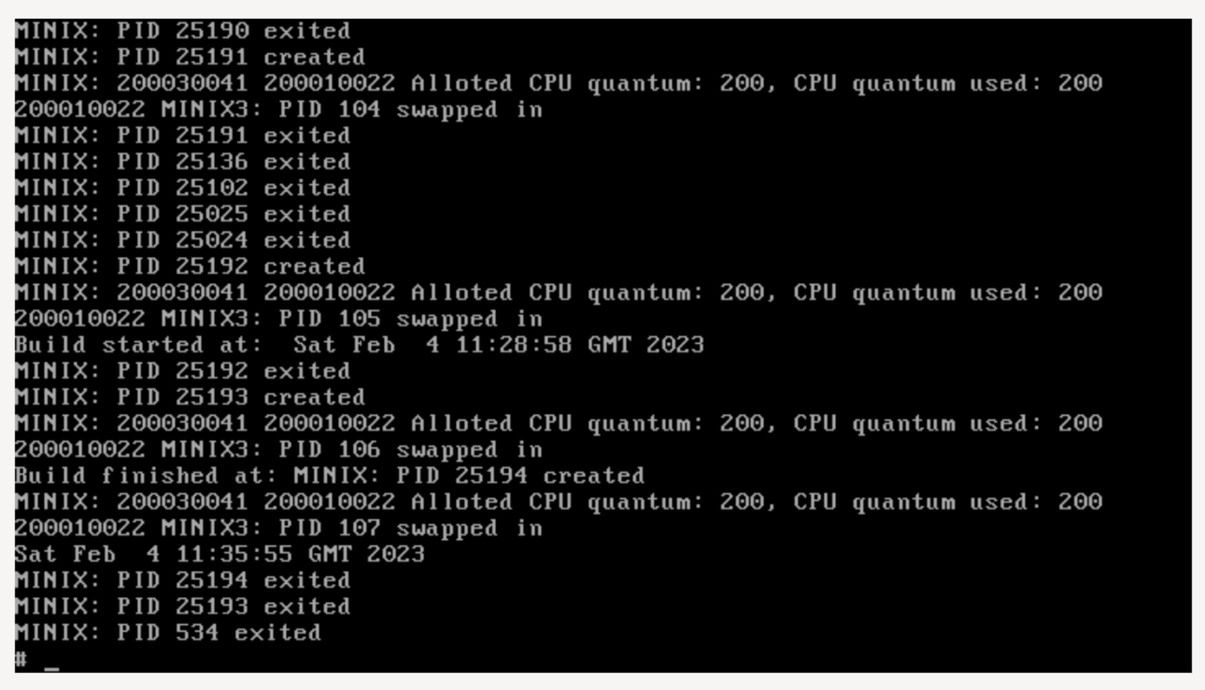
Operating Systems Laboratory

Lab 5 Report

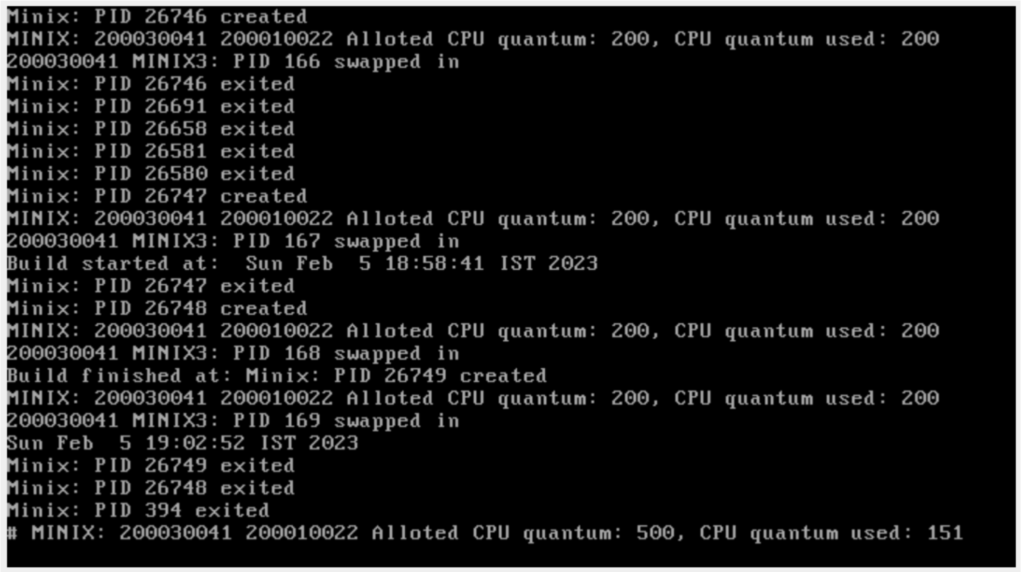
Pavan Kumar V Patil 200030041
Karthik J Ponarkar 200010022

February 5, 2023



```
MINIX: PID 25190 exited
MINIX: PID 25191 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 104 swapped in
MINIX: PID 25191 exited
MINIX: PID 25136 exited
MINIX: PID 25102 exited
MINIX: PID 25025 exited
MINIX: PID 25024 exited
MINIX: PID 25192 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 105 swapped in
Build started at:  Sat Feb  4 11:28:58 GMT 2023
MINIX: PID 25192 exited
MINIX: PID 25193 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 106 swapped in
Build finished at: MINIX: PID 25194 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 107 swapped in
Sat Feb  4 11:35:55 GMT 2023
MINIX: PID 25194 exited
MINIX: PID 25193 exited
MINIX: PID 534 exited
# _
```

Figure 1: Output of make build part 1



```
Minix: PID 26746 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200030041 MINIX3: PID 166 swapped in
Minix: PID 26746 exited
Minix: PID 26691 exited
Minix: PID 26658 exited
Minix: PID 26581 exited
Minix: PID 26580 exited
Minix: PID 26747 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200030041 MINIX3: PID 167 swapped in
Build started at:  Sun Feb  5 18:58:41 IST 2023
Minix: PID 26747 exited
Minix: PID 26748 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200030041 MINIX3: PID 168 swapped in
Build finished at: Minix: PID 26749 created
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200030041 MINIX3: PID 169 swapped in
Sun Feb  5 19:02:52 IST 2023
Minix: PID 26749 exited
Minix: PID 26748 exited
Minix: PID 394 exited
# MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 151
```

Figure 2: Output of make build part 2

1 Part 1

Task: Prepare workload mixes having different characteristics, ranging from all compute-intensive benchmarks to all I/O-intensive benchmarks. Each workload should spawn around 5 processes. You can compose these workloads of benchmarks from the UnixBench suite, or write your own.

- We have created 4 workload mix files each of which contains processes ranging from computationally intensive tasks to I/O bound tasks. Each of these workloads spawns around 6 processes (like arithoh, fstime, syscall, etc..).
- To get the required features of a process for the analysis on UnixBench, the file `system.c` present in `minix/kernel` directory was modified.
- In the `sched_proc` function, the following piece of code was added to print the information about the time quanta allocation and usage by a currently executing process. In the `sched_proc` function, the following print statements were added just before the definition check of `CONFIG_SMP`.

```
    // system.c
    unsigned cpu_total_time = p->p_quantum_size_ms;
    unsigned cpu_time_used =  cpu_total_time - cpu_time_2_ms(p->p_cpu_time_left);
    printf("MINIX: 200030041 200010022 Alloted CPU quantum: %d, CPU quantum used: %d\n",
        cpu_total_time, cpu_time_used);
```

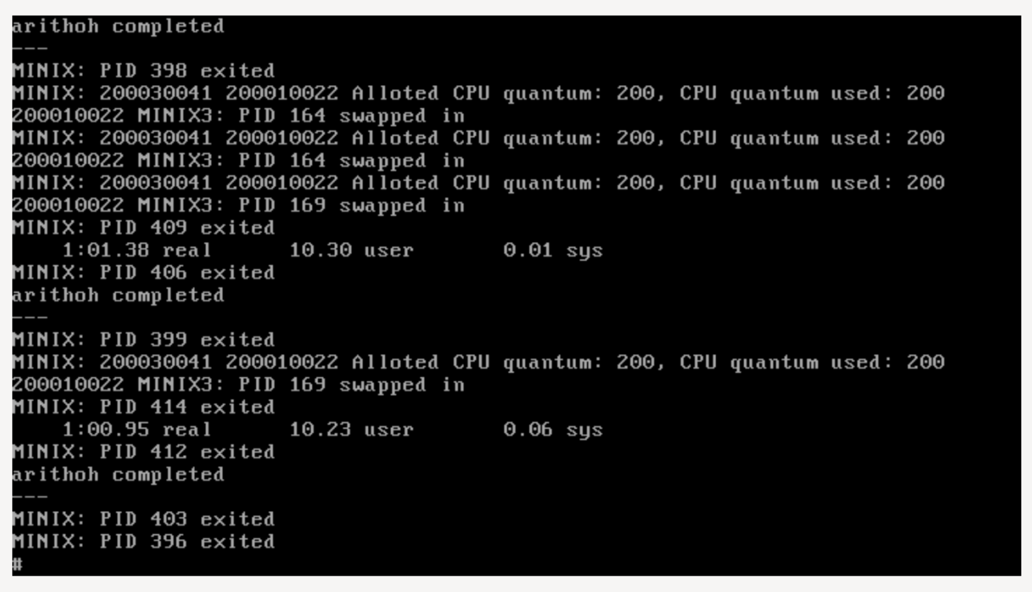
- If the `src` in minix operating system is not initialized with git, executing the script will modify the src directory with the required changes in system.c. The script and modified system.c files should be in the same directory in mininx os.

```
    # runme.sh
    rm -f /usr/src/minix/kernel/system.c
    rm -f /usr/src/minix/servers/sched/schedule.c
    mv schedule.c /usr/src/minix/servers/sched
    mv system.c /usr/src/minix/kernel
    make build MKUPDATE=yes -C /usr/src
```

- How does the MINIX3 scheduler work?
  - Minix3 uses a multilevel queuing system for scheduling. Sixteen queues are defined, and the idle process uses the lowest priority queue.
  - User process starts by default in a queue several levels higher than the lowest one. Server processes have higher priorities than user processes, drivers have higher priorities than servers, and clock and system tasks have the highest priority.
  - If a process has not used its entire quantum and is blocked, then it means it got blocked waiting for i/o. After i/o is complete the process is put at the head of the queue with the remaining time quantum. The process that uses the entire time quantum is placed at the end of the queue.
  - When picking a process to run, the scheduler checks the highest priority queue. If one or more processes are ready, then the process at the head is executed. If there is no process then the next lower-level priority queue is similarly tested.
  - At each clock tick, a check is made to see if the current process has run for more than the allowed quantum. If yes, the scheduler moves the process to the end of the queue. Drivers and servers are given a time quantum large enough that the clock never preempts them.

1.a Workload mix 1

```
# workload1.sh
#!/bin/sh
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
wait
```



```
arithoh completed
---
MINIX: PID 398 exited
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 164 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 164 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 169 swapped in
MINIX: PID 409 exited
    1:01.38 real      10.30 user       0.01 sys
MINIX: PID 406 exited
arithoh completed
---
MINIX: PID 399 exited
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 169 swapped in
MINIX: PID 414 exited
    1:00.95 real      10.23 user       0.06 sys
MINIX: PID 412 exited
arithoh completed
---
MINIX: PID 403 exited
MINIX: PID 396 exited
#
```

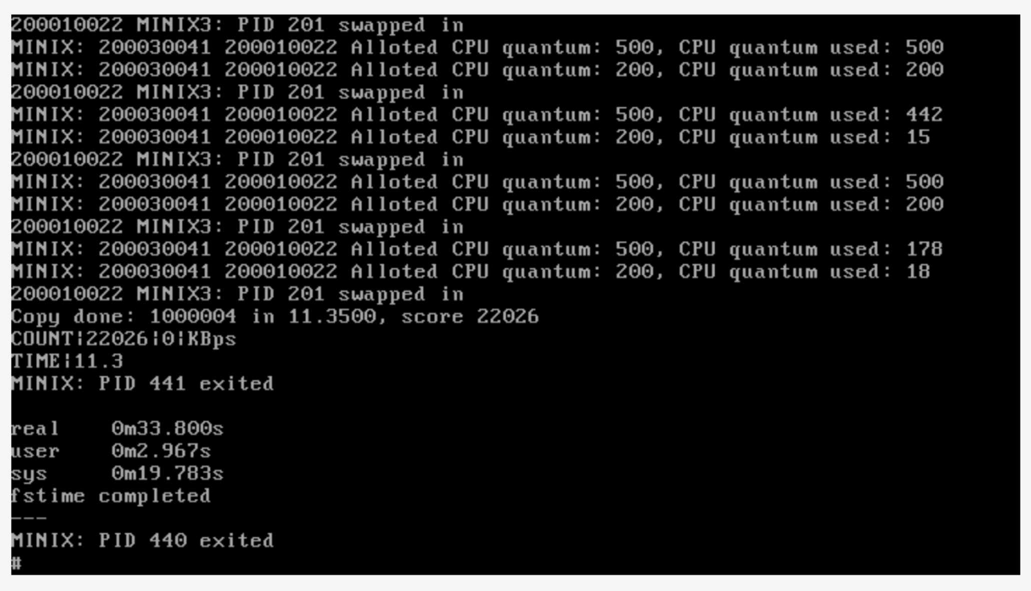
Figure 3: Output of workload mix 1

OBSERVATION:

- The processes in this workload are CPU intensive. Most of the processes in this workload use all of their CPU quanta.
- After a process has used its allocated time quanta, it is preempted, and a new process is brought into the CPU by the schedular which follows Round Robin policy by default.
- In the above image, we observe that a process with PID 164, executes for 200ms and gets preempted. Immediately it is again brought in for the executing next for 200ms.
- We observe that the average time slice given to a process for this workload is 200ms and most of the processes tend to use all of this time allocated, alternatively most of the processes have CPU used quanta as 200ms.

1.b Workload mix 2

```
# workload2.sh
#!/bin/sh
./fstime.sh &
./fstime.sh &
./fstime.sh &
./fstime.sh &
./fstime.sh &
./fstime.sh &
wait
```



```
200010022 MINIX3: PID 201 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 201 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 442
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 15
200010022 MINIX3: PID 201 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 201 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 178
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 18
200010022 MINIX3: PID 201 swapped in
Copy done: 1000004 in 11.3500, score 22026
COUNT|22026|0|KBps
TIME|11.3
MINIX: PID 441 exited

real    0m33.800s
user    0m2.967s
sys     0m19.783s
fstime completed
---
MINIX: PID 440 exited
#
```

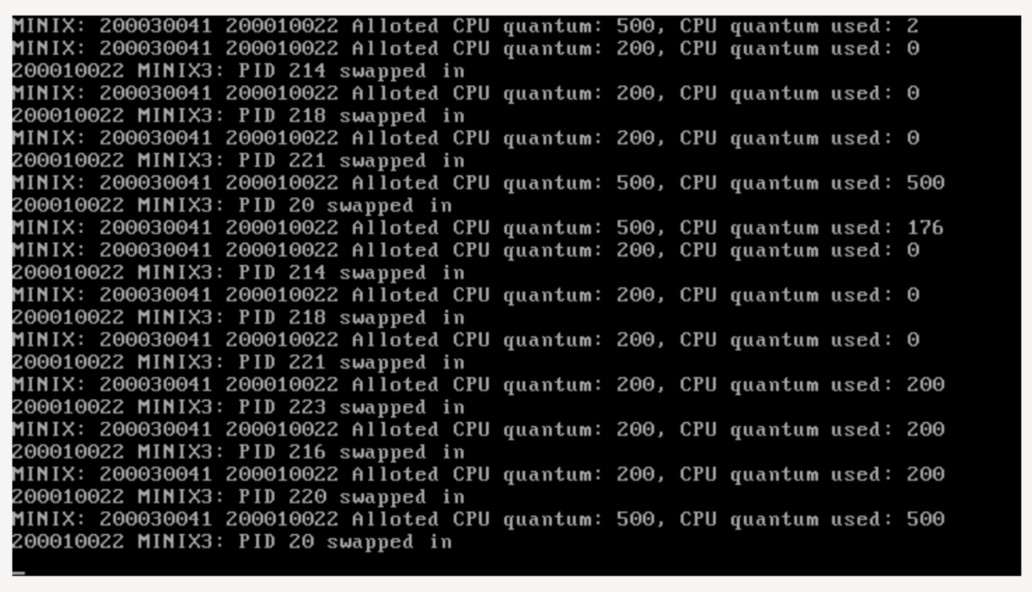
Figure 4: Output of workload mix 2

OBSERVATION:

- The processes in this workload are I/O bound. Most of the processes in this workload do not tend to use all of their CPU quanta.
- After a process has used its allocated time quanta, it is preempted, and a new process is brought into the CPU by the schedular which follows Round Robin policy by default.
- If a process does not use its entire time quanta, it is pushed to the head of the ready queue (this queue corresponds to the process's new priority).
- In the above image, we observe that a process with PID 201, executes for 178ms, gets preempted, and waits for I/O, although the time slice allocated for it was 500ms.
- We observe that most of the processes in this workload get a total time slice of 500ms, but most of them tend to use only some of the allocated time slices and wait for I/O.
- I/O bound processes are given more time slice so that they complete all of their CPU tasks in a single go.

1.c Workload mix 3

```
# workload3.sh
#!/bin/sh
./arithoh.sh &
./fstime.sh &
./arithoh.sh &
./fstime.sh &
./arithoh.sh &
./fstime.sh &
wait
```



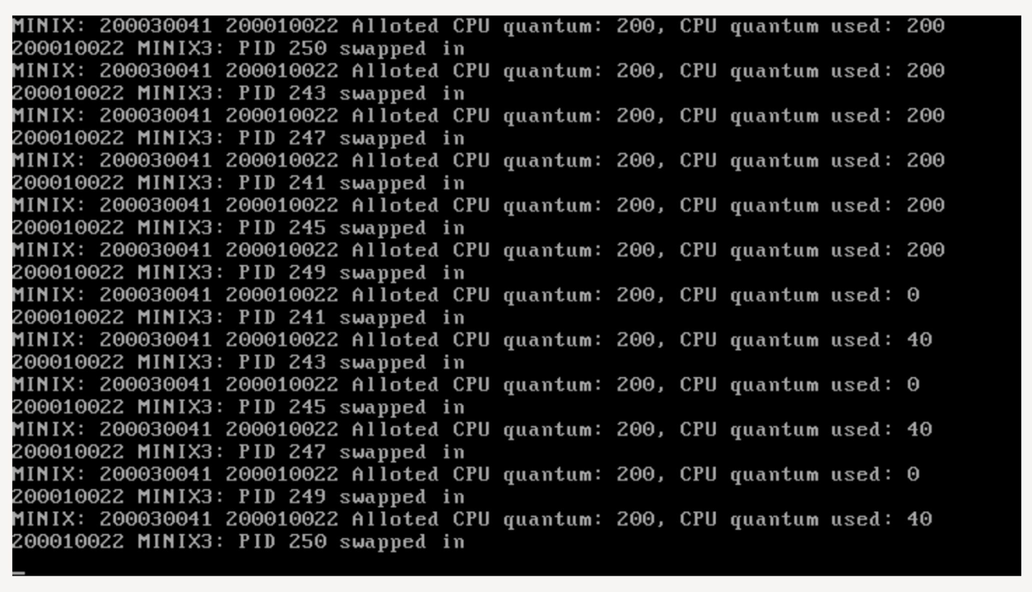
```
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 2
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 214 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 218 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 221 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
200010022 MINIX3: PID 20 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 176
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 214 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 218 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 221 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 223 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 216 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 220 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
200010022 MINIX3: PID 20 swapped in
_
```

Figure 5: Output of workload mix 3

- In the above image, the processes with a time slice of 500ms (I/O) (example process with PID 20), it does completely not use their allocated time while the process with a time slice of 200ms (CPU intensive) (example process with PID 223) tend to use all of their allotted CPU time slices.
- We observe I/O processes are given more time slices as compared to the CPU-bound processes.
- After a process has used its allocated time quanta, it is preempted, and a new process is brought into the CPU by the schedular which follows Round Robin policy by default.
- If a process does not use its entire time quanta, it is pushed to the head of the ready queue (this queue corresponds to the process's new priority).

1.d Workload mix 4

```
# workload4.sh
#!/bin/sh
./arithoh.sh &
./syscall.sh &
./arithoh.sh &
./syscall.sh &
./arithoh.sh &
./syscall.sh &
wait
```



```
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 250 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 243 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 247 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 241 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 245 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
200010022 MINIX3: PID 249 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 241 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 40
200010022 MINIX3: PID 243 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 245 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 40
200010022 MINIX3: PID 247 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 0
200010022 MINIX3: PID 249 swapped in
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 40
200010022 MINIX3: PID 250 swapped in
```

Figure 6: Output of workload mix 4

- In the workload, we have included the arithoh and syscall, arithoh is CPU intensive process but syscall is CPU bound light process (not so intensive).
- We observe that the processes that have allocated time quanta as 200ms and tend to use all of that allocated time (arithoh) are CPU-intensive processes (for example, process with PID 250).
- We observe that the processes that have allocated time quanta as 200ms and do not use most of the allocated time quanta (syscall) are CPU-bound processes that are not so intensive (for example, process with PID 241).
- After a process has used its allocated time quanta, it is preempted, and a new process is brought into the CPU by the schedular which follows Round Robin policy by default.
- If a process does not use its entire time quanta, it is pushed to the head of the ready queue (this queue corresponds to the process's new priority).

2 Part 2

Task: Modify the user-level scheduler in Minix3 to the following "Pseudo-FIFO" policy: among the user-level processes that are ready to execute, the one that entered the earliest must be scheduled.

- To modify the user-level scheduler in Minix3 to the Pseudo FIFO policy, the following changes were made in `schedule.c` in `minix/servers/sched` directory.

```
// schedule.c in do_noquantum method
if (rmp->priority != 0  && rmp->priority > 0 && rmp->priority <= MIN_USER_Q)
{
    rmp->priority -= 1;
}
//rmp->priority += 1; /* lower priority */
```

- If the priority of the process is not equal to 0, its priority is $>$ 0 and $\leq$ MIN_USER_Q, then its priority is increased. We also commented the line where the current process priority is reduced by increasing `rmp->priority` by 1.

- We also disabled the priority booster given to the other processes in the ready queue by commenting the `set_timer` function.

```
// schedule.c in do_noquantum method
void init_scheduling(void)
{
    balance_timeout = BALANCE_TIMEOUT * sys_hz();
    init_timer(&sched_timer);
    //set_timer(&sched_timer, balance_timeout, balance_queues, 0);
}
```

- `set_time` takes some parameters which consist of the function `balance_queues`, `set_timer` calls this function after every 100 ticks in order to boost the priority of the lower ready queue processes.

- By doing these changes, the processes in the higher priority queues will never come down to the lower queue and vice versa.

- This approximately implies that we are maintaining the FIFO (pseudo) policy because in actual FIFO only one queue is maintained and the process that arrives first in this queue, has to execute first.

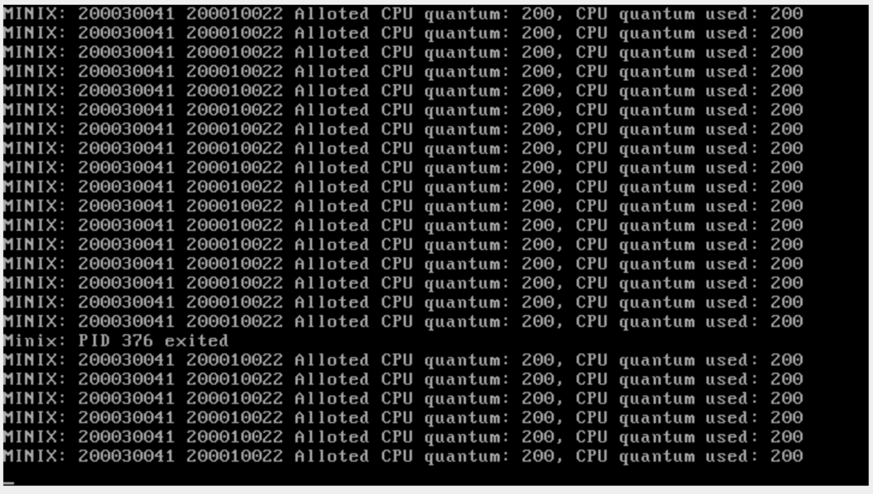
- Here also we are maintaining a similar policy by enforcing that the process which is currently executing always increases its priority and the other processes in the ready queue never get their priorities boosted.

- This is the combined `runme` for both the parts. The `runme.sh`, `schedule.c`, and `system.c` must be present in the same directory.

```
# runme.sh
rm -f /usr/src/minix/kernel/system.c
rm -f /usr/src/minix/servers/sched/schedule.c
mv schedule.c /usr/src/minix/servers/sched
mv system.c /usr/src/minix/kernel
make build MKUPDATE=yes -C /usr/src
```

2.a Workload mix 1

```
# workload1.sh
#!/bin/sh
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
./arithoh.sh &
wait
```



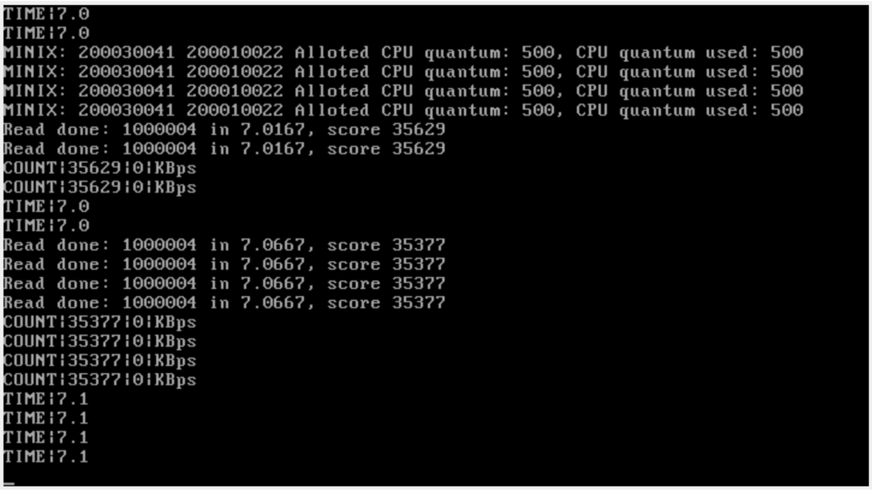
```
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
Minix: PID 376 exited
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
_
```

Figure 7: Output of workload mix 1

- This workload contains CPU intensive process(arithoh).
- We observe that once a process is swapped in and allocated a CPU, it gets a CPU time slice of 200ms and the same process will execute repeatedly until it is completely executed.
- Policy-wise, the currently executing process is getting executed for its time slice and after preemption, the same process is getting executed till its completion.
- This means that other processes are expected to start getting scheduled after this process.
- This is approximately matching the FIFO policy with the support of the observations made from the image above.

2.b Workload mix 2

```
# workload2.sh
#!/bin/sh
./fstime.sh &
./fstime.sh &
./fstime.sh &
./fstime.sh &
./fstime.sh &
./fstime.sh &
wait
```



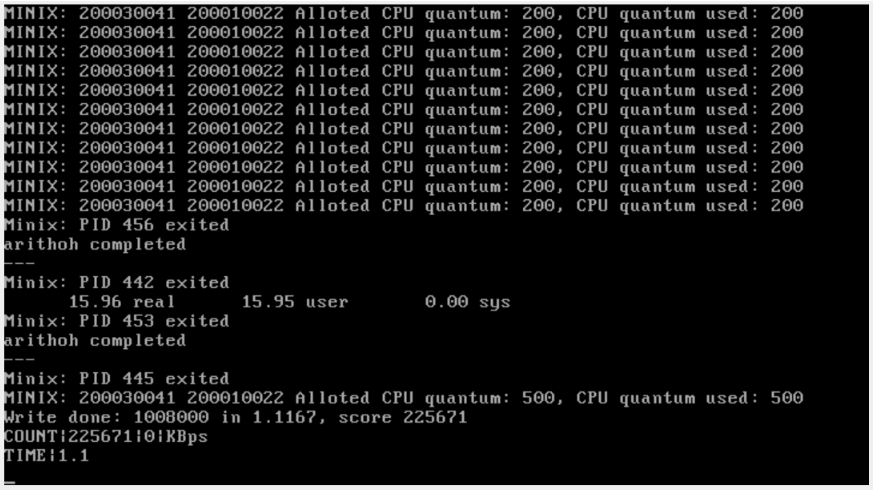
```
TIME¦7.0
TIME¦7.0
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
Read done: 1000004 in 7.0167, score 35629
Read done: 1000004 in 7.0167, score 35629
COUNT¦35629¦0¦KBps
COUNT¦35629¦0¦KBps
TIME¦7.0
TIME¦7.0
Read done: 1000004 in 7.0667, score 35377
Read done: 1000004 in 7.0667, score 35377
Read done: 1000004 in 7.0667, score 35377
Read done: 1000004 in 7.0667, score 35377
COUNT¦35377¦0¦KBps
COUNT¦35377¦0¦KBps
COUNT¦35377¦0¦KBps
COUNT¦35377¦0¦KBps
TIME¦7.1
TIME¦7.1
TIME¦7.1
TIME¦7.1
_
```

Figure 8: Output of workload mix 2

- This workload contains I/O bound processes(fstime).
- We observe that once a process is swapped in and allocated a CPU, it gets a CPU time slice of 500ms and the same process will execute repeatedly until it is completely executed.
- Policy-wise, the currently executing process is getting executed for its time slice and after preemption, the same process is getting executed till its completion.
- This means that other processes are expected to start getting scheduled after this process.
- This is approximately matching the FIFO policy with the support of the observations made from the image above.

2.c Workload mix 3

```
    # workload3.sh
    #!/bin/sh
    ./arithoh.sh &
    ./fstime.sh &
    ./arithoh.sh &
    ./fstime.sh &
    ./arithoh.sh &
    ./fstime.sh &
    wait
```



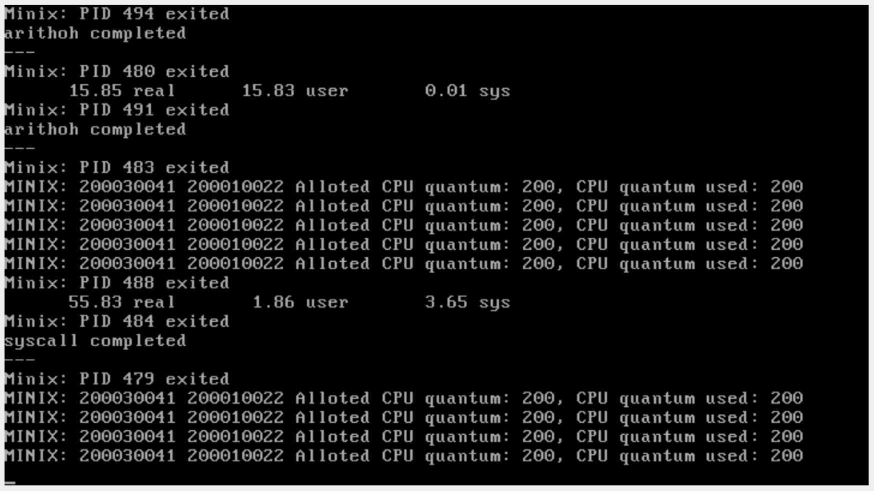
```
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
Minix: PID 456 exited
arithoh completed
---
Minix: PID 442 exited
      15.96 real       15.95 user        0.00 sys
Minix: PID 453 exited
arithoh completed
---
Minix: PID 445 exited
MINIX: 200030041 200010022 Alloted CPU quantum: 500, CPU quantum used: 500
Write done: 1008000 in 1.1167, score 225671
COUNT|225671|0|KBps
TIME|1.1
```

Figure 9: Output of workload mix 3

- Workload mix 3 contains arithoh and fstime process which are CPU and I/O bound processes respectively.
- Here also till one process is not completed other process is not brought into CPU for execution, which means earliest process brought into CPU gets completed first, similarly for all other processes, therefore scheduler approximately follows FIFO policy.

2.d Workload mix 4

```
    # workload4.sh
    #!/bin/sh
    ./arithoh.sh &
    ./syscall.sh &
    ./arithoh.sh &
    ./syscall.sh &
    ./arithoh.sh &
    ./syscall.sh &
    wait
```



```
Minix: PID 494 exited
arithoh completed
---
Minix: PID 480 exited
      15.85 real       15.83 user        0.01 sys
Minix: PID 491 exited
arithoh completed
---
Minix: PID 483 exited
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
Minix: PID 488 exited
      55.83 real        1.86 user        3.65 sys
Minix: PID 484 exited
syscall completed
---
Minix: PID 479 exited
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
MINIX: 200030041 200010022 Alloted CPU quantum: 200, CPU quantum used: 200
_
```

Figure 10: Output of workload mix 4

- Workload mix 4 contains arithoh and syscall processes which are CPU intensive and CPU not intensive processes respectively.
- Till the one process completes other process is not preemted, which approximately follows FIFO policy.