Exploration of Neural Network Model using PyTorch on Graphics Processing Unit

19 DEC 2023

PyTorch Setup

Step 1

https://pytorch.org/get-started/locally/

PyTorch Setup

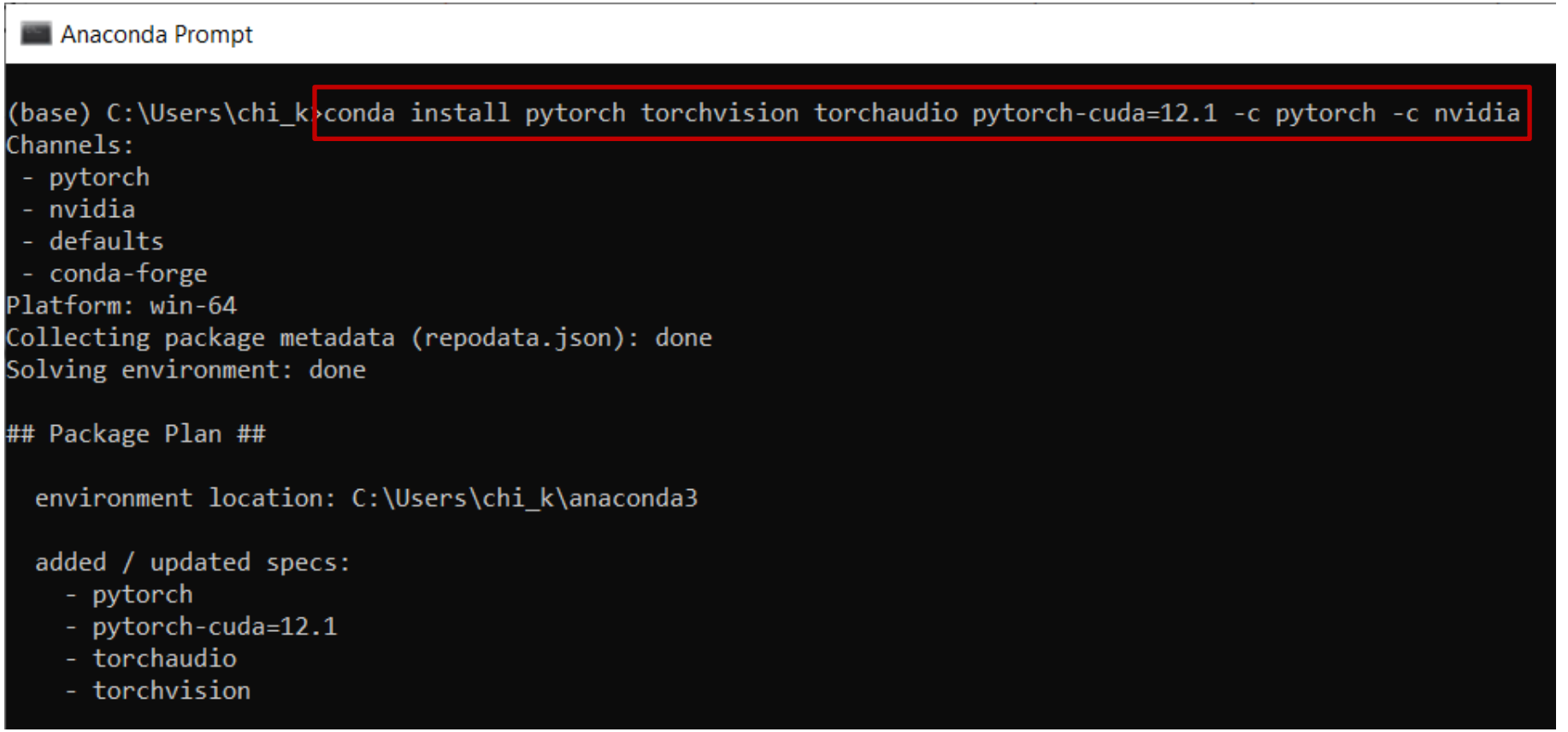
Step 2

NOTE: Latest PyTorch requires Python 3.8 or later.

PyTorch Build	Stable (2.1.1)		Preview (Nightly)	
Your OS	Linux	Mac	Windows	
Package	Conda	Pip	LibTorch	Source
Language	Python		C++ / Java	
Compute Platform	CUDA 11.8	CUDA 12.1	~~ROCm 5.6~~	CPU
Run this Command:	`conda install pytorch torchvision torchaudio pytorch-cuda=12.1 -c pytorch -c nvidia`			

PyTorch Setup

Step 3



PyTorch Setup

Step 4

Success if you can get this

[1]:
```
import torch

print('GPU device available for use: ', torch.cuda.is_available())
print()

print('Number of GPU devices: ', torch.cuda.device_count())
print()

print('GPU device number: ', torch.cuda.current_device())
print()

print('Model of GPU device: ', torch.cuda.get_device_name(torch.cuda.current_device()))
print()
```

```
GPU device available for use:  True

Number of GPU devices:  1

GPU device number:  0

Model of GPU device:  NVIDIA GeForce GTX 1660 Ti
```

Dataframe and Tensor

From Pandas dataframe to PyTorch tensor

```
[3]: df_dataframe
```

[3]:

	col_X1	col_X2	col_y
0	1	2	10
1	2	4	20
2	3	6	30
3	4	8	40
4	5	10	50

```
[4]: type(df_dataframe)
```

```
[4]: pandas.core.frame.DataFrame
```

```
[12]: X
```

```
[12]: tensor([[ 1.,  2.],
              [ 2.,  4.],
              [ 3.,  6.],
              [ 4.,  8.],
              [ 5., 10.]])
```

```
[13]: type(X)
```

```
[13]: torch.Tensor
```

```
[14]: X.dtype
```

```
[14]: torch.float32
```

Push Tensor and Model to GPU

To train NN model in GPU, tensor and NN model must be pushed to GPU before training

Step 6: Set up GPU

[10]:
```
if torch.cuda.is_available():
    device = torch.device("cuda:0")
    print("Running on the GPU")
else:
    device = torch.device("cpu")
    print("Running on the CPU")
```

```
Running on the GPU
```

Step 7: Push to GPU

[11]:
```
X = X.to(device)
y = y.to(device)
```

[12]:
```
X[:5]
```

[12]:
```
tensor([[6.0000e+00, 1.4800e+02, 7.2000e+01, 3.5000e+01, 0.0000e+00, 3.3600e+01,
         6.2700e-01, 5.0000e+01],
        [1.0000e+00, 8.5000e+01, 6.6000e+01, 2.9000e+01, 0.0000e+00, 2.6600e+01,
         3.5100e-01, 3.1000e+01],
        [8.0000e+00, 1.8300e+02, 6.4000e+01, 0.0000e+00, 0.0000e+00, 2.3300e+01,
         6.7200e-01, 3.2000e+01],
        [1.0000e+00, 8.9000e+01, 6.6000e+01, 2.3000e+01, 9.4000e+01, 2.8100e+01,
         1.6700e-01, 2.1000e+01],
        [0.0000e+00, 1.3700e+02, 4.0000e+01, 3.5000e+01, 1.6800e+02, 4.3100e+01,
         2.2880e+00, 3.3000e+01]], device='cuda:0')
```

Step 10: Set up model and push to GPU

[19]:
```
# Hidden layer
#    Multi-Layer Perceptron = ReLU
#    Convolutional Neural Network = ReLU
#    Recurrent Neural Network = Sigmoid or Tanh

# Output layer
#    Regression = Linear
#    Binary = Sigmoid
#    Multi-class = Softmax
#    Multi-label = Sigmoid

model = nn.Sequential(
    nn.Linear(8, 12),
    nn.ReLU(),
    nn.Linear(12, 8),
    nn.ReLU(),
    nn.Linear(8, 1),
    nn.Sigmoid()
).to(device)
print(model)
```

```
Sequential(
  (0): Linear(in_features=8, out_features=12, bias=True)
  (1): ReLU()
  (2): Linear(in_features=12, out_features=8, bias=True)
  (3): ReLU()
  (4): Linear(in_features=8, out_features=1, bias=True)
  (5): Sigmoid()
)
```

[20]:
```
next(model.parameters()).is_cuda
```

[20]:
```
True
```

Context

I want to know if GPU can train NN model faster than GPU

Computational Load on GPU and CPU

Size of tensor

Number of hidden layers (tensor operations)

Number of nodes (tensor operations)

Experimental Controls for Study

Random seeds for random numbers and PyTorch algorithms were fixed.

Epoch count and batch size were fixed.

Learning rate, optimizer (method to minimise error amount), and loss function (function to calculate the error amount) were fixed.

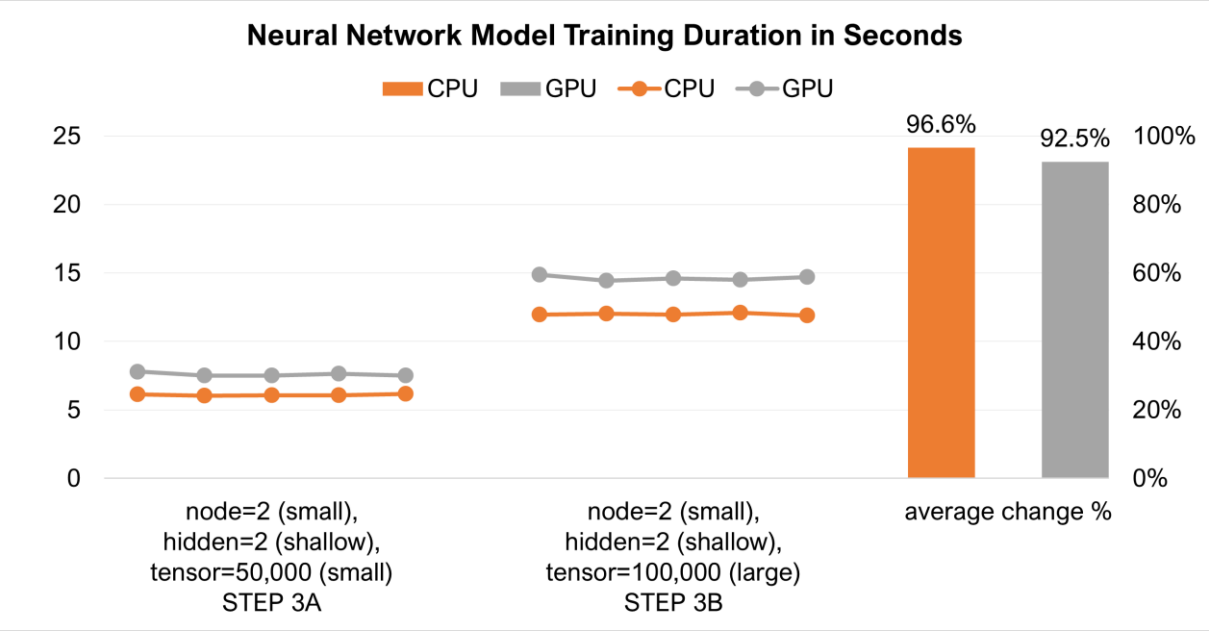
Power supply to laptop was switched on.

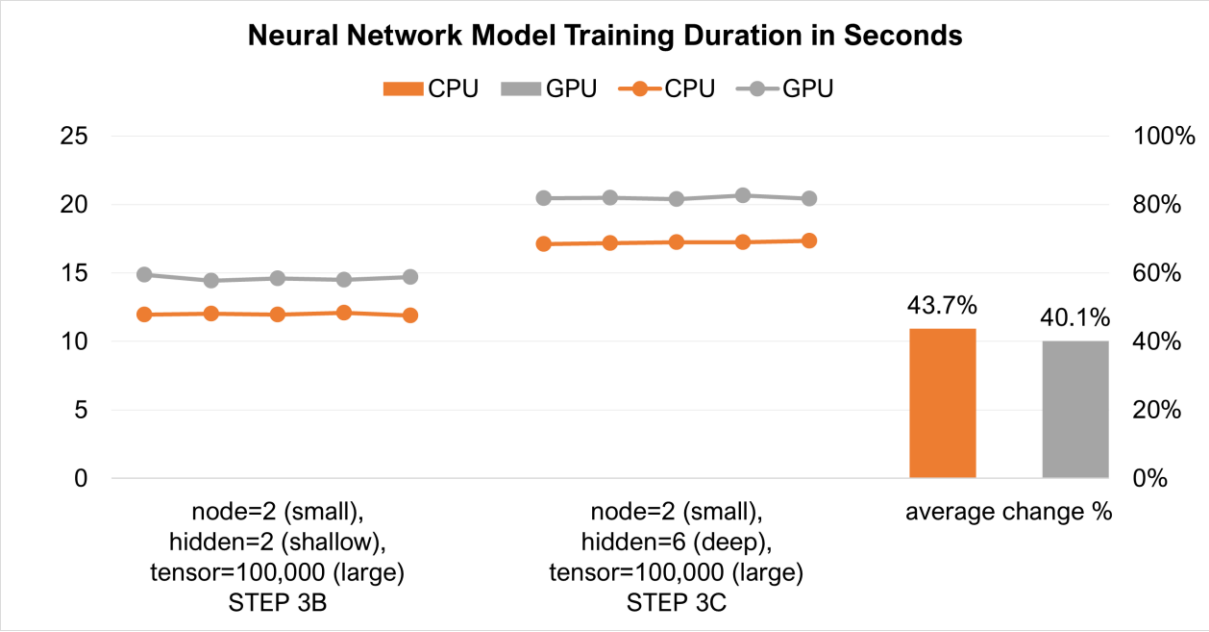
Before every run of the Python codes in the jupyter notebook, the kernel was re-started and the outputs were cleared.

While running the Python codes, no other programmes were accessed.

Result

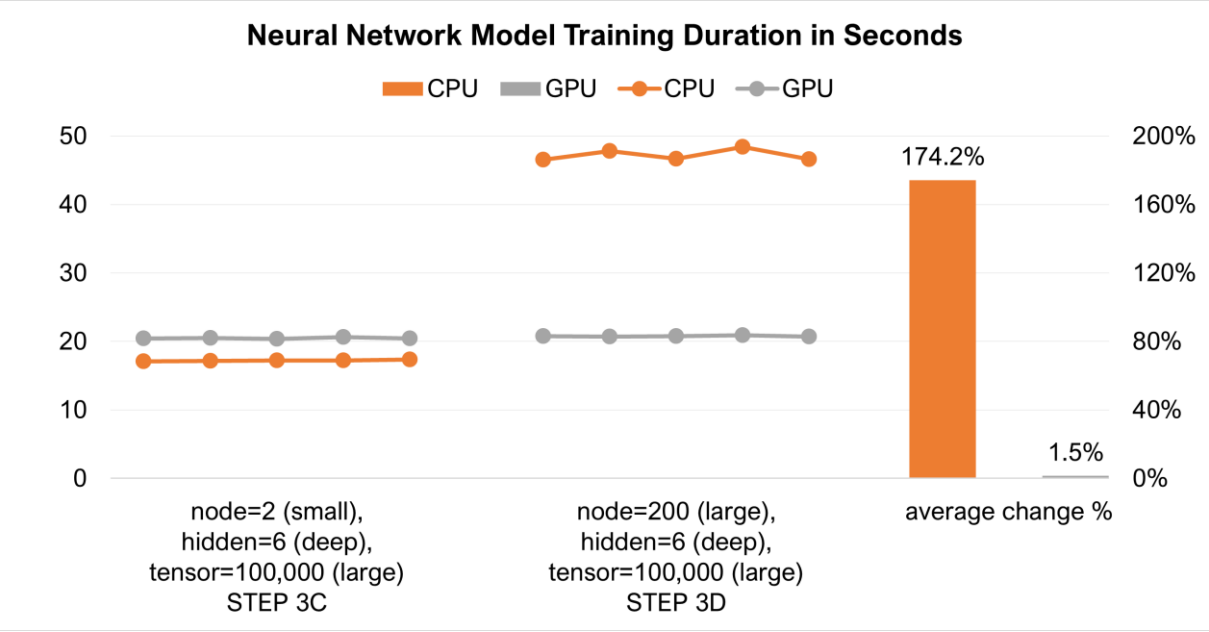
Difference in training duration change due to tensor size alone and hidden layers alone **NOT** significant

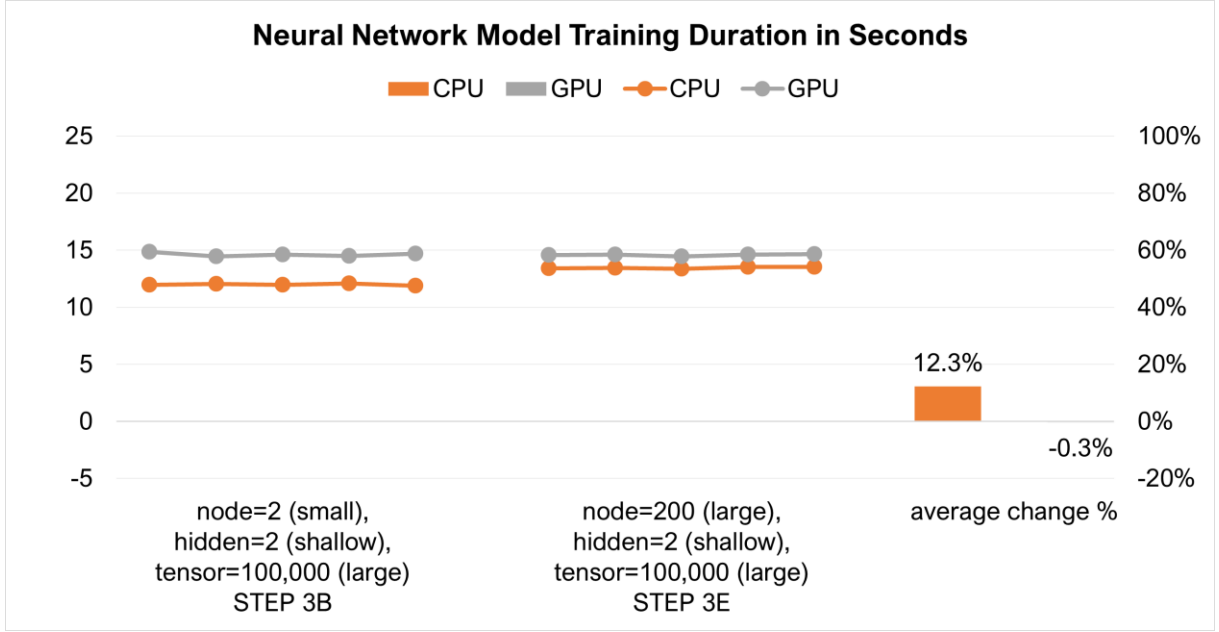




Result

Difference in training duration change due to interaction between node size and hidden layers **IS** significant





Conclusion

Deep NN models (many hidden layers) with high node count can be trained faster on GPU compared to on CPU

The End

Hope you find this useful

Visit my GitHub for the codes

https://github.com/johnwck/my_da_ds_work/tree/master/my_projects_github_pages/pytorch_neural_network_model_on_gpu