Exercise 7.1

Create a tensor with random integer values from interval $[-1000, 1000]$. The shape of tensor is $(100, 1000, 1000)$ and it is on the CPU. Use number 222 as a seed.

Move tensor to GPU. Compute the mean and the standard deviation of tensors all elements on the GPU.

Move results back to the CPU. Make a tensor of shape $(2,)$ from the results, i.e. it is a vector.

Make a new tensor to CPU that has random integer values from interval $[1, 10]$. The shape of this tensor is $(10, 2)$, i.e. it is a matrix. Use number 888 as a seed.

Make the product of the matrix (10×2) and the vector (2) resulting a tensor of shape $(10,)$.

What is the mean of this resulting tensor? Give the answer rounded to two decimals.

Note: `torch.matmul` is the function for the matrix vs. vector product.

Exercise 7.2

Dataset (`torch.utils.data.Dataset`) and Dataloader (`torch.utils.data.DataLoader`) are two PyTorch classes that are used to make a data suitable for tensor based PyTorch neural networks.

In lecture material was introduced a custom class `CustomDataset`. Create a new custom dataset class that is based to that example and add the following to the class:

- Object constructor, i.e. `__init__` method, has an extra parameter for the transformations to be made. Value of this parameter is a list of functions and it's default is `None`.
- The method `__getitem__` does the following transformations to the data before it is returned:
  - X is transformed with all the functions given to the object at creation time.
  - both X and y are changed to tensors with `dtype=torch.float32`.

Make the following transformation function:

- function `Squared` which gets a numpy array and returns a numpy array with squared values
- function `Log` which get a numpy array and returns a numpy array with (natural) logarithm values

Load the Iris data with function `sklearn.datasets.load.iris`. Note that you can read the data to two numpy arrays using the parameter `return_X_y=True`.

Make a list of transform functions as follows: `[Squared, Log]`.

Create a dataset givin the following values: numpy array X, numpy array y and the list of functions created above.

Create then a dataloader, i.e. object of class `torch.utils.data.DataLoader` for the dataset using a batch size of 16 and no shuffling (`shuffle=False`).

What is the mean of second column the 8th batch rounded to three decimals?

Exercise 7.3

Create a tensor x with gradients for a vector $[3.2, 2.1, 0.6, 8.3]$. Compute the following $\sqrt{\sum_{i=1}^{n} 3(2x_i)^2}$.

What is the sum of partial derivatives respect to x , i.e. the gradient of x? Give the answer rounded to two decimals.