# OS Project 1 Report

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# 設計

## syscall 設計

- 簡單的使用 getnstimeofday, printk 來完成system call的設計，然後編入kernal
  - void print(int pid, long start_time, long end_time)
    - code 334
  - get_time(void)
    - code 333

## Schedular 設計

- Schedular 的部分總共使用五個檔案： main.c, schedular.c, proc.c, schedular.h, proc.h
  - main.c --> 負責主要的input, output，以及負責跑整個scheduling 的迴圈
  - schedular.c --> 包含多個函式，主要負責計算排程，以及下一個被排進cpu的process
  - proc.c --> 執行 assign cpu, block process, exec process, unblock process 等和child process 相關的函式，並定義單位時間及Proc 的structure
  - main.py (http://main.py) 跑在 CPU 0, 其他Child process 跑在 CPU 1
- schedular.c 函式介紹
  - FIFO
    - Loop 過所有的process，照開始順序跑
  - RR_push
    - 把所有除了當前在跑的loop一次，檢查可以加入的並加入 RR 的queue
  - RR_POP
    - 把執行玩的從queue pop掉
  - SJF
    - 一個跑完後，檢查剩下最短時間的task，回傳index
  - PSJF

        - 一個就緒後，檢查全部最短時間的task，回傳index
- proc.c 函式介紹
    - run_unit
        - 跑一個單位的時間
    - set_cpu
        - 設定這個process要在第幾個cpu上跑
        - 用來把child設在cpu[1], main在 cpu[0]
    - set_unblock
        - 把process priority調高，讓他unblock
    - run_proc
        - fork process

# 核心版本

- Linux 4.14.25.

# 比較結果

- 實際結果可以看出執行時間越長的process在實際執行時間與理論執行時間上的差異特別明顯，應該是因為本來的理論結果沒有考慮到 cpu 上會有其他process在執行，以及context switch的時間。而實際執行時間越長的 process, 通常這種overhead特別明顯。
- 除了上面說的部分以外，main.c 本身在很多計算的部分，比如找下個執行process 及 wait 上，也會花不少時間，這些在理論結果上都是沒被考慮到的，理論結果是考慮理想情況下，做schedulaing過程本身的overhead也趨近於0的情形。
- 所有的結果，圖表及計算有依靠 b06902024, b06902019

# | unit time | 0.001547 |

FIFO_1_stdout.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 | 482.26 | 482.26 | 3.55% |
| P2 | 500 | 1000 | 500 | 486.93 | 984.66 | 497.73 | 0.45% |
| P3 | 1000 | 1500 | 500 | 998.55 | 1526.07 | 527.52 | 5.50% |
| P4 | 1500 | 2000 | 500 | 1526.18 | 2033.58 | 507.40 | 1.48% |
| P5 | 2000 | 2500 | 500 | 2033.67 | 2537.05 | 503.38 | 0.68% |

FIFO_2_stdout.txt

| **process** | **start time** | **end time** | **expect exec time** | **my start time** | **my end time** | **my exec time** | **err rat** |
|---|---|---|---|---|---|---|---|
| P1 | 0 | 80000 | 80000 | 0.00 | 81364.84 | 81364.84 | 1.71 |
| P2 | 80000 | 85000 | 5000 | 82147.50 | 87286.46 | 5138.96 | 2.7 |
| P3 | 85000 | 86000 | 1000 | 87313.26 | 88327.05 | 1013.79 | 1.3 |
| P4 | 86000 | 87000 | 1000 | 88327.65 | 89350.24 | 1022.59 | 2.2 |

FIFO_3_stdout.txt

| process | start time | end time | expect exec time | my end time | my start time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P1 | 0 | 8000 | 8000 | 7688.64 | 0.00 | 7688.64 | 3.89% |
| P2 | 8000 | 13000 | 5000 | 12589.15 | 7827.78 | 4761.37 | 4.77% |
| P3 | 13000 | 16000 | 3000 | 15502.87 | 12654.93 | 2847.94 | 5.07% |
| P4 | 16000 | 17000 | 1000 | 16458.85 | 15531.92 | 926.94 | 7.31% |
| P5 | 17000 | 18000 | 1000 | 17427.03 | 16468.23 | 958.80 | 4.12% |
| P6 | 18000 | 19000 | 1000 | 18385.14 | 17430.79 | 954.35 | 4.57% |
| P7 | 19000 | 23000 | 4000 | 22327.40 | 18385.62 | 3941.78 | 1.46% |

FIFO_4_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P1 | 0 | 2000 | 2000 | 0.00 | 2035.25 | 2035.25 | 1.76% |
| P2 | 2000 | 2500 | 500 | 2066.60 | 507.90 | 2574.50 | 1.58% |
| P3 | 2500 | 2700 | 200 | 2579.52 | 206.72 | 2786.24 | 3.36% |
| P4 | 2700 | 3200 | 500 | 2787.76 | 509.65 | 3297.41 | 1.93% |

FIFO_5_stdout.txt

| process | start time | end time | expect exec time | my end time | my start time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P1 | 0 | 8000 | 8000 | 7899.11 | 0.00 | 7899.11 | 1.26% |
| P2 | 8000 | 13000 | 5000 | 12962.22 | 8053.29 | 4908.93 | 1.82% |
| P3 | 13000 | 16000 | 3000 | 16089.62 | 13014.53 | 3075.08 | 2.50% |
| P4 | 16000 | 17000 | 1000 | 17271.77 | 16131.19 | 1140.58 | 14.06 |
| P5 | 17000 | 18000 | 1000 | 18389.56 | 17272.33 | 1117.23 | 11.72 |
| P6 | 18000 | 19000 | 1000 | 19498.19 | 18389.81 | 1108.38 | 10.84 |
| P7 | 19000 | 23000 | 4000 | 23776.81 | 19507.22 | 4269.58 | 6.74% |

PSJF_1_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P4 | 3000 | 6000 | 3000 | 3045.17 | 3011.91 | 6057.08 | 0.40% |
| P3 | 2000 | 10000 | 8000 | 2005.87 | 8106.45 | 10112.33 | 1.33% |
| P2 | 1000 | 16000 | 15000 | 994.53 | 15224.59 | 16219.13 | 1.50% |
| P1 | 0 | 25000 | 25000 | 0.00 | 25316.01 | 25316.01 | 1.26% |

PSJF_2_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P2 | 1000 | 2000 | 1000 | 1040.24 | 1018.49 | 2058.72 | 1.85% |
| P1 | 0 | 4000 | 4000 | 0.00 | 3987.32 | 3987.32 | 0.32% |
| P4 | 5000 | 7000 | 2000 | 4966.81 | 1991.26 | 6958.06 | 0.44% |
| P5 | 7000 | 8000 | 1000 | 6962.84 | 987.40 | 7950.24 | 1.26% |
| P3 | 4000 | 11000 | 7000 | 4008.39 | 6790.04 | 10798.43 | 3.00% |

PSJF_3_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P2 | 500 | 1000 | 500 | 527.34 | 496.06 | 1023.41 | 0.79% |
| P3 | 1000 | 1500 | 500 | 1025.46 | 476.27 | 1501.73 | 4.75% |
| P4 | 1500 | 2000 | 500 | 1503.94 | 511.20 | 2015.14 | 2.24% |
| P1 | 0 | 3500 | 3500 | 0.00 | 3517.36 | 3517.36 | 0.50% |

PSJF_4_stdout.txt

| process | start time | end time | expect exec time | my end time | my start time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P3 | 100 | 1100 | 1000 | 1080.43 | 102.10 | 978.34 | 2.17% |
| P2 | 0 | 3000 | 3000 | 2944.78 | 0.00 | 2944.78 | 1.84% |
| P4 | 3000 | 7000 | 4000 | 6869.23 | 2982.38 | 3886.85 | 2.83% |
| P1 | 7000 | 14000 | 7000 | 13864.27 | 6893.88 | 6970.38 | 0.42% |

PSJF_5_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P1 | 100 | 200 | 100 | 0.00 | 104.37 | 104.37 | 4.37% |
| P3 | 200 | 400 | 200 | 114.39 | 214.80 | 329.19 | 7.40% |
| P2 | 400 | 4400 | 4000 | 335.86 | 4174.98 | 4510.85 | 4.37% |
| P4 | 4400 | 8400 | 4000 | 4549.24 | 4184.77 | 8734.01 | 4.62% |
| P5 | 8400 | 15400 | 7000 | 8799.89 | 6676.45 | 15476.34 | 4.62% |

RR_1_stdout.txt

| process | start time | end time | expect exec time | my end time | my start time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P1 | 0 | 500 | 500 | 515.88 | 0.00 | 515.88 | 3.18% |
| P2 | 500 | 1000 | 500 | 1066.49 | 526.68 | 539.81 | 7.96% |
| P3 | 1000 | 1500 | 500 | 1624.00 | 1090.81 | 533.19 | 6.64% |
| P4 | 1500 | 2000 | 500 | 2142.46 | 1624.08 | 518.38 | 3.68% |
| P5 | 2000 | 2500 | 500 | 2668.68 | 2147.80 | 520.89 | 4.18% |

RR_2_stdout.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 | 7652.64 | 7652.64 | 2.04% |
| P2 | 1100 | 9600 | 8500 | 491.43 | 9163.53 | 8672.10 | 2.02% |

RR_3_stdout.txt

| process | start time | end time | expect exec time | my end time | my start time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P3 | 4200 | 18200 | 14000 | 17344.05 | 3105.27 | 14238.78 | 1.71% |
| P1 | 1200 | 19700 | 18500 | 18837.36 | 0.00 | 18837.36 | 1.82% |
| P2 | 2700 | 20200 | 17500 | 19326.81 | 1574.54 | 17752.27 | 1.44% |
| P6 | 8200 | 28200 | 20000 | 27167.83 | 7272.53 | 19895.29 | 0.52% |
| P5 | 6700 | 30200 | 23500 | 29009.64 | 5705.73 | 23303.90 | 0.83% |
| P4 | 6200 | 31200 | 25000 | 29909.97 | 5181.37 | 24728.60 | 1.09% |

RR_4_stdout.txt

| process | start time | end time | expect exec time | my end time | my start time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P4 | 1500 | 5500 | 4000 | 5538.04 | 1540.48 | 3997.55 | 0.06% |
| P5 | 2000 | 6000 | 4000 | 6099.87 | 2105.30 | 3994.56 | 0.14% |
| P6 | 2500 | 6500 | 4000 | 6606.34 | 2596.91 | 4009.43 | 0.24% |
| P3 | 1000 | 14500 | 13500 | 14667.46 | 1050.74 | 13616.72 | 0.86% |
| P7 | 3500 | 18500 | 15000 | 18936.64 | 3597.14 | 15339.50 | 2.26% |
| P2 | 500 | 20000 | 19500 | 20427.30 | 533.49 | 19893.82 | 2.02% |
| P1 | 0 | 23000 | 23000 | 23552.15 | 0.00 | 23552.15 | 2.40% |

RR_5_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P4 | 1500 | 5500 | 4000 | 1542.79 | 4005.18 | 5547.97 | 0.13% |
| P5 | 2000 | 6000 | 4000 | 2044.20 | 4057.77 | 6101.96 | 1.44% |
| P6 | 3000 | 7000 | 4000 | 2990.47 | 4074.57 | 7065.03 | 1.86% |
| P3 | 1000 | 14500 | 13500 | 1023.11 | 13595.80 | 14618.91 | 0.71% |
| P7 | 3500 | 18500 | 15000 | 3572.23 | 15088.78 | 18661.01 | 0.59% |
| P2 | 500 | 20000 | 19500 | 518.92 | 19628.49 | 20147.41 | 0.66% |
| P1 | 0 | 23000 | 23000 | 0.00 | 23054.24 | 23054.24 | 0.24% |

SJF_1_stdout.txt

| process | start time | end time | expect exec time | my start time | my exec time | my end time | error rate |
|---|---|---|---|---|---|---|---|
| P2 | 0 | 2000 | 2000 | 0.00 | 2231.95 | 2231.95 | 11.60% |
| P3 | 2000 | 3000 | 1000 | 2240.02 | 1122.46 | 3362.48 | 12.25% |
| P4 | 3000 | 7000 | 4000 | 3362.65 | 4362.87 | 7725.52 | 9.07% |
| P1 | 7000 | 14000 | 7000 | 7752.40 | 7701.01 | 15453.40 | 10.01% |

SJF_2_stdout.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 | 99.49 | 99.49 | 0.51% |
| P3 | 200 | 400 | 200 | 100.55 | 300.70 | 200.15 | 0.07% |
| P2 | 400 | 4400 | 4000 | 313.67 | 4267.35 | 3953.68 | 1.16% |
| P4 | 4400 | 8400 | 4000 | 4293.61 | 8191.14 | 3897.53 | 2.56% |
| P5 | 8400 | 15400 | 7000 | 8207.44 | 15123.47 | 6916.02 | 1.20% |

SJF_3_stdout.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 | 3236.55 | 3236.55 | 7.88% |
| P4 | 3100 | 3110 | 10 | 3330.31 | 3342.72 | 12.41 | 24.15 |
| P5 | 3110 | 3120 | 10 | 3342.88 | 3355.42 | 12.55 | 25.49 |
| P6 | 3120 | 7120 | 4000 | 3355.66 | 7705.09 | 4349.44 | 8.74% |
| P7 | 7120 | 11120 | 4000 | 7774.32 | 12030.89 | 4256.57 | 6.41% |
| P2 | 11120 | 16120 | 5000 | 12071.30 | 17312.52 | 5241.22 | 4.82% |
| P3 | 16120 | 23120 | 7000 | 17347.34 | 24516.31 | 7168.98 | 2.41% |
| P8 | 23120 | 32120 | 9000 | 24549.84 | 34299.21 | 9749.38 | 8.33% |

SJF_4_stdout.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 | 3101.30 | 3101.30 | 3.38% |
| P2 | 3000 | 4000 | 1000 | 3118.20 | 4096.25 | 978.05 | 2.20% |
| P3 | 4000 | 8000 | 4000 | 4099.09 | 7998.21 | 3899.12 | 2.52% |
| P5 | 8000 | 9000 | 1000 | 8029.25 | 8959.24 | 929.99 | 7.00% |
| P4 | 9000 | 11000 | 2000 | 8962.35 | 10909.06 | 1946.71 | 2.66% |

SJF_5_stdout.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 | 2172.55 | 2172.55 | 8.63% |
| P2 | 2000 | 2500 | 500 | 2183.48 | 2724.80 | 541.32 | 8.26% |
| P3 | 2500 | 3000 | 500 | 2730.70 | 3267.93 | 537.23 | 7.45% |
| P4 | 3000 | 3500 | 500 | 3268.17 | 3821.07 | 552.90 | 10.58% |

TIME_MEASUREMENT_stdout.txt

| process | start time | end time | expect exec time | my start time | my end time | my exec time | error rate |
|---|---|---|---|---|---|---|---|
| P0 | 0 | 500 | 500 | 0.00 | 494.87 | 494.87 | 1.03% |
| P1 | 1000 | 1500 | 500 | 964.00 | 1462.80 | 498.80 | 0.24% |
| P2 | 2000 | 2500 | 500 | 1943.23 | 2457.36 | 514.13 | 2.83% |
| P3 | 3000 | 3500 | 500 | 2906.39 | 3426.20 | 519.81 | 3.96% |
| P4 | 4000 | 4500 | 500 | 3893.59 | 4401.97 | 508.38 | 1.68% |
| P5 | 5000 | 5500 | 500 | 4869.18 | 5376.59 | 507.42 | 1.48% |
| P6 | 6000 | 6500 | 500 | 5857.70 | 6335.03 | 477.34 | 4.53% |
| P7 | 7000 | 7500 | 500 | 6848.90 | 7344.78 | 495.88 | 0.82% |
| P8 | 8000 | 8500 | 500 | 7827.48 | 8313.90 | 486.43 | 2.71% |
| P9 | 9000 | 9500 | 500 | 8777.34 | 9274.29 | 496.95 | 0.61% |

3.7568705150591257

## Demo 影片

由於電腦本身速度太慢… 光是編譯kernal就花了10小時，為了能在五分鐘內跑完，影片這邊有稍微把 Unit time 調小來展示

## To run my code…

In the directory, run the command below…
make
./a.out < input_file
done!!