SIMPLE PRESENTATION FOR COMPETITION CHOOSE U-NET

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LITERATURE REVIEW

- What is U-Net?
  - U-Net: Convolutional Networks for Biomedical Image Segmentation
- What is U-Net++?
  - UNet++: A Nested U-Net Architecture for Medical Image Segmentation
  - UNet++: Redesigning Skip Connections to Exploit Multiscale Features in Image Segmentation

DIFFICULTIES OF AGGC22

- Huge Dataset: nearly 400GB (Insufficient computing power…)
  - Solution 1: Resize images
    - Will loss too many features.
  - Solution 2: Intercept only the characteristic parts.
    - Difficult to compile automated code (official contest requirements)
- Lack of time…

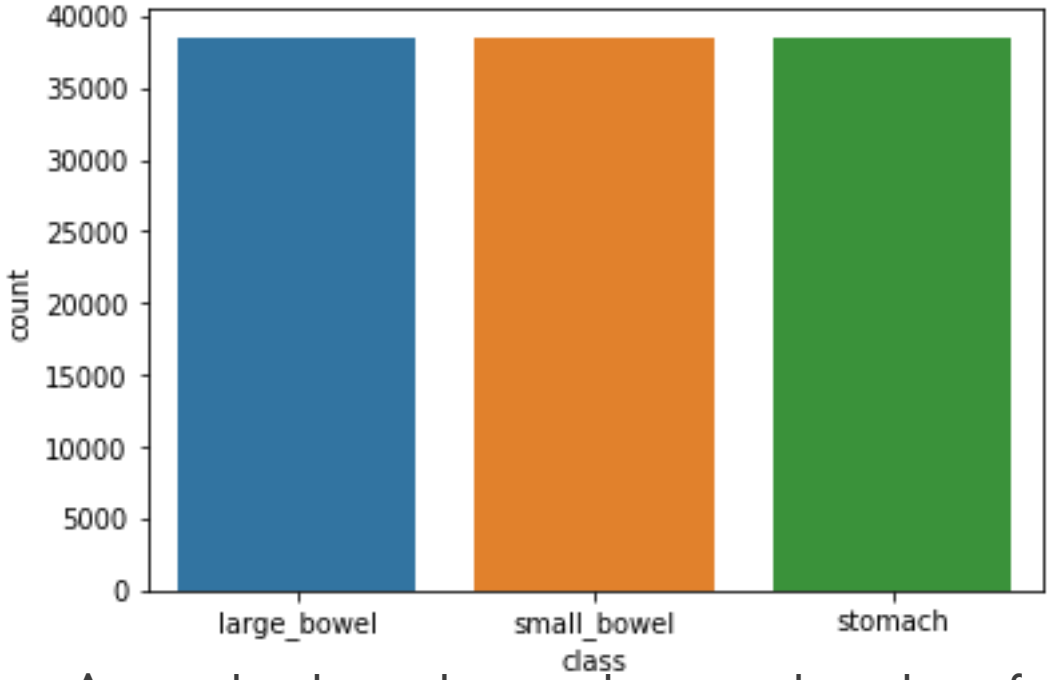
LEARN FROM AGGC22

- Sigmoid for overlapping mask
  - Use SoftMax to convert logits into a probability distribution, and then take the one with the highest probability value as the classification of the sample. (One label for one Sample)
  - A sample has multiple labels. (When applying the sigmoid activation function to multi-label classification, its loss function should be set to binary cross entropy.)

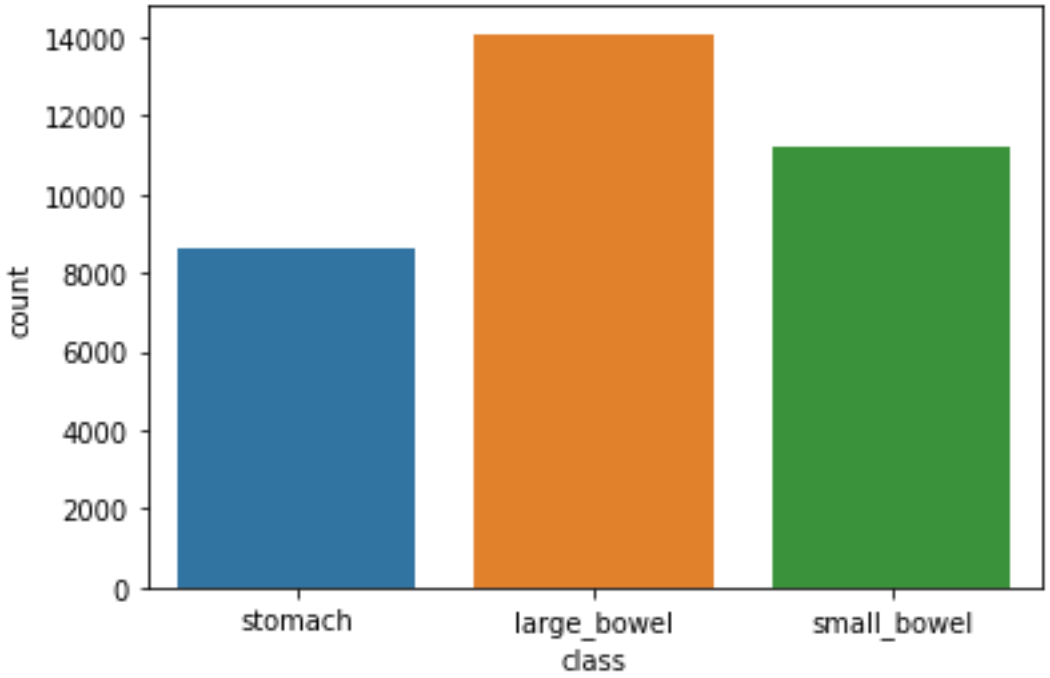
TWO NEW COMPETITION: UW-MADISON GI TRACT IMAGE SEGMENTATION TASK

- Create a model to automatically segment the stomach and intestines on MRI scans.
- The training annotations are provided as RLE-encoded masks, and the images are in 16-bit grayscale PNG format.
- Files
  - train.csv - IDs and masks for all training objects.
  - sample_submission.csv - a sample submission file in the correct format
  - train - a folder of case/day folders, each containing slice images for a particular case on a given day.

TWO NEW COMPETITION:
UW-MADISON GI TRACT IMAGE SEGMENTATION TASK



- As per the above chart we have equal number of slices for each of the three classes.



- The order of number of annotation data available for the training can be observed from above.

U-NET IMPLEMENTATION RESULT

- Details that could be upgraded.
  - Data pre-processing
  - Network model complexity
  - Hyperparameters

Run history:

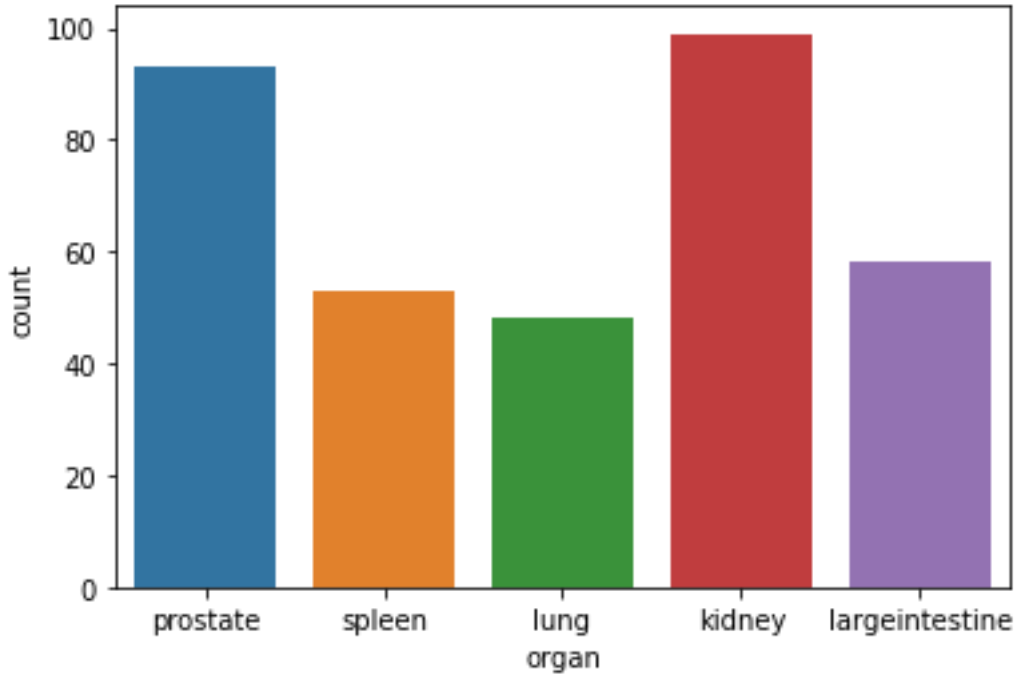
LR	
Train Loss	
Valid Dice	
Valid Jaccard	
Valid Loss	

Run summary:

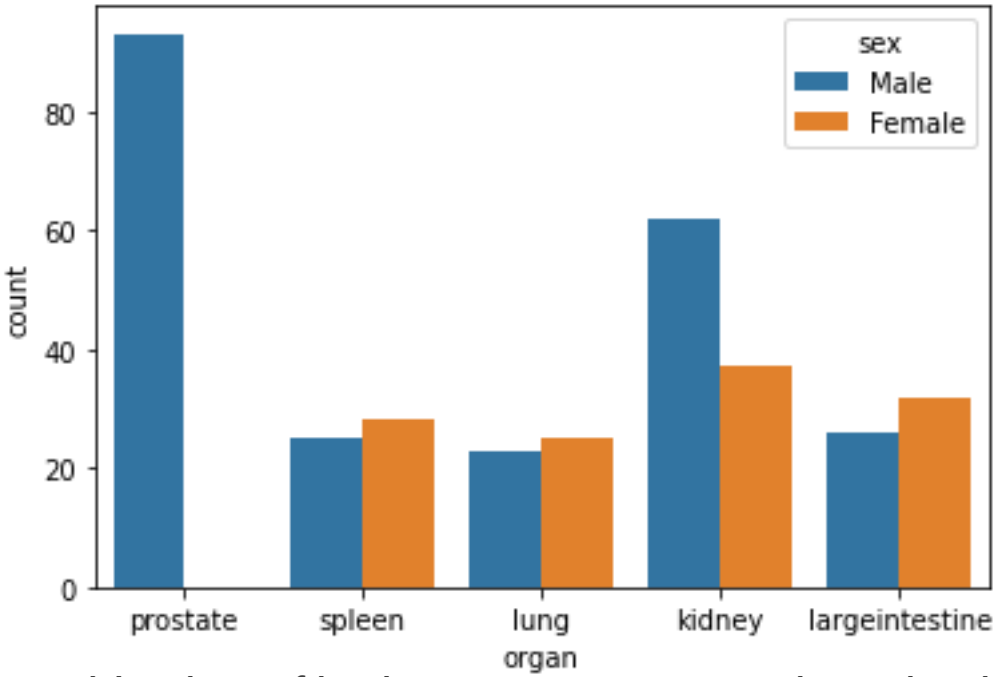
Best Dice	0.90578
Best Epoch	13
Best Jaccard	0.87745
LR	0.0
Train Loss	0.0788
Valid Dice	0.90559
Valid Jaccard	0.87726
Valid Loss	0.12213

TWO NEW COMPETITION: HUBMAP + HPA - HACKING THE HUMAN BODY TASK

- Identify and segment functional tissue units (FTUs) across five human organs.



- Number of body organizations sample in the dataset.



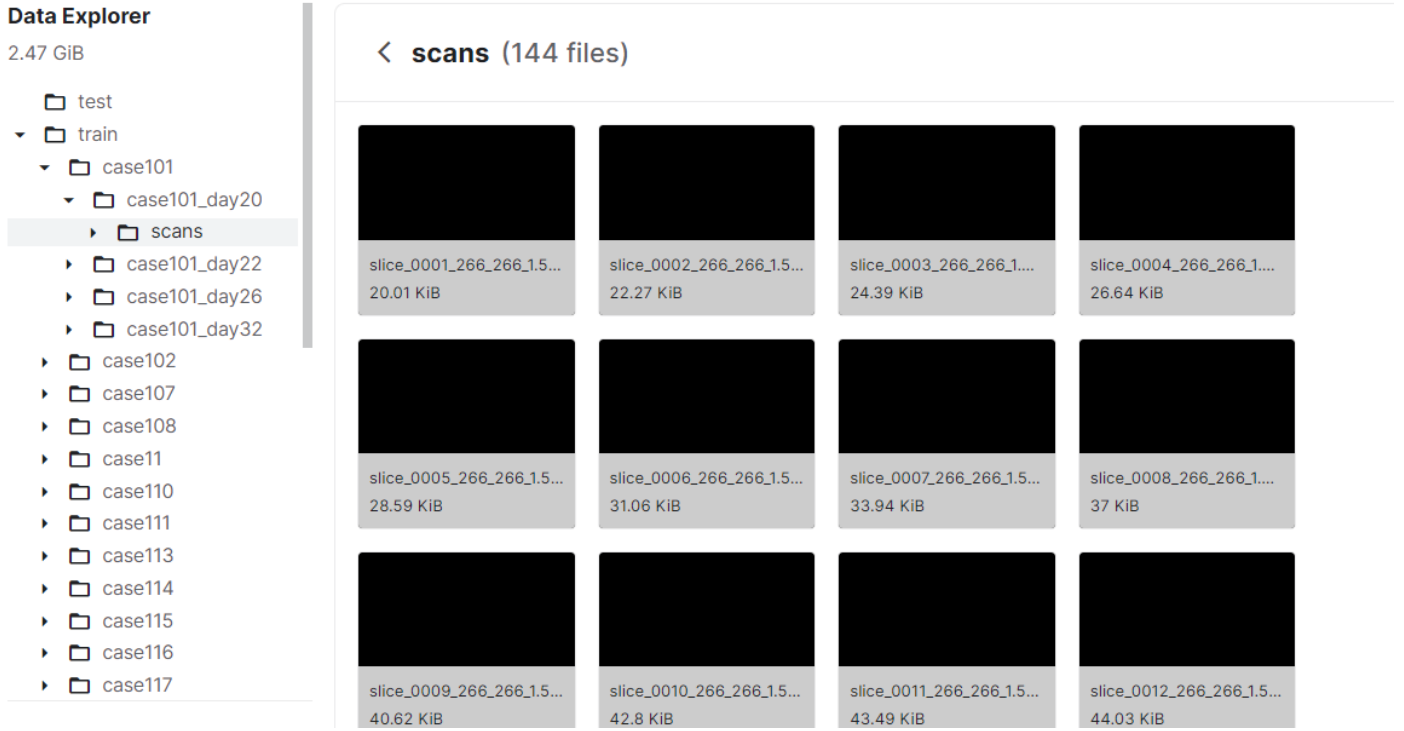
- Number of body organizations sample in the dataset. (With Gender)

COMPETITION OVERVIEW

In this competition, we need to come up with a deep learning solution to automatically segment 3 classes of stomach, large bowel and small bowel on MRI scans.

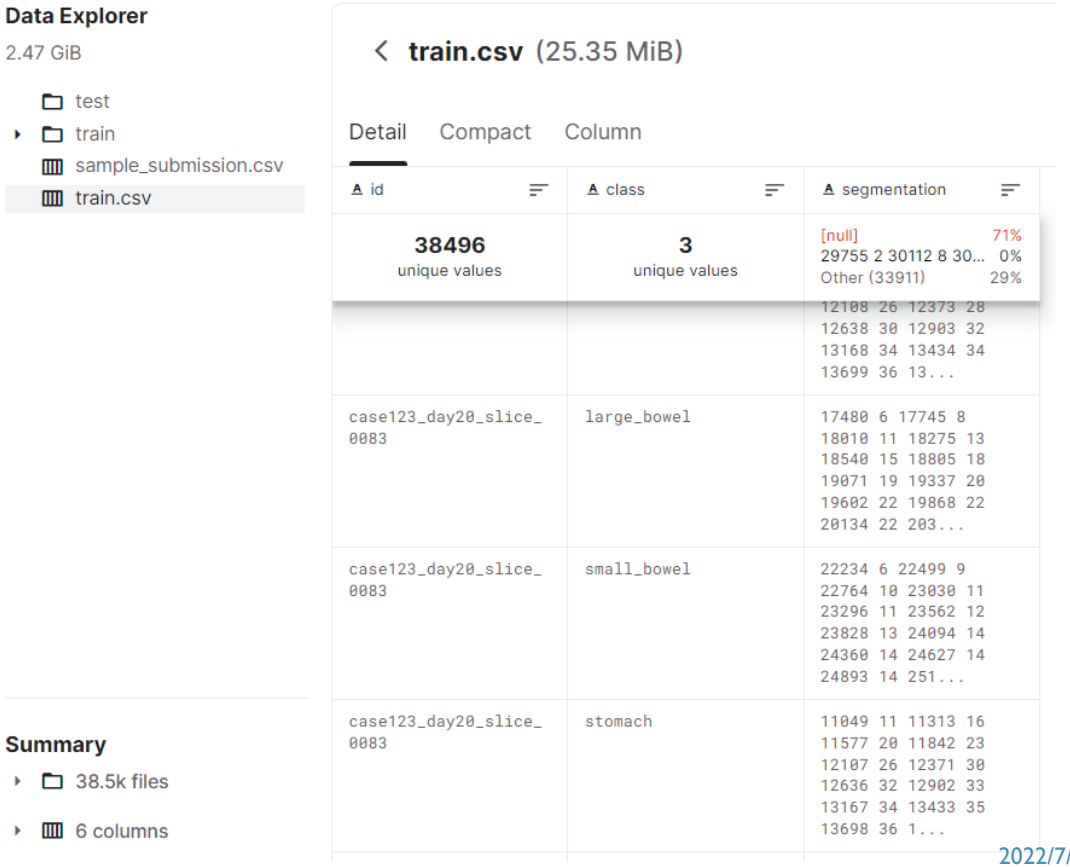
DATASET

- Each case in this competition is represented by multiple sets of scan slices. Note that some cases are split for training set and test set.
- The training images are provided in 16-bit grayscale PNG format.
- Each images are named with the slice number, image size and pixel size.

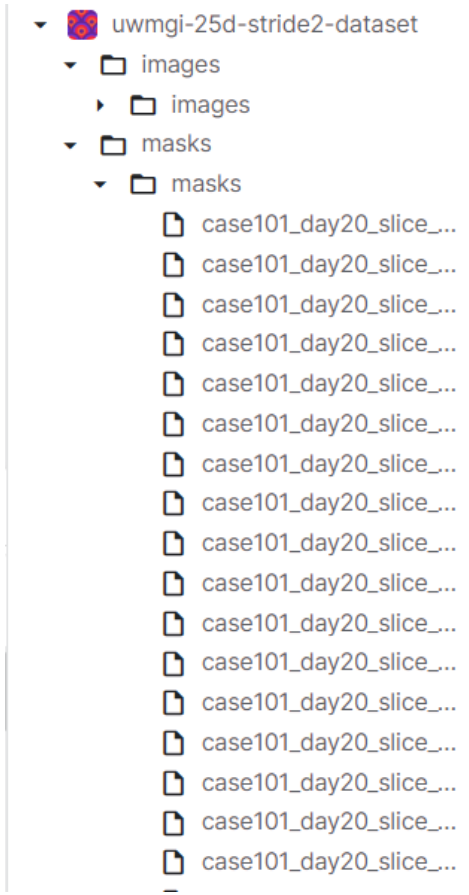


DATASET

- The training annotations in this dataset are provided as RLE-encoded masks.
- RLE-encoded masks are in the forms of several binary arrays, where the first one in the array is the location of first pixel and the second one is the running length of this pixel.



UNET++ IMPLEMENTATION



- Data pre-processing:
  - Convert the names of slices in multi-level folders to the ids consist of original name with the head of cases and days in single level folder.
  - Implement functions to convert the RLE mask to the files in the format of ndarray.

UNET++ IMPLEMENTATION

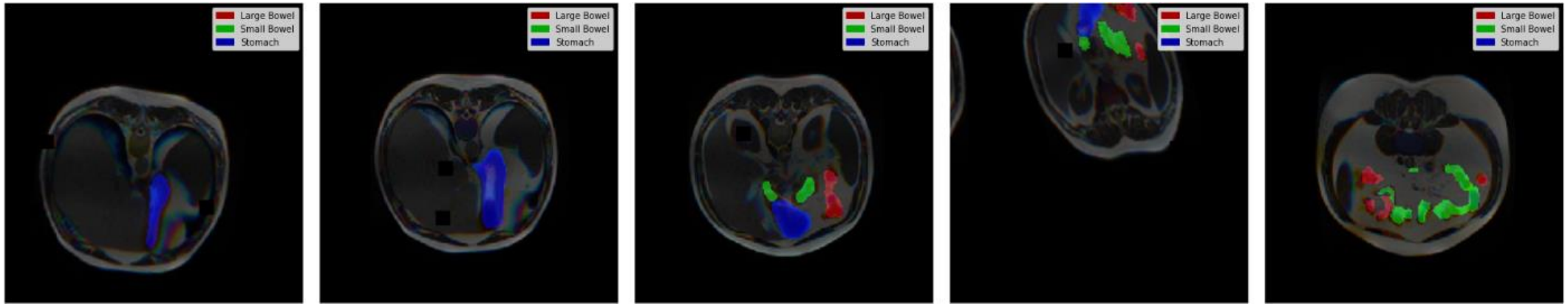
- Data Augmentation

```
data_transforms = {
    "train": A.Compose([
        A.Resize(*CFG.img_size, interpolation=cv2.INTER_NEAREST),
        A.HorizontalFlip(p=0.5),
        A.VerticalFlip(p=0.5),
        A.ShiftScaleRotate(shift_limit=0.0625, scale_limit=0.05, rotate_limit=10, p=0.5),
        A.OneOf([
#             A.GridDistortion(num_steps=5, distort_limit=0.05, p=1.0),
            A.OpticalDistortion(distort_limit=0.05, shift_limit=0.05, p=1.0),
            A.ElasticTransform(alpha=1, sigma=50, alpha_affine=50, p=1.0)
        ], p=0.25),
        A.CoarseDropout(max_holes=8, max_height=CFG.img_size[0]//20, max_width=CFG.img_size[1]//20,
                        min_holes=5, fill_value=0, mask_fill_value=0, p=0.5),
        ], p=1.0),

    "valid": A.Compose([
        A.Resize(*CFG.img_size, interpolation=cv2.INTER_NEAREST),
        ], p=1.0)
}
```

UNET++ IMPLEMENTATION

Batch review



UNET++ IMPLEMENTATION

```python
import segmentation_models_pytorch as smp

def build_model():
    model = smp.UnetPlusPlus(
        encoder_name=CFG.backbone,
        encoder_weights="imagenet",
        in_channels=3,
        classes=CFG.num_classes,
        activation=None,
    )
    model.to(CFG.device)
    return model

def load_model(path):
    model = build_model()
    model.load_state_dict(torch.load(path))
    model.eval()
    return model
```

- Model

```python
JaccardLoss = smp.losses.JaccardLoss(mode='multilabel')
DiceLoss    = smp.losses.DiceLoss(mode='multilabel')
BCELoss     = smp.losses.SoftBCEWithLogitsLoss()
LovaszLoss  = smp.losses.LovaszLoss(mode='multilabel', per_image=False)
TverskyLoss = smp.losses.TverskyLoss(mode='multilabel', log_loss=False)

def dice_coef(y_true, y_pred, thr=0.5, dim=(2,3), epsilon=0.001):
    y_true = y_true.to(torch.float32)
    y_pred = (y_pred>thr).to(torch.float32)
    inter = (y_true*y_pred).sum(dim=dim)
    den = y_true.sum(dim=dim) + y_pred.sum(dim=dim)
    dice = ((2*inter+epsilon)/(den+epsilon)).mean(dim=(1,0))
    return dice

def iou_coef(y_true, y_pred, thr=0.5, dim=(2,3), epsilon=0.001):
    y_true = y_true.to(torch.float32)
    y_pred = (y_pred>thr).to(torch.float32)
    inter = (y_true*y_pred).sum(dim=dim)
    union = (y_true + y_pred - y_true*y_pred).sum(dim=dim)
    iou = ((inter+epsilon)/(union+epsilon)).mean(dim=(1,0))
    return iou

def criterion(y_pred, y_true):
    return 0.5*BCELoss(y_pred, y_true) + 0.5*DiceLoss(y_pred, y_true)
```

- Loss

UNET++ IMPLEMENTATION

- Hyper parameters:

```python
class CFG:
    seed          = 101
    debug         = False # set debug=False for Full Training
    exp_name      = '2.5D'
    comment       = 'unetplusplus - regnet_008'
    model_name    = 'UNetPlusPlus'
    backbone      = 'timm-regnety_008'
    train_bs      = 32
    valid_bs      = train_bs*2
    img_size      = [224, 224]
    epochs        = 15
    lr            = 2e-3
    scheduler     = 'CosineAnnealingWarmRestarts'
    min_lr        = 1e-6
    T_max         = int(30000/train_bs*epochs)+50
    T_0           = 25
    warmup_epochs = 0
    wd            = 1e-6
    n_accumulate  = max(1,64/train_bs)
    n_fold        = 5
    folds         = [0]
    num_classes   = 3
    device        = torch.device("cuda:0" if torch.cuda.is_available()
```

```python
class CFG:
    seed          = 101
    debug         = False # set debug=False for Full Training
    exp_name      = '2.5D'
    comment       = 'unetplusplus - resnet34'
    model_name    = 'UNetPlusPlus'
#     backbone      = 'timm-regnety_008'
    backbone      = 'resnet34'
    train_bs      = 32
    valid_bs      = train_bs*2
    img_size      = [224, 224]
    epochs        = 15
    lr            = 2e-3
    scheduler     = 'CosineAnnealingWarmRestarts'
    min_lr        = 1e-6
    T_max         = int(30000/train_bs*epochs)+50
    T_0           = 25
    warmup_epochs = 0
    wd            = 1e-6
    n_accumulate  = max(1,64/train_bs)
    n_fold        = 5
    folds         = [0]
    num_classes   = 3
    device        = torch.device("cuda:0" if torch.cuda.is_available()
```

UNET++ IMPLEMENTATION

```
Training complete in 6h 30m 57s
Best Score: 0.8683
```
Waiting for W&B process to finish... **(success).**

Links: fold-0|dim-224x224|model-UNetPlusPlus | uw-maddison-gi-tract – Weights & Biases (wandb.ai)

Run history:

Run summary:

Best Dice	0.8991
Best Epoch	15
Best Jaccard	0.86834
LR	0.00069
Train Loss	0.05347
Valid Dice	0.8991
Valid Jaccard	0.86834
Valid Loss	0.10597

Source code with different loss function, scheduler and data augmentation.

UNET++ IMPLEMENTATION

Links: unetplusplus - resnet34 | anony-moose-348813 Workspace – Weights & Biases (wandb.ai)

Run history:

LR	
Train Loss	
Valid Dice	
Valid Jaccard	
Valid Loss	

Run summary:

Best Dice	0.88545
Best Epoch	11
Best Jaccard	0.85445
LR	0.00069
Train Loss	0.05773
Valid Dice	0.88079
Valid Jaccard	0.85112
Valid Loss	0.12554

Unet++ with Resnet34

Thank you!