CN Assignment 2 - Report

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Q1.

```
het@het:~/Desktop/CN/pa2/pa2/q1$ taskset -c 0 ./server 8080
Server setup successful, listening port 8080
Handling client in thread: 252470615929248
Client request: GET_TOP_CPU_PROCESSES
Handling client in thread: 252470605443488
Client request: GET_TOP_CPU_PROCESSES
Handling client in thread: 252470523654560
Client request: GET_TOP_CPU_PROCESSES
Handling client in thread: 252470513168800
Client request: GET_TOP_CPU_PROCESSES
```

```
het@het:~/Desktop/CN/pa2/pa2/q1$ taskset -c 1 ./client 4
Thread ID: 256267314590112 is connecting to server
Thread ID: 256267304104352 is connecting to server
Thread ID: 256267293618592 is connecting to server
Thread ID: 256267283132832 is connecting to server
Thread ID: 256267314590112 - Response from server:
Process 1: gnome-shell (PID: 1889), User Time: 4819, Kernel Time: 4797
Process 2: code (PID: 3579), User Time: 8041, Kernel Time: 1428

Thread ID: 256267304104352 - Response from server:
Process 1: gnome-shell (PID: 1889), User Time: 4819, Kernel Time: 4797
Process 2: code (PID: 3579), User Time: 8041, Kernel Time: 1428

Thread ID: 256267293618592 - Response from server:
Process 1: gnome-shell (PID: 1889), User Time: 4819, Kernel Time: 4797
Process 2: code (PID: 3579), User Time: 8041, Kernel Time: 1428

Thread ID: 256267283132832 - Response from server:
Process 1: gnome-shell (PID: 1889), User Time: 4819, Kernel Time: 4797
Process 2: code (PID: 3579), User Time: 8041, Kernel Time: 1428
```

Q2 (a).

Performance data observed for the client:
task clock = 12.22 msec
Context switched = 27
Cpu migrations = 0
Page faults = 838
cycles= 30735067
Instructions = 16716368
Branches = 3749454
Branch misses = 397814
Elapsed time = 0.0151 sec
screenshot:

```
himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/a_b$ sudo /usr/lib/linux-tools/6.8.0-45-generic/perf stat sudo taskset
 -c 1 ./client 1
Thread ID: 140653384615616 is connecting to server
Thread ID: 140653384615616 - Response from server:
Process 1: systemd-udevd (PID: 72), User Time: 62, Kernel Time: 132
Process 2: systemd (PID: 1), User Time: 59, Kernel Time: 60


 Performance counter stats for 'sudo taskset -c 1 ./client 1':

            12.22 msec task-clock                       #    0.805 CPUs utilized
               27      context-switches                 #    2.210 K/sec
                0      cpu-migrations                   #    0.000 /sec
              838      page-faults                      #   68.585 K/sec
         30735067      cycles                           #    2.515 GHz
           302243      stalled-cycles-frontend          #    0.98% frontend cycles idle
          3875664      stalled-cycles-backend           #   12.61% backend cycles idle
         16716368      instructions                     #    0.54  insn per cycle
                                                  #    0.23  stalled cycles per insn
          3749454      branches                         #  306.867 M/sec
           397814      branch-misses                    #   10.61% of all branches

       0.015180120 seconds time elapsed

       0.000000000 seconds user
       0.008440000 seconds sys


himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/a_b$
```

Performance data observed for server:
task clock = 14.31 msec
Context switched = 28
Cpu migrations = 1
Page faults = 871
cycles= 34717090
Instructions = 359148
Branches = 4003141
Branch misses = 426320
Screenshot:

```
himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/a_b$ sudo /usr/lib/linux-tools/6.8.0-45-generic/perf stat sudo taskset -c 0 ./serve
r 8080
[sudo] password for himang:
Server setup successful, listening on port 8080
Client request: GET_TOP_CPU_PROCESSES
^Csudo: Interrupt

 Performance counter stats for 'sudo taskset -c 0 ./server 8080':

            14.31 msec task-clock                       #    0.001 CPUs utilized
               28      context-switches                 #    1.957 K/sec
                1      cpu-migrations                   #   69.896 /sec
              871      page-faults                      #   60.879 K/sec
         34717090      cycles                           #    2.427 GHz
           359148      stalled-cycles-frontend          #    1.03% frontend cycles idle
          5249038      stalled-cycles-backend           #   15.12% backend cycles idle
         17822336      instructions                     #    0.51  insn per cycle
                                                  #    0.29  stalled cycles per insn
          4003141      branches                         #  279.803 M/sec
           426320      branch-misses                    #   10.65% of all branches

      27.163491889 seconds time elapsed

       0.010181000 seconds user
       0.000000000 seconds sys


himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/a_b$
```

Observations and analysis:

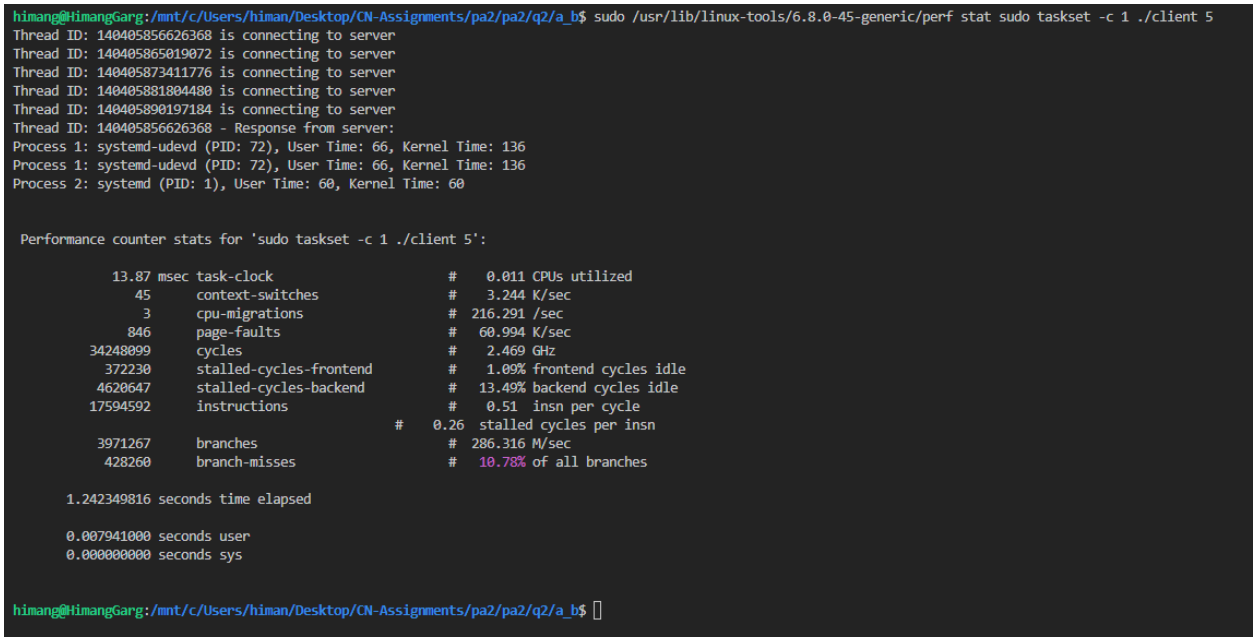
1. Requests are processed one at a time in a sequential manner using the single-threaded approach.
2. The number of context switches is high.
3. Page faults and CPU migrations are lowest.
4. Cycles, instructions, and branch mispredictions indicate that the performance is mainly influenced by the linear execution of the operations.

(b)

Performance data observed for the 5 clients:

task clock = 13.87 msec
Context switched = 45
Cpu migrations = 3
Page faults = 846
cycles= 34248099
Instructions = 17594592
Branches = 3971267
Branch misses = 428260
Elapsed time = 1.2423 sec

Screenshot:



Performance data observed for the server:

task clock = 16.38 msec
Context switched = 39
Cpu migrations = 2
Page faults = 879
cycles= 41746016
Instructions = 22577421
Branches = 5090841
Branch misses = 522533
screenshot:

```
himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/a_b$ sudo /usr/lib/linux-tools/6.8.0-45-generic/perf stat sudo taskset -c 0 ./server 8080
[sudo] password for himang:
Sorry, try again.
[sudo] password for himang:
Server setup successful, listening on port 8080
Client request: GET_TOP_CPU_PROCESSES
Client request: GET_TOP_CPU_PROCESSES
Client request: GET_TOP_CPU_PROCESSES
Client request: GET_TOP_CPU_PROCESSES
Client request: GET_TOP_CPU_PROCESSES
^Csudo: Interrupt

 Performance counter stats for 'sudo taskset -c 0 ./server 8080':

            16.38 msec task-clock                       #    0.000 CPUs utilized
               39      context-switches                 #    2.381 K/sec
                2      cpu-migrations                   #  122.119 /sec
              879      page-faults                      #   53.671 K/sec
         41746016      cycles                           #    2.549 GHz
           392141      stalled-cycles-frontend          #    0.94% frontend cycles idle
          6998095      stalled-cycles-backend           #   16.76% backend cycles idle
         22577421      instructions                     #    0.54  insn per cycle
                                                  #    0.31  stalled cycles per insn
          5090841      branches                         #  310.844 M/sec
           522533      branch-misses                    #   10.26% of all branches

      62.810243380 seconds time elapsed

       0.009336000 seconds user
       0.000000000 seconds sys

himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/a_b$
```

Observations and analysis:

1. The number of context switches have increased for client side.
2. The task time has decreased slightly for both the client and server.
3. Page faults and CPU migrations are approximately same.
4. The number of cycles are increased.

(c)

Performance data observed for the client:

task clock = 8.97 msec
Context switched = 25
Cpu migrations = 2
Page faults = 816
cycles= 27211238
Instructions = 16339942
Branches = 3656608
Branch misses = 365930
Elapsed time = 0.011 sec
screenshot:

```
himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/c$ sudo /usr/lib/linux-tools/6.8.0-45-generic/perf stat sudo taskset -c 1 ./client
Usage: ./client <n_clients>

 Performance counter stats for 'sudo taskset -c 1 ./client':

              8.97 msec task-clock                       #    0.811 CPUs utilized
                25      context-switches                 #    2.786 K/sec
                 1      cpu-migrations                   #  111.442 /sec
               816      page-faults                      #   90.936 K/sec
          27211238      cycles                           #    3.032 GHz
            212822      stalled-cycles-frontend          #    0.78% frontend cycles idle
           2000608      stalled-cycles-backend           #    7.35% backend cycles idle
          16339942      instructions                     #    0.60  insn per cycle
                                                  #    0.12  stalled cycles per insn
           3656608      branches                         #  407.499 M/sec
            365930      branch-misses                    #   10.01% of all branches

       0.011059559 seconds time elapsed

       0.006082000 seconds user
       0.000000000 seconds sys


himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/c$
```

Performance data observed for the server:

task clock = 9.78 msec
Context switched = 28
Cpu migrations = 2
Page faults = 801
cycles= 27758963
Instructions = 16371882
Branches = 3668591
Branch misses = 366550
screenshot:

```
himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/c$ sudo /usr/lib/linux-tools/6.8.0-45-generic/perf stat sudo taskset -c 0 ./server 8080
Server setup successful, listening on port 8080
^Csudo: Interrupt

 Performance counter stats for 'sudo taskset -c 0 ./server 8080':

              9.78 msec task-clock                       #    0.000 CPUs utilized
                28      context-switches                 #    2.864 K/sec
                 2      cpu-migrations                   #  204.555 /sec
               801      page-faults                      #   81.924 K/sec
          27758963      cycles                           #    2.839 GHz
            237709      stalled-cycles-frontend          #    0.86% frontend cycles idle
           3096900      stalled-cycles-backend           #   11.16% backend cycles idle
          16371882      instructions                     #    0.59  insn per cycle
                                                  #    0.19  stalled cycles per insn
           3668591      branches                         #  375.215 M/sec
            366550      branch-misses                    #    9.99% of all branches

      71.769274054 seconds time elapsed

       0.001962000 seconds user
       0.004659000 seconds sys


himang@HimangGarg:/mnt/c/Users/himan/Desktop/CN-Assignments/pa2/pa2/q2/c$
```

Observations and analysis:

1. Task clock values are lowest.
2. Context switches are nearly same.
3. Cycles, instructions, and branch misses are slightly lower.

Performance Evaluation:

1. Most optimal in terms of task clock time, cycles, and context switches:n select-based model is the top choice for managing numerous clients with limited resource usage.

2. Ideal for ease of use: The single-threaded approach is easier to execute but not ideal for handling many concurrent tasks.

3. Best choice for scalability utilizing threads: The concurrent approach can handle numerous clients but requires more resources like context switches and branch misses.