Building GPU-enabled Kubernetes single node cluster for MLOps experiments with new+second hand components

1. **SUPERMICRO MBD-X11SAE-M-O Micro ATX Server Motherboard LGA 1151 Intel C236** from newegg.com - $200 (Link to Newegg)

2. **Intel Xeon E3-1275 V6 Kaby Lake 3.8 GHz (4.2 GHz Turbo) LGA 1151 Server Processor Intel HD Graphics P630** - $360 (Link to Newegg)

3. 64GB of RAM: four DIMMs of **16GB DDR4-2400 UDIMM 1.2V CL17 (SKU: CT16G4DFD824A)** from Crucial: $250 (Link to Crucial)

4. **Sabrent Rocket Q 1TB NVMe PCIe M.2 2280 Internal SSD High Performance Solid State Drive R/W 3200/2000MB/s (SB-RKTQ-1TB)**: $110 (Link to Amazon)

5. **Supermicro SNK-P0046A4 Heatsink 2U+ Active Heatsink LGA1156 & LGA1155**: $25 (Link to Supermicro store)

6. **Nvidia Tesla M40 12GB** (Second hand): $125(Link to Ebay)

7. Dual 8 to 8 Graphics Power Cable (SKU: 030-0571-000): $6 (Link to Ebay)

Really old components:

8. HDD and SSD: Western Digital HDD 250GB SATA3 6.0Gb/s 7.2K (Used): $0, SSD 120 GB SATA3 6.0 Gb/s 2.5” (Used): $0, SSD 120 GB SATA3 6.0 Gb/s 2.5” (Used): $0

9. SuperMicro Chassis 733I-500B with 500W PSU (Used): $0 (Link to SuperMicro)

Final configuration: 1 x Xeon E3-1275, 64GB RAM, 1.5TB storage with 1TB on NVMe, NVIDIA GPU (Maxwell architecture) with 12GB GDDR5 for **total: $1076.0 (Ouch!)**

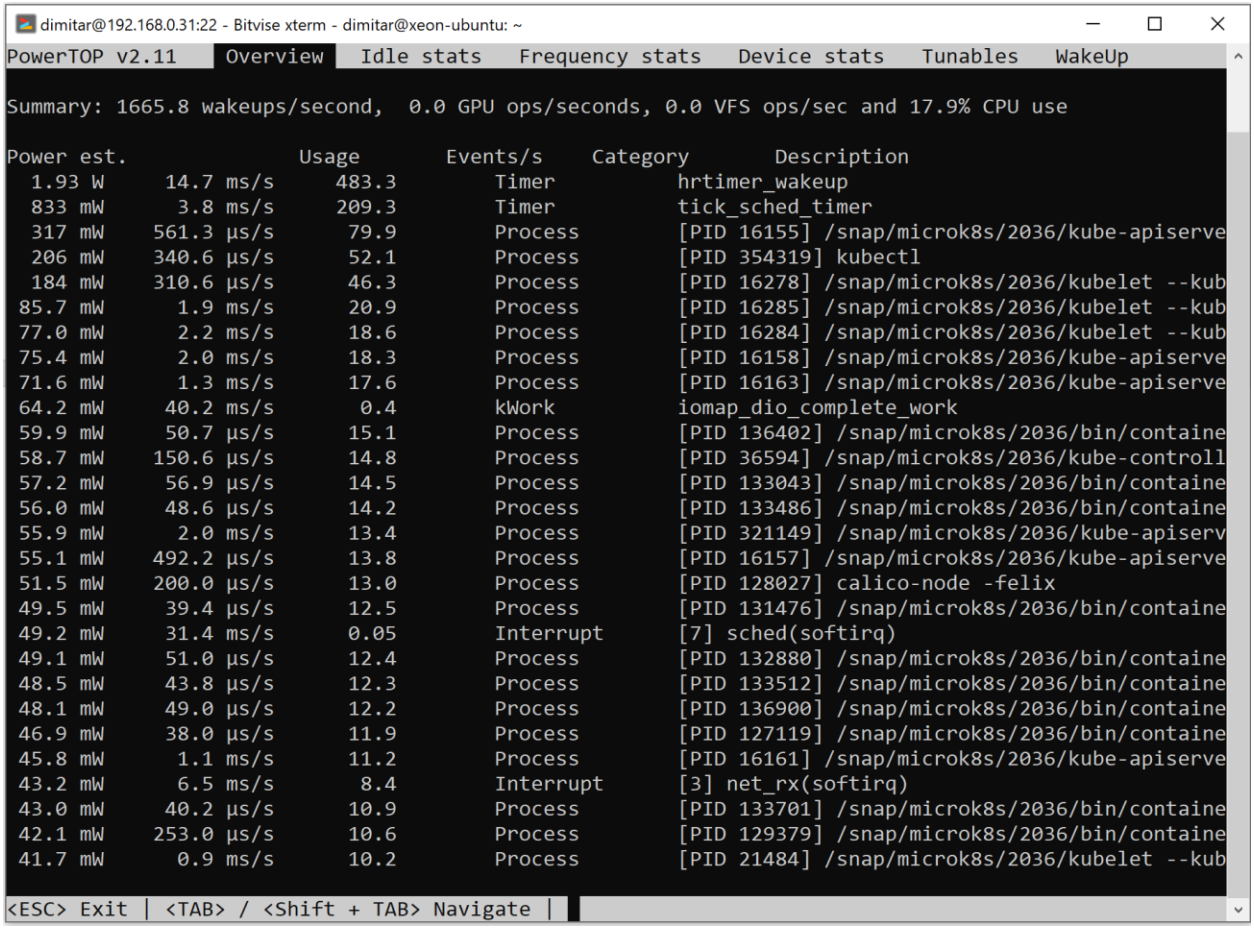
Additional Notes:

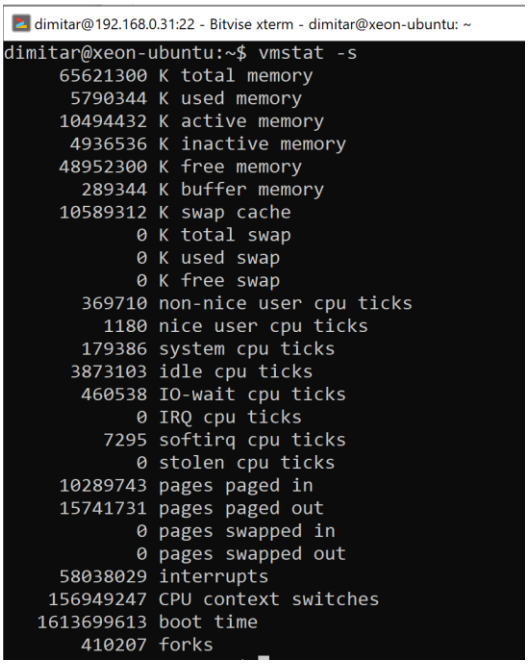
The 500W power supply coming with the mid tower chassis seems adequate for the graphics card provided you do not plan to reach frequently the max 250W which the card may need in peak memory and GPU utilization. The CPU drains no more than 73W, and the motherboard with the chipset and 64GB of RAM. Note that the chassis has an extension space allowing mounting larger power supply in case the one with 500W is not sufficient.

Use Ubuntu 20.04 and upgrade to 20.10.

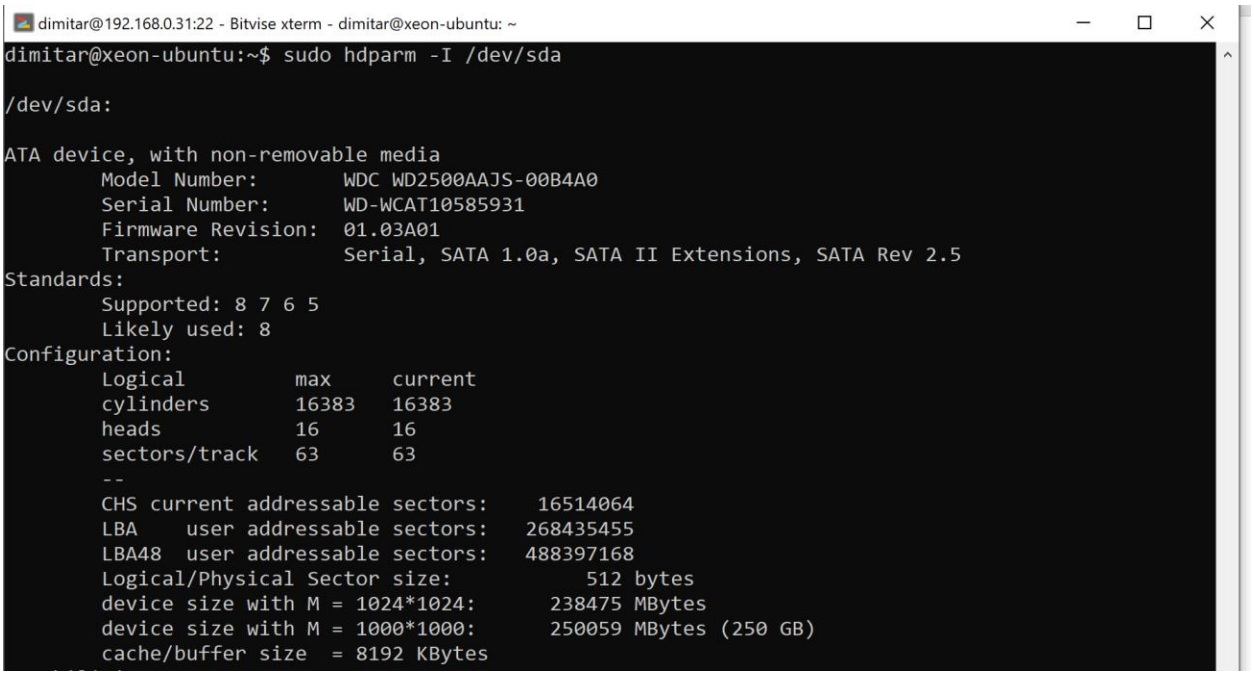
Connect all disks (NVMe, SSD1, SSD2, and HDD) in a single file system using LVM2

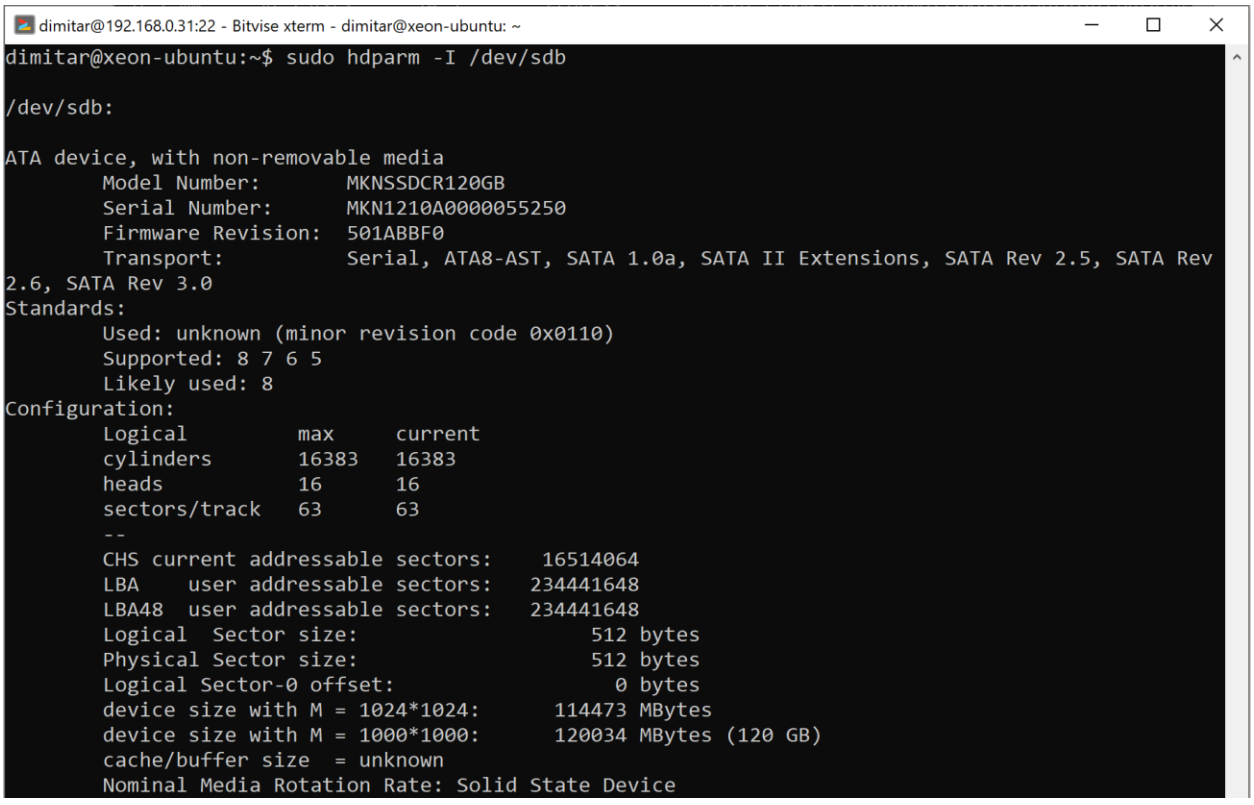
Do not configure swap partition in case you are going to run Kubernetes locally using microk8s or minikube.

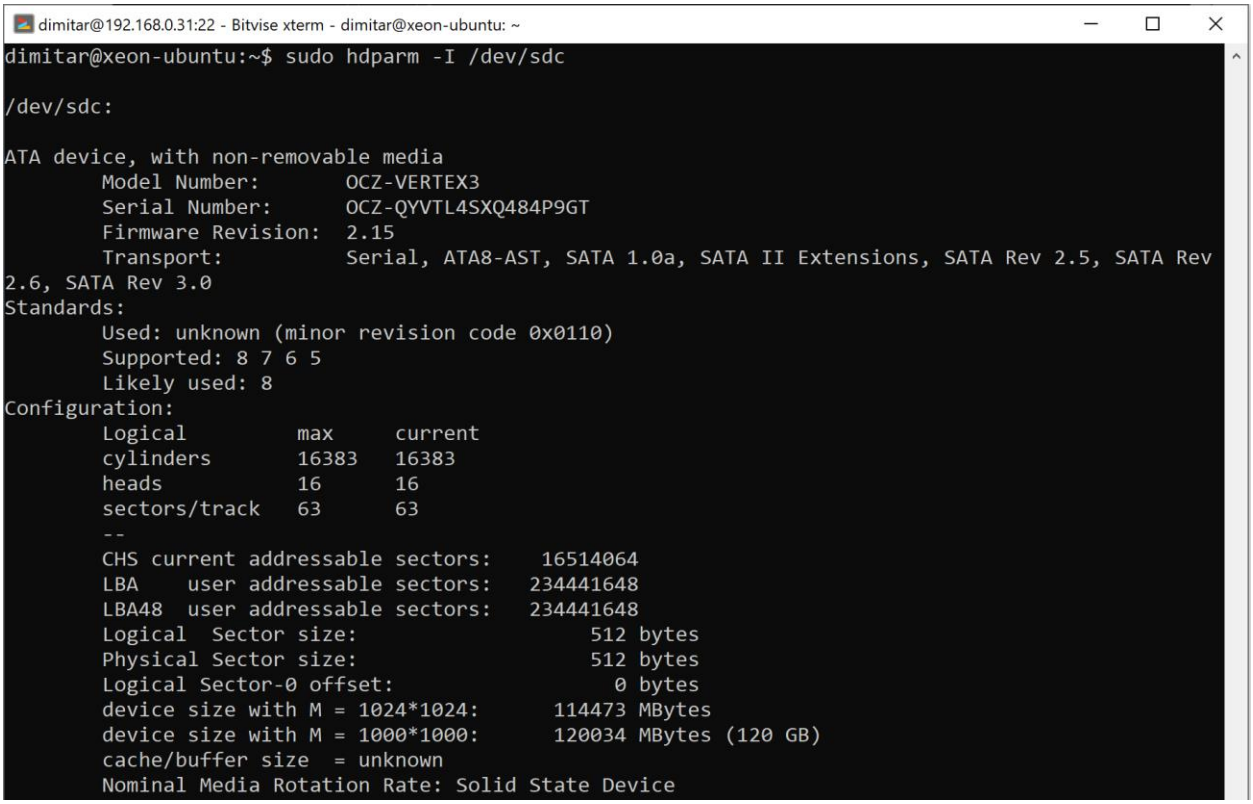

dimitar@192.168.0.31:22 - Bitvise xterm - dimitar@xeon-ubuntu: ~
PowerTOP v2.11 Overview Idle stats Frequency stats Device stats Tunables WakeUp
Summary: 1665.8 wakeups/second, 0.0 GPU ops/seconds, 0.0 VFS ops/sec and 17.9% CPU use
Power est. Usage Events/s Category Description
1.93 W 14.7 ms/s 483.3 Timer hrtimer_wakeup
833 mW 3.8 ms/s 209.3 Timer tick_sched_timer
317 mW 561.3 µs/s 79.9 Process [PID 16155] /snap/microk8s/2036/kube-apiserve
206 mW 340.6 µs/s 52.1 Process [PID 354319] kubectl
184 mW 310.6 µs/s 46.3 Process [PID 16278] /snap/microk8s/2036/kubelet --kub
85.7 mW 1.9 ms/s 20.9 Process [PID 16285] /snap/microk8s/2036/kubelet --kub
77.0 mW 2.2 ms/s 18.6 Process [PID 16284] /snap/microk8s/2036/kubelet --kub
75.4 mW 2.0 ms/s 18.3 Process [PID 16158] /snap/microk8s/2036/kube-apiserve
71.6 mW 1.3 ms/s 17.6 Process [PID 16163] /snap/microk8s/2036/kube-apiserve
64.2 mW 40.2 ms/s 0.4 kWork iomap_dio_complete_work
59.9 mW 50.7 µs/s 15.1 Process [PID 136402] /snap/microk8s/2036/bin/containe
58.7 mW 150.6 µs/s 14.8 Process [PID 36594] /snap/microk8s/2036/kube-controll
57.2 mW 56.9 µs/s 14.5 Process [PID 133043] /snap/microk8s/2036/bin/containe
56.0 mW 48.6 µs/s 14.2 Process [PID 133486] /snap/microk8s/2036/bin/containe
55.9 mW 2.0 ms/s 13.4 Process [PID 321149] /snap/microk8s/2036/kube-apiserv
55.1 mW 492.2 µs/s 13.8 Process [PID 16157] /snap/microk8s/2036/kube-apiserve
51.5 mW 200.0 µs/s 13.0 Process [PID 128027] calico-node -felix
49.5 mW 39.4 µs/s 12.5 Process [PID 131476] /snap/microk8s/2036/bin/containe
49.2 mW 31.4 ms/s 0.05 Interrupt [7] sched(softirq)
49.1 mW 51.0 µs/s 12.4 Process [PID 132880] /snap/microk8s/2036/bin/containe
48.5 mW 43.8 µs/s 12.3 Process [PID 133512] /snap/microk8s/2036/bin/containe
48.1 mW 49.0 µs/s 12.2 Process [PID 136900] /snap/microk8s/2036/bin/containe
46.9 mW 38.0 µs/s 11.9 Process [PID 127119] /snap/microk8s/2036/bin/containe
45.8 mW 1.1 ms/s 11.2 Process [PID 16161] /snap/microk8s/2036/kube-apiserve
43.2 mW 6.5 ms/s 8.4 Interrupt [3] net_rx(softirq)
43.0 mW 40.2 µs/s 10.9 Process [PID 133701] /snap/microk8s/2036/bin/containe
42.1 mW 253.0 µs/s 10.6 Process [PID 129379] /snap/microk8s/2036/bin/containe
41.7 mW 0.9 ms/s 10.2 Process [PID 21484] /snap/microk8s/2036/kubelet --kub
<ESC> Exit | <TAB> / <Shift + TAB> Navigate |


dimitar@192.168.0.31:22 - Bitvise xterm - dimitar@xeon-ubuntu: ~
dimitar@xeon-ubuntu:~$ vmstat -s
65621300 K total memory
5790344 K used memory
10494432 K active memory
4936536 K inactive memory
48952300 K free memory
289344 K buffer memory
10589312 K swap cache
0 K total swap
0 K used swap
0 K free swap
369710 non-nice user cpu ticks
1180 nice user cpu ticks
179386 system cpu ticks
3873103 idle cpu ticks
460538 IO-wait cpu ticks
0 IRQ cpu ticks
7295 softirq cpu ticks
0 stolen cpu ticks
10289743 pages paged in
15741731 pages paged out
0 pages swapped in
0 pages swapped out
58038029 interrupts
156949247 CPU context switches
1613699613 boot time
410207 forks


dimitar@xeon-ubuntu:~$ sudo nvme list
Node SN Model Namespace Usage Format FW Rev
/dev/nvme0n1 0546070A1EF388282021 Sabrent Rocket Q 1 1.00 TB / 1.00 TB 512 B + 0 B RKT30Q.2
dimitar@xeon-ubuntu:~$


dimitar@192.168.0.31:22 - Bitvise xterm - dimitar@xeon-ubuntu: ~
dimitar@xeon-ubuntu:~$ sudo hdparm -I /dev/sda
/dev/sda:
ATA device, with non-removable media
Model Number: WDC WD2500AAJS-00B4A0
Serial Number: WD-WCAT10585931
Firmware Revision: 01.03A01
Transport: Serial, SATA 1.0a, SATA II Extensions, SATA Rev 2.5
Standards:
Supported: 8 7 6 5
Likely used: 8
Configuration:
Logical max current
cylinders 16383 16383
heads 16 16
sectors/track 63 63
--
CHS current addressable sectors: 16514064
LBA user addressable sectors: 268435455
LBA48 user addressable sectors: 488397168
Logical/Physical Sector size: 512 bytes
device size with M = 1024*1024: 238475 MBytes
device size with M = 1000*1000: 250059 MBytes (250 GB)
cache/buffer size = 8192 KBytes


dimitar@192.168.0.31:22 - Bitvise xterm - dimitar@xeon-ubuntu: ~
dimitar@xeon-ubuntu:~$ sudo hdparm -I /dev/sdb
/dev/sdb:
ATA device, with non-removable media
Model Number: MKNSSDCR120GB
Serial Number: MKN1210A0000055250
Firmware Revision: 501ABBF0
Transport: Serial, ATA8-AST, SATA 1.0a, SATA II Extensions, SATA Rev 2.5, SATA Rev 2.6, SATA Rev 3.0
Standards:
Used: unknown (minor revision code 0x0110)
Supported: 8 7 6 5
Likely used: 8
Configuration:
Logical max current
cylinders 16383 16383
heads 16 16
sectors/track 63 63
--
CHS current addressable sectors: 16514064
LBA user addressable sectors: 234441648
LBA48 user addressable sectors: 234441648
Logical Sector size: 512 bytes
Physical Sector size: 512 bytes
Logical Sector-0 offset: 0 bytes
device size with M = 1024*1024: 114473 MBytes
device size with M = 1000*1000: 120034 MBytes (120 GB)
cache/buffer size = unknown
Nominal Media Rotation Rate: Solid State Device


dimitar@192.168.0.31:22 - Bitvise xterm - dimitar@xeon-ubuntu: ~
dimitar@xeon-ubuntu:~$ sudo hdparm -I /dev/sdc
/dev/sdc:
ATA device, with non-removable media
Model Number: OCZ-VERTEX3
Serial Number: OCZ-QYVTL4SXQ484P9GT
Firmware Revision: 2.15
Transport: Serial, ATA8-AST, SATA 1.0a, SATA II Extensions, SATA Rev 2.5, SATA Rev 2.6, SATA Rev 3.0
Standards:
Used: unknown (minor revision code 0x0110)
Supported: 8 7 6 5
Likely used: 8
Configuration:
Logical max current
cylinders 16383 16383
heads 16 16
sectors/track 63 63
--
CHS current addressable sectors: 16514064
LBA user addressable sectors: 234441648
LBA48 user addressable sectors: 234441648
Logical Sector size: 512 bytes
Physical Sector size: 512 bytes
Logical Sector-0 offset: 0 bytes
device size with M = 1024*1024: 114473 MBytes
device size with M = 1000*1000: 120034 MBytes (120 GB)
cache/buffer size = unknown
Nominal Media Rotation Rate: Solid State Device