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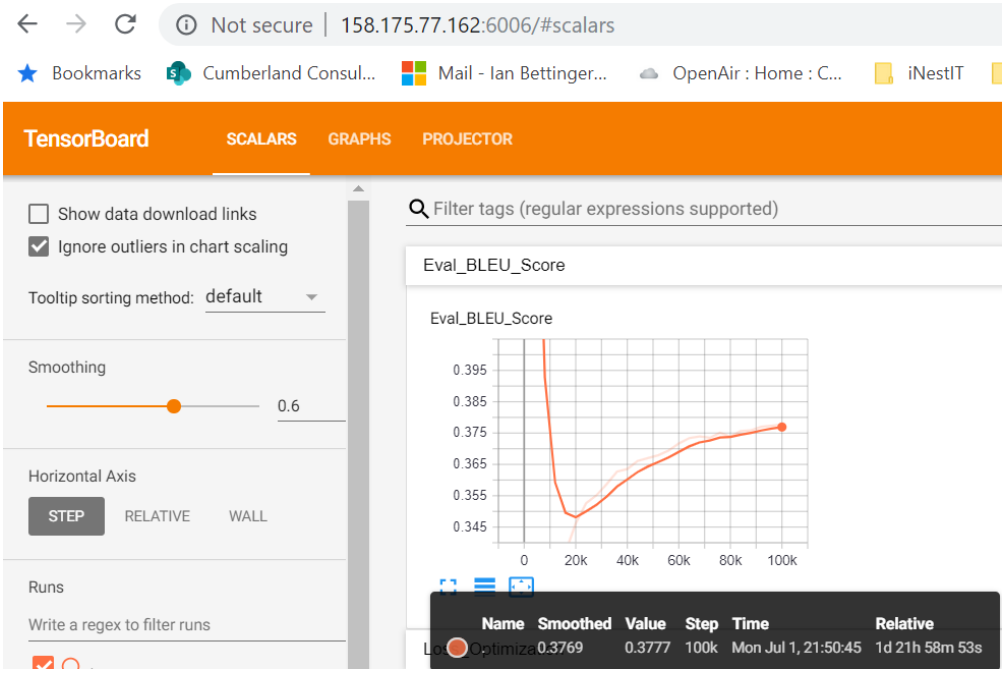
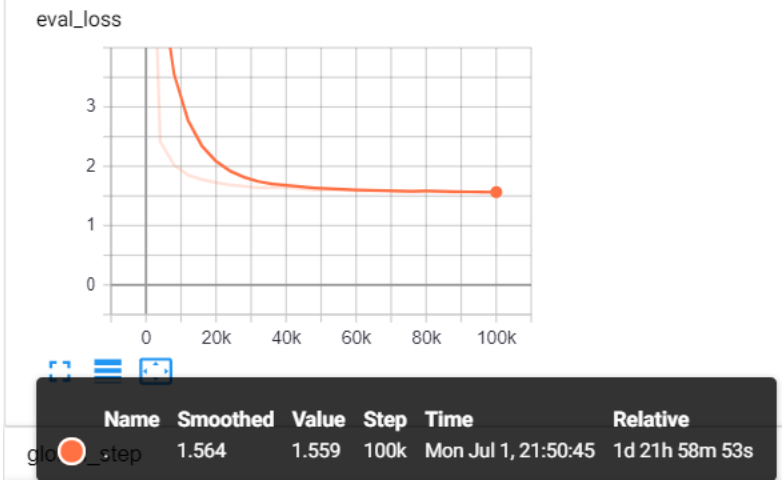
HW 9 – July 1, 2019

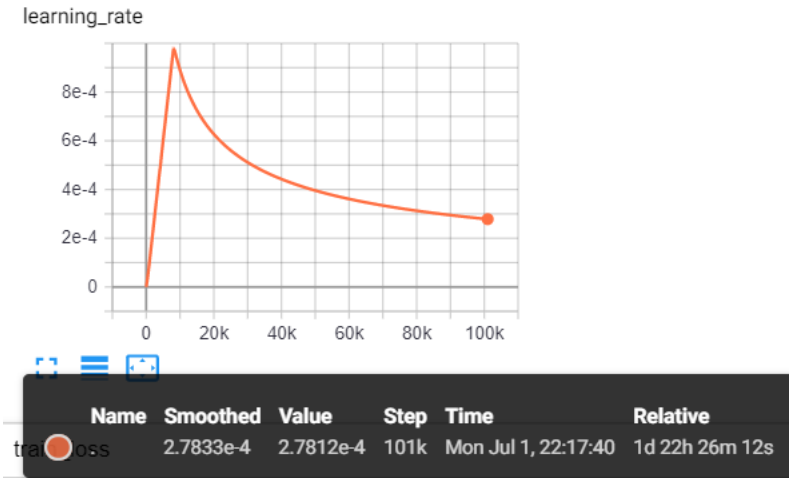
1. Bleu Score



2. Eval Loss



3. Learning Rate



* How long does it take to complete the training run? (hint: this session is on distributed training, so it *will* take a while)

It took 47 hours.

* Do you think your model is fully trained? How can you tell?

Not yet. The BLEU score is still slowly increasing. As well, the Eval Loss and Learning Rate are still slowly decreasing. When they flatline, then it will be fully trained. However they are both moving at a very slow rate.

* Were you overfitting?

Early on, it was overfitting, but now it doesn't appear to be. For example at step 10K, the Train loss was less than the Eval Loss. At step 100K, they are approximately matched at 1.6.

* Were your GPUs fully utilized?

Yes.

Sample screenshots from each V100

V100B

```
  main()
root@v100b:/opt/OpenSeq2Seq#  vi run.py
root@v100b:/opt/OpenSeq2Seq# nvidia -smi
bash: nvidia: command not found
root@v100b:/opt/OpenSeq2Seq# nvidia-smi
Sun Jun 30 07:08:28 2019
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.67       Driver Version: 418.67       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| 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  | 00000000:00:07.0 Off |                    0 |
| N/A   37C    P0    41W / 250W |  15424MiB / 16130MiB |    100%      Default |
+-------------------------------+----------------------+----------------------+
|   1  Tesla V100-PCIE...  Off  | 00000000:00:08.0 Off |                    0 |
| N/A   37C    P0    41W / 250W |  15424MiB / 16130MiB |    100%      Default |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
+-----------------------------------------------------------------------------+
```

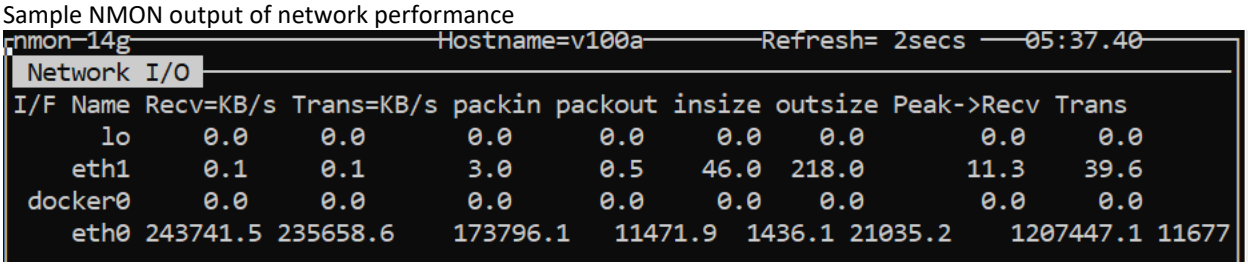
V100A

```
*** System restart required ***
Last login: Sun Jun 30 06:51:53 2019 from 198.27.174.17
root@v100a:~# nvidia-smi
Sun Jun 30 07:10:08 2019
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.67       Driver Version: 418.67       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| 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  | 00000000:00:07.0 Off |                    0 |
| N/A   36C    P0    42W / 250W |  15422MiB / 16130MiB |    100%      Default |
+-------------------------------+----------------------+----------------------+
|   1  Tesla V100-PCIE...  Off  | 00000000:00:08.0 Off |                    0 |
| N/A   37C    P0    43W / 250W |  15424MiB / 16130MiB |    100%      Default |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
|    0     49027      C   python                                    15409MiB |
|    1     49028      C   python                                    15409MiB |
+-----------------------------------------------------------------------------+
root@v100a:~#
```

* Did you monitor network traffic (hint: ```apt install nmon ```) ? Was network the bottleneck?

Sample NMON output of network performance

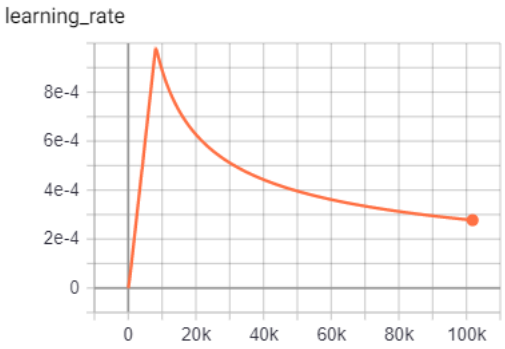


The transmission is very high – over 2GB's/s. Much higher than the promised 1GB network bandwidth. I assume network is the bottleneck because any calculations done by a GPU or CPU would be done at a much higher rate and it would be consolidation of the data via the network that would be the slowest point.

* Take a look at the plot of the learning rate and then check the config file. Can you explan this setting?

Config File snippet

```
"lr_policy": transformer_policy,
"lr_policy_params": {
  "learning_rate": 2.0,
  "warmup_steps": 8000,
  "d_model": d_model,
},
```



Appears the learning rate has a warmup of 8000 steps, so it's clear why they rate dramatically shifts at 8,000.

The learning rate policy is specified in the code for transformer_policy and is detailed here

```
def transformer_policy(global_step, learning_rate, d_model, warmup_steps,
                       max_lr=None, coefficient=1.0, dtype=tf.float32):
  """Transformer's learning rate policy from
  https://arxiv.org/pdf/1706.03762.pdf
  with a hat (max_lr) (also called "noam" learning rate decay scheme).

  Args:
    global_step: global step TensorFlow tensor (ignored for this policy).
    learning_rate (float): initial learning rate to use.
    d_model (int): model dimensionality.
    warmup_steps (int): number of warm-up steps.
    max_lr (float): maximal learning rate, i.e. hat.
    coefficient (float): optimizer adjustment.
        Recommended 0.002 if using "Adam" else 1.0.
    dtype: dtype for this policy.

  Returns:
    learning rate at step ``global_step``.
  """
  step_num = tf.cast(global_step, dtype=dtype)
  ws = tf.cast(warmup_steps, dtype=dtype)

  decay = coefficient * d_model ** -0.5 * tf.minimum(
      (step_num + 1) * ws ** -1.5, (step_num + 1) ** -0.5
  )

  new_lr = decay * learning_rate
```

* How big was your training set (mb)? How many training lines did it contain?

958Mb

```
-rw-r--r-- 1 root root  958585615 Jun 30 06:06 train.clean.en.shuffled.BPE_common.32K.tok
```

* What are the files that a TF checkpoint is comprised of?

- The data
- An index file
- A Meta file

```
val_loss=1.5589-step-100026.data-00000-of-00001
val_loss=1.5589-step-100026.index
val_loss=1.5589-step-100026.meta
```

* How big is your resulting model checkpoint (mb)?

852,267,044
About 850 MB

* Remember the definition of a "step". How long did an average step take?

About 1.69 seconds

* How does that correlate with the observed network utilization between nodes?

850MB for model size

Given ~2,200,000 bytes/second in network traffic
47 hours = 169,200 seconds
This equals about 364,320,000,000 or 372 MB.

Maybe it's doubled since there are 2 nodes doing the work so this is about 740MB which is about equal to the model size. Not sure if the math is right on this.