PCAP : Demonstration of openmp semaphore & mutex programs

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1 :openmp Mutex

Code

```c
#include <stdio.h>
#include <stdlib.h>
#include <omp.h>

int main(int argc, char** argv){

    if(argc < 2) {
        printf("Enter the correct arguments\n");
        return 1;
    }
    int threads = atoi(argv[1]);
    omp_set_num_threads(threads);

    int partial_Sum, total_Sum = 0, shared_sum = 0;
    omp_lock_t writelock;
    omp_init_lock(&writelock);

    #pragma omp parallel private(partial_Sum) shared(total_Sum, shared_sum)
    {
        partial_Sum = 0;

        #pragma omp for
        for(int i = 1; i <= 1000; i++){
            partial_Sum += i;
            omp_set_lock(&writelock);
            shared_sum += i;
            omp_unset_lock(&writelock);
        }

        #pragma omp critical
        {
            printf("Sum Calculated by Thread No. %d is %d\n", omp_get_thread_num(), partial_Sum);
            total_Sum += partial_Sum;
        }
    }
    omp_destroy_lock(&writelock);
    printf("Total Sum: %d\n", total_Sum);
    printf("Shared Sum: %d\n", shared_sum);
    return 0;
}
```

Output

```
hp@aditi:~/Desktop/BTech/PCAP/LAB/mpi$ sudo perf stat ./mutex 2
Sum Calculated by Thread No. 0 is 125250
Sum Calculated by Thread No. 1 is 375250
Total Sum: 500500
Shared Sum: 500500

 Performance counter stats for './mutex 2':

              2.38 msec task-clock                #    0.906 CPUs utilized
                13      context-switches          #    0.005 M/sec
                 0      cpu-migrations            #    0.000 K/sec
                83      page-faults               #    0.035 M/sec
        40,24,460       cycles                    #    1.691 GHz
         9,28,064       stalled-cycles-frontend   #   23.06% frontend cycles idle
        14,60,707       stalled-cycles-backend    #   36.30% backend cycles idle
        19,68,448       instructions              #    0.49  insn per cycle
                                                  #    0.74  stalled cycles per insn
         4,60,439       branches                  #  193.500 M/sec
           15,426       branch-misses             #    3.35% of all branches

       0.002625142 seconds time elapsed

       0.002934000 seconds user
       0.000000000 seconds sys
```

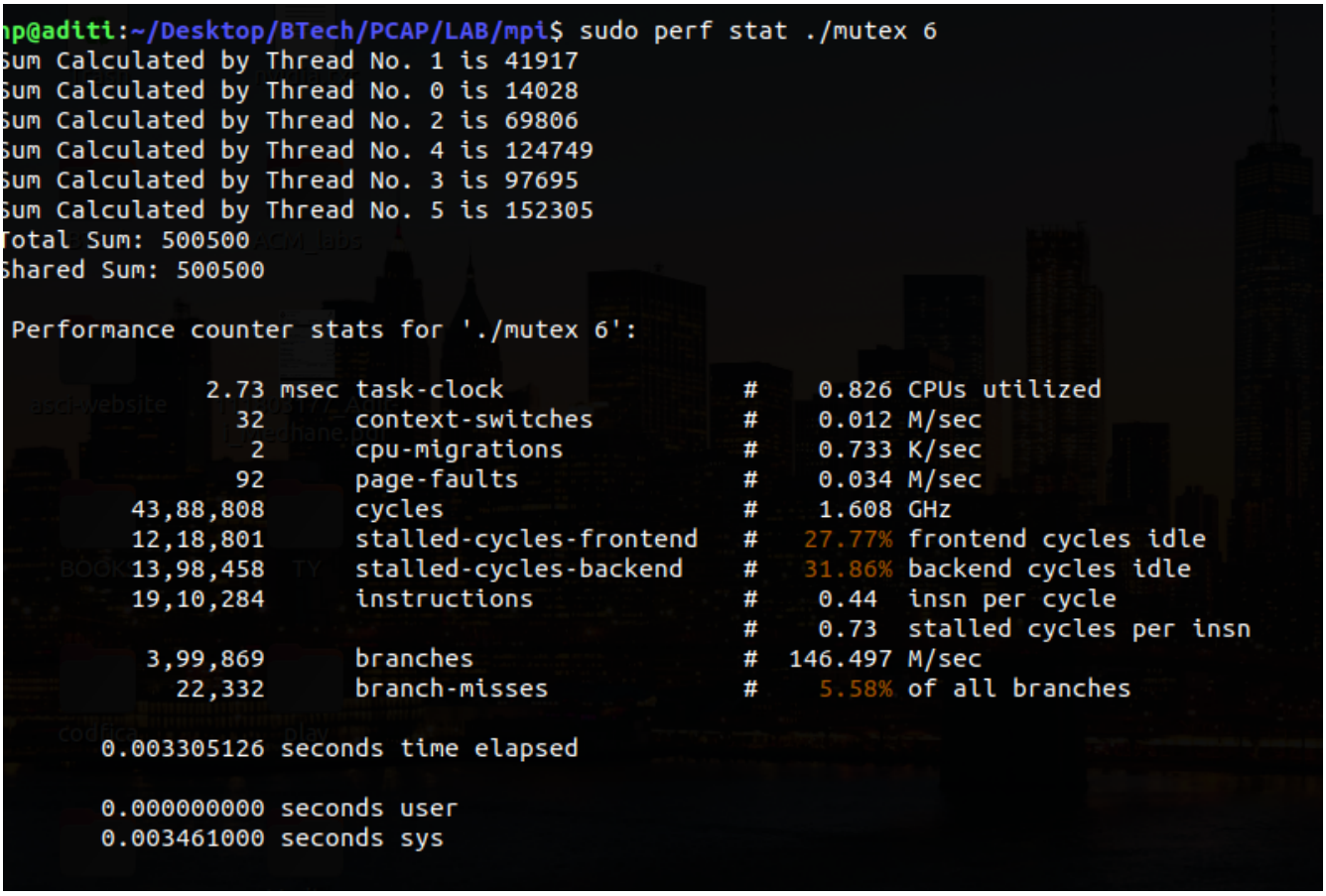
```
hp@aditi:~/Desktop/BTech/PCAP/LAB/mpi$ sudo perf stat ./mutex 4
Sum Calculated by Thread No. 2 is 156375
Sum Calculated by Thread No. 3 is 218875
Sum Calculated by Thread No. 0 is 31375
Sum Calculated by Thread No. 1 is 93875
Total Sum: 500500
Shared Sum: 500500

 Performance counter stats for './mutex 4':

              2.47 msec task-clock                #    0.835 CPUs utilized
                25      context-switches          #    0.010 M/sec
                 2      cpu-migrations            #    0.810 K/sec
                89      page-faults               #    0.036 M/sec
        48,18,680       cycles                    #    1.953 GHz
        13,02,798       stalled-cycles-frontend   #   27.04% frontend cycles idle
        18,37,297       stalled-cycles-backend    #   38.13% backend cycles idle
        17,55,184       instructions              #    0.36  insn per cycle
                                                  #    1.05  stalled cycles per insn
         3,70,015       branches                  #  149.931 M/sec
           20,599       branch-misses             #    5.57% of all branches

       0.002954496 seconds time elapsed

       0.003067000 seconds user
       0.000000000 seconds sys
```


np@aditi:~/Desktop/BTech/PCAP/LAB/mpi$ sudo perf stat ./mutex 6
Sum Calculated by Thread No. 1 is 41917
Sum Calculated by Thread No. 0 is 14028
Sum Calculated by Thread No. 2 is 69806
Sum Calculated by Thread No. 4 is 124749
Sum Calculated by Thread No. 3 is 97695
Sum Calculated by Thread No. 5 is 152305
Total Sum: 500500
Shared Sum: 500500
Performance counter stats for './mutex 6':
2.73 msec task-clock # 0.826 CPUs utilized
32 context-switches # 0.012 M/sec
2 cpu-migrations # 0.733 K/sec
92 page-faults # 0.034 M/sec
43,88,808 cycles # 1.608 GHz
12,18,801 stalled-cycles-frontend # 27.77% frontend cycles idle
13,98,458 stalled-cycles-backend # 31.86% backend cycles idle
19,10,284 instructions # 0.44 insn per cycle
0.73 stalled cycles per insn
3,99,869 branches # 146.497 M/sec
22,332 branch-misses # 5.58% of all branches
0.003305126 seconds time elapsed
0.000000000 seconds user
0.003461000 seconds sys

1 :openmp Semaphores

Code

```c
#include <stdio.h>
#include <stdlib.h>
#include <semaphore.h>
#include <omp.h>

int main(int argc, char** argv){

    if(argc < 2) {
        printf("Enter the correct arguments\n");
        return 1;
    }
    int threads = atoi(argv[1]);
    omp_set_num_threads(threads);

    int partial_Sum, total_Sum = 0, shared_sum = 0;
    sem_t semaphore;
    sem_init(&semaphore, 0, 1);

    #pragma omp parallel private(partial_Sum) shared(total_Sum, shared_sum)
    {
        partial_Sum = 0;

        #pragma omp for
        for(int i = 1; i <= 1000; i++){
            partial_Sum += i;
            sem_wait(&semaphore);
            shared_sum += i;
            sem_post(&semaphore);
        }

        #pragma omp critical
        {
            printf("Sum Calculated by Thread No. %d is %d\n", omp_get_thread_num(), partial_Sum);
            total_Sum += partial_Sum;
        }
    }
    sem_destroy(&semaphore);
    printf("Total Sum: %d\n", total_Sum);
    printf("Shared Sum: %d\n", shared_sum);
    return 0;
}
```

Output

```
hp@aditi:~/Desktop/BTech/PCAP/LAB/mpi$ sudo perf stat ./sem 2
Sum Calculated by Thread No. 1 is 375250
Sum Calculated by Thread No. 0 is 125250
Total Sum: 500500
Shared Sum: 500500

 Performance counter stats for './sem 2':

              2.48 msec task-clock                #    0.934 CPUs utilized
                 4      context-switches          #    0.002 M/sec
                 0      cpu-migrations            #    0.000 K/sec
                84      page-faults               #    0.034 M/sec
        43,42,244      cycles                    #    1.749 GHz
         9,32,871      stalled-cycles-frontend   #   21.48% frontend cycles idle
        13,58,633      stalled-cycles-backend    #   31.29% backend cycles idle
        24,09,258      instructions              #    0.55  insn per cycle
                                                 #    0.56  stalled cycles per insn
         5,57,002      branches                  #  224.352 M/sec
           16,271      branch-misses             #    2.92% of all branches

       0.002656752 seconds time elapsed

       0.003084000 seconds user
       0.000000000 seconds sys
```

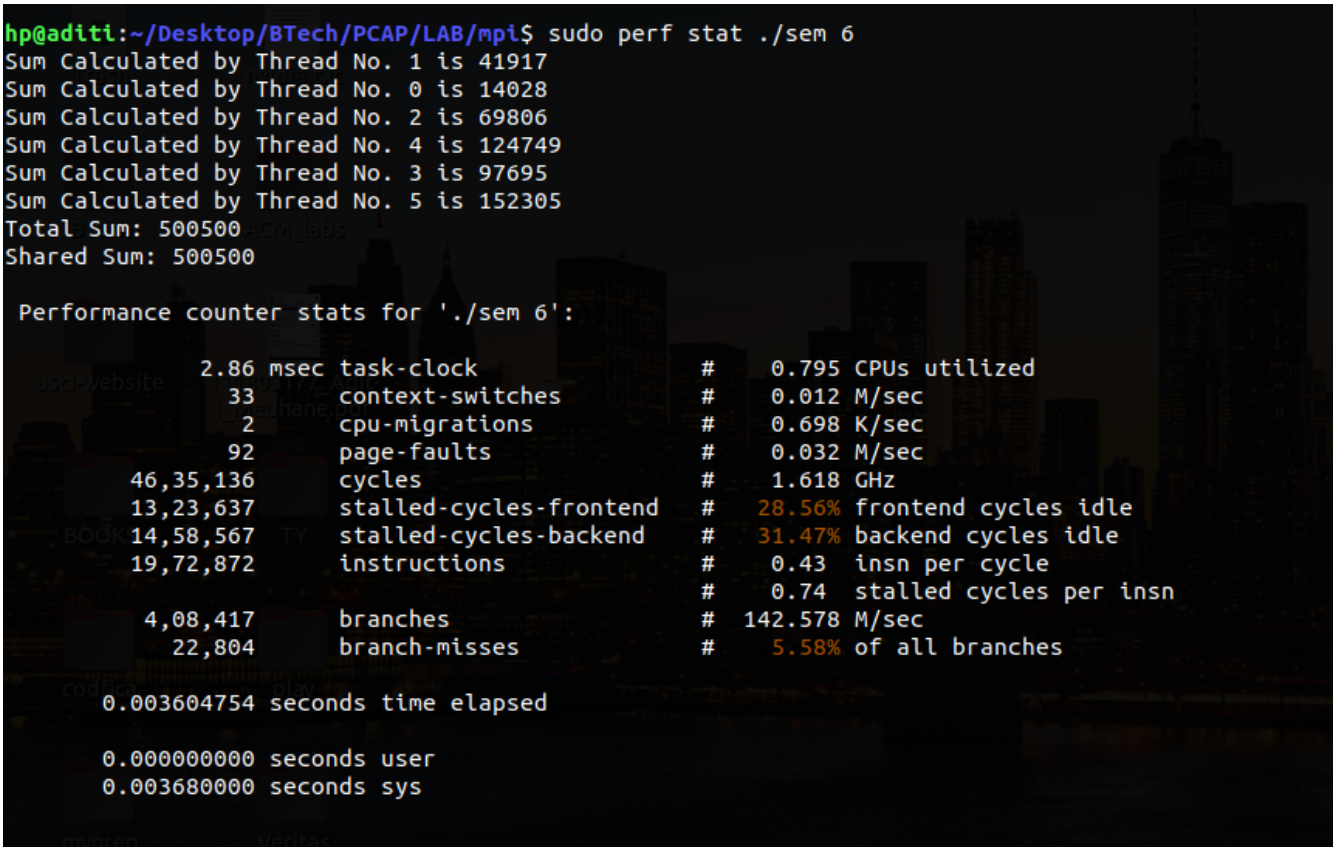
```
hp@aditi:~/Desktop/BTech/PCAP/LAB/mpi$ sudo perf stat ./sem 4
Sum Calculated by Thread No. 1 is 93875
Sum Calculated by Thread No. 0 is 31375
Sum Calculated by Thread No. 2 is 156375
Sum Calculated by Thread No. 3 is 218875
Total Sum: 500500
Shared Sum: 500500

 Performance counter stats for './sem 4':

              2.31 msec task-clock                #    0.848 CPUs utilized
                22      context-switches          #    0.010 M/sec
                 1      cpu-migrations            #    0.433 K/sec
                89      page-faults               #    0.039 M/sec
        44,84,884      cycles                    #    1.943 GHz
        11,66,439      stalled-cycles-frontend   #   26.01% frontend cycles idle
        15,13,853      stalled-cycles-backend    #   33.75% backend cycles idle
        18,30,733      instructions              #    0.41  insn per cycle
                                                 #    0.83  stalled cycles per insn
         3,74,733      branches                  #  162.367 M/sec
           19,676      branch-misses             #    5.25% of all branches

       0.002721191 seconds time elapsed

       0.002897000 seconds user
       0.000000000 seconds sys
```


hp@aditi:~/Desktop/BTech/PCAP/LAB/mpi$ sudo perf stat ./sem 6
Sum Calculated by Thread No. 1 is 41917
Sum Calculated by Thread No. 0 is 14028
Sum Calculated by Thread No. 2 is 69806
Sum Calculated by Thread No. 4 is 124749
Sum Calculated by Thread No. 3 is 97695
Sum Calculated by Thread No. 5 is 152305
Total Sum: 500500
Shared Sum: 500500
Performance counter stats for './sem 6':
2.86 msec task-clock # 0.795 CPUs utilized
33 context-switches # 0.012 M/sec
2 cpu-migrations # 0.698 K/sec
92 page-faults # 0.032 M/sec
46,35,136 cycles # 1.618 GHz
13,23,637 stalled-cycles-frontend # 28.56% frontend cycles idle
14,58,567 stalled-cycles-backend # 31.47% backend cycles idle
19,72,872 instructions # 0.43 insn per cycle
0.74 stalled cycles per insn
4,08,417 branches # 142.578 M/sec
22,804 branch-misses # 5.58% of all branches
0.003604754 seconds time elapsed
0.000000000 seconds user
0.003680000 seconds sys