PyTorch — Tensors from Images

Goal

1. Download a small image dataset.
2. Read a short intro about **PyTorch tensors**.
3. Load **one image**, convert it to a PyTorch tensor **with all color channels**, then:
    - print its **label**
    - print the tensor **min/max**
    - implement `show_tensor_image()` to display the image correctly
4. Create a **vector** representation of the image tensor, print its shape, then reshape it back to the original image shape.

This is a setup assignment for later PyTorch work.

Dataset choice

We will use **CIFAR-10** (32×32 RGB) via `torchvision.datasets`.

Part 0 — Download the dataset

The starter script will download CIFAR-10 automatically to `torch/data/` when you run it.

From this folder:

```
python torch_tensors_images.py
```

Part 1 — Read

Read (skim is fine) these topics:

- What is a `torch.Tensor`?
- Tensor shapes for images: `(C, H, W)`
- Dtypes (e.g. `float32`) and value ranges (e.g. `[0, 1]` for `ToTensor()`)
- Why matplotlib expects images as `(H, W, C)`

Suggested docs:

- PyTorch tensors: https://pytorch.org/docs/stable/tensors.html
- torchvision transforms: https://pytorch.org/vision/stable/transforms.html
- CIFAR-10 dataset: https://pytorch.org/vision/stable/datasets.html

Part 2 — Assignment

Open `torch_tensors_images.py` and complete the TODOs:

1. Download/load CIFAR-10 (alredy started for you)

2. Take **one image** from the dataset
3. Convert it to a tensor of shape `(3, H, W)` (keep all color channels)
4. Print the numeric `label` and the class name
5. Print the tensor **min** and **max** values
6. Implement `show_tensor_image()` and display the image with matplotlib
7. Implement `image_tensor_to_vector()` to convert `(3, H, W)` → `(3*H*W,)`
8. Print the vector shape
9. Reshape the vector back to `(3, H, W)` and (optionally) verify it matches the original

Then change `index = 0` to a different value (e.g. 10, 100, 999) and re-run to see different images.

Important note: channel order

PyTorch (and `transforms.ToTensor()`) stores images as `(C, H, W)`, but `matplotlib.pyplot.imshow()` expects `(H, W, C)`.

Hint: use `permute`:

```
img_hwc = img_tensor.permute(1, 2, 0)
```

Report (PDF)

Create a short report (PDF) and include:

1. **Examples of the dataset**: include several CIFAR-10 images (at least 3) with their labels.
2. **Vector representation**: explain how you converted an image tensor of shape `(3, H, W)` into a vector of shape `(3*H*W,)`, and how you reshaped it back.

Run:

```
python torch_tensors_images.py
```

What to submit

- `torch_tensors_images.py`
- Your report PDF