

1.- Demonstrate single threaded 120K pixel sharpening 10+ times and examine htop noting CPU used and number of cores. Compare to 12M pixel sharpening 10+ times and again note CPU used.

1.a: ./sharpen Cactus-120kpixel-sharpen.ppm Cactus-120kpixel-sharpened.ppm

```
luis@luis-AOA150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen Cactus-120kpixel-sharpen.ppm Cac
tus-120kpixel-sharpened.ppm
start test at 0.884511
stop test at 12.566324 for 300 frames
luis@luis-AOA150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$
```

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14. 192.168.100.40

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1 [|||||||||||||||||||||100.0%] Tasks: 116, 196 thr; 2 running
2 [||||| 7.8%] Load average: 0.30 0.16 0.13
Mem [|||||||||||||||||446M/986M] Uptime: 03:01:40
Swp [||||| 2.51M/976M]

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
1	root	20	0	2304K	464K	354K	S	0.0	0.5	0:04:00	/sbin/init

```
luis@luis-AOA150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen Cactus-120kpixel-sharpen.ppm Cac
tus-120kpixel-sharpened.ppm
[sudo] password for luis:
start test at 0.885257
stop test at 12.566324 for 300 frames
luis@luis-AOA150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$
```

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1 [||||| 5.2%] Tasks: 114, 197 thr; 1 running
2 [||||| 16.8%] Load average: 0.26 0.15 0.12
Mem [|||||||||||||||||445M/986M] Uptime: 03:01:08
Swp [||||| 2.51M/976M]

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
1	root	20	0	2304K	464K	354K	S	0.0	0.5	0:04:00	/sbin/init

Total time 12.56 s

1.b: ./sharpen Cactus-12mpixel.ppm Cactus-12mpixel.ppm

```
luis@luis-AOA150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen Cactus-12mpixel.ppm Cactus-12mpi
xel.ppm
start test at 0.930913
stop test at 0.930913
luis@luis-AOA150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$
```

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1 [|||||||||||||||||100.0%] Tasks: 116, 196 thr; 2 running
2 [||||| 7.1%] Load average: 0.21 0.16 0.12
Mem [|||||||||||||||||446M/986M] Uptime: 03:03:26
Swp [||||| 2.51M/976M]

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
1	root	20	0	2304K	464K	354K	S	0.0	0.5	0:04:00	/sbin/init

```

luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/Us
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen Cactus-12mpixel.ppm Cactus-12mp
xel.ppm
start test at 0.930913
stop test at 12.843085 for 300 frames
luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/Us
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$

```

luis-A0A150 1% 0.58 GB / 0.96 GB 0.01 Mb/s 0.00 Mb/s 184 min

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```

1  [|||||] 4.5% Tasks: 114, 198 thr; 1 running
2  [|||||] 4.6% Load average: 0.22 0.17 0.13
Mem[|||||] 445M/986M Uptime: 03:04:03
Swp[|] 2.51M/976M

```

PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command

Total time 12.84 s

./sharpen Cactus-120kpixel-sharpen.ppm Cactus-120kpixel-sharpened.ppm ---- 12.56s
./sharpen Cactus-12mpixel.ppm Cactus-12mpixel.ppm ----- 12.84s

2.- Demonstrate 4+ threaded 120K pixel sharpening 10+ times and examine htop noting CPU used and number of cores. Compare to 12M pixel sharpening 10+ times and again note CPU used.

2.a ./sharpen_grid Cactus-120kpixel-sharpen.ppm Cactus-120kpixel-sharpened.ppm

```

luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/Us
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen_grid Cactus-120kpixel-sharpen.p
m Cactus-120kpixel-sharpened.ppm
source file Cactus-120kpixel-sharpen.ppm read
start test at 0.859225
stop test at 12.718405 for 300 frames
luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/Us
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$

```

luis-A0A150 97% 0.58 GB / 0.96 GB 0.01 Mb/s 0.01 Mb/s 188 min

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1  [|||||] 98.1% Tasks: 116, 207 thr; 13 running
2  [|||||] 97.5% Load average: 0.41 0.18 0.12
Mem[|||||] 446M/986M Uptime: 03:08:34
Swp[|] 2.51M/976M

```

```

luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/Us
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen_grid Cactus-120kpixel-sharpen.p
m Cactus-120kpixel-sharpened.ppm
source file Cactus-120kpixel-sharpen.ppm read
start test at 0.859225
start test at 8.606414 for 300 frames
starting sink file Cactus-120kpixel-sharpened.ppm write
sink file Cactus-120kpixel-sharpened.ppm written
luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/Us
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$

```

luis-A0A150 3% 0.58 GB / 0.96 GB 0.01 Mb/s 0.00 Mb/s 190 min

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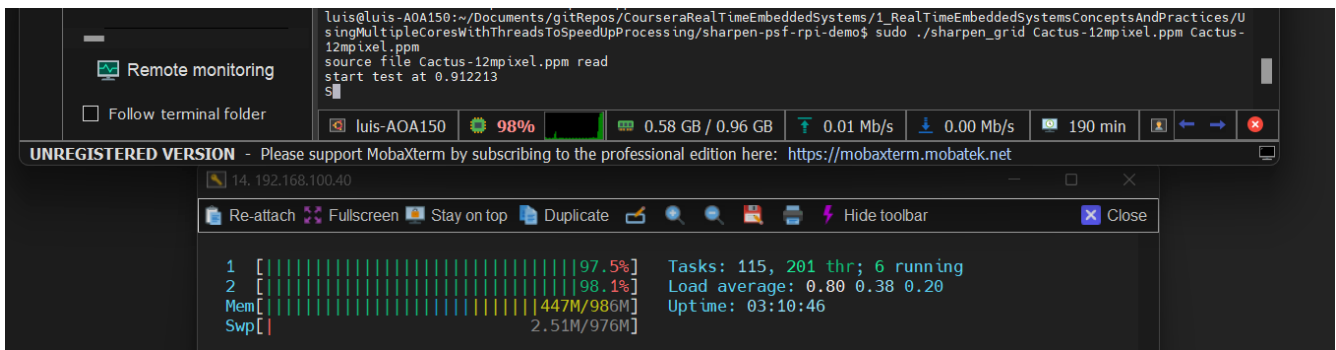
```

1  [|||||] 3.9% Tasks: 114, 198 thr; 1 running
2  [|||||] 5.2% Load average: 0.37 0.28 0.17
Mem[|||||] 445M/986M Uptime: 03:10:07
Swp[|] 2.51M/976M

```

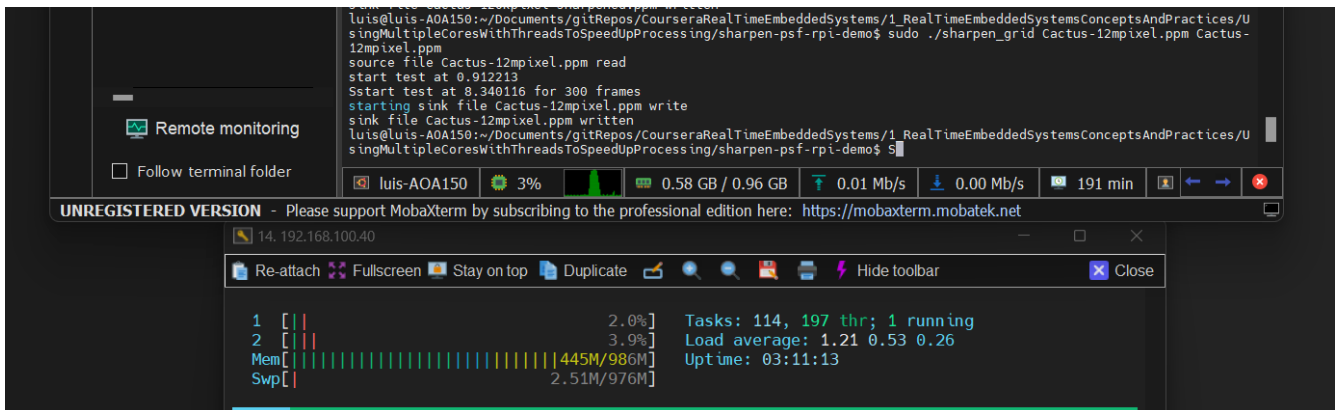
Total time 8.60 s

2.b ./sharpen_grid Cactus-12mpixel.ppm Cactus-12mpixel.ppm



```
luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen_grid Cactus-12mpixel.ppm Cactus-
12mpixel.ppm
source file Cactus-12mpixel.ppm read
start test at 0.912213
S█

1 [|||||||||||||||||||||||||||||||||97.5%] Tasks: 115, 201 thr; 6 running
2 [|||||||||||||||||||||||||||||||||98.1%] Load average: 0.80 0.38 0.20
Mem[|||||||||||||||||||||||||||||447M/986M] Uptime: 03:10:46
Swp[|||||2.51M/976M]
```



```
luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ sudo ./sharpen_grid Cactus-12mpixel.ppm Cactus-
12mpixel.ppm
source file Cactus-12mpixel.ppm read
start test at 0.912213
Sstart test at 8.340116 for 300 frames
starting sink file Cactus-12mpixel.ppm write
sink file Cactus-12mpixel.ppm written
luis@luis-A0A150:~/Documents/gitRepos/CourseraRealTimeEmbeddedSystems/1_RealTimeEmbeddedSystemsConceptsAndPractices/U
singMultipleCoresWithThreadsToSpeedUpProcessing/sharpen-psf-rpi-demo$ S█

1 [|||2.0%] Tasks: 114, 197 thr; 1 running
2 [|||3.9%] Load average: 1.21 0.53 0.26
Mem[|||||||||||||||||||||||||445M/986M] Uptime: 03:11:13
Swp[|||||2.51M/976M]
```

Total time 8.34 s

./sharpen_grid Cactus-120kpixel-sharpen.ppm Cactus-120kpixel-sharpened.ppm ---- 8.606s

./sharpen_grid Cactus-12mpixel.ppm Cactus-12mpixel.ppm ----- 8.34s

3.- Compare 4+ threaded 12M pixel sharpening frame rate and completion time latency to single-threaded.

./sharpen Cactus-12mpixel.ppm Cactus-12mpixel.ppm ----- 12.84s

./sharpen_grid Cactus-12mpixel.ppm Cactus-12mpixel.ppm ----- 8.34s

Conclusion: with more threads the time is better.