VIETNAM NATIONAL UNIVERSITY, HO CHI MINH CITY
UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

OPERATING SYSTEM (Lab)

Report

Assignment

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1 Scheduler

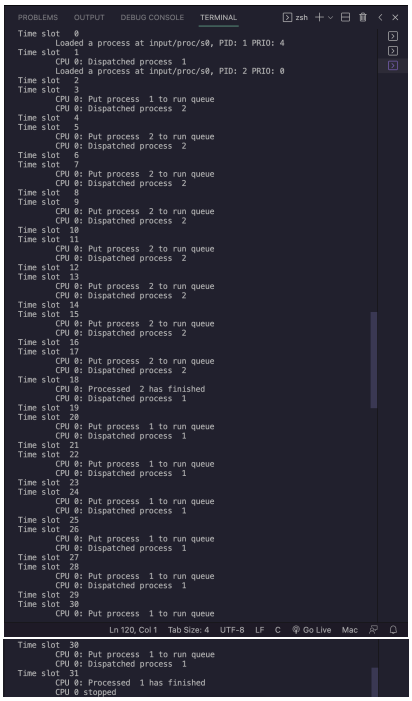
1.1 Question

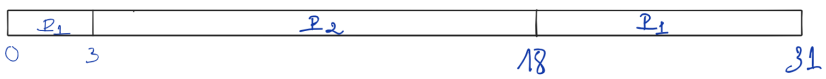
What is the advantage of using a priority queue in comparison with other scheduling algorithms you have learned?
Answer:

- Easy to use.
- Processes with higher priority execute first which saves time.
- The importance of each process is precisely defined.
- A good algorithm for applications with fluctuating time and resource requirements.

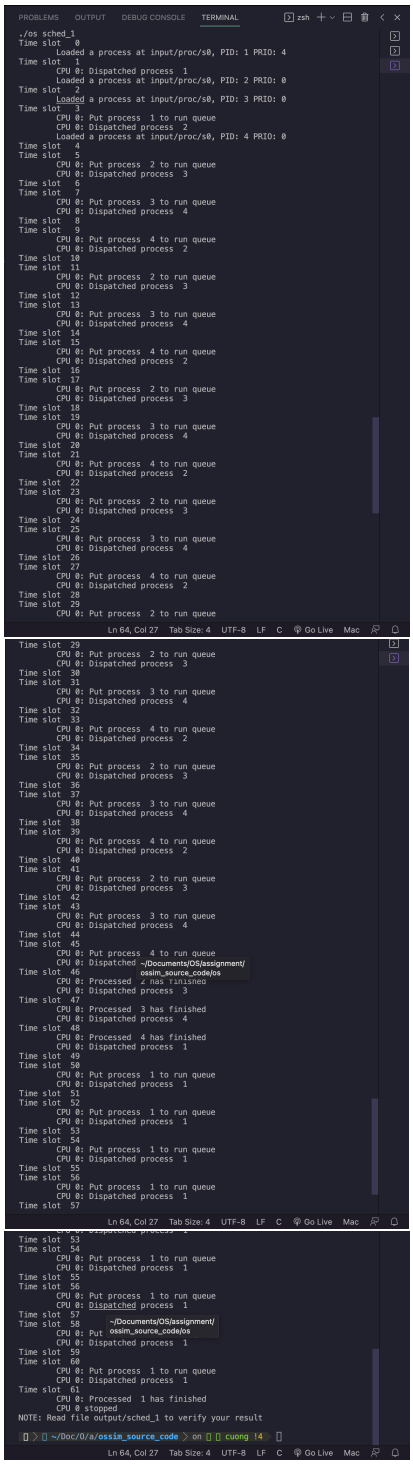
1.2 Run sched

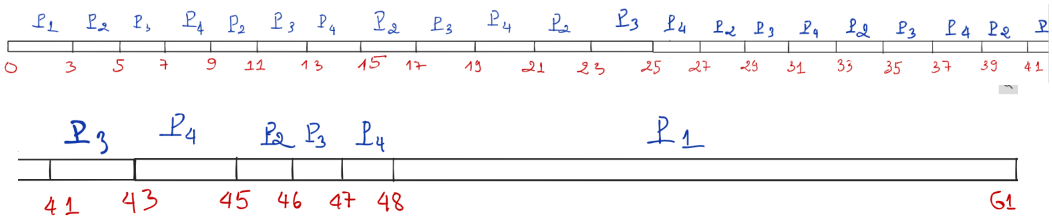
1.2.1 sched_0





1.2.2 sched_1


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
zsh
./os sched_1
Time slot 0
Loaded a process at input/proc/s0, PID: 1 PRIO: 4
Time slot 1
CPU 0: Dispatched process 1
Loaded a process at input/proc/s0, PID: 2 PRIO: 0
Time slot 2
Loaded a process at input/proc/s0, PID: 3 PRIO: 0
Time slot 3
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 2
Loaded a process at input/proc/s0, PID: 4 PRIO: 0
Time slot 4
Time slot 5
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 6
Time slot 7
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 8
Time slot 9
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 10
Time slot 11
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 12
Time slot 13
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 14
Time slot 15
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 16
Time slot 17
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 18
Time slot 19
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 20
Time slot 21
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 22
Time slot 23
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 24
Time slot 25
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 26
Time slot 27
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 28
Time slot 29
CPU 0: Put process 2 to run queue
Ln 64, Col 27
Tab Size: 4
UTF-8
LF
C
Go Live
Mac
Time slot 29
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 30
Time slot 31
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 32
Time slot 33
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 34
Time slot 35
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 36
Time slot 37
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 38
Time slot 39
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 40
Time slot 41
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 42
Time slot 43
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 44
Time slot 45
CPU 0: Put process 4 to run queue
CPU 0: Dispatched
~/Documents/OS/assignment/ossim_source_code/os
Time slot 46
CPU 0: Processed 2 has finished
CPU 0: Dispatched process 3
Time slot 47
CPU 0: Processed 3 has finished
CPU 0: Dispatched process 4
Time slot 48
CPU 0: Processed 4 has finished
CPU 0: Dispatched process 1
Time slot 49
Time slot 50
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 51
Time slot 52
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 53
Time slot 54
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 55
Time slot 56
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 57
Ln 64, Col 27
Tab Size: 4
UTF-8
LF
C
Go Live
Mac
Time slot 53
Time slot 54
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 55
Time slot 56
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 57
Time slot 58
~/Documents/OS/assignment/ossim_source_code/os
CPU 0: Put
CPU 0: Dispatched process 1
Time slot 59
Time slot 60
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 61
CPU 0: Processed 1 has finished
CPU 0 stopped
NOTE: Read file output/sched_1 to verify your result
~/Doc/O/a/ossim_source_code on cuong !4
Ln 64, Col 27
Tab Size: 4
UTF-8
LF
C
Go Live
Mac



2 Memory management

2.1 Question

What is the advantage and disadvantage of segmentation with paging?
Answer:
Advantages of Paging in OS

- The memory management algorithm is easy to use.
- External Fragmentation is not required.
- Swapping between equal-sized pages and page frames becomes easier.

Disadvantages of Paging in OS

- Internal fragmentation.
- Additional memory consumption by Page tables.
- Memory reference overhead due to multi-level paging.

Advantages of segmentation in OS

- Provides protection within segments.
- Segments referencing multiple processes can help achieve sharing.
- No internal fragmentation
- As compared to paging, segment tables use lesser memory.

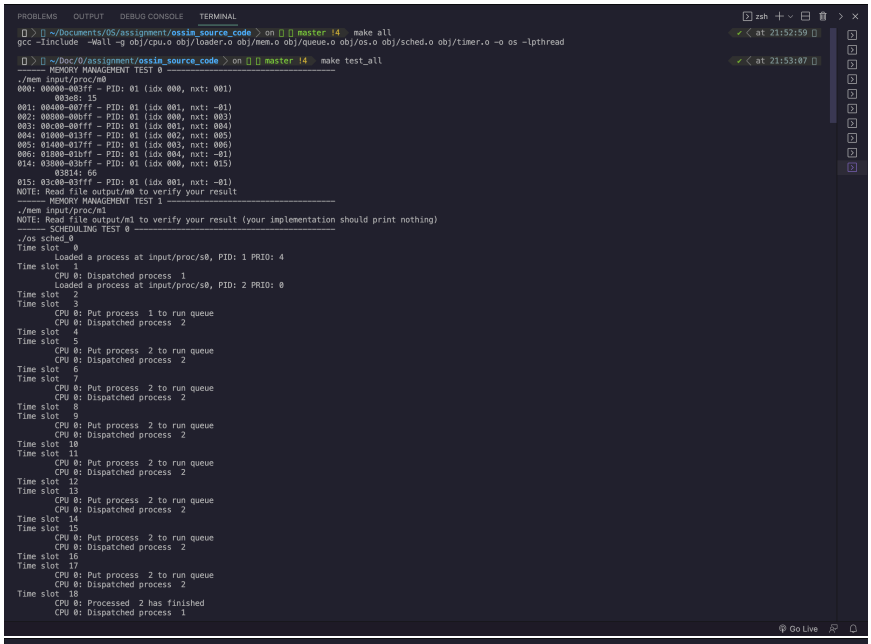
Disadvantages of segmentation in OS

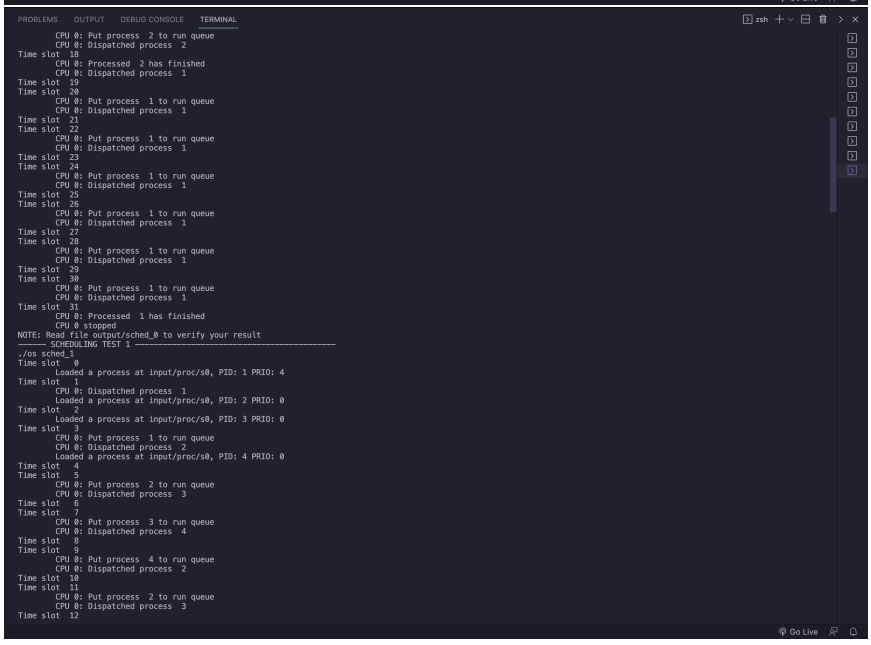
- The separation of free memory space into small pieces can cause external fragmentation.
- It is costly.

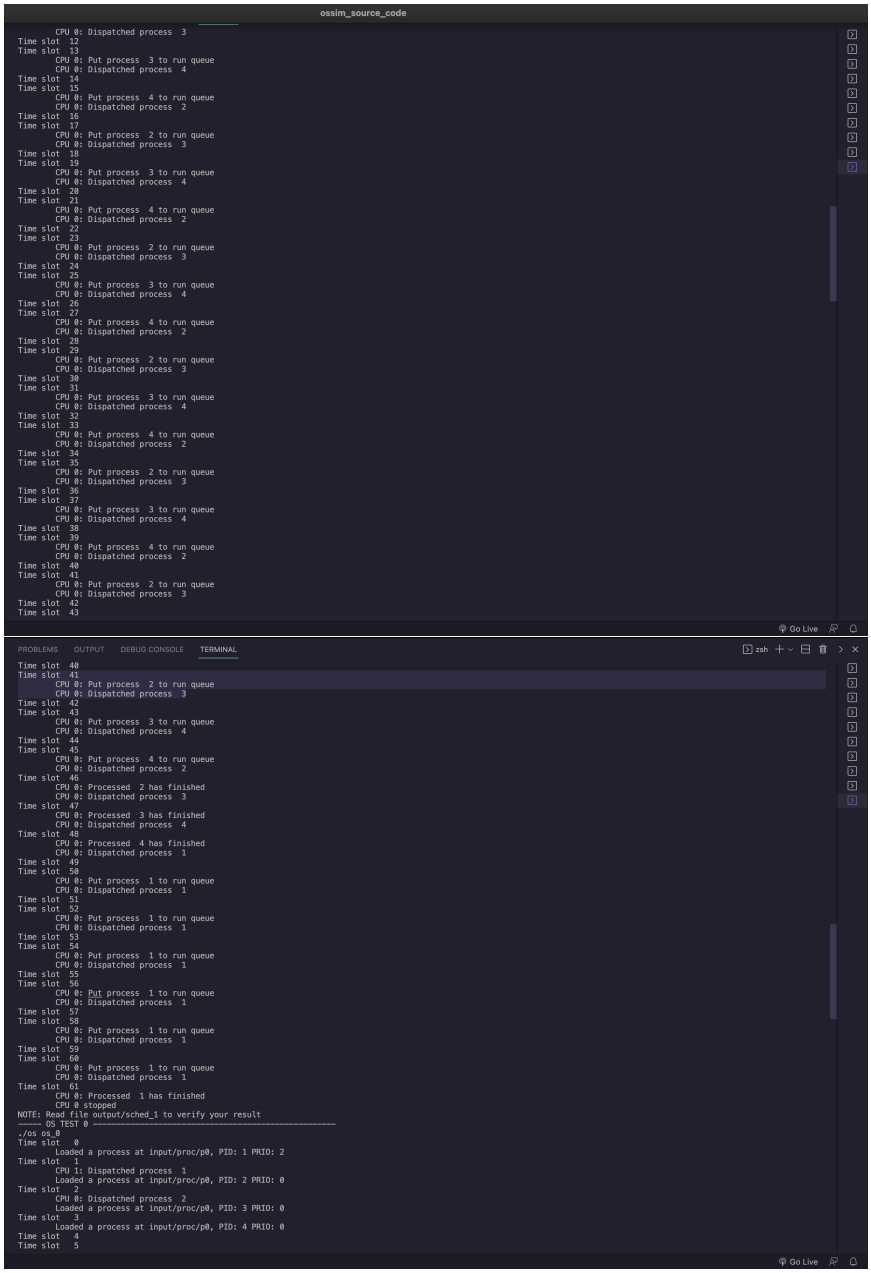
2.2 Run mem

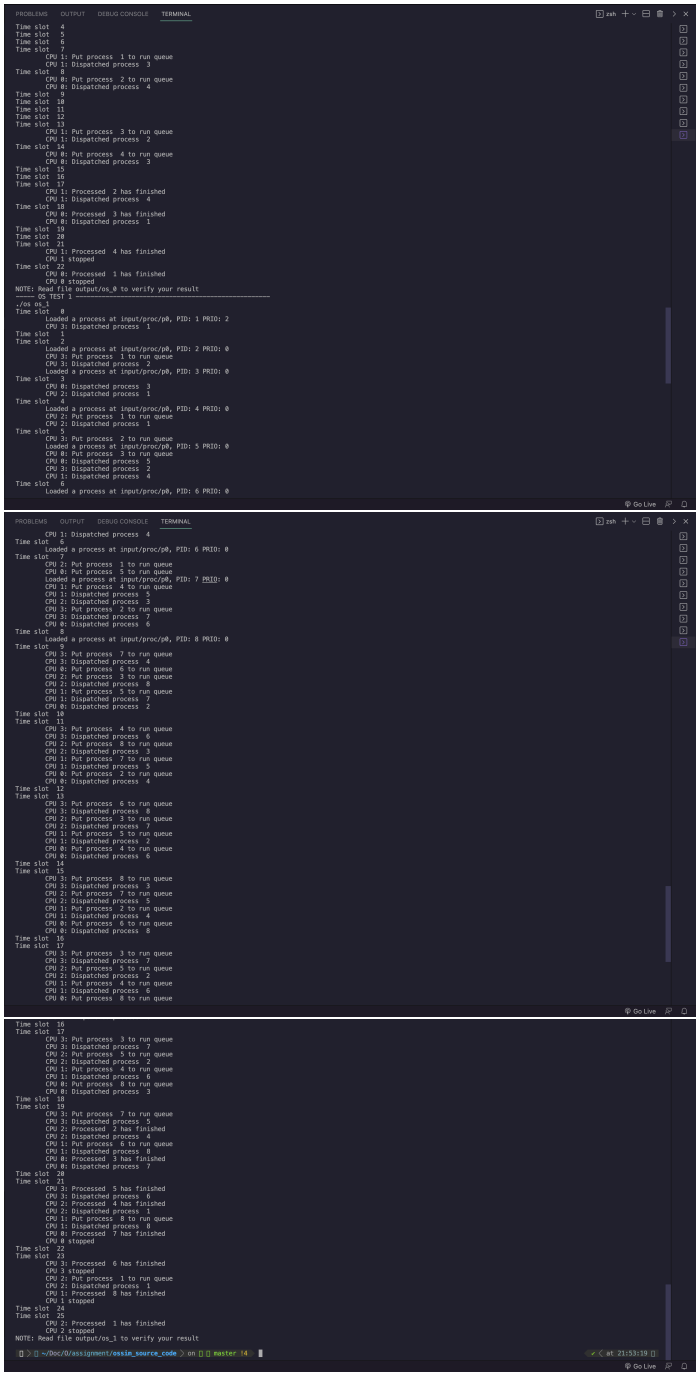
```
~/Doc/O/a/ossim_source_code on master !4 make test_mem
------ MEMORY MANAGEMENT TEST 0 ------------------------------------
./mem input/proc/m0
000: 00000-003ff - PID: 01 (idx 000, nxt: 001)
        003e8: 15
001: 00400-007ff - PID: 01 (idx 001, nxt: -01)
002: 00800-00bff - PID: 01 (idx 000, nxt: 003)
003: 00c00-00fff - PID: 01 (idx 001, nxt: 004)
004: 01000-013ff - PID: 01 (idx 002, nxt: 005)
005: 01400-017ff - PID: 01 (idx 003, nxt: 006)
006: 01800-01bff - PID: 01 (idx 004, nxt: -01)
014: 03800-03bff - PID: 01 (idx 000, nxt: 015)
        03814: 66
015: 03c00-03fff - PID: 01 (idx 001, nxt: -01)
NOTE: Read file output/m0 to verify your result
------ MEMORY MANAGEMENT TEST 1 ------------------------------------
./mem input/proc/m1
NOTE: Read file output/m1 to verify your result (your implementation should print nothing)
```

3 Run all


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
zsh
~/Documents/OS/assignment/ossim_source_code on master !4 make all
at 21:52:59
gcc -Iinclude -Wall -g obj/cpu.o obj/loader.o obj/mem.o obj/queue.o obj/os.o obj/sched.o obj/timer.o -o os -lpthread
~/Doc/O/assignment/ossim_source_code on master !4 make test_all
at 21:53:07
------- MEMORY MANAGEMENT TEST 0 ---
./mem input/proc/m0
000: 00000-003ff - PID: 01 (idx 000, nxt: 001)
003e8: 15
001: 00400-007ff - PID: 01 (idx 001, nxt: -01)
002: 00800-00bff - PID: 01 (idx 000, nxt: 003)
003: 00c00-00fff - PID: 01 (idx 001, nxt: 004)
004: 01000-013ff - PID: 01 (idx 002, nxt: 005)
005: 01400-017ff - PID: 01 (idx 003, nxt: 006)
006: 01800-01bff - PID: 01 (idx 004, nxt: -01)
014: 03800-03bff - PID: 01 (idx 000, nxt: 015)
03814: 66
015: 03c00-03fff - PID: 01 (idx 001, nxt: -01)
NOTE: Read file output/m0 to verify your result
------- MEMORY MANAGEMENT TEST 1 ---
./mem input/proc/m1
NOTE: Read file output/m1 to verify your result (your implementation should print nothing)
------- SCHEDULING TEST 0 --
./os sched_0
Time slot 0
Loaded a process at input/proc/s0, PID: 1 PRIO: 4
Time slot 1
CPU 0: Dispatched process 1
Loaded a process at input/proc/s0, PID: 2 PRIO: 0
Time slot 2
Time slot 3
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 2
Time slot 4
Time slot 5
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 6
Time slot 7
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 8
Time slot 9
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 10
Time slot 11
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 12
Time slot 13
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 14
Time slot 15
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 16
Time slot 17
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 18
CPU 0: Processed 2 has finished
CPU 0: Dispatched process 1
Go Live


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
zsh
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 2
Time slot 18
CPU 0: Processed 2 has finished
CPU 0: Dispatched process 1
Time slot 19
Time slot 20
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 21
Time slot 22
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 23
Time slot 24
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 25
Time slot 26
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 27
Time slot 28
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 29
Time slot 30
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 31
CPU 0: Processed 1 has finished
CPU 0 stopped
NOTE: Read file output/sched_0 to verify your result
------- SCHEDULING TEST 1 --
./os sched_1
Time slot 0
Loaded a process at input/proc/s0, PID: 1 PRIO: 4
Time slot 1
CPU 0: Dispatched process 1
Loaded a process at input/proc/s0, PID: 2 PRIO: 0
Time slot 2
Loaded a process at input/proc/s0, PID: 3 PRIO: 0
Time slot 3
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 2
Loaded a process at input/proc/s0, PID: 4 PRIO: 0
Time slot 4
Time slot 5
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 6
Time slot 7
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 8
Time slot 9
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 10
Time slot 11
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 12
Go Live


ossim_source_code
CPU 0: Dispatched process 3
Time slot 12
Time slot 13
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 14
Time slot 15
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 16
Time slot 17
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 18
Time slot 19
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 20
Time slot 21
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 22
Time slot 23
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 24
Time slot 25
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 26
Time slot 27
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 28
Time slot 29
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 30
Time slot 31
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 32
Time slot 33
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 34
Time slot 35
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 36
Time slot 37
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 38
Time slot 39
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 40
Time slot 41
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 42
Time slot 43
Go Live
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
zsh
Time slot 40
Time slot 41
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 3
Time slot 42
Time slot 43
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 4
Time slot 44
Time slot 45
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 2
Time slot 46
CPU 0: Processed 2 has finished
CPU 0: Dispatched process 3
Time slot 47
CPU 0: Processed 3 has finished
CPU 0: Dispatched process 4
Time slot 48
CPU 0: Processed 4 has finished
CPU 0: Dispatched process 1
Time slot 49
Time slot 50
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 51
Time slot 52
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 53
Time slot 54
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 55
Time slot 56
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 57
Time slot 58
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 59
Time slot 60
CPU 0: Put process 1 to run queue
CPU 0: Dispatched process 1
Time slot 61
CPU 0: Processed 1 has finished
CPU 0 stopped
NOTE: Read file output/sched_1 to verify your result
----- OS TEST 0 -----
./os os_0
Time slot 0
Loaded a process at input/proc/p0, PID: 1 PRIO: 2
Time slot 1
CPU 1: Dispatched process 1
Loaded a process at input/proc/p0, PID: 2 PRIO: 0
Time slot 2
CPU 0: Dispatched process 2
Loaded a process at input/proc/p0, PID: 3 PRIO: 0
Time slot 3
Loaded a process at input/proc/p0, PID: 4 PRIO: 0
Time slot 4
Time slot 5
Go Live


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
Time slot 4
Time slot 5
Time slot 6
Time slot 7
CPU 1: Put process 1 to run queue
CPU 1: Dispatched process 3
Time slot 8
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 4
Time slot 9
Time slot 10
Time slot 11
Time slot 12
Time slot 13
CPU 1: Put process 3 to run queue
CPU 1: Dispatched process 2
Time slot 14
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 3
Time slot 15
Time slot 16
Time slot 17
CPU 1: Processed 2 has finished
CPU 1: Dispatched process 4
Time slot 18
CPU 0: Processed 3 has finished
CPU 0: Dispatched process 1
Time slot 19
Time slot 20
Time slot 21
CPU 1: Processed 4 has finished
CPU 1 stopped
Time slot 22
CPU 0: Processed 1 has finished
CPU 0 stopped
NOTE: Read file output/os_0 to verify your result
./os os_1
Time slot 0
Loaded a process at input/proc/p0, PID: 1 PRIO: 2
CPU 3: Dispatched process 1
Time slot 1
Time slot 2
Loaded a process at input/proc/p0, PID: 2 PRIO: 0
CPU 3: Put process 1 to run queue
CPU 3: Dispatched process 2
Loaded a process at input/proc/p0, PID: 3 PRIO: 0
Time slot 3
CPU 0: Dispatched process 3
CPU 2: Dispatched process 1
Time slot 4
Loaded a process at input/proc/p0, PID: 4 PRIO: 0
CPU 2: Put process 1 to run queue
CPU 2: Dispatched process 1
Time slot 5
CPU 3: Put process 2 to run queue
Loaded a process at input/proc/p0, PID: 5 PRIO: 0
CPU 0: Put process 3 to run queue
CPU 0: Dispatched process 5
CPU 3: Dispatched process 2
CPU 1: Dispatched process 4
Time slot 6
Loaded a process at input/proc/p0, PID: 6 PRIO: 0
Go Live
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
CPU 1: Dispatched process 4
Time slot 6
Loaded a process at input/proc/p0, PID: 6 PRIO: 0
Time slot 7
CPU 2: Put process 1 to run queue
CPU 0: Put process 5 to run queue
Loaded a process at input/proc/p0, PID: 7 PRIO: 0
CPU 1: Put process 4 to run queue
CPU 1: Dispatched process 5
CPU 2: Dispatched process 3
CPU 3: Put process 2 to run queue
CPU 3: Dispatched process 7
CPU 0: Dispatched process 6
Time slot 8
Loaded a process at input/proc/p0, PID: 8 PRIO: 0
Time slot 9
CPU 3: Put process 7 to run queue
CPU 3: Dispatched process 4
CPU 0: Put process 6 to run queue
CPU 2: Put process 3 to run queue
CPU 2: Dispatched process 8
CPU 1: Put process 5 to run queue
CPU 1: Dispatched process 7
CPU 0: Dispatched process 2
Time slot 10
Time slot 11
CPU 3: Put process 4 to run queue
CPU 3: Dispatched process 6
CPU 2: Put process 8 to run queue
CPU 2: Dispatched process 3
CPU 1: Put process 7 to run queue
CPU 1: Dispatched process 5
CPU 0: Put process 2 to run queue
CPU 0: Dispatched process 4
Time slot 12
Time slot 13
CPU 3: Put process 6 to run queue
CPU 3: Dispatched process 8
CPU 2: Put process 3 to run queue
CPU 2: Dispatched process 7
CPU 1: Put process 5 to run queue
CPU 1: Dispatched process 2
CPU 0: Put process 4 to run queue
CPU 0: Dispatched process 6
Time slot 14
Time slot 15
CPU 3: Put process 8 to run queue
CPU 3: Dispatched process 3
CPU 2: Put process 7 to run queue
CPU 2: Dispatched process 5
CPU 1: Put process 2 to run queue
CPU 1: Dispatched process 4
CPU 0: Put process 6 to run queue
CPU 0: Dispatched process 8
Time slot 16
Time slot 17
CPU 3: Put process 3 to run queue
CPU 3: Dispatched process 7
CPU 2: Put process 5 to run queue
CPU 2: Dispatched process 2
CPU 1: Put process 4 to run queue
CPU 1: Dispatched process 6
CPU 0: Put process 8 to run queue
Go Live
Time slot 16
Time slot 17
CPU 3: Put process 3 to run queue
CPU 3: Dispatched process 7
CPU 2: Put process 5 to run queue
CPU 2: Dispatched process 2
CPU 1: Put process 4 to run queue
CPU 1: Dispatched process 6
CPU 0: Put process 8 to run queue
CPU 0: Dispatched process 3
Time slot 18
Time slot 19
CPU 3: Put process 7 to run queue
CPU 3: Dispatched process 5
CPU 2: Processed 2 has finished
CPU 2: Dispatched process 4
CPU 1: Put process 6 to run queue
CPU 1: Dispatched process 8
CPU 0: Processed 3 has finished
CPU 0: Dispatched process 7
Time slot 20
Time slot 21
CPU 3: Processed 5 has finished
CPU 3: Dispatched process 6
CPU 2: Processed 4 has finished
CPU 2: Dispatched process 1
CPU 1: Put process 8 to run queue
CPU 1: Dispatched process 8
CPU 0: Processed 7 has finished
CPU 0 stopped
Time slot 22
Time slot 23
CPU 3: Processed 6 has finished
CPU 3 stopped
CPU 2: Put process 1 to run queue
CPU 2: Dispatched process 1
CPU 1: Processed 8 has finished
CPU 1 stopped
Time slot 24
Time slot 25
CPU 2: Processed 1 has finished
CPU 2 stopped
NOTE: Read file output/os_1 to verify your result
~/Doc/01/assignment/assim_source_code on master !4
at 21:53:19
Go Live