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# 2025 USA-NA-AIO Round 2, Problem 3, Part 15

USAAIO 

May 2025

## Part 15 (5 points, coding task)

In this part, you are asked to define a loss function.

Let  $I_i$  and  $T_j$  be image  $i$ 's embedding and text  $j$ 's embedding, respectively. Let  $B$  be the batch size. Let  $\tau$  be the temperature.

Then the loss function is defined as

$$= \frac{1}{2} \left( -\frac{1}{B} \sum_{i=0}^{B-1} \log \frac{\exp(\text{SIM}(I_i, T_i) / \tau)}{\sum_{j=0}^{B-1} \exp(\text{SIM}(I_i, T_j) / \tau)} - \frac{1}{B} \sum_{i=0}^{B-1} \log \frac{\exp(\text{SIM}(I_i, T_i) / \tau)}{\sum_{j=0}^{B-1} \exp(\text{SIM}(I_j, T_i) / \tau)} \right)$$

where

$$\text{SIM}(I_i, T_j) = \frac{I_i^\top T_j}{\|I_i\|_2 \|T_j\|_2}.$$

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```
### WRITE YOUR SOLUTION HERE ###
```

```
def CLIP_loss_fn(image_embedding, text_embedding):
    image_embedding = image_embedding / torch.norm(image_embedding, dim = -1, keepdim=True)
    text_embedding = text_embedding / torch.norm(text_embedding, dim = -1, keepdim=True)
    sim = torch.sum(image_embedding.unsqueeze(1) * text_embedding.unsqueeze(0), dim = -1)
    loss = .5 * (-torch.mean(torch.diagonal(torch.log_softmax(sim / torch.exp(mod
```

 

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```
-torch.mean(torch.diagonal(torch.log_softmax(sim / torch.exp(mod
return loss

""" END OF THIS PART """
```

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