Homework 2

starter code data

In this homework, we will train a convolutional network to classify images from SuperTuxKart.

This assignment should be solved **individually**. No collaboration, sharing of solutions, or exchange of models is allowed. Please, do not directly copy existing code from anywhere other than your previous solutions, or the previous master solution. We will check assignments for duplicates. See below for more details.

Starter code and dataset

The starter code for this assig[illegible]arter code contains several useful scripts:

- `bundle.py` will zip up [illegible]sion. Only submit zip files created by this bundling script
- `grader` locally grades [illegible]zip files and your homework directory.

The starter code also contain[illegible]copy (or symlink) the SuperTuxKart classification dataset. Unzip the data directly into the homework folder, rep[illegible]ompletely. Make sure you see the following directories and files inside your main directory

```
homework
grader
bundle.py
data
data/train
data/valid
```


You will run all scripts from inside this main directory.

CNN Model (10pts)

Implement the `CNNClassifier` in `models.py`. Similar to homework 1, your model should return a `(B,6)` `torch.Tensor` which represents the logits of the classes. Use convolutions this time. Use `python3 -m grader homework -v` to grade the first part.

Relevant Operations

- torch.nn.Conv2d
- and all previous

Logging (30pts)

In this part, we learn how to use `tensorboard`. We created a dummy training procedure in `logging.py`, and provided you with two `tb.SummaryWriter` as logging utilities. Use those summary writers to log the training loss at every iteration, the training accuracy at each epoch and the validation accuracy at each epoch. Log everything in *global training steps*. Here is a simple example of how to use the `SummaryWriter`.


```
import torch.utils.tensorboard as tb
logger = tb.SummaryWriter('cnn')

logger.add_scalar('train/loss', t_loss, 0)
```

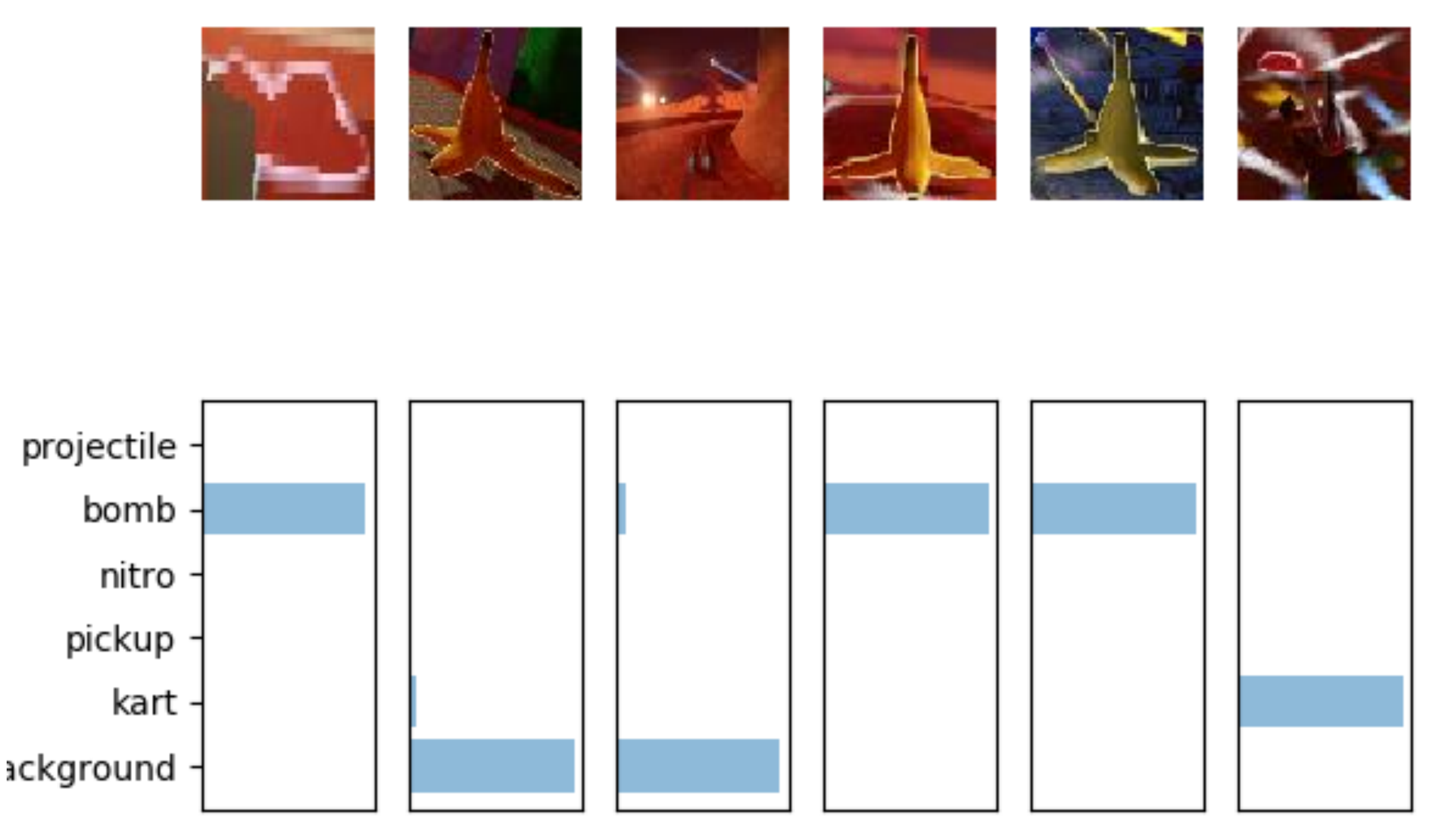
In `logging.py`, you should **not** create your own `SummaryWriter`, but rather use the one provided. You can test your logger by calling `python3 -m homework.acc_logging log`, where `log` is your favorite directory. Then start up tensorboard: `tensoboard --logdir log`. Use `python3 -m grader homework -v` to grade the logging.

Relevant Operations

- torch.utils.tensorboard.SummaryWriter
- torch.utils.tensorboard.SummaryWriter.add_scalar
- and all previous

Training your CNN model (60pts)

Train your model and save it as `cnn.th`. You can reuse some of the training functionality in `train.py` from homework 1. We highly recommend you incorporate the logging functionality from section 2 into your training routine. Once you trained your model, you can optionally visualize your model's prediction using `python3 -m homework.viz_prediction [DATASET_PATH]`.



After implementing everything, you can use `python3 -m grader homework` to test your solutions against the validation grader locally. Your model should achieve a 0.85 test accuracy to receive full points. Note that we will use a testing dataset to grade the accuracy part of your model, so your local grades are not guaranteed to be your actual grades. (Don't overfit!)

Note

If you are normalizing the images, please do it in your `models.py` not in your dataset file, because our online grader will not perform the normalization in dataset.

Relevant Operations

- torch.nn.CrossEntropyLoss
- and all previous

Grading

The test grader we provide

```
python3 -m grader homework -v
```

will run a subset of test cases we use during the actual testing. The point distributions will be the same, but we will use additional test cases. More importantly, we evaluate your model on the test set. The performance on the test grader may vary. Try not to overfit to the validation set too much.

Submission

Once you finished the assignment, create a submission bundle using

```
python3 bundle.py homework [YOUR UT ID]
```

and submit the zip file on canvas. Please note that the maximum file size our grader accepts is **20MB**. Please keep your model compact. Please double-check that your zip file was properly created, by grading it again

```
python3 -m grader [YOUR UT ID].zip
```

Online grader

We will use an automated grader through canvas to grade all your submissions. There is a soft limit of **5** submisisons per assignment. Please contact the course staff before going over this limit, otherwise your submission might be counted as invalid.

The online grading system will use a slightly modified version of python and the grader:

- Please do not use the `exit` or `sys.exit` command, it will likely lead to a crash in the grader
- Please do not try to access, read, or write files outside the ones specified in the assignment. This again will lead to a crash. File writing is disabled.
- Network access is disabled. Please do not try to communicate with the outside world.
- Forking is not allowed!
- `print` or `sys.stdout.write` statements from your code are ignored and not returned.

Please do not try to break or hack the grader. Doing so will have negative consequences for your standing in this class and the program.

Running your assignment on google colab

You might need a GPU to train your models. You can get a free one on google colab. We provide you with a ipython notebook that can get you started on colab for each homework.

If you've never used colab before, go through colab notebook (tutorial)
When you're comfortable with the workflow, feel free to use colab notebook (shortened)

Follow the instructions below to use it.

- Go to http://colab.research.google.com/.
- Sign in to your Google account.
- Select the upload tab then select the `.ipynb` file.
- Follow the instructions on the homework notebook to upload code and data.

Honor code

This assignment should be solved **individually**.

What interaction with classmates is allowed?

- Talking about high-level concepts and class material
- Talking about the general structure of the solution (e.g. You should use convolutions and ReLU layers)
- Looking at online solutions, and pytorch samples **without** directly copying or transcribing those solutions (rule of thumb, do not have your coding window and the other solution open at the same time). Always cite your sources in the code (put the full URL)!
- Using any of your submissions to prior homework
- Using the master solution to prior homework
- Using ipython notebooks from class

What interaction is *not* allowed?

- Exchange of code
- Exchange of architecture details
- Exchange of hyperparameters
- Directly (or slightly) modified code from online sources
- Any collaboration
- Putting your solution on a public repo (e.g. github). You will fail the assignment if someone copies your code.

Ways students failed in past years (do **not** do this):

- Student A has a GPU, student B does not. Student B sends his solution to Student A to train 3 days before the assignment is due. Student A promises not to copy it but fails to complete the homework in time. In a last-minute attempt, Student A submits a slightly modified version of Student B's solution. Result: Both students fail the assignment.
- Student A struggles in class. Student B helps Student A and shows him/her his/her solution. Student A promises to not copy the solution but does it anyway. Result: Both students fail the assignment.
- Student A sits behind Student B in class. Student B works on his homework, instead of paying attention. Student A sees Student B's solution and copies it. Result: Both students fail the assignment.
- Student A and B do not read the honor code and submit identical solutions for all homework. Result: Both students fail the class.

Installation and setup

Installing python 3

Go to https://www.python.org/downloads/ to download python 3. Alternatively, you can install a python distribution such as Anaconda. Please select python 3 (not python 2).

Installing the dependencies

Install all dependencies using

```
python3 -m pip install -r requirements.txt
```

Note: On some systems, you might be required to use `pip3` instead of `pip` for python 3.

If you're using conda use

```
conda env create environment.yml
```

The test grader will not have any dependencies installed, other than native python3 libraries and libraries mentioned in `requirements.txt`. `pandas` is not allowed for this assignment. If you use pandas or any library other than native python3 libraries and libraries mentioned in `requirements.txt`, your assignment will crash the canvas grader. Your local grader may not crash because you have the libraries installed locally.

Manual installation of pytorch

Go to https://pytorch.org/get-started/locally/ then select the stable Pytorch build, your OS, package (pip if you installed python 3 directly, conda if you installed Anaconda), python version, cuda version. Run the provided command. Note that cuda is not required, you can select cuda = None if you don't have a GPU or don't want to do GPU training locally. We will provide instruction for doing remote GPU training on Google Colab for free.

Manual installation of the Python Imaging Library (PIL)

The easiest way to install the PIL is through `pip` or `conda`.

```
python3 -m pip install -U Pillow
```

There are a few important considerations when using PIL. First, make sure that your OS uses `libjpeg-turbo` and not the slower `libjpeg` (all modern Ubuntu versions do by default). Second, if you're frustrated with slow image transformations in PIL use `Pillow-SIMD` instead:

```
CC="cc -mavx2" python3 -m pip install -U --force-reinstall Pillow-SIMD
```

The `CC="cc -mavx2"` is only needed if your CPU supports AVX2 instructions. `pip` will most likely complain a bit about missing dependencies. Install them, either through `conda`, or your favorite package manager (`apt`, `brew`, …).