CSCI-GA.3033-022 Lab2

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C1: see code.

C2: The results are attached below, running on Prince with the following configurations.

Configuration:
SBATCH --nodes=1
#SBATCH --ntasks-per-node=1
#SBATCH --cpus-per-task=2

#SBATCH --time=5:00:00
#SBATCH --mem=8GB
#SBATCH --job-name=visionExperiment
#SBATCH --mail-type=END
#SBATCH --mail-user=yl5090@nyu.edu
#SBATCH --output=slurm_%j.out

Results:

This is epoch0
Waiting time : 336.9140309970826 secs
Compute time : 54.10260959342122 secs
Epoch time : 391.02214116603136 secs

This is epoch1
Waiting time : 336.83822311321273 secs
Compute time : 54.28430272685364 secs
Epoch time : 391.12363370414823 secs

This is epoch2
Waiting time : 410.20431612664834 secs
Compute time : 52.16937217442319 secs
Epoch time : 462.37474297266454 secs

This is epoch3
Waiting time : 325.32706746831536 secs
Compute time : 53.89947357773781 secs
Epoch time : 379.22757972497493 secs

This is epoch4
Waiting time : 354.654990457464 secs

Compute time : 53.163443291559815 secs
Epoch time : 407.8195492569357 secs

C3

Results attached below for number of workers increasing from 2 to 36. The number of workers are highlighted in yellow.

Conclusion: 24 workers are good enough for best performance. When keep increasing the number, time will increase as a result for overhead.

Number of workers 2
This is epoch0
Waiting time : 882.0130517631769 secs
Compute time : 41.19710404379293 secs
Epoch time : 923.2111178715713 secs
Number of workers 2
This is epoch1
Waiting time : 230.8063620813191 secs
Compute time : 58.58630386227742 secs
Epoch time : 289.39349669823423 secs
Number of workers 2
This is epoch2
Waiting time : 156.1685389955528 secs
Compute time : 58.57784634409472 secs
Epoch time : 214.74724402232096 secs
Number of workers 2
This is epoch3
Waiting time : 99.78026999067515 secs
Compute time : 53.93105484591797 secs
Epoch time : 153.71213587978855 secs
Number of workers 2
This is epoch4
Waiting time : 94.68459060648456 secs
Compute time : 53.876126632560045 secs
Epoch time : 148.56157326931134 secs

Number of workers 4
This is epoch0
Waiting time : 488.4206365956925 secs
Compute time : 40.39304074505344 secs
Epoch time : 528.8290420160629 secs
Number of workers 4
This is epoch1
Waiting time : 362.29514878755435 secs

Compute time : 44.0019585066475 secs
Epoch time : 406.31459263386205 secs
Number of workers 4
This is epoch2
Waiting time : 133.1883670105599 secs
Compute time : 63.603955023456365 secs
Epoch time : 196.79318878008053 secs
Number of workers 4
This is epoch3
Waiting time : 64.11337553802878 secs
Compute time : 59.638811827171594 secs
Epoch time : 123.76853013876826 secs
Number of workers 4
This is epoch4
Waiting time : 84.48716916656122 secs
Compute time : 59.36896401224658 secs
Epoch time : 143.85697863111272 secs

Number of workers 8
This is epoch0
Waiting time : 221.5496346335858 secs
Compute time : 59.350017393473536 secs
Epoch time : 280.9302802509628 secs
Number of workers 8
This is epoch1
Waiting time : 236.1803433895111 secs
Compute time : 59.63246555952355 secs
Epoch time : 295.83406716398895 secs
Number of workers 8
This is epoch2
Waiting time : 195.24518889840692 secs
Compute time : 63.121997143141925 secs
Epoch time : 258.39306045509875 secs
Number of workers 8
This is epoch3
Waiting time : 79.61109937960282 secs
Compute time : 85.9637725604698 secs
Epoch time : 165.59509752923623 secs
Number of workers 8
This is epoch4
Waiting time : 34.63451681099832 secs
Compute time : 96.25817398680374 secs
Epoch time : 130.92280558682978 secs

Number of workers 12
This is epoch0
Waiting time : 136.91606784192845 secs

Compute time : 62.61137820687145 secs
Epoch time : 199.53897623997182 secs
Number of workers 12
This is epoch1
Waiting time : 144.64400974055752 secs
Compute time : 62.116847429424524 secs
Epoch time : 206.77475334331393 secs
Number of workers 12
This is epoch2
Waiting time : 145.81470367126167 secs
Compute time : 61.74969713110477 secs
Epoch time : 207.5875221658498 secs
Number of workers 12
This is epoch3
Waiting time : 125.43090993724763 secs
Compute time : 67.15218567987904 secs
Epoch time : 192.58403025567532 secs
Number of workers 12
This is epoch4
Waiting time : 40.829161829315126 secs
Compute time : 89.94084487250075 secs
Epoch time : 130.77954472601414 secs

Number of workers 16
This is epoch0
Waiting time : 87.29225396970287 secs
Compute time : 71.0953484843485 secs
Epoch time : 158.39014262193814 secs
Number of workers 16
This is epoch1
Waiting time : 97.09684382472187 secs
Compute time : 69.41041457932442 secs
Epoch time : 166.54953348403797 secs
Number of workers 16
This is epoch2
Waiting time : 97.71101761329919 secs
Compute time : 71.12606338458136 secs
Epoch time : 168.85628614295274 secs
Number of workers 16
This is epoch3
Waiting time : 99.2604484972544 secs
Compute time : 70.05790488934144 secs
Epoch time : 169.35556225292385 secs
Number of workers 16
This is epoch4
Waiting time : 65.12115315487608 secs
Compute time : 86.30250580888242 secs

Epoch time : 151.4342846996151 secs

Number of workers 20
This is epoch0
Waiting time : 48.72505577048287 secs
Compute time : 86.67115376517177 secs
Epoch time : 135.41895600687712 secs
Number of workers 20
This is epoch1
Waiting time : 47.64103918103501 secs
Compute time : 86.47278310731053 secs
Epoch time : 134.1328736450523 secs
Number of workers 20
This is epoch2
Waiting time : 54.87268427526578 secs
Compute time : 86.46804299438372 secs
Epoch time : 141.34192721918225 secs
Number of workers 20
This is epoch3
Waiting time : 52.76160594262183 secs
Compute time : 90.13946936186403 secs
Epoch time : 142.91701677488163 secs
Number of workers 20
This is epoch4
Waiting time : 61.76518695149571 secs
Compute time : 85.60888508101925 secs
Epoch time : 147.4086578860879 secs

Number of workers 24
This is epoch0
Waiting time : 22.200478611979634 secs
Compute time : 115.45384214678779 secs
Epoch time : 137.7766142738983 secs
Number of workers 24
This is epoch1
Waiting time : 29.202822398860008 secs
Compute time : 110.49803918320686 secs
Epoch time : 139.70463202893734 secs
Number of workers 24
This is epoch2
Waiting time : 24.543701133690774 secs
Compute time : 133.25577826518565 secs
Epoch time : 157.8038281989284 secs
Number of workers 24
This is epoch3
Waiting time : 21.01554827950895 secs
Compute time : 109.97429646225646 secs

Epoch time : 131.11497587384656 secs
Number of workers 24
This is epoch4
Waiting time : 23.554985066875815 secs
Compute time : 122.37106967531145 secs
Epoch time : 145.92886216612533 secs

Number of workers 28
This is epoch0
Waiting time : 30.874863754492253 secs
Compute time : 103.09353293478489 secs
Epoch time : 134.33042321167886 secs
Number of workers 28
This is epoch1
Waiting time : 29.79168302938342 secs
Compute time : 116.15462890081108 secs
Epoch time : 146.09767881780863 secs
Number of workers 28
This is epoch2
Waiting time : 33.30633915076032 secs
Compute time : 129.3982645822689 secs
Epoch time : 162.70802652230486 secs
Number of workers 28
This is epoch3
Waiting time : 26.12819259800017 secs
Compute time : 112.73142029065639 secs
Epoch time : 138.86907289503142 secs
Number of workers 28
This is epoch4
Waiting time : 28.050842970144004 secs
Compute time : 97.9057036889717 secs
Epoch time : 126.05704603111371 secs

Number of workers 32
This is epoch0
Waiting time : 44.894418311305344 secs
Compute time : 93.77032909216359 secs
Epoch time : 138.6703636967577 secs
Number of workers 32
This is epoch1
Waiting time : 57.410582568496466 secs
Compute time : 83.84722373494878 secs
Epoch time : 141.2683215388097 secs
Number of workers 32
This is epoch2
Waiting time : 63.033128838054836 secs
Compute time : 84.5371521548368 secs

Epoch time : 147.60237356368452 secs
Number of workers 32
This is epoch3
Waiting time : 57.19432642683387 secs
Compute time : 89.62054473115131 secs
Epoch time : 146.87662029778585 secs
Number of workers 32
This is epoch4
Waiting time : 68.17093027662486 secs
Compute time : 79.65672725159675 secs
Epoch time : 147.82872012909502 secs

Number of workers 36
This is epoch0
Waiting time : 41.244972974061966 secs
Compute time : 93.70879061240703 secs
Epoch time : 134.95658881682903 secs
Number of workers 36
This is epoch1
Waiting time : 45.59600055310875 secs
Compute time : 89.94007909670472 secs
Epoch time : 135.55688986182213 secs
Number of workers 36
This is epoch2
Waiting time : 53.780724117998034 secs
Compute time : 86.11133345169947 secs
Epoch time : 139.89328769827262 secs
Number of workers 36
This is epoch3
Waiting time : 55.74623293010518 secs
Compute time : 87.33781108446419 secs
Epoch time : 143.09557427093387 secs
Number of workers 36
This is epoch4
Waiting time : 47.86419050535187 secs
Compute time : 93.25864457711577 secs
Epoch time : 141.1514574722387 secs

C4

Difference:

- Increasing the number of workers significantly reduced the time for data loading. For example, compared to number of workers = 1, for number of workers = 24 the top activities are no longer data loading but “autograd” and “backward”. See the following log.

Results for workers = 1, top 10 longest function calls

```
Sun Oct 28 16:43:14 2018    lab2_profiled_1.prof

         2114953 function calls (2086394 primitive calls) in 4125.757 seconds

   Ordered by: cumulative time
   List reduced from 6444 to 10 due to restriction <10>

   ncalls  tottime  percall  cumtime  percall filename:lineno(function)
   1296/1    0.055    0.000 4125.760 4125.760 {built-in method builtins.exec}
        1    0.001    0.001 4125.760 4125.760 lab2.py:7(<module>)
        1    0.404    0.404 4123.104 4123.104 lab2.py:168(main)
      605    0.006    0.000 3912.388    6.467 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/utils/data/dataloader.py:311(__next__)
      600    0.002    0.000 3912.260    6.520 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/utils/data/dataloader.py:302(_get_batch)
      600    0.007    0.000 3912.257    6.520 /home/yl5090/.conda/envs/nlp/lib/python3.6/multiprocessing/queues.py:340(get)
     4200    0.012    0.000 3911.653    0.931 /home/yl5090/.conda/envs/nlp/lib/python3.6/multiprocessing/connection.py:208(recv_bytes)
     4200    0.015    0.000 3911.637    0.931 /home/yl5090/.conda/envs/nlp/lib/python3.6/multiprocessing/connection.py:406(_recv_bytes)
     8400    0.032    0.000 3911.615    0.466 /home/yl5090/.conda/envs/nlp/lib/python3.6/multiprocessing/connection.py:374(_recv)
     8402 3911.576    0.466 3911.576    0.466 {built-in method posix.read}
```

Results for workers = 24, top 10 longest function calls

```
Sun Oct 28 16:43:15 2018    lab2_profiled_24.prof

         2159362 function calls (2130803 primitive calls) in 836.401 seconds

   Ordered by: cumulative time
   List reduced from 6444 to 10 due to restriction <10>

   ncalls  tottime  percall  cumtime  percall filename:lineno(function)
   1296/1    0.056    0.000  836.403  836.403 {built-in method builtins.exec}
        1    0.008    0.008  836.400  836.400 lab2.py:7(<module>)
        1    0.681    0.681  833.915  833.915 lab2.py:168(main)
      600    0.058    0.000  356.320    0.594 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/tensor.py:65(backward)
      600    0.024    0.000  356.263    0.594 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/autograd/__init__.py:38(backward)
      600  355.907    0.593  355.907    0.593 {method 'run_backward' of 'torch._C._EngineBase' objects}
10800/1200    0.460    0.000  312.381    0.260 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/nn/modules/module.py:471(__call__)
      600    0.060    0.000  311.938    0.520 lab2.py:103(forward)
```

2400 0.283 0.000 311.810 0.130 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/nn/modules/container.py:89(forward)
1200 0.026 0.000 179.078 0.149 /home/yl5090/.conda/envs/nlp/lib/python3.6/site-packages/torch/nn/modules/conv.py:299(forward)

C5

1) Average epoch time for number of workers = 1 and optimizer = SGD. Batch size = 150 to fit in memory on Prince for GPU. For CPU the batch size is 250.

Epoch	CPU	GPU
0	391.02	436.51
1	391.12	399.69
2	462.37	421.83
3	379.23	829.06
4	407.82	593.26
Mean	406.31	536.07

2) As below: Batch size = 150 to fit in memory on Prince.

Optimization	Mean epoch time (seconds)	Mean loss	Mean precision@1	Mean precision@3
Adadelta	92.05	0.29	0.92	0.62
Adagrad	88.04	0.21	0.94	0.67
Adam	85.35	0.24	0.93	0.65
SGD	85.39	0.26	0.93	0.64
sgd-nesterov	88.04	0.26	0.93	0.64