

## Homework 3: Chapter 12

Do Exercise 12.12 of the textbook.

**Exercise 12.** Implement a custom layer that performs Layer Normalization (we will use this type of layer in Chapter 15):

- a. The `build()` method should define two trainable weights  $\alpha$  and  $\beta$ , both of shape `input_shape[-1:]` and data type `tf.float32`.  $\alpha$  should be initialized with 1s, and  $\beta$  with 0s.
- b. The `call()` method should compute the mean  $\mu$  and standard deviation  $\sigma$  of each instance's features. For this, you can use `tf.nn.moments(inputs, axes=-1, keepdims=True)`, which returns the mean  $\mu$  and the variance  $\sigma^2$  of all instances (compute the square root of the variance to get the standard deviation). Then the function should compute and return

$$\alpha \odot \frac{X - \mu}{\sigma + \varepsilon} + \beta,$$

where  $\odot$  represents itemwise multiplication (`*`) and  $\varepsilon$  is a smoothing term (small constant to avoid division by zero, e.g., 0.001).

- c. Ensure that your custom layer produces the same (or very nearly the same) output as the `keras.layers.LayerNormalization` layer.

Report what you find. Don't forget attach your code with you report. **Deadline:** [Nov 31, 2025]