

# COMPARISON OF GPU AND CPU PERFORMANCE

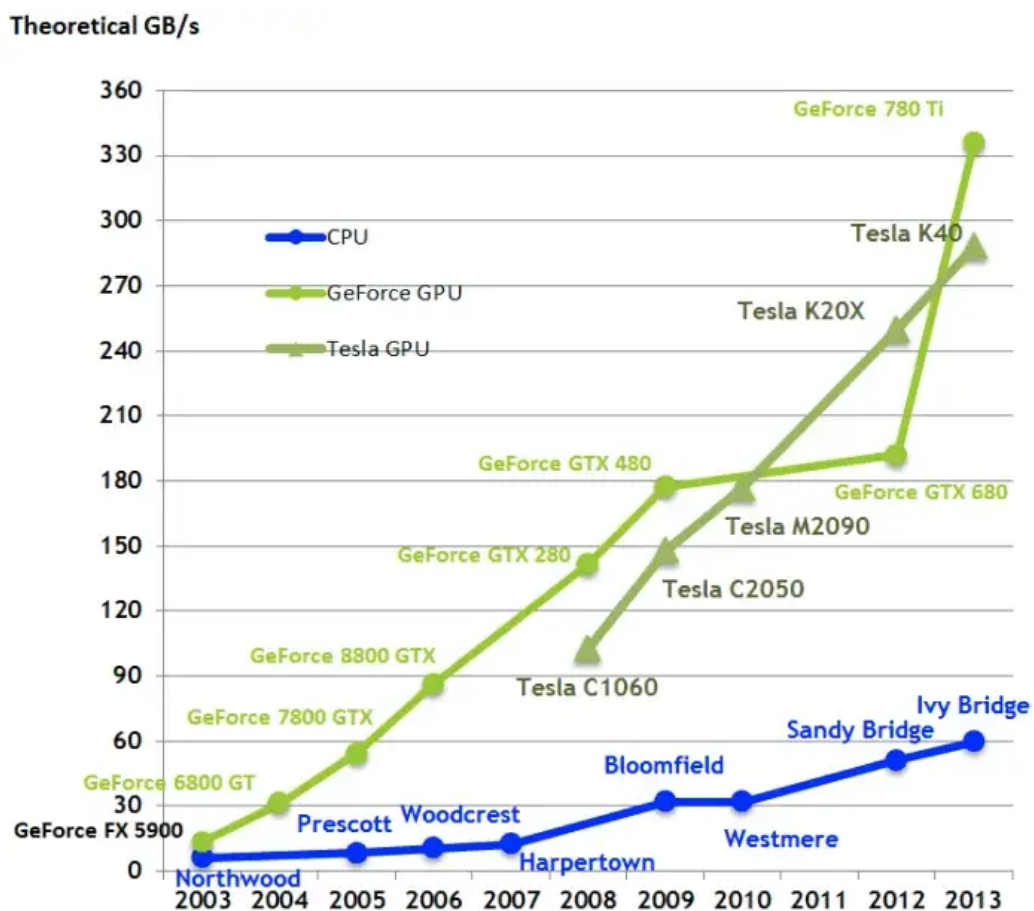
## CPU :

The CPU (Central Processing Unit) or the main processor executes computing instructions. Attached to the motherboard via a CPU socket, the CPU listens for input from a computer program or a peripheral such as a keyboard, mouse, or touchpad. It then interprets and processes the input and sends the resulting output to peripherals or stores it in the memory.

## GPU :

The GPU (Graphics Processing Unit) is a specialised graphics processor designed to be able to process thousands of operations simultaneously. Demanding 3D applications require parallel texture, mash, and light processing to keep images moving smoothly across the screen, and the CPU architecture is not optimised for those tasks. The original purpose of GPUs was to accelerate graphics rendering.

## GPU vs CPU Performance in DNN:



[Medium.com blog on gpu performance in machine learning]



```

Activities  Terminal  Wed 15:19
cse@openv: ~
Every 2.0s: nvidia-smi

Wed Oct 19 09:49:56 2022
+-----+
| NVIDIA-SMI 470.141.03   Driver Version: 470.141.03   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. |
|-----+-----+-----+
| 0  Tesla V100-PCIE...    Off      | 00000000:08:00:0 | Off           |
| N/A   35C    P0      24W / 250W   | 13MiB / 16100MiB | 0%          Default  |
+-----+-----+-----+

Processes:
+-----+
| GPU  GI    CI       PID  Type  Process name          GPU Memory |
| ID   ID   ID               |              | Usage       |
+-----+-----+
| 0    N/A   N/A      1858   G   /usr/lib/xorg/Xorg     4MiB      |
| 0    N/A   N/A     25912   G   /usr/lib/xorg/Xorg     4MiB      |
+-----+-----+

```

## GPU PERFORMANCE :

```

Activities  Terminal  Wed 15:23
cse@openv: ~/gpu
wandb: W&B syncing is set to 'offline' in this directory.
wandb: Run 'wandb online' or set WANDB_MODE=online to enable cloud syncing.
Epochs 0/5. Running Loss: 1.7979: 100%
Running Evaluation: 100%
Epochs 1/5. Running Loss: 0.9194: 100%
Running Evaluation: 100%
Epochs 2/5. Running Loss: 0.9343: 100%
Running Evaluation: 100%
Epochs 3/5. Running Loss: 0.6680: 100%
Running Evaluation: 100%
Epochs 4/5. Running Loss: 0.4023: 100%
Running Evaluation: 100%
Epoch 5 of 5: 100%
Running Evaluation: 100%
convert squad examples to features: 100%
add example index and unique id: 100%
Running Prediction: 100%
[['id': '0', 'answer': ['Mistborn', 'a Mistborn', 'Mistborn of great power and skill']]]
wandb: Waiting for W&B process to finish... (success).
wandb:
wandb: Run history:
wandb:   Training loss
wandb:   correct
wandb:   eval_loss
wandb:   global_step
wandb:   incorrect
wandb:   lr
wandb:   similar
wandb:   train_loss
wandb:
wandb: Run summary:
wandb:   Training loss 0.43352
wandb:   correct 494
wandb:   eval_loss -6.24609
wandb:   global_step 360
wandb:   incorrect 238
wandb:   lr 0.0
wandb:   similar 651
wandb:   train_loss 0.40232
wandb:
wandb: You can sync this run to the cloud by running:
wandb: wandb sync /home/cse/gpu/wandb/offline-run-20221019_095118-38t83s7c
wandb: Find logs at: ./wandb/offline-run-20221019_095118-38t83s7c/logs
cse@openv:~/gpu$

```

RUNTIME : 3 mins 21 sec

USAGE AND THERMALS:

GPU Memory	11628 Mib of 16160 Mib
GPU Power	138 W of 250 W
GPU Temperature	60 C

```

Wed Oct 19 09:52:23 2022
+-----+
| NVIDIA-SMI 470.141.03   Driver Version: 470.141.03   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-PCIE...    Off          | 00000000:08:00:0 | Off      |
| N/A   60C   P0   138W / 250W | 11628MiB / 16160MiB | 93%      | Default |
+-----+

Processes:
+-----+
| GPU  GI  CI       PID   Type   Process name          GPU Memory |
|   ID  ID  ID             |                 |       Usage   |
+-----+
| 0  N/A  N/A     1858    G   /usr/lib/xorg/Xorg      4MiB |
| 0  N/A  N/A     25912   G   /usr/lib/xorg/Xorg      4MiB |
| 0  N/A  N/A    789348   C   python3                11615MiB |
+-----+

```

## 2. IMAGE PROCESSING:

Image classification using deep neural networks in keras framework. The data set using is a classic cats vs dogs dataset.

## CPU PERFORMANCE:



```
Activities Terminal Wed 15:44 cse@openv: ~/gpu
File Edit View Search Terminal Help

(gpu) cse@openv:~/gpu$ python dogsvs cats.py
./train/dog.6153.jpg
cuda
100%| 625/625 [00:44<00:00, 14.15it/s]
100%| 157/157 [00:11<00:00, 13.58it/s]
saving best model with accuracy: 0.5054
100%| 625/625 [00:44<00:00, 14.02it/s]
100%| 157/157 [00:11<00:00, 13.98it/s]
100%| 625/625 [00:44<00:00, 14.15it/s]
100%| 157/157 [00:11<00:00, 13.82it/s]
100%| 625/625 [00:44<00:00, 14.07it/s]
100%| 157/157 [00:11<00:00, 14.20it/s]
100%| 625/625 [00:44<00:00, 14.02it/s]
100%| 157/157 [00:11<00:00, 14.26it/s]
100%| 625/625 [00:44<00:00, 14.10it/s]
100%| 157/157 [00:10<00:00, 14.35it/s]
100%| 625/625 [00:44<00:00, 14.12it/s]
100%| 157/157 [00:11<00:00, 13.85it/s]
100%| 625/625 [00:43<00:00, 14.46it/s]
100%| 157/157 [00:11<00:00, 13.88it/s]
100%| 625/625 [00:44<00:00, 13.91it/s]
100%| 157/157 [00:11<00:00, 14.04it/s]
100%| 625/625 [00:44<00:00, 14.00it/s]
100%| 157/157 [00:11<00:00, 14.02it/s]
100%| 157/157 [00:11<00:00, 14.12it/s]
/home/cse/gpu/lib/python3.8/site-packages/sklearn/metrics/_classification.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and be
ing set to 0.0 in labels with no predicted samples. Use 'zero_division' parameter to control this behavior.
_warn_prf(average, modifier, msg_start, len(result))
/home/cse/gpu/lib/python3.8/site-packages/sklearn/metrics/_classification.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and be
ing set to 0.0 in labels with no predicted samples. Use 'zero_division' parameter to control this behavior.
_warn_prf(average, modifier, msg_start, len(result))
/home/cse/gpu/lib/python3.8/site-packages/sklearn/metrics/_classification.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and be
ing set to 0.0 in labels with no predicted samples. Use 'zero_division' parameter to control this behavior.
_warn_prf(average, modifier, msg_start, len(result))
precision recall f1-score support
0.0 0.00 0.00 0.00 2527
1.0 0.49 1.00 0.66 2473

accuracy 0.49 5000
macro avg 0.25 0.50 0.33 5000
weighted avg 0.24 0.49 0.33 5000

(gpu) cse@openv:~/gpu$
```

RUNTIME : around 40 secs for a train epoch

## HTOP PERFORMANCE MEASURE:

```
Activities Terminal Wed 15:55 cse@openv: ~
File Edit View Search Terminal Help

1 [ 0.0%] 9 [ 3.9%] 17 [ 99.4%] 25 [ 99.4%]
2 [ 0.0%] 10 [ 1.9%] 18 [ 100.0%] 26 [ 100.0%]
3 [ 99.4%] 11 [ 100.0%] 19 [ 0.6%] 27 [ 0.6%]
4 [ 100.0%] 12 [ 99.4%] 20 [ 0.6%] 28 [ 0.0%]
5 [ 99.4%] 13 [ 10.8%] 21 [ 4.5%] 29 [ 100.0%]
6 [ 100.0%] 14 [ 0.7%] 22 [ 0.0%] 30 [ 99.4%]
7 [ 0.0%] 15 [ 1.9%] 23 [ 99.4%] 31 [ 99.4%]
8 [ 1.9%] 16 [ 1.9%] 24 [ 100.0%] 32 [ 100.0%]
Mem [ 3.96G/126G] Tasks: 168, 665 thr; 17 running
Swap [ 0K/8.00G] Load average: 15.24 13.42 8.89
Uptime: 26 days, 04:51:08

PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
871407 cse 20 0 11.4G 2191M 250M R 100.7 1.7 2h14:07 python dogsvs cats.py
910111 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:96 python dogsvs cats.py
910109 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:72 python dogsvs cats.py
910110 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:78 python dogsvs cats.py
871657 cse 20 0 11.4G 2191M 250M R 100.7 1.7 8:57:43 python dogsvs cats.py
910099 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:73 python dogsvs cats.py
910259 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:04:14 python dogsvs cats.py
910094 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:06:06 python dogsvs cats.py
910097 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:67 python dogsvs cats.py
871656 cse 20 0 11.4G 2191M 250M R 100.7 1.7 8:59:45 python dogsvs cats.py
910098 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:86 python dogsvs cats.py
910100 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:49 python dogsvs cats.py
910112 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:81 python dogsvs cats.py
910095 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:70 python dogsvs cats.py
910113 cse 20 0 11.4G 2191M 250M R 100.7 1.7 0:05:74 python dogsvs cats.py
910096 cse 20 0 11.4G 2191M 250M R 99.5 1.7 0:05:42 python dogsvs cats.py
909008 cse 20 0 8828 4936 3340 R 4.5 0.0 0:00:57 htop
26289 cse 20 0 8546M 223M 124M S 2.6 0.2 22:10:66 /usr/bin/gnome-shell
1485 syslog 20 0 219M 5764 3808 S 0.6 0.0 9:02:10 /usr/sbin/rsyslogd -n -iNONE
371715 root 20 0 2615M 52264 20640 S 0.0 0.0 1:00:24 /usr/lib/snapd/snapd
1592390 root 20 0 2615M 156M 37232 S 0.0 0.1 1h57:01 /snap/nextcloud/31751/bin/mysqld --defaults-file=/snap/nextcloud/31751/my.cnf --basedir
1592410 root 20 0 2615M 156M 37232 S 0.0 0.1 1h15:54 /snap/nextcloud/31751/bin/mysqld --defaults-file=/snap/nextcloud/31751/my.cnf --basedir
371768 root 20 0 3452M 52264 20640 S 0.0 0.0 0:01:69 /usr/lib/snapd/snapd
371741 root 20 0 3452M 52264 20640 S 0.0 0.0 0:04:67 /usr/lib/snapd/snapd
1592408 root 20 0 2615M 156M 37232 S 0.0 0.1 6:43:29 /snap/nextcloud/31751/bin/mysqld --defaults-file=/snap/nextcloud/31751/my.cnf --basedir
871717 cse 20 0 9719M 377M 31024 S 0.0 0.3 0:26:22 python dogsvs cats.py
846125 cse 20 0 6612 3408 2480 S 0.0 0.0 0:01:31 watch nvidia-smi
1591815 root 20 0 59844 5732 3936 S 0.0 0.0 26:21:64 redis-server unixsocket:/tmp/sockets/redis.sock
1478 root 20 0 82000 3740 3280 S 0.0 0.0 11:06:98 /usr/sbin/irqbalance --foreground
1899 rtkit 20 0 149M 3292 3028 S 0.0 0.0 0:23:52 /usr/libexec/rtkit-daemon

F1 Help F2 Setup F3 Search F4 Filter F5 Tree F6 Sort by F7 Lice F8 Lice F9 Kill F10 Quit
```

## USAGE AND THERMALS:

GPU Memory	11628 Mib of 16160 Mib
GPU Power	226 W of 250 W
GPU Temperature	64 C

```

cse@openv: ~
$ nvidia-smi
Wed Oct 19 09:52:54 2022
NVIDIA-SMI 470.141.03 Driver Version: 470.141.03 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.
-+-----+
0 Tesla V100-PCIE... Off 00000000:08:00:0 Off 0
N/A 64C P0 226W / 250W 11628M / 16160M 94% Default
N/A
-+-----+
Processes:
GPU GI CI PID Type Process name GPU Memory
ID ID ID Usage
-+-----+
0 N/A N/A 1858 G /usr/lib/xorg/Xorg 4M
0 N/A N/A 25912 G /usr/lib/xorg/Xorg 4M
0 N/A N/A 789348 C python3 11615M
-+-----+

```

## CONCLUSION

By comparing the performance of gpu and cpu for various deep learning tasks it is evident that gpu's provide significant performance levels compared to a cpu. The results show that a gpu can complete the training time way before a cpu in both text and image training.