Lab 1 Report

Group Members:

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Question 1:

Number of cpu cores are	:	4
Total Memory	:	8142244 kB
Memory Free	:	1328044 kB
Fraction Free	:	0.16310540435
Number of context switches	:	368384286
Number of processes forked	:	1648009

Question 2:

For cpu1:

Output of top:

```
PID USER    PR NI  VIRT   RES   SHR S  %CPU %MEM    TIME+ COMMAND
25872 dibyendu  20  0   4188   356   276 R 100.0  0.0  2:55.49 cpu1
```

Output of iostat -d -x:

```
Device:      rrqm/s  wrqm/s   r/s   w/s   rkB/s   wkB/s avgrq-sz avgqu-sz  await r_await w_await svctm %util
sda          0.40    8.40   2.20  22.80   12.80  156.80  13.57    0.19   7.62  14.18   6.98  5.79  14.48
```

Output of sudo nethogs:

```
PID  USER   PROGRAM                 DEV    SENT    RECEIVED
1809  vpb    /opt/google/chrome/chrome   wlan0   0.594    0.443 KB/sec
```

The bottleneck resource is CPU.
Since other resources are not being used and CPU is used 100%, it's the bottleneck.

For cpu1printf:

Output of top for the program's process:

```
PID USER    PR NI  VIRT   RES   SHR S  %CPU %MEM    TIME+ COMMAND
26013 dibyendu  20  0   4192   356   276 S  25.1  0.0  0:01.49 cpu1print
```

Output of top for shell process:

```
 PID USER    PR NI  VIRT   RES   SHR S  %CPU %MEM    TIME+ COMMAND
 8848 vpb     20  0 623456 29444 20420 R  98.2  0.8  3:02.14 gnome-term+
```

Output of iostat -d -x:

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	2.40	0.00	0.40	0.00	11.20	56.00	0.01	28.00	0.00	28.00	28.00	1.12

Output of sudo nethogs:

PID	USER	PROGRAM	DEV	SENT	RECEIVED
1809	vpb	/opt/google/chrome/chrome	wlan0	1.635	1.024 KB/sec

The bottleneck in this case is CPU. But this resource isn't maxed out for this process, but for the shell process which is called in every iteration of the program for printing on the terminal. Thus this program is slowed down because of the shell process whose bottleneck resource is CPU, hence, the bottleneck resource for this program is CPU.

For cpu2:

Output of top:

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
26028	dibyendu	20	0	4188	356	276	R	100.0	0.0	0:10.00	cpu2

Output of iostat -d -x:

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	1.20	2.00	0.20	4.20	5.60	26.40	14.55	0.01	2.36	0.00	2.48	2.36	1.04

Output of sudo nethogs:

PID	USER	PROGRAM	DEV	SENT	RECEIVED
1809	vpb	/opt/google/chrome/chrome	wlan0	1.635	1.024 KB/sec

The bottleneck resource is CPU
Since other resources are not being used and CPU is used 100%, it's the bottleneck.

For disk:

Output of top:

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
26093	dibyendu	20	0	4328	528	436	D	1.0	0.0	0:00.07	disk

Output of iostat -d -x:

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	45.60	201.60	522.60	12.60	54481.60	858.40	206.80	2.22	4.16	4.10	6.60	1.86	99.60

Output of sudo nethogs:

```
 PID USER    PROGRAM                DEV     SENT     RECEIVED
1809  vpb     /opt/google/chrome/chrome   wlan0    1.635      1.024 KB/sec
```

The bottleneck resource is disk
%util is 99.6. Since disk I/Os are used, it's the bottleneck.

<u>For disk1:</u>

Output of top:

```
PID USER     PR NI   VIRT   RES    SHR S  %CPU %MEM     TIME+ COMMAND
26143 dibyendu 20  0    4328    524    432 R  15.9 0.0   0:01.83 disk1
```

Output of iostat -d -x:

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	53.80	3.80	72.80	0.80	1437.60	18.40	39.57	0.41	5.52	5.20	35.00	2.98	21.92

Output of nethogs:

```
 PID USER    PROGRAM                DEV     SENT     RECEIVED
1809  vpb     /opt/google/chrome/chrome   wlan0    1.635      1.024 KB/sec
```

The bottleneck resource is disk
Since disk I/Os are used, it's the bottleneck.

Question 3:

<u>For cpu1:</u>

Time in User Mode: 2866
Time in Kernel Mode: 6

Reason: Time taken in user mode is greater than time taken in kernel mode because the instructions in the program do not need to make any system calls.

<u>For cpu1print:</u>

Time in User Mode: 26
Time in Kernel Mode: 146

Reason: Time taken in user mode is less than time taken in kernel mode because printf instruction is used which makes system calls resulting in majority time spent to execute the printf function.

Time in User Mode: 3605
Time in Kernel Mode: 6

Reason: Time taken in user mode is greater than time taken in kernel mode because all instructions except "gettimeofday" do not need to make any system calls. Also, gettimeofday has to just retrieve the system time and hence it is done quite fast.

Question 4:

For cpu1:

voluntary_ctxt_switches: 2
nonvoluntary_ctxt_switches: 3443

Reason: The voluntary context switches are less because there are no other events involved due to which the process would very rarely voluntarily give up the CPU. The large number of non-voluntary context switches are due to the infinite loop.

For disk:

voluntary_ctxt_switches: 4338
nonvoluntary_ctxt_switches: 4841

Reason: The voluntary context switches are more compared to cpu1 because the process voluntarily give up the process to the CPU for disk operations (reading from files). The large number of non-voluntary context switches are due to the infinite loop.