

CS-308

Embedded Systems Lab

Assignment-1 Report

Submitted by:

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CSE B.Tech.(4th Year)

Task:

1. Write a Program to record the CPU usage of your system at the interval of 1 second. Take at least 1000 readings. Store the recorded data with its time-stamp(3 places after decimal) into a log file. The entry in log file should contain time-stamp and CPU usage at that time. You can use any programming language and operating system.
2. Now using the log file, plot a graph between the Recorded CPU Usage v/s Time.
3. Draw the histogram of the time interval between two readings vs count of samples. All readings should be taken after precisely 1 Second.
4. Give reason(s), why the inter sample interval is not uniformly one second.

To Run:

1. `chmod +x usage.sh`
2. `./usage.sh > log.txt` (Records: **Time-stamp(HH:MM:SS)___CPU usage%** in log.txt)
3. `chmod +x time.sh`
4. `./time.sh > file.txt` (Records: **Time-stamp(seconds)___CPU usage%** in file.txt using log.txt)

Solutions:

1. Program(bash script) is attached along with the submission. It used the `proc/stat` command to get the CPU usage statistics. The `proc/stat` command gives the cpu usage in the following manner:^[2]

	user	nice	system	idle	iowait	irq	softirq	steal	guest	guest_nice
cpu	7154286	96238	1192451	17525707	514162	225	12621	0	0	0

The final CPU usage is calculated as:

$PrevIdle = previdle + previowait$

$Idle = idle + iowait$

$PrevNonIdle = prevuser + prevnice + prevsystem + previrq + prevsoftirq + prevsteal$

$\text{NonIdle} = \text{user} + \text{nice} + \text{system} + \text{irq} + \text{softirq} + \text{steal}$

$\text{PrevTotal} = \text{PrevIdle} + \text{PrevNonIdle}$

$\text{Total} = \text{Idle} + \text{NonIdle}$

$\text{CPU_Percentage} = ((\text{Total} - \text{PrevTotal}) - (\text{Idle} - \text{PrevIdle})) / (\text{Total} - \text{PrevTotal})$

The script loops forever (just hit Ctrl-C when you want it to stop). Each time through the loop, it calculates the CPU usage by subtracting the CPU's "idle" time from the CPU's "total" time. The percentage is calculated by multiplying by 1000, and then dividing by 10 at the end, instead of the "normal" approach of multiplying by 100. This is actually a way of rounding off. I also add 5 just before the divide by 10. So, for example, if the percentage was 45.6% then BASH would truncate the result to 45%. But, by multiplying by 1000 (instead of 100), and adding 5, the result is 456 (i.e. $45.6 \times 1000 + 5$), which, when divided by 10 at the end, yields the correctly rounded result of 46%^[1]

Also since we do not have the PrevIdle and PrevNonIdle times, therefore we do not consider the first observation in our calculations (first row in file.txt is not being considered in drawing the graphs).

Log files: log.txt & file.txt

2. Graph between the Recorded CPU Usage v/s Time (for 1303 readings)

Attached as Figure1.png

3. Histogram of the time interval between two readings vs count of samples

Attached as Figure2.png

4. Inter sample interval is not uniformly one second because:

1. of the scheduling done by the operating system. Our program runs as a process on the OS. The process records the CPU usage at an instant and then goes into sleep(blocked) state for 1 second. When process becomes ready after 1 second, our process is not dispatched instantly but it has to wait until the OS schedules it(there are other processes currently using the CPU). Hence, the process remains in ready state (not running state) for some time until it is scheduled and this adds to inter-sample interval.
2. The process itself may take some time to gather the cpu usage statistics. The process does several operations(file processing of proc/stat/, accessing current time, writing to log file etc.). Hence, it consumes some time in running state. This also adds up to inter-sample interval.

Hence, we see that inter-sample interval is always a little more than 1 second.

References:

1. Calculating CPU Usage from /proc/stat, Paul Colby

<http://www.mail-archive.com/linuxkernelnewbies@googlegroups.com/msg01690.html>

2. <http://stackoverflow.com/questions/23367857/accurate-calculation-of-cpu-usage-given-in-percentage-in-linux>

OS used: Ubuntu LTS 12.04

Language used: bash/awk