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Assignment 2

3
  a. Sequential server

```
    The server sent the data: 121645100408832000
    the client sent: 20
    The server sent the data: 121645100408832000
    the client sent: 20
    The server sent the data: 2432902008176640000
    The server sent the data: 2432902008176640000

    real    0m0.064s
    user    0m0.004s
    sys     0m0.045s
  mrishika@mrishika-virtual-machine:~/Documents/CN_Assign2$
```

Concurrent server - Fork

```
    the client sent: 18
    The server sent the data: 6402373705728000
    the client sent: 19
    The server sent the data: 121645100408832000
    the client sent: 20
    The server sent the data: 2432902008176640000

    real    0m0.074s
    user    0m0.009s
    sys     0m0.044s
  mrishika@mrishika-virtual-machine:~/Documents/CN_Assign2$
```

Concurrent server - Multithreading

```
    the client sent: 19
    the client sent: 20
    The server sent the data: 2432902008176640000
    The server sent the data: 121645100408832000
    the client sent: 20
    The server sent the data: 2432902008176640000

    real    0m0.096s
    user    0m0.000s
    sys     0m0.062s
  mrishika@mrishika-virtual-machine:~/Documents/CN_Assign2$
```

Server select

```
   The server sent the data: 6402373705728000
   the client sent: 19
   The server sent the data: 121645100408832000
   the client sent: 20
   The server sent the data: 2432902008176640000

   real    0m0.086s
   user    0m0.016s
   sys     0m0.031s
   mrishika@mrishika-virtual-machine:~/Documents/
   CN Assign2$
```

Server Poll

```
   the client sent: 20
   The server sent the data: 121645100408832000
   The server sent the data: 2432902008176640000
   The server sent the data: 2432902008176640000
   the client sent: 20
   The server sent the data: 2432902008176640000

   real    0m0.066s
   user    0m0.011s
   sys     0m0.036s
   mrishika@mrishika-virtual-machine:~/Documents/CN_Assign2$
```
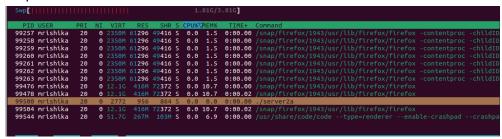
Server Epoll

```
   The server sent the data: 6402373705728000
   the client sent: 19
   The server sent the data: 121645100408832000
   the client sent: 20
   The server sent the data: 2432902008176640000

   real    0m0.060s
   user    0m0.006s
   sys     0m0.041s
   mrishika@mrishika-virtual-machine:~/Documents/
   CN Assign2$
```
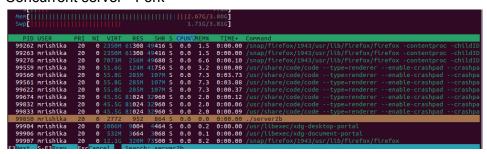
b. The observations after running htop for all servers are attached below.

Sequential server

```
Swp[||||||||||||||||||||||||||                              1.81G/3.81G]

  PID USER       PRI  NI  VIRT   RES   SHR S CPU%▽MEM%   TIME+  Command
99257 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99258 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99259 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99260 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99261 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99262 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99263 mrishika    20   0 2350M 61296 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99476 mrishika    20   0 12.1G  416M 72372 S  0.0 10.7  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox
99478 mrishika    20   0 12.1G  416M 72372 S  0.0 10.7  0:00.02 /snap/firefox/1943/usr/lib/firefox/firefox
99500 mrishika    20   0  2772   956   864 S  0.0  0.0  0:00.00 ./server2a
99504 mrishika    20   0 12.1G  416M 72372 S  0.0 10.7  0:00.02 /snap/firefox/1943/usr/lib/firefox/firefox
99544 mrishika    20   0 51.7G  267M  103M S  0.0  6.9  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
```
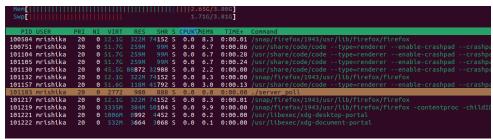
Concurrent server - Fork

```
Mem[||||||||||||||||||||||||||||||||||||||||||||||||||2.67G/3.80G]
Swp[||||||||||||||||||||||||||||                       1.71G/3.81G]

  PID USER       PRI  NI  VIRT   RES   SHR S CPU%▽MEM%   TIME+  Command
99262 mrishika    20   0 2350M 61308 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99263 mrishika    20   0 2350M 61308 49416 S  0.0  1.5  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99276 mrishika    20   0 7073M  256M 49680 S  0.0  6.6  0:00.10 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
99559 mrishika    20   0 51.6G  124M 41756 S  0.0  3.2  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99560 mrishika    20   0 55.8G  285M  107M S  0.0  7.3  0:03.73 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99561 mrishika    20   0 55.8G  285M  107M S  0.0  7.3  0:03.88 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99622 mrishika    20   0 55.8G  285M  107M S  0.0  7.3  0:00.37 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99674 mrishika    20   0 45.5G 81024 32960 S  0.0  2.0  0:00.12 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99832 mrishika    20   0 45.5G 81024 32960 S  0.0  2.0  0:00.06 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99833 mrishika    20   0 45.5G 81024 32960 S  0.0  2.0  0:00.09 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
99850 mrishika    20   0  2772   952   864 S  0.0  0.0  0:00.00 ./server2b
99904 mrishika    20   0 1006M  9004  4464 S  0.0  0.2  0:00.00 /usr/libexec/xdg-desktop-portal
99906 mrishika    20   0  532M  3664  3068 S  0.0  0.1  0:00.00 /usr/libexec/xdg-document-portal
99907 mrishika    20   0 12.1G  320M 73500 S  0.0  8.2  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox
F3Next  S-F3Prev   EscCancel    Search: server2b
```

Concurrent server - Multithreading

```
 2[||||                                      4.6%]   Uptime: 1 day, 08:07:54
 3[                                          0.0%]
Mem[|||||||||||||||||||||||||||||||||||||||||2.68G/3.80G]
Swp[||||||||||||||||||||||||||||               1.71G/3.81G]

   PID USER       PRI  NI  VIRT   RES   SHR S CPU%▽MEM%   TIME+  Command
100049 mrishika    20   0 12.1G  321M 73764 S  0.0  8.3  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox
100094 mrishika    20   0 45.5G 84040 33008 S  0.0  2.1  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
100369 mrishika    39  19  773M 22312  7372 S  0.0  0.6  0:00.00 /usr/libexec/tracker-miner-fs-3
100370 mrishika    20   0 51.6G  119M 41768 S  0.0  3.1  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
100371 mrishika    20   0 51.6G  119M 41768 S  0.0  3.1  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
100377 mrishika    20   0 45.5G 84040 33008 S  0.0  2.1  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
100378 mrishika    20   0  2772  1040   948 S  0.0  0.0  0:00.00 ./server2c
100379 mrishika    20   0 45.5G 84040 33008 S  0.0  2.1  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
100415 mrishika    20   0 1006M  9004  4464 S  0.0  0.2  0:00.00 /usr/libexec/xdg-desktop-portal
100416 mrishika    20   0  532M  3664  3068 S  0.0  0.1  0:00.00 /usr/libexec/xdg-document-portal
```

Server select

```
Swp[||||||||||||||||||||||||||                         1.71G/3.81G]

   PID USER       PRI  NI  VIRT   RES   SHR S CPU%▽MEM%   TIME+  Command
100975 mrishika    20   0 45.5G 87412 32988 S  0.0  2.2  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
100976 mrishika    20   0 45.5G 87412 32988 S  0.0  2.2  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101013 mrishika    20   0 12.1G  322M 74152 S  0.0  8.3  0:00.02 /snap/firefox/1943/usr/lib/firefox/firefox
101014 mrishika    20   0 12.1G  322M 74152 S  0.0  8.3  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox
101051 mrishika    20   0 51.6G  125M 41792 S  0.0  3.2  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101052 mrishika    20   0 51.6G  125M 41792 S  0.0  3.2  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101065 mrishika    20   0  2772   944   852 S  0.0  0.0  0:00.00 ./server_select
101076 mrishika    39  19  773M 20652  7372 S  0.0  0.5  0:00.06 /usr/libexec/tracker-miner-fs-3
101099 mrishika    20   0 33.0G 17324 15496 S  0.0  0.4  0:00.00 /usr/share/code/code --type=utility --utility-sub-type=network.m
101100 mrishika    20   0 37.7G  102M 52084 S  0.0  2.6  0:00.00 /usr/share/code/code --unity-launch --enable-crashpad
101101 mrishika    20   0  532M  3664  3068 S  0.0  0.1  0:00.00 /usr/libexec/xdg-document-portal
101103 mrishika    20   0 1006M  8992  4452 S  0.0  0.2  0:00.00 /usr/libexec/xdg-desktop-portal
```
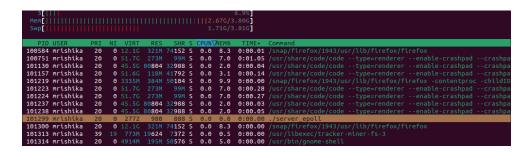
Server Poll

```
Mem[|||||||||||||||||||||||||||||||||||||||||2.65G/3.80G]
Swp[|||||||||||||||||||||||||             1.71G/3.81G]

  PID USER      PRI  NI  VIRT   RES   SHR S CPU%▽MEM%   TIME+  Command
100584 mrishika   20   0 12.1G  322M 74152 S  0.0  8.3  0:00.01 /snap/firefox/1943/usr/lib/firefox/firefox
100751 mrishika   20   0 51.7G  259M   99M S  0.0  6.7  0:00.86 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101104 mrishika   20   0 51.7G  259M   99M S  0.0  6.7  0:00.28 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101105 mrishika   20   0 51.7G  259M   99M S  0.0  6.7  0:00.24 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101130 mrishika   20   0 45.5G 88872 32988 S  0.0  2.2  0:00.00 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101132 mrishika   20   0 12.1G  322M 74152 S  0.0  8.3  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox
101157 mrishika   20   0 51.6G  118M 41792 S  0.0  3.0  0:00.13 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101183 mrishika   20   0  2772   980   888 S  0.0  0.0  0:00.00 ./server_poll
101217 mrishika   20   0 12.1G  322M 74152 S  0.0  8.3  0:00.01 /snap/firefox/1943/usr/lib/firefox/firefox
101219 mrishika   20   0 3335M  384M 50104 S  0.0  9.9  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
101221 mrishika   20   0 1006M  8992  4452 S  0.0  0.2  0:00.00 /usr/libexec/xdg-desktop-portal
101222 mrishika   20   0  532M  3664  3068 S  0.0  0.1  0:00.00 /usr/libexec/xdg-document-portal
```

Server Epoll

```
  3[||||                                            6.9%]
Mem[|||||||||||||||||||||||||||||||||||||||||||||2.67G/3.80G]
Swp[|||||||||||||||||||||||||             1.71G/3.81G]

  PID USER      PRI  NI  VIRT   RES   SHR S CPU%▽MEM%   TIME+  Command
100584 mrishika   20   0 12.1G  321M 74152 S  0.0  8.3  0:00.01 /snap/firefox/1943/usr/lib/firefox/firefox
100751 mrishika   20   0 51.7G  273M   99M S  0.0  7.0  0:01.05 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101130 mrishika   20   0 45.5G 80804 32988 S  0.0  2.0  0:00.04 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101157 mrishika   20   0 51.6G  118M 41792 S  0.0  3.1  0:00.14 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101219 mrishika   20   0 3335M  384M 50104 S  0.0  9.9  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox -contentproc -childID
101223 mrishika   20   0 51.7G  273M   99M S  0.0  7.0  0:00.28 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101224 mrishika   20   0 51.7G  273M   99M S  0.0  7.0  0:00.27 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101237 mrishika   20   0 45.5G 80804 32988 S  0.0  2.0  0:00.03 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101238 mrishika   20   0 45.5G 80804 32988 S  0.0  2.0  0:00.05 /usr/share/code/code --type=renderer --enable-crashpad --crashpa
101299 mrishika   20   0  2772   980   888 S  0.0  0.0  0:00.00 ./server_epoll
101300 mrishika   20   0 12.1G  321M 74152 S  0.0  8.3  0:00.00 /snap/firefox/1943/usr/lib/firefox/firefox
101313 mrishika   39  19  773M 19624  7372 S  0.0  0.5  0:00.00 /usr/libexec/tracker-miner-fs-3
101314 mrishika   20   0 4914M  195M 50576 S  0.0  5.0  0:00.00 /usr/bin/gnome-shell
```

4.

Time justifications
- Multiple threads allows us to do work while other threads are sleeping, this increases the efficiency but also the turnaround time is more than fork.
- Epoll is generally faster than poll, once there are many file descriptors to monitor.
- Poll is faster than select since select forces scan over all the bitmasks to find the exact file descriptor, whereas poll and epoll don't do that.

CPU and Memory
Every server shows 0.0 for both CPU and Memory utilization, since the server stops as soon as we run the client process. But the observations for the same are attached above.

/// References used ///

- Tutorial code
- GFG