# AI Alignment Cohort: Assignment 3

This assignment covers einops, einsum and pytorch.

**suman.14san@gmail.com** Switch accounts                    ☁️ Draft saved

* Indicates required question

Email *

suman.14san@gmail.com

What is Einsum notation, and why is it useful in deep learning?

Einsum notation is a compact and expressive

Given two vectors a and b, both of length I, how would you compute their dot product using Einsum notation?

einsum("i, i -> ", a, b)

Explain how Einsum can be used to perform a batch matrix multiplication in PyTorch. Provide a code example.

Let's assume we have two matrix A and B, such that they can be multiplied, then we can use einsum('bij,bjk->bik', A, B) to multiply both the matrix using einsum, where b is the batchsize

What are the primary operations provided by einops, and what is the purpose of each?

It provides many functions, but primary are like

Using einops, how would you convert a 4D tensor of shape (b, h, w, c) into a 1D tensor while preserving the number of elements?

einops.rearrange(ims, 'b h w c -> (b h w c)')

Write the einops operation to perform mean-pooling with a 2x2 kernel on a 4D tensor of shape (b, h, w, c). What will be the shape of the resulting tensor if h and w are both even?

reduce(x, 'b (h h2) (w w2) c -> b h w c', 'mean', h2=2, w2=2)
resultant shape would be : (b, h/2,  w/2, c)

To reinforce your understanding of neural networks, PyTorch, and the training process. Evaluate the current model's performance and experiment with different techniques to improve it. Use the provided code to display a batch of test images along with their predicted and true labels. Identify and analyze a few examples where the model made incorrect predictions.

**Experiment with Different Hyperparameters:**
Modify the learning rate and observe how it affects the model's performance. Try at least two different learning rates (e.g., 0.01 and 0.0001).
Change the number of epochs to 20 and report how the extended training impacts accuracy and loss.
**Experiment with a Different Optimizer:**
Change the optimizer from SGD to Adam and compare the results. Report on the differences in training speed and model accuracy.
**Create and Train a Deeper Model:**
Add more layers to the neural network to create a deeper model. Train this new model and compare its performance to the original model.

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