5)
ReduceLROnPlateau	Monitor on validation of the Total loss with factor = 0.8, patience = 5, min_lr = LR/Epochs