CS211: Operating Systems

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SYSTEM MONITOR

I.   Goal

Our objective is to replicate the functionality of Ubuntu's System Monitor application, focusing on its three main components: Processes, Resources, and File Systems. Additionally, we have included related extra statistics not present in the original app, such as the total number of processes, and detailed CPU usage breakdown.

II.   Key results

We have developed a system monitor that displays output directly in the terminal. It retrieves and processes information from the `/proc` virtual file system, providing accurate and real-time data consistent with Ubuntu's System Monitor.
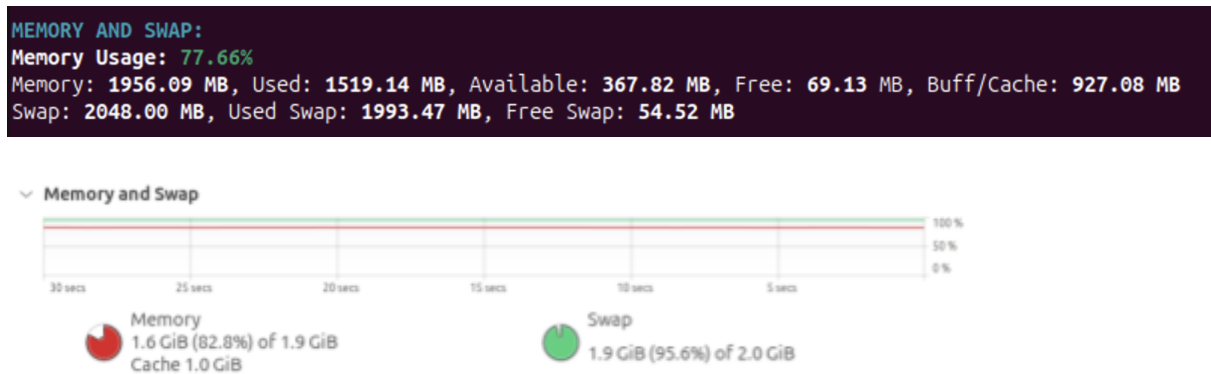
1. Our system monitor **accurately displays Task statistics and CPU usage** with a detailed breakdown, which we compared to the output of the `top` command (our system monitor output appears in the upper figure, while the OS's top command is shown in the lower figure). Task statistics and CPU Usage breakdown are not available in Ubuntu's System Monitor application.

```
SYSTEM MONITOR
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Task Statistics:
Tasks: 230, Running: 1, Sleeping: 228, Stopped: 0, Zombie: 1

CPU INFORMATION:
Total CPU Usage: 4.5%%
Usage Breakdown: us=2.2% sy=2.2% id=95.5% io=0.2% hi=0.0% si=0.0% st=0.0%
```

```
top - 14:21:30 up 3 days, 13:23,  1 user,  load average: 0.12, 0.21, 1.47
Tasks: 230 total,   1 running, 228 sleeping,   0 stopped,   1 zombie
%Cpu(s):  2.5 us,  2.2 sy,  0.0 ni, 95.2 id,  0.2 wa,  0.0 hi,  0.0 si,  0.0 st
```

2. Our system monitor **accurately displays memory resources**, consistent with Ubuntu's System Monitor application. Additionally, we have included extra statistics to provide a more comprehensive view of memory usage.

```
MEMORY AND SWAP:
Memory Usage: 77.66%
Memory: 1956.09 MB, Used: 1519.14 MB, Available: 367.82 MB, Free: 69.13 MB, Buff/Cache: 927.08 MB
Swap: 2048.00 MB, Used Swap: 1993.47 MB, Free Swap: 54.52 MB
```


3. Our system monitor **accurately displays detailed information for each process**. While there may be slight differences in statistics due to varying update intervals between our system monitor and Ubuntu's System Monitor, the overall data remains consistent. Additionally, we filter and display only the top 10 processes based on CPU usage.

PID	USER	PRIORITY	NICE	VIRTUAL_MEM	RES_MEM	SH_MEM	STATUS	CPU_USAGE(%)	MEM_USAGE(%)	DISK READ (MB)	DISK WRITE (MB)	NAME
355691	parallels	20 (Normal)	0	2193992	237128	24848	S	9.67	11.84	20051.21	0.08	gnome-system-mo
2476	parallels	20 (Normal)	0	3951624	151708	44980	R	5.33	7.57	117048.46	1123.72	gnome-shell
5682	parallels	20 (Normal)	0	804152	50892	24628	S	1.00	2.54	7739.09	48.36	gnome-terminal-
504287	parallels	20 (Normal)	0	11756	5376	3328	S	0.67	0.27	0.00	0.00	top
49	root	20 (Normal)	0	23464	8832	4992	S	0.33	0.44	0.00	0.00	kswapd0
1110	messagebus	20 (Normal)	0	12580	4492	2304	S	0.33	0.22	0.00	0.00	dbus-daemon
2650	parallels	20 (Normal)	0	160416	1124	868	S	0.33	0.06	374.37	62.98	prldnd
380770	parallels	20 (Normal)	0	69610292	8176	7052	S	0.33	0.41	996.20	0.00	yelp
449438	parallels	20 (Normal)	0	1299184	129912	55540	S	0.33	6.49	4004.37	1.98	soffice.bin
498185	parallels	20 (Normal)	0	2812292	33760	23680	S	0.33	1.69	32.34	0.00	gjs

ID	User	Priority	Nice	Virtual Memory	Resident Memo	Shared Memor	Statu	% CPU	Memory	Disk read total	Disk write total	Process Name
355691	parallels	Normal	0	2.2 GB	244.9 MB	27.5 MB	Runr	9.11	217.4 MB	20.1 GB	81.9 kB	gnome-system-monitor
2476	parallels	Normal	0	4.0 GB	155.6 MB	46.5 MB	Runr	5.73	109.2 MB	117.0 GB	1.1 GB	gnome-shell
504287	parallels	Normal	0	12.0 MB	5.5 MB	3.4 MB	Runr	1.01	2.1 MB	N/A	N/A	top
385239	parallels	Normal	0	2.5 GB	21.4 MB	14.7 MB	Runr	0.67	6.8 MB	3.7 GB	N/A	Web Content
516189	parallels	Normal	0	3.6 MB	1.8 MB	1.6 MB	Runr	0.67	258.0 kB	N/A	N/A	sysmon
498185	parallels	Normal	0	2.9 GB	36.1 MB	25.7 MB	Runr	0.34	10.5 MB	32.3 MB	N/A	gjs
2650	parallels	Normal	0	164.3 MB	1.2 MB	888.8 kB	Runr	0.34	262.1 kB	374.4 MB	63.0 MB	prldnd
2656	parallels	Normal	0	482.4 MB	3.3 MB	3.0 MB	Runr	0.34	249.9 kB	867.5 MB	270.3 kB	prlsga
5682	parallels	Normal	0	823.5 MB	52.5 MB	25.6 MB	Runr	0.34	26.9 MB	7.7 GB	48.4 MB	gnome-terminal-server
380770	parallels	Normal	0	71.3 GB	8.4 MB	7.2 MB	Slee|	0.00	1.2 MB	996.2 MB	4.1 kB	yelp
15875	parallels	Normal	0	399.0 MB	3.7 MB	3.3 MB	Slee|	0.00	393.2 MB	95.2 MB	N/A	gvfsd-dnssd
3134	parallels	Normal	0	1.0 GB	8.7 MB	7.0 MB	Slee|	0.00	1.7 MB	1.1 GB	N/A	mutter-x11-frames
476624	parallels	Normal	0	1.4 GB	7.6 MB	6.2 MB	Slee|	0.00	1.4 MB	241.5 MB	32.8 kB	nautilus

4. Our system monitor **accurately displays file system** statistics. To enhance clarity, we filter and display only the disks and partitions that contain files and applications, rather than listing all file systems.

FILE SYSTEM:				
Device	Directory	Type	Total (GB)	Available (GB)
/dev/sda2	/	ext4	66.21	50.83
iCloud	/media/psf/iCloud	fuse.prl_fsd	245.11	24.28
/dev/sda1	/boot/efi	vfat	1.12	1.12

Device	Directory	Total	Type	Free	Available
/dev/sda1	/boot/efi	1.1 GB	vfat	1.1 GB	1.1 GB
/dev/sda2	/	66.2 GB	ext4	54.2 GB	50.8 GB
iCloud	/media/psf/iCloud	245.1 GB	fuse.pr	24.3 GB	24.3 GB

III. Key findings

- Directly accessing the kernel is a complex task that involves working with multiple kernel modules, which must be inserted and removed while managing the high complexity of concurrency handling. To protect the real kernel, this process is best carried out on a virtual machine.

- However, the kernel's information is conveniently stored in the /proc virtual file system, making it much easier to access.

- Retrieving and processing data from /proc is efficient and provides timely updates comparable to Ubuntu's System Monitor.

- The CPU usage displayed in the system monitor reflects usage between the two most recent refreshes rather than the cumulative usage since the process started.