Analyze Jetson processor and memory usage

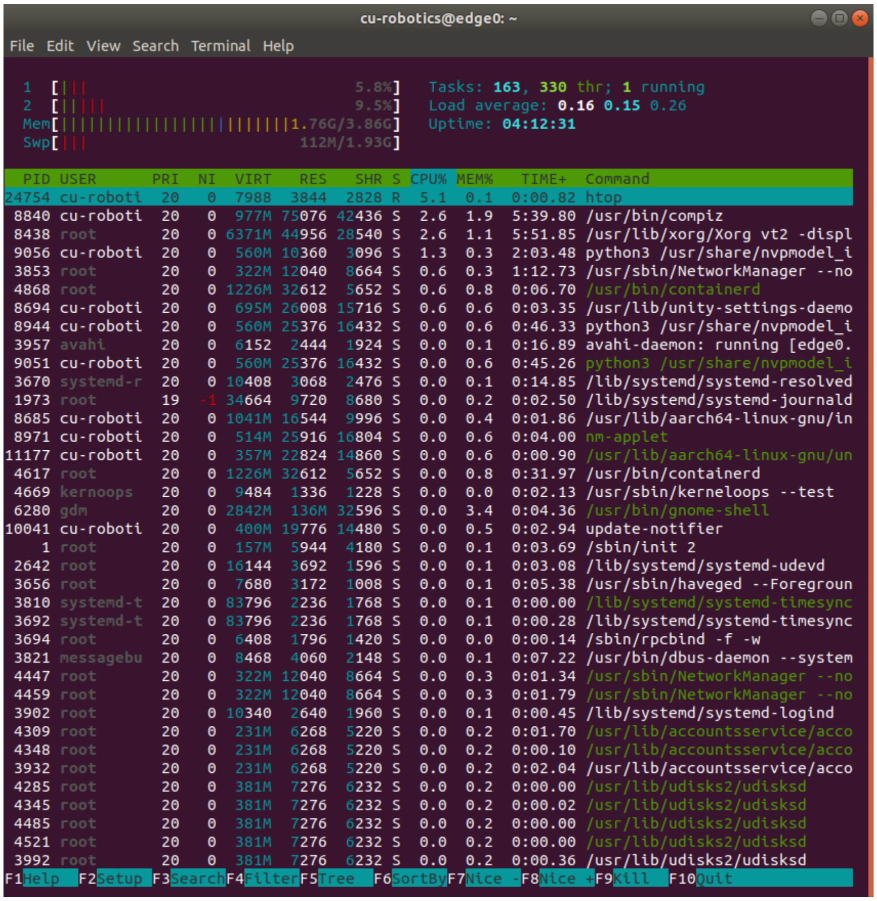
An important part of edge computing is optimizing our programs to get the most out of our processor. This document gives an overview of how to monitor your processor and memory usage.

Viewing processor stats

In this example we will be working with a 4GB Jetson nano. This device has 4 cores in max power mode (10W) and 2 in 5W mode. The Jetson also has 4GB of RAM (hence the name 4GB) and a 2GB swapfile (usually half the size of RAM). To view the processor usage we will use the command htop. Open a terminal and run:

```
htop
```

You should now see the below output:



```
  1  [|||                            5.8%]   Tasks: 163, 330 thr; 1 running
  2  [|||||                          9.5%]   Load average: 0.16 0.15 0.26
  Mem[|||||||||||||||||||||||||1.76G/3.86G]   Uptime: 04:12:31
  Swp[|||                      112M/1.93G]

  PID USER      PRI  NI  VIRT   RES   SHR S CPU% MEM%   TIME+  Command
24754 cu-roboti  20   0  7988  3844  2828 R  5.1  0.1  0:00.82 htop
 8840 cu-roboti  20   0  977M 75076 42436 S  2.6  1.9  5:39.80 /usr/bin/compiz
 8438 root       20   0 6371M 44956 28540 S  2.6  1.1  5:51.85 /usr/lib/xorg/Xorg vt2 -displ
 9056 cu-roboti  20   0  560M 10360  3096 S  1.3  0.3  2:03.48 python3 /usr/share/nvpmodel_i
 3853 root       20   0  322M 12040  8664 S  0.6  0.3  1:12.73 /usr/sbin/NetworkManager --no
 4868 root       20   0 1226M 32612  5652 S  0.6  0.8  0:06.70 /usr/bin/containerd
 8694 cu-roboti  20   0  695M 26008 15716 S  0.6  0.6  0:03.35 /usr/lib/unity-settings-daemo
 8944 cu-roboti  20   0  560M 25376 16432 S  0.0  0.6  0:46.33 python3 /usr/share/nvpmodel_i
 3957 avahi      20   0  6152  2444  1924 S  0.0  0.1  0:16.89 avahi-daemon: running [edge0.
 9051 cu-roboti  20   0  560M 25376 16432 S  0.0  0.6  0:45.26 python3 /usr/share/nvpmodel_i
 3670 systemd-r  20   0 10408  3068  2476 S  0.0  0.1  0:14.85 /lib/systemd/systemd-resolved
 1973 root       19  -1 34664  9720  8680 S  0.0  0.2  0:02.50 /lib/systemd/systemd-journald
 8685 cu-roboti  20   0 1041M 16544  9996 S  0.0  0.4  0:01.86 /usr/lib/aarch64-linux-gnu/in
 8971 cu-roboti  20   0  514M 25916 16804 S  0.0  0.6  0:04.00 nm-applet
11177 cu-roboti  20   0  357M 22824 14860 S  0.0  0.6  0:00.90 /usr/lib/aarch64-linux-gnu/un
 4617 root       20   0 1226M 32612  5652 S  0.0  0.8  0:31.97 /usr/bin/containerd
 4669 kernoops   20   0  9484  1336  1228 S  0.0  0.0  0:02.13 /usr/sbin/kerneloops --test
 6280 gdm        20   0 2842M  136M 32596 S  0.0  3.4  0:04.36 /usr/bin/gnome-shell
10041 cu-roboti  20   0  400M 19776 14480 S  0.0  0.5  0:02.94 update-notifier
    1 root       20   0  157M  5944  4180 S  0.0  0.1  0:03.69 /sbin/init 2
 2642 root       20   0 16144  3692  1596 S  0.0  0.1  0:03.08 /lib/systemd/systemd-udevd
 3656 root       20   0  7680  3172  1008 S  0.0  0.1  0:05.38 /usr/sbin/haveged --Foregroun
 3810 systemd-t  20   0 83796  2236  1768 S  0.0  0.1  0:00.00 /lib/systemd/systemd-timesync
 3692 systemd-t  20   0 83796  2236  1768 S  0.0  0.1  0:00.28 /lib/systemd/systemd-timesync
 3694 root       20   0  6408  1796  1420 S  0.0  0.0  0:00.14 /sbin/rpcbind -f -w
 3821 messagebu  20   0  8468  4060  2148 S  0.0  0.1  0:07.22 /usr/bin/dbus-daemon --system
 4447 root       20   0  322M 12040  8664 S  0.0  0.3  0:01.34 /usr/sbin/NetworkManager --no
 4459 root       20   0  322M 12040  8664 S  0.0  0.3  0:01.79 /usr/sbin/NetworkManager --no
 3902 root       20   0 10340  2640  1960 S  0.0  0.1  0:00.45 /lib/systemd/systemd-logind
 4309 root       20   0  231M  6268  5220 S  0.0  0.2  0:01.70 /usr/lib/accountsservice/acco
 4348 root       20   0  231M  6268  5220 S  0.0  0.2  0:00.10 /usr/lib/accountsservice/acco
 3932 root       20   0  231M  6268  5220 S  0.0  0.2  0:02.04 /usr/lib/accountsservice/acco
 4285 root       20   0  381M  7276  6232 S  0.0  0.2  0:00.00 /usr/lib/udisks2/udisksd
 4345 root       20   0  381M  7276  6232 S  0.0  0.2  0:00.02 /usr/lib/udisks2/udisksd
 4485 root       20   0  381M  7276  6232 S  0.0  0.2  0:00.00 /usr/lib/udisks2/udisksd
 4521 root       20   0  381M  7276  6232 S  0.0  0.2  0:00.00 /usr/lib/udisks2/udisksd
 3992 root       20   0  381M  7276  6232 S  0.0  0.2  0:00.36 /usr/lib/udisks2/udisksd
F1Help  F2Setup F3SearchF4FilterF5Tree  F6SortByF7Nice -F8Nice +F9Kill  F10Quit
```

This window shows all of the running process and the resources they are consuming. At the top there are some overall stats on the processor. You can see that we have two cores that are hardly being utilized and we are using 1.76GB of RAM (out of 3.86GB, not truely 4GB). This window also shows our swapfile usage (swapfiles are used to help with context switching).

Now we can put our device into 10W mode and run htop again:

```
sudo nvpmodel -m0 1
htop
```

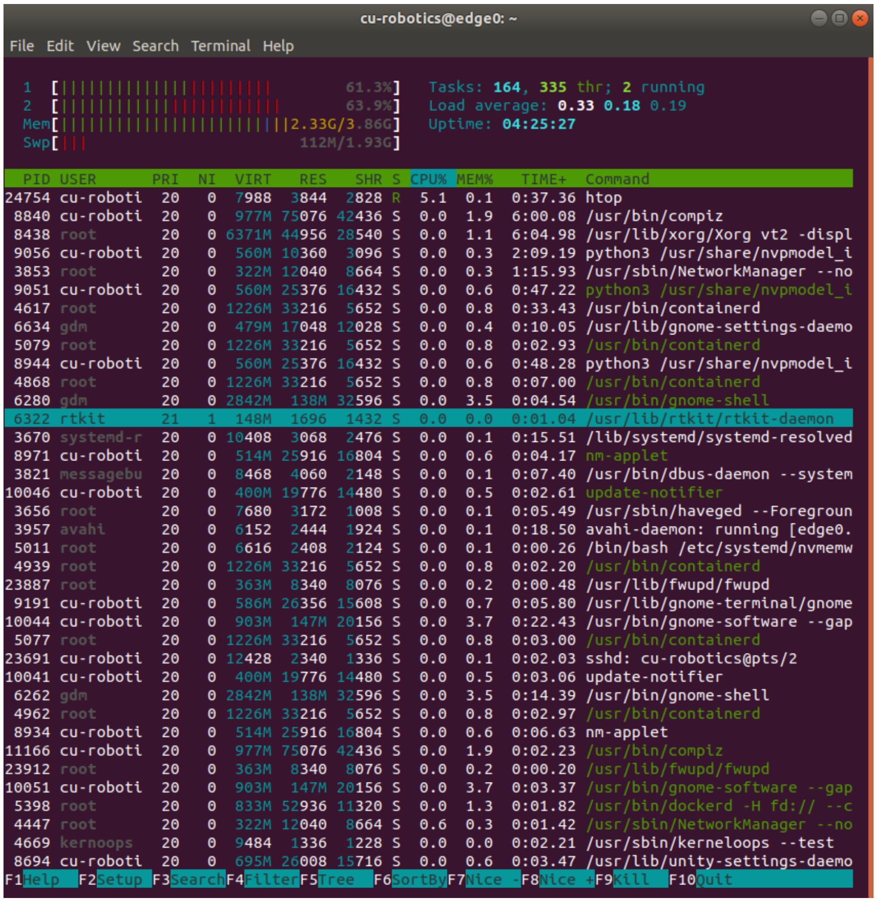
Now the output will show all four cores.

Running a compute intensive example

For this example we will run a jetson inference object detection example. This part requires that jetson inference is installed. Change into the jetson-inference bin and run the example:

```
cd jetson-inference/build/aarch64/bin
./detectnet.py --network=ssd-mobilenet-v2 images/peds_0.jpg images/test/output.jpg
```

Now run htop in another terminal and watch the process take up the devices resources.

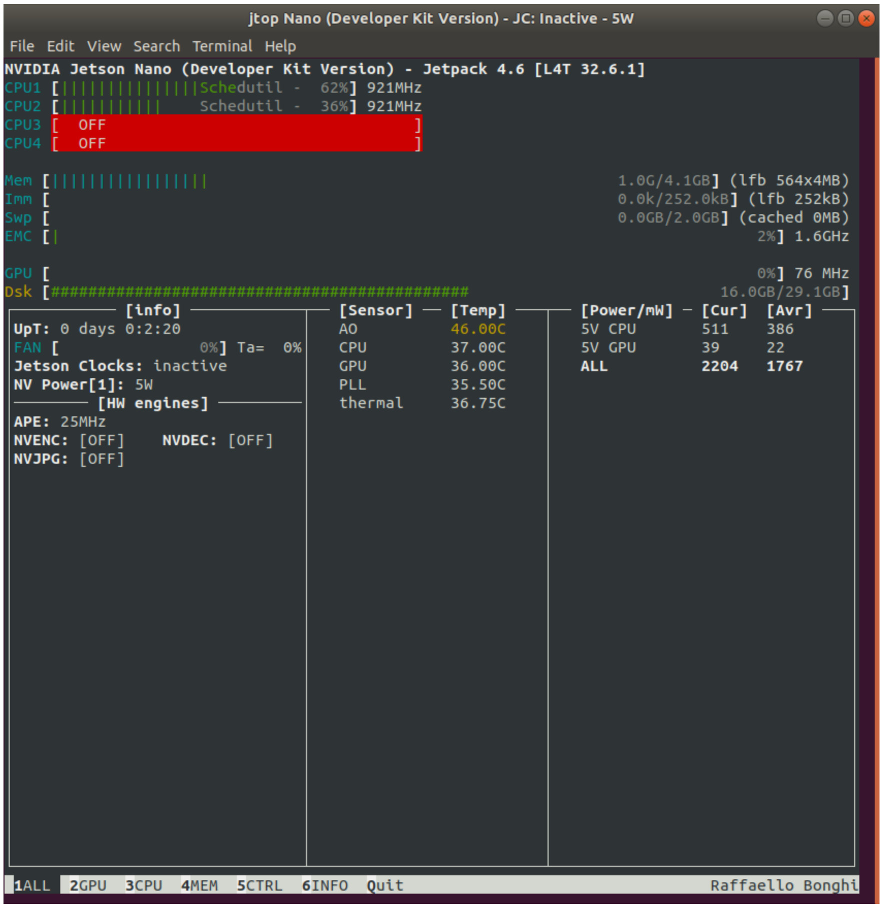


```
  1  [||||||||||||||||||||||          61.3%]   Tasks: 164, 335 thr; 2 running
  2  [|||||||||||||||||||||||         63.9%]   Load average: 0.33 0.18 0.19
  Mem[|||||||||||||||||||||||||2.33G/3.86G]   Uptime: 04:25:27
  Swp[|||                      112M/1.93G]

  PID USER      PRI  NI  VIRT   RES   SHR S CPU% MEM%   TIME+  Command
24754 cu-roboti  20   0  7988  3844  2828 R  5.1  0.1  0:37.36 htop
 8840 cu-roboti  20   0  977M 75076 42436 S  0.0  1.9  6:00.08 /usr/bin/compiz
 8438 root       20   0 6371M 44956 28540 S  0.0  1.1  6:04.98 /usr/lib/xorg/Xorg vt2 -displ
 9056 cu-roboti  20   0  560M 10360  3096 S  0.0  0.3  2:09.19 python3 /usr/share/nvpmodel_i
 3853 root       20   0  322M 12040  8664 S  0.0  0.3  1:15.93 /usr/sbin/NetworkManager --no
 9051 cu-roboti  20   0  560M 25376 16432 S  0.0  0.6  0:47.22 python3 /usr/share/nvpmodel_i
 4617 root       20   0 1226M 33216  5652 S  0.0  0.8  0:33.43 /usr/bin/containerd
 6634 gdm        20   0  479M 17048 12028 S  0.0  0.4  0:10.05 /usr/lib/gnome-settings-daemo
 5079 root       20   0 1226M 33216  5652 S  0.0  0.8  0:02.93 /usr/bin/containerd
 8944 cu-roboti  20   0  560M 25376 16432 S  0.0  0.6  0:48.28 python3 /usr/share/nvpmodel_i
 4868 root       20   0 1226M 33216  5652 S  0.0  0.8  0:07.00 /usr/bin/containerd
 6280 gdm        20   0 2842M  138M 32596 S  0.0  3.5  0:04.54 /usr/bin/gnome-shell
 6322 rtkit      21   1  148M  1696  1432 S  0.0  0.0  0:01.04 /usr/lib/rtkit/rtkit-daemon
 3670 systemd-r  20   0 10408  3068  2476 S  0.0  0.1  0:15.51 /lib/systemd/systemd-resolved
 8971 cu-roboti  20   0  514M 25916 16804 S  0.0  0.6  0:04.17 nm-applet
 3821 messagebu  20   0  8468  4060  2148 S  0.0  0.1  0:07.40 /usr/bin/dbus-daemon --system
10046 cu-roboti  20   0  400M 19776 14480 S  0.0  0.5  0:02.61 update-notifier
 3656 root       20   0  7680  3172  1008 S  0.0  0.1  0:05.49 /usr/sbin/haveged --Foregroun
 3957 avahi      20   0  6152  2444  1924 S  0.0  0.1  0:18.50 avahi-daemon: running [edge0.
 5011 root       20   0  6616  2408  2124 S  0.0  0.1  0:00.26 /bin/bash /etc/systemd/nvmemw
 4939 root       20   0 1226M 33216  5652 S  0.0  0.8  0:02.20 /usr/bin/containerd
23887 root       20   0  363M  8340  8076 S  0.0  0.2  0:00.48 /usr/lib/fwupd/fwupd
 9191 cu-roboti  20   0  586M 26356 15608 S  0.0  0.7  0:05.80 /usr/lib/gnome-terminal/gnome
10044 cu-roboti  20   0  903M  147M 20156 S  0.0  3.7  0:22.43 /usr/bin/gnome-software --gap
 5077 root       20   0 1226M 33216  5652 S  0.0  0.8  0:03.00 /usr/bin/containerd
23691 cu-roboti  20   0 12428  2340  1336 S  0.0  0.1  0:02.03 sshd: cu-robotics@pts/2
10041 cu-roboti  20   0  400M 19776 14480 S  0.0  0.5  0:03.06 update-notifier
 6262 gdm        20   0 2842M  138M 32596 S  0.0  3.5  0:14.39 /usr/bin/gnome-shell
 4962 root       20   0 1226M 33216  5652 S  0.0  0.8  0:02.97 /usr/bin/containerd
 8934 cu-roboti  20   0  514M 25916 16804 S  0.0  0.6  0:06.63 nm-applet
11166 cu-roboti  20   0  977M 75076 42436 S  0.0  1.9  0:02.23 /usr/bin/compiz
23912 root       20   0  363M  8340  8076 S  0.0  0.2  0:00.20 /usr/lib/fwupd/fwupd
10051 cu-roboti  20   0  903M  147M 20156 S  0.0  3.7  0:03.37 /usr/bin/gnome-software --gap
 5398 root       20   0  833M 52936 11320 S  0.0  1.3  0:01.82 /usr/bin/dockerd -H fd:// --c
 4447 root       20   0  322M 12040  8664 S  0.6  0.3  0:01.42 /usr/sbin/NetworkManager --no
 4669 kernoops   20   0  9484  1336  1228 S  0.0  0.0  0:02.21 /usr/sbin/kerneloops --test
 8694 cu-roboti  20   0  695M 26008 15716 S  0.0  0.6  0:03.47 /usr/lib/unity-settings-daemo
F1Help  F2Setup F3SearchF4FilterF5Tree  F6SortByF7Nice -F8Nice +F9Kill  F10Quit
```

Viewing the GPU stats

Jetson-inference uses the GPU to perform parallelizable processes very quickly. Because we are doing a lot of deep learning this will come in handy. To do this we will use jtop (requires jetson-stats installed with pip3).


jtop Nano (Developer Kit Version) - JC: Inactive - 5W
File Edit View Search Terminal Help

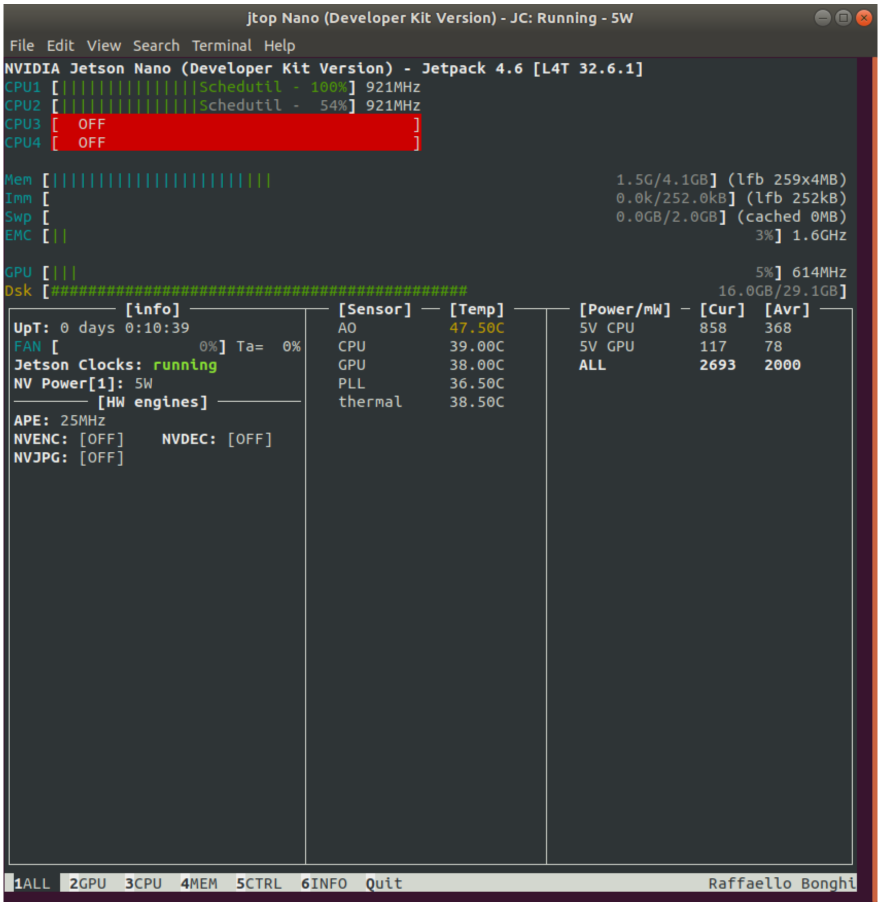
```
NVIDIA Jetson Nano (Developer Kit Version) - Jetpack 4.6 [L4T 32.6.1]
CPU1 [|||||||||||||||Schedutil -   62%] 921MHz
CPU2 [|||||||||||    Schedutil -   36%] 921MHz
CPU3 [  OFF                            ]
CPU4 [  OFF                            ]

Mem [|||||||||||||||||                           1.0G/4.1GB] (lfb 564x4MB)
Imm [                                           0.0k/252.0kB] (lfb 252kB)
Swp [                                           0.0GB/2.0GB] (cached 0MB)
EMC [|                                                   2%] 1.6GHz

GPU [                                                    0%] 76 MHz
Dsk [#############################################   16.0GB/29.1GB]
 ──────── [info] ──────────── [Sensor] ─ [Temp] ──── [Power/mW] ─ [Cur]  [Avr] ──
 UpT: 0 days 0:2:20          AO          46.00C       5V CPU       511    386
 FAN [              0%] Ta=  0%  CPU     37.00C       5V GPU       39     22
 Jetson Clocks: inactive     GPU         36.00C       ALL          2204   1767
 NV Power[1]: 5W             PLL         35.50C
 ────── [HW engines] ─────── thermal     36.75C
 APE: 25MHz
 NVENC: [OFF]    NVDEC: [OFF]
 NVJPG: [OFF]

 1ALL  2GPU  3CPU  4MEM  5CTRL  6INFO  Quit                        Raffaello Bonghi
```

jtop shows us the CPU and GPU usage as well as sensors from the device and power consumption. We can see the GPU is at rest while jetson-inference is not running.


jtop Nano (Developer Kit Version) - JC: Running - 5W
File Edit View Search Terminal Help

```
NVIDIA Jetson Nano (Developer Kit Version) - Jetpack 4.6 [L4T 32.6.1]
CPU1 [|||||||||||||||Schedutil - 100%] 921MHz
CPU2 [|||||||||||||||Schedutil -  54%] 921MHz
CPU3 [  OFF                           ]
CPU4 [  OFF                           ]

Mem [||||||||||||||||||||||||                        1.5G/4.1GB] (lfb 259x4MB)
Imm [                                              0.0k/252.0kB] (lfb 252kB)
Swp [                                                0.0GB/2.0GB] (cached 0MB)
EMC [||                                                       3%] 1.6GHz

GPU [|||                                                      5%] 614MHz
Dsk [#############################################   16.0GB/29.1GB]
 ───────────── [info] ───────────── [Sensor] ─ [Temp] ──── [Power/mW] ─ [Cur]  [Avr] ─
 UpT: 0 days 0:10:39               AO          47.50C      5V CPU        858    368
 FAN [                0%] Ta=   0% CPU         39.00C      5V GPU        117    78
 Jetson Clocks: running            GPU         38.00C      ALL           2693   2000
 NV Power[1]: 5W                   PLL         36.50C
 ──────── [HW engines] ────────    thermal     38.50C
 APE: 25MHz
 NVENC: [OFF]     NVDEC: [OFF]
 NVJPG: [OFF]

1ALL  2GPU  3CPU  4MEM  5CTRL  6INFO  Quit                          Raffaello Bonghi
```

Now we can see that the jetson inference is using the GPU.