

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

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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 τ 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

```
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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
```

```
-torch.mean(torch.diagonal(torch.log_softmax(sim / torch.exp(mod, dim=1), dim=1))  
return loss  
  
""" END OF THIS PART """
```

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