

January 12, 2021

## Advanced Image Processing Final Exam and Some Image Segmentation Research

I'm mainly preparing for the final exam of advanced image processing and doing the final assignment of IVSS this week, but I do some research on image segmentation.

### 1 Feature Pyramid Network Architecture

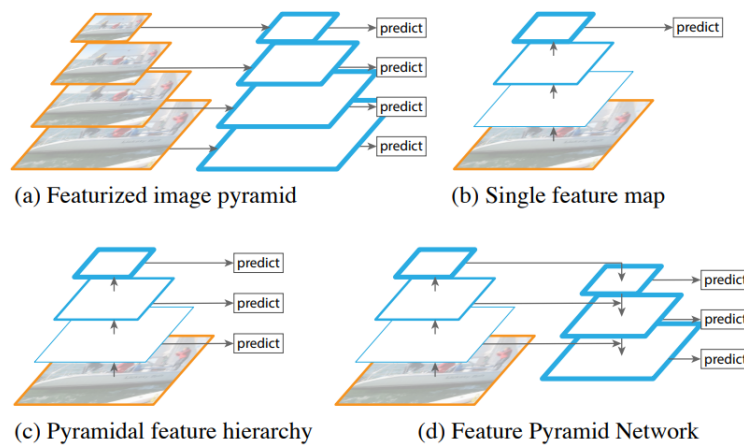


Figure 1: Feature pyramid

The Feature Pyramid Network is used to extract multi-scale features, traditionally used image pyramid approach (figure a) to solve the problem. But this method is not very efficient either in time or in space. Therefore, they combined the encode-decode architecture to deal with this problem, and called its architecture Feature Pyramid (figure d). Predict block are designed according to the task that you want to achieve, e.g., classification, detection and segmentation.

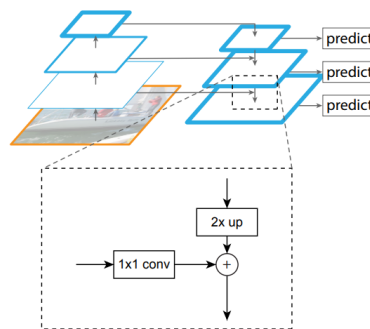


Figure 2: Detailed architecture

In practice, ResNet is taken as the backbone. Since ResNet will undergo downsample for five times, so it serves as encoder architecture, and takes the output of downsample multiplier of 4, 8, 16, 32 as decoder input, that is, the output of ResNet block 14 as decoder input. In this paper, a Lateral Connection is

designed to improve the effect, that is, encoder output will first undergo 1x1 convolution and decoder results, followed by 3x3 convolution as the output of this layer.

## 2 Loss Function: Dice Loss

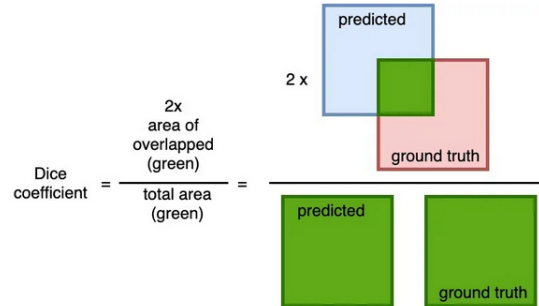


Figure 3: Dice loss

Dice can be understood as the similarity of two contour areas, and A and B represent the set contained in the two contour area. This value is between  $[0, 1]$ .

$$DSC(A, B) = 2 \frac{|A \cap B|}{|A| + |B|}$$

## 3 Loss Function: IoU Loss

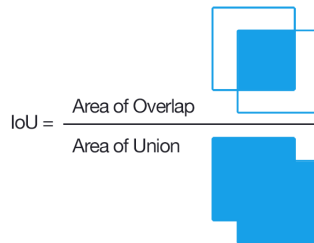


Figure 4: Dice loss

IoU a.k.a. intersection over union, which is the most commonly used indicator in target detection. It can be used not only to determine positive and negative samples, but also to evaluate the distance between the output box and ground-truth. This value is bigger, the better.

$$IoU(A, B) = \frac{|A \cap B|}{|A \cup B|}$$

## 4 Some Result in Final Assignment



Figure 5: Image Segmentation

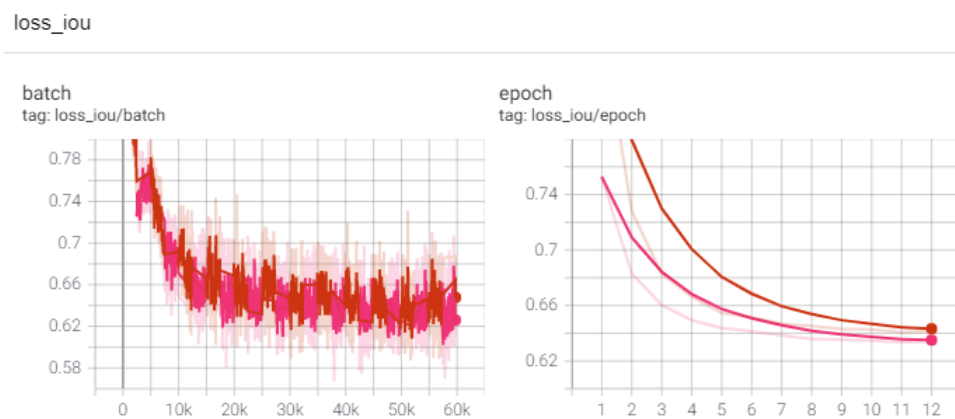


Figure 6: IoU loss

loss\_ce

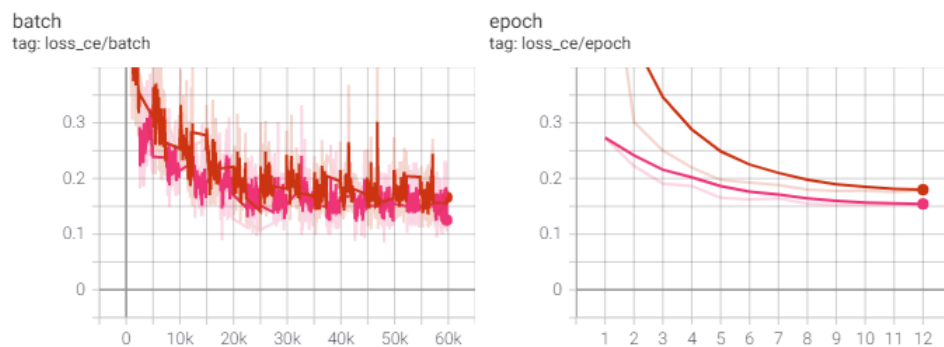


Figure 7: Cross-Entropy loss

loss\_dice

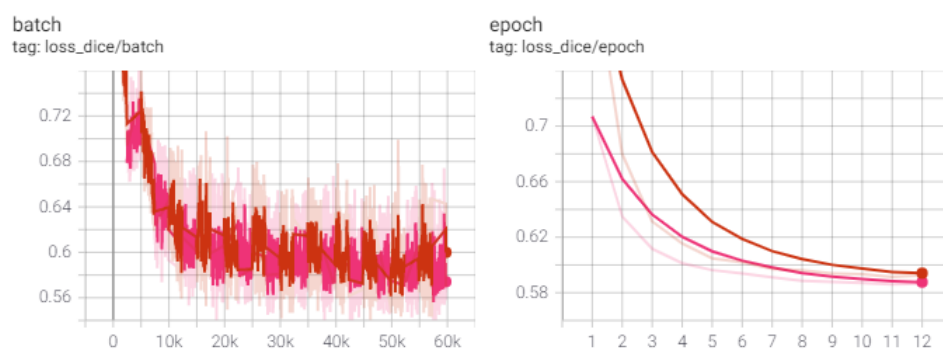


Figure 8: Dice loss

loss

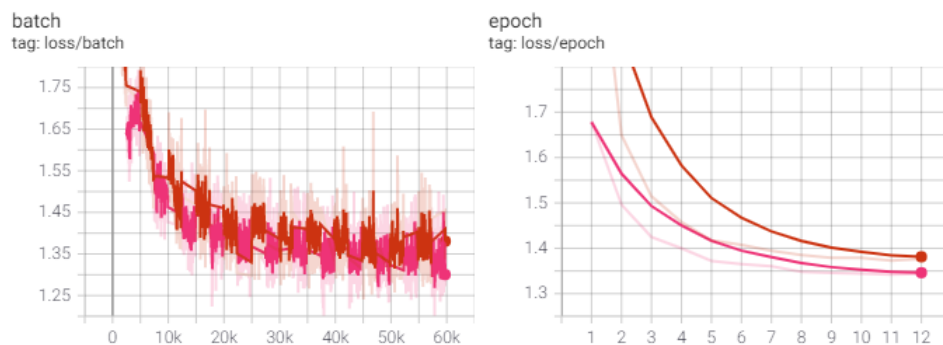


Figure 9: Total loss