

# Homework Template

This is a template for collecting the required responses from the homework.

## 2.1 Environment

Insert a screenshot of your terminal connected to a GCP instance, displaying both htop and nvidia-smi inside a tmux / screen window.

```
0[ 0.0%] 4[ 0.0%]
1[ 0.7%] 5[ 0.0%]
2[ 0.7%] 6[ 0.0%]
3[ 0.0%] 7[ 0.0%]
Mem[|||||] Tasks: 84, 225 thr, 139 kthr; 1 running
Swap[|||||] Load average: 0.08 0.24 0.23
Uptime: 00:15:46

PID USER      PR  NI  VIRT  RES  SHR  S CPU% MEM%   TIME+  Command
3818 root        20   0 191M 5244 3860 S  0.7  0.0 0:01.28 SCHROD -T lic-0 11.16 6 -c ./licenses
5533 root        20   0 195M 5748 4292 S  0.7  0.0 0:00.40 SCHROD -T sch-lic 11.16 7 -c ./licenses
17547 wz2164      20   0 35664 5296 4120 S  0.7  0.0 0:00.28 tmux
21616 wz2164   20   0 38368 6500 4488 R  0.7  0.0 0:01.36 http/lib/systemd/systemd-journald
1 root        20   0 246M 14476 9464 S  0.0  0.0 0:01.93 /usr/lib/systemd/systemd --switched-r
665 root        20   0 938M 12116 10868 S  0.0  0.0 0:00.18 /usr/lib/systemd/systemd-journald
781 root        20   0 138M 13388 9468 S  0.0  0.0 0:00.26 /usr/lib/systemd/systemd-udev
765 rpc        20   0 67176 8596 4868 S  0.0  0.0 0:00.03 /usr/bin/rpcbind -w -f
773 root        16 -4 208M 11300 9948 S  0.0  0.0 0:00.04 /sbin/auditd
774 root        16 -4 208M 11300 9948 S  0.0  0.0 0:00.00 /sbin/auditd
838 dbus        20   0 156M 12200 10652 S  0.0  0.0 0:00.16 /usr/bin/dbus-daemon --system --addre
842 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.10 /usr/lib/polkit-1/polkitd --no-debug
845 root        20   0 247M 10624 16328 S  0.0  0.1 0:00.08 /usr/sbin/sssd -i --logger=files
847 chrony      20   0 111M 3224 2984 S  0.0  0.0 0:00.00 /usr/sbin/chronyd
850 rngd        20   0 372M 6520 5680 S  0.0  0.0 0:18.12 /sbin/rngd -f --fill-watermark=0
860 dbus        20   0 156M 12200 10652 S  0.0  0.0 0:00.00 /usr/bin/dbus-daemon --system --addre
867 root        20  2045M 32124 21992 S  0.0  0.1 0:00.55 /usr/libexec/sss/sssd_be --domain im
882 rngd        20   0 372M 6520 5680 S  0.0  0.0 0:04.08 /sbin/rngd -f --fill-watermark=0
886 rngd        20   0 372M 6520 5680 S  0.0  0.0 0:04.02 /sbin/rngd -f --fill-watermark=0
888 rngd        20   0 372M 6520 5680 S  0.0  0.0 0:03.99 /sbin/rngd -f --fill-watermark=0
889 rngd        20   0 372M 6520 5680 S  0.0  0.0 0:04.23 /sbin/rngd -f --fill-watermark=0
894 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
895 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.01 /usr/lib/polkit-1/polkitd --no-debug
896 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
897 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
898 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
899 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
900 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
901 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
902 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
903 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
905 root        20  233M 42220 40408 S  0.0  0.1 0:00.50 /usr/libexec/sss/sssd_nss --uid 0 --
906 polkitd     20  2045M 32124 21992 S  0.0  0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
908 root        20   0 308M 42704 19256 S  0.0  0.1 0:00.69 /usr/libexec/platform-python -s /usr/
911 root        20   0 388M 21860 17148 S  0.0  0.1 0:00.26 /usr/sbin/NetworkManager --no-daemon
915 root        20   0 388M 21860 17148 S  0.0  0.1 0:00.00 /usr/sbin/NetworkManager --no-daemon
916 root        20   0 388M 21860 17148 S  0.0  0.1 0:00.02 /usr/sbin/NetworkManager --no-daemon
917 root        20  412M 20984 15624 S  0.0  0.1 0:00.39 /usr/libexec/platform-python -Es /usr
928 root        20   0 99M 3632 2972 S  0.0  0.0 0:00.00 /usr/sbin/gssproxy -D
931 munge        20   0 312M 9560 8404 S  0.0  0.0 0:00.01 /usr/sbin/munged
932 root        20   0 99M 3632 2972 S  0.0  0.0 0:00.00 /usr/sbin/gssproxy -D
933 root        20   0 99M 3632 2972 S  0.0  0.0 0:00.00 /usr/sbin/gssproxy -D
934 root        20   0 99M 3632 2972 S  0.0  0.0 0:00.00 /usr/sbin/gssproxy -D
935 root        20   0 99M 3632 2972 S  0.0  0.0 0:00.00 /usr/sbin/gssproxy -D
936 root        20   0 99M 3632 2972 S  0.0  0.0 0:00.00 /usr/sbin/gssproxy -D
938 munge        20  312M 9560 8404 S  0.0  0.0 0:00.01 /usr/sbin/munged
940 munge        20  312M 9560 8404 S  0.0  0.0 0:00.00 /usr/sbin/munged
941 munge        20  312M 9560 8404 S  0.0  0.0 0:00.00 /usr/sbin/munged
1140 root        20  412M 20984 15624 S  0.0  0.1 0:00.13 /usr/libexec/platform-python -Es /usr
1144 root        20  412M 20984 15624 S  0.0  0.1 0:00.00 /usr/libexec/platform-python -Es /usr
1145 root        20  412M 20984 15624 S  0.0  0.1 0:00.00 /usr/libexec/platform-python -Es /usr

=====
- Hostname.....: b-3-3
- IP Address.....: 10.144.0.22 10.22.0.1
- Disk Space.....: remaining
=====
- CPU usage.....: 0.09, 0.25, 0.23 (1, 5, 15 min)
- Memory used.....: 701 MB / 29940 MB
- Swap in use.....: 0 MB
=====

[wz2164@b-3-3 ~]$ nvidia-smi
Thu Sep 23 18:44:50 2021

+-----+
| NVIDIA-SMI 470.57.02   Driver Version: 470.57.02   CUDA Version: 11.4   |
+-----+
| GPU Name               Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|  Memory-Usage | GPU-Util  Compute M. |
|                               | MIG M.       |
+-----+-----+
| 0 Tesla V100-SXM2...  On           | 00000000:00:04:0 Off |             0%          |
| N/A    35C    P0      25W / 300W |  6M1B / 16160M1B |           0%          |
+-----+-----+
| Processes:
| GPU   GI   CI          PID    Type    Process name                        GPU Memory
| ID   ID   ID                                  Usage                                  |
+-----+-----+
| No running processes found
+-----+

[wz2164@b-3-3 ~]$
```

## 2.3 Singularity

Number of files in dataset: **1803460**

Copy your script for computing that result below.

Script:

In [1]: import pandas as pd

In [2]: train\_images = pd.read\_csv('places365\_train\_standard.txt', header=None)

In [3]: train\_images.shape[0]

Out[3]: 1803460

```
In [1]: import pandas as pd
```

```
In [2]: train_images = pd.read_csv('places365_train_standard.txt', header=None)
```

```
In [3]: train_images.shape[0]
```

```
Out[3]: 1803460
```

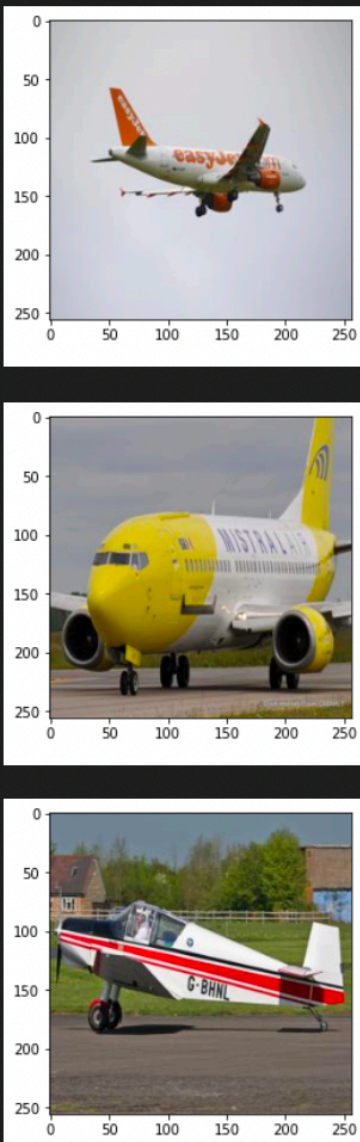
## 2.4 VSCode

Insert a screenshot of the notebook interface displaying a couple of images from the dataset

```
import matplotlib.pyplot as plt
import matplotlib.image as mpimg

def process(filename: str=None) -> None:
    """
    View multiple images stored in files, stacking vertically
    """
    image = mpimg.imread(filename)
    plt.figure()
    plt.imshow(image)
images = ['/places365/data_256_standard/a/airfield/00000001.jpg', \
          '/places365/data_256_standard/a/airfield/00000100.jpg', \
          '/places365/data_256_standard/a/airfield/00001000.jpg']
for file in images:
    process(file)
```

[1] ✓ 0.8s



The notebook interface displays three vertically stacked image plots, each with x and y axes ranging from 0 to 250. The first plot shows an EasyJet airplane in flight. The second plot shows a yellow and white Astra airplane on a tarmac. The third plot shows a small white and red biplane on a grassy field.

### 3.1.1 Training smoke test

Network architecture: MobileNetV3 large (replace if not using provided example)

Performance 32-bit float: [834] img / s. (2x GPU)

32-bit Float:

- Batch size = 256
- 3.28 it/s
- 834 img/s

```
Epoch 0: 86% | 6172/7188 [31:24<05:10, 3.28it/s, loss=2.47, v_num=0, accuracy=0.461]Epoch 0: 100% | 7188/7188 [35:33<00:00, 3.37it/s, loss=2.38, v_num=0, accuracy=0.367]Training costs 2161.2039148807526 seconds in total
Number of images processed per second is: 834.4696155612453
```

Performance 16-bit float: [935] img / s. (2x GPU)

16-bit Float:

- Batch size = 256
- 3.73 it/s
- 935 img/s

```
sing later iterations to have unused parameters. (function operator())
Epoch 0: 100% | 7188/7188 [32:09<00:00, 3.73it/s, loss=2.39, v_num=0, accuracy=0.388]
(/ext3/conda/bootcamp) wz2164@b-6-7:~/cds-bootcamp/lecture2$
```

### 3.1.2 Long training

Insert tensorboard screenshot here.

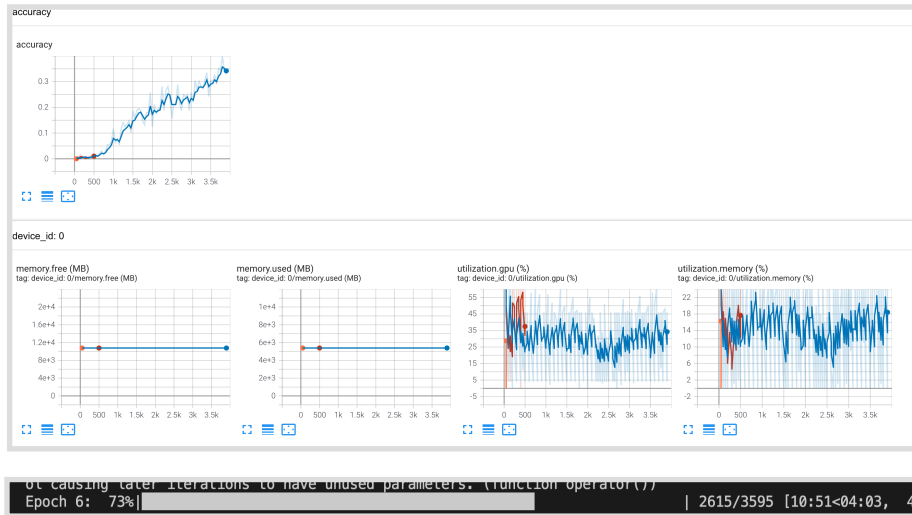
A few words to explain:

Unfortunately, I cannot get the final result by running 30 epochs here, since at the time this HW is due, there are still several epochs to be run. (Sorry for that, I just wasted lots of time to figure out how to copy files from Greene to GPC and how to launch tensorboard effectively.)

Having solved various of bugs, finally I made it to move the data from /scratch/wz2247/data/ at Greene to the local place at GCP called /tmp/ as shown below. And to unsquashfs the places365.squashfs, I used conda to install unsquashfs in the process of creating package overlay.

```
# DATA_DIRECTORY=${DATA_DIRECTORY:-/scratch/wz2247/data/}
cp "/scratch/wz2247/data/places365.squashfs" "/tmp"
DATA_DIRECTORY=${DATA_DIRECTORY:-/tmp}
```

Here, all I can do now is to show the visualization of running 1 epoch, and the speed of running 30 epoch. From the shortcut below, when running the 6th epoch, the speed is 4.02it/s(), and it may be even quicker later. Compared to the result of 3.1.1, we can see that moving data indeed improves the speed of training.



## 3.2 Portability

Performance 4x GPU Greene: [insert here] img / s  
Copy sbatch script here.

## 3.3 Testing

Insert screenshot of vscode test explorer here