

OS 2020 project

– Project 1 –

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Kernel

- **Version:**
Linux 4.14.25 -> <https://cdn.kernel.org/pub/linux/kernel/v4.x/linux-4.14.25.tar.xz>
- Added syscall 334: **sys_my_printk()**
 - prints a string to dmesg

Design

main.c

- Read the input (number of process, scheduling policy, process name, ready time, execution time)
- Use scheduler() funtion to implement sheduling.

process.c

Define the followin function:

- TIME_UNIT(): define a basic unit of execution time.
 - assign_proc_core(pid, core): decide which core the process “pid” will run on.
 - proc_out(pid): use sched_setscheduler() to reduce the priority “pid” of process and then assign the child process back to the core 0 where the parent process is running.
 - proc_wakeup(pid): assign the child process to the core where the core 1 and then use sched_setscheduler() to raise the priority “pid” of process.
 - proc_exec(Process):
 - (1) Scheduling process call fork() to simulate the process which is ready and stops child process by reducing its priority until parent process wakes it up.Because parent and child process are in the same core. So due to the priority,child process won’t run if it shouldn’t run.But in case the child process run in the unavailable time and unfortunately start the timer, we set a while() loop to avoid the above problem and it will break the loop when child process priority is raised by parent process.
 - (2) When the timer starts, child process will enter a while() loop for execution time of TIME_UNIT().
 - (3) When the timer ends, use system call to output the message into dmesg.
- scheduler.c**
- First, we will assign a particular core 0 to scheduling process and raise its priority to the highest level to prevent potential preemptive problem between scheduling process and the child processes which are are generated by fork().
 - Second,initializes child process by -1 to represent not ready process or already finished process.
 - In while(1) loop, we will kepp doing tje following five steps until all processes are done.
- Step1:**
- Check whether there are some process are already done in last UNIT_TIME.If so,label process’s pid into -1 and finished processes number += 1.If finished processes number is equal to total process number,break the while(1) loop and finish scheduling.
- Step2:**
- Check whether there are some processes which are ready and if so,implement proc_exec().
- Step3:**
- Use switch to choose the scheduling policy to find the next process to implement it.
- There are four policies:
Assume there are some ready processes.
- FIFO():**
- When the implementing process i finish,the next implement process will be i+1.
- SJF():**
- When the implementing process i finish,the next implement process will be the shortest execution time process in the ready queue.
- RR():**In each time slice 500 UNIT_TIME or the implementing process finish in time slice,the next implementing process will be the next in the ready queue.
- PSJF():**
- NO matter the implementing process i is finished,the next implement process will be the shortest execution time process in the ready queue.
- Step4:**
- If the next running process isn’t the same as now running process,then scheduling process will reduce the priority of now runnig process and raise the priority of next running process.
- Step5:**
- run a TIME_UNIT in parent and now runnig child process simultaneously.

Result

Error Rate: round off to the 4nd decimal place

Start time, End time: theoretical time (calculate by math)

Expect exec time:the time the process should finish

My start time, My end time:the time I get from my program

My exec time:the time the process finish in my program

Error rate: the error between Expect exec time & My exec time

Unit Time

| | |
|-----------|----------|
| Unit Time | 0.001377 |
|-----------|----------|

FIFO_1.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 500 | 500 | 0.00 | 489.92 | 489.92 | 2.02% |
| P2 | 500 | 1000 | 500 | 501.70 | 989.51 | 487.81 | 2.44% |
| P3 | 1000 | 1500 | 500 | 989.66 | 1471.77 | 482.11 | 3.58% |
| P4 | 1500 | 2000 | 500 | 1473.90 | 1944.95 | 471.06 | 5.79% |
| P5 | 2000 | 2500 | 500 | 1955.16 | 2440.11 | 484.95 | 3.01% |

FIFO_2.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 80000 | 80000 | 0.00 | 81020.72 | 81020.72 | 1.28% |
| P2 | 80000 | 85000 | 5000 | 81480.00 | 86600.20 | 5120.19 | 2.40% |
| P3 | 85000 | 86000 | 1000 | 86615.81 | 87680.65 | 1064.84 | 6.48% |
| P4 | 86000 | 87000 | 1000 | 87686.84 | 88737.23 | 1050.39 | 5.04% |

FIFO_3.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 8000 | 8000 | 0.00 | 8272.39 | 8272.39 | 3.40% |
| P2 | 8000 | 13000 | 5000 | 8331.03 | 13369.11 | 5038.09 | 0.76% |
| P3 | 13000 | 16000 | 3000 | 13616.25 | 16751.26 | 3135.01 | 4.50% |
| P4 | 16000 | 17000 | 1000 | 16779.69 | 17781.91 | 1002.22 | 0.22% |
| P5 | 17000 | 18000 | 1000 | 17852.79 | 18812.31 | 959.52 | 4.05% |
| P6 | 18000 | 19000 | 1000 | 18856.43 | 19819.16 | 962.74 | 3.73% |
| P7 | 19000 | 23000 | 4000 | 19845.95 | 23677.05 | 3831.10 | 4.22% |

FIFO_4.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 2000 | 2000 | 0.00 | 1908.33 | 1908.33 | 4.58% |
| P2 | 2000 | 2500 | 500 | 1908.45 | 2393.82 | 485.37 | 2.93% |
| P3 | 2500 | 2700 | 200 | 2393.94 | 2580.48 | 186.54 | 6.73% |
| P4 | 2700 | 3200 | 500 | 2580.58 | 3071.49 | 490.91 | 1.82% |

FIFO_5.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 8000 | 8000 | 0.00 | 7615.50 | 7615.50 | 4.81% |
| P2 | 8000 | 13000 | 5000 | 7684.69 | 12521.26 | 4836.57 | 3.27% |
| P3 | 13000 | 16000 | 3000 | 12521.39 | 15365.40 | 2844.01 | 5.20% |
| P4 | 16000 | 17000 | 1000 | 15374.26 | 16343.53 | 969.28 | 3.07% |
| P5 | 17000 | 18000 | 1000 | 16343.65 | 17308.94 | 965.29 | 3.47% |
| P6 | 18000 | 19000 | 1000 | 17329.71 | 18302.54 | 972.83 | 2.72% |
| P7 | 19000 | 23000 | 4000 | 18302.65 | 22178.37 | 3875.72 | 3.11% |

PSJF_1.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P4 | 3000 | 6000 | 3000 | 2952.96 | 5772.22 | 2819.26 | 6.02% |
| P3 | 2000 | 10000 | 8000 | 1985.08 | 9565.21 | 7580.13 | 5.25% |
| P2 | 1000 | 16000 | 15000 | 999.11 | 15534.46 | 14535.35 | 3.10% |
| P1 | 0 | 25000 | 25000 | 0.00 | 24435.57 | 24435.57 | 2.26% |

PSJF_2.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P2 | 1000 | 2000 | 1000 | 1025.34 | 2047.76 | 1022.42 | 2.24% |
| P1 | 0 | 4000 | 4000 | 0.00 | 4247.36 | 4247.36 | 6.18% |
| P4 | 5000 | 7000 | 2000 | 5300.43 | 7204.36 | 1903.93 | 4.80% |
| P5 | 7000 | 8000 | 1000 | 7246.28 | 8194.32 | 948.04 | 5.20% |
| P3 | 4000 | 11000 | 7000 | 4267.75 | 11281.43 | 7013.68 | 0.20% |

PSJF_3.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P2 | 500 | 1000 | 500 | 527.20 | 1058.74 | 531.55 | 6.31% |
| P3 | 1000 | 1500 | 500 | 1058.93 | 1572.18 | 513.25 | 2.65% |
| P4 | 1500 | 2000 | 500 | 1591.81 | 2092.58 | 500.77 | 0.15% |
| P1 | 0 | 3500 | 3500 | 0.00 | 3587.39 | 3587.39 | 2.50% |

PSJF_4.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P3 | 100 | 1100 | 1000 | 105.83 | 1097.84 | 992.01 | 0.80% |
| P2 | 0 | 3000 | 3000 | 0.00 | 3008.82 | 3008.82 | 0.29% |
| P4 | 3000 | 7000 | 4000 | 3008.94 | 7102.74 | 4093.80 | 2.35% |
| P1 | 7000 | 14000 | 7000 | 7102.88 | 14252.52 | 7149.64 | 2.14% |

PSJF_5.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 100 | 200 | 100 | 0.00 | 97.86 | 97.86 | 2.14% |
| P3 | 200 | 400 | 200 | 98.11 | 288.63 | 190.51 | 4.74% |
| P2 | 400 | 4400 | 4000 | 288.74 | 4451.90 | 4163.16 | 4.08% |
| P4 | 4400 | 8400 | 4000 | 4452.02 | 8822.97 | 4370.95 | 9.27% |
| P5 | 8400 | 15400 | 7000 | 8823.09 | 15905.36 | 7082.27 | 1.18% |

RR_1.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 500 | 500 | 0.00 | 476.97 | 476.97 | 4.61% |
| P2 | 500 | 1000 | 500 | 477.08 | 963.75 | 486.67 | 2.67% |
| P3 | 1000 | 1500 | 500 | 963.93 | 1448.80 | 484.87 | 3.03% |
| P4 | 1500 | 2000 | 500 | 1451.45 | 1931.59 | 480.14 | 3.97% |
| P5 | 2000 | 2500 | 500 | 1933.55 | 2413.40 | 479.85 | 4.03% |

RR_2.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 600 | 8100 | 7500 | 0.00 | 7469.94 | 7469.94 | 0.40% |
| P2 | 1100 | 9600 | 8500 | 543.74 | 8740.55 | 8196.80 | 3.57% |

RR_3.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P3 | 4200 | 18200 | 14000 | 2864.92 | 15990.97 | 13126.06 | 6.24% |
| P1 | 1200 | 19700 | 18500 | 0.00 | 18079.26 | 18079.26 | 4.85% |
| P2 | 2700 | 20200 | 17500 | 1422.31 | 18412.00 | 16989.68 | 5.61% |
| P6 | 8200 | 28200 | 20000 | 5658.99 | 25624.15 | 19965.16 | 4.93% |
| P5 | 6700 | 30200 | 23500 | 5202.43 | 27845.31 | 22642.87 | 3.65% |
| P4 | 6200 | 31200 | 25000 | 4744.18 | 28304.54 | 23560.37 | 5.76% |

RR_4.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P4 | 1500 | 5500 | 4000 | 1414.06 | 5132.77 | 3718.71 | 7.03% |
| P5 | 2000 | 6000 | 4000 | 1881.51 | 5690.23 | 3808.72 | 4.78% |
| P6 | 2500 | 6500 | 4000 | 2353.02 | 6146.94 | 3793.92 | 5.15% |
| P3 | 1000 | 14500 | 13500 | 936.79 | 13741.42 | 12804.63 | 5.15% |
| P7 | 3500 | 18500 | 15000 | 2820.43 | 17203.33 | 14382.89 | 4.11% |
| P2 | 500 | 20000 | 19500 | 468.53 | 19318.20 | 18849.67 | 3.34% |
| P1 | 0 | 23000 | 23000 | 0.00 | 21573.35 | 21573.35 | 6.20% |

RR_5.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P4 | 1500 | 5500 | 4000 | 1452.16 | 5294.98 | 3842.81 | 3.93% |
| P5 | 2000 | 6000 | 4000 | 1929.89 | 5743.69 | 3813.80 | 4.66% |
| P6 | 3000 | 7000 | 4000 | 2420.96 | 6250.48 | 3829.52 | 4.26% |
| P3 | 1000 | 14500 | 13500 | 967.05 | 13983.14 | 13016.09 | 3.58% |
| P7 | 3500 | 18500 | 15000 | 2896.11 | 17334.03 | 14437.92 | 3.75% |
| P2 | 500 | 20000 | 19500 | 484.09 | 19231.51 | 18747.42 | 3.86% |
| P1 | 0 | 23000 | 23000 | 0.00 | 22300.76 | 22300.76 | 3.04% |

SJF_1.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P2 | 0 | 2000 | 2000 | 0.00 | 1924.81 | 1924.81 | 3.76% |
| P3 | 2000 | 3000 | 1000 | 1924.92 | 2868.64 | 943.72 | 5.63% |
| P4 | 3000 | 7000 | 4000 | 2881.88 | 6726.39 | 3844.50 | 3.89% |
| P1 | 7000 | 14000 | 7000 | 6726.53 | 13442.00 | 6715.47 | 4.06% |

SJF_2.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 100 | 200 | 100 | 0.00 | 93.84 | 93.84 | 6.16% |
| P3 | 200 | 400 | 200 | 94.06 | 280.43 | 186.37 | 6.81% |
| P2 | 400 | 4400 | 4000 | 282.73 | 4076.89 | 3794.17 | 5.15% |
| P4 | 4400 | 8400 | 4000 | 4122.07 | 7888.90 | 3766.83 | 5.83% |
| P5 | 8400 | 15400 | 7000 | 7901.57 | 14839.23 | 6937.66 | 0.89% |

SJF_3.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 100 | 3100 | 3000 | 0.00 | 2922.60 | 2922.60 | 2.58% |
| P4 | 3100 | 3110 | 10 | 2948.51 | 2958.10 | 9.59 | 4.11% |
| P5 | 3110 | 3120 | 10 | 2958.60 | 2968.18 | 9.58 | 4.24% |
| P6 | 3120 | 7120 | 4000 | 2968.26 | 6903.22 | 3934.96 | 1.63% |
| P7 | 7120 | 11120 | 4000 | 6923.27 | 10888.61 | 3965.34 | 0.87% |
| P2 | 11120 | 16120 | 5000 | 10888.77 | 15678.89 | 4790.12 | 4.20% |
| P3 | 16120 | 23120 | 7000 | 15703.92 | 22392.17 | 6688.25 | 4.45% |
| P8 | 23120 | 32120 | 9000 | 22469.48 | 31038.16 | 8568.68 | 4.79% |

SJF_4.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---------|------------|----------|------------------|---------------|-------------|--------------|------------|
| P1 | 0 | 3000 | 3000 | 0.00 | 2956.21 | 2956.21 | 1.46% |
| P2 | 3000 | 4000 | 1000 | 2956.33 | 3949.70 | 993.37 | 0.66% |
| P3 | 4000 | 8000 | 4000 | 3949.83 | 7682.86 | 3733.03 | 6.67% |
| P5 | 8000 | 9000 | 1000 | 7840.16 | 8820.35 | 980.19 | 1.98% |
| P4 | 9000 | 11000 | 2000 | 8820.46 | 10685.87 | 1865.41 | 6.73% |

SJF_5.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time |
|---------|------------|----------|------------------|---------------|-------------|--------------|
|---------|------------|----------|------------------|---------------|-------------|--------------|