OS Project1 Report

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Design

- **First in first out(FIFO):**

  原理為對於每個 process，ready time 越小的(代表越早抵達)便越早執行。實際實作是將所有 process 以其 ready time 做排序，若 ready time 相同則以 process ID 小的為優先，依照 waiting list 的順序依序執行即可。

- **Round Robin(RR):**

  原理為利用計時器固定週期(time quantum=500)，讓正在執行的 process 同時進入 waiting list 中等待，等到其做完 time quantum 的時間後再從 waiting list 中選定下一個執行的 process。實際實作是先將所有 process 以其 ready time 做排序，若 ready time 相同則以 process ID 小的為優先。當有新的 process 抵達時，若是已經有 process 正在運行，插入新的 process 在倒數第二個位置(倒數第一為現在正在運行的 process)；若目前沒有在執行 process，並且 waiting list 中有 process，則從當中取出 process 執行，並計算該 process 是否會在此執行周期內執行結束。如果沒有結束，在執行一個周期後將剩餘的 execution time 減少一個週期，並將該 process 放回 waiting list 中，如果會結束，便在結束後檢查 waiting list 是否仍有 process，若是有則直接執行下一個 process，不用等到週期時間過後再執行。

- **Shortest job first(SJF):**

  原理為對於每個 process，讓執行時間越短的越早開始執行。實際實作是

將所有 process 以其 ready time 做排序，若 ready time 相同則以 process ID 小的為優先，當有新的 process 抵達時，將其以此 process 的執行時間和其他 process 的執行時間相比較後插入至 waiting list 中適當的位置。

- **Preemptive shortest job first(PSJF)**

  原理為每次選擇剩餘執行時間最短的 process 來執行，當新產生的 process 執行時間更短時，就可以插隊。實際實作是將所有 process 以其 ready time 做排序，若 ready time 相同則以 process ID 小的為優先，若當前 waiting list 頂端 process 的 remaining execution time 比目前執行中的 process 更小，則將當前執行的 process 換成該從 waiting list 取出的 process，並將原本執行的 process 放入 waiting list 中。

Kernel version

4.14.25

Comparison between theory & experiments

Results of test case

FIFO-1
```
[77893.843250] [Project1] 25686 1588161837.951284132 1588161838.840919808
[77894.644079] [Project1] 25687 1588161838.841255622 1588161839.641705071
[77895.575772] [Project1] 25688 1588161839.642052407 1588161840.573347991
[77896.427962] [Project1] 25689 1588161840.573716599 1588161841.425492322
[77897.337414] [Project1] 25690 1588161841.425815748 1588161842.334894865
```
FIFO-2
```
[78154.972582] [Project1] 25794 1588161957.863865509 1588162099.956038331
[78163.888193] [Project1] 25795 1588162099.956454260 1588162108.871161086
[78165.658954] [Project1] 25796 1588162108.871507749 1588162110.641824201
[78167.438952] [Project1] 25797 1588162110.642214526 1588162112.421724939
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FIFO-3
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[78230.305683] [Project1] 25816 1588162161.079426238 1588162175.285004136
[78239.286972] [Project1] 25817 1588162175.285340036 1588162184.265798612
[78244.620753] [Project1] 25818 1588162184.266137651 1588162189.599286399
[78246.388849] [Project1] 25819 1588162189.599621886 1588162191.367277772
[78248.163274] [Project1] 25820 1588162191.367615994 1588162193.141612955
[78249.934640] [Project1] 25821 1588162193.141947480 1588162194.912881593
[78255.597177] [Project1] 25822 1588162194.913217762 1588162200.575106151
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FIFO-4

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[78340.490877] [Project1] 25839 1588162281.927443836 1588162285.464128189
[78341.577950] [Project1] 25840 1588162285.464524935 1588162286.551140551
[78341.928480] [Project1] 25841 1588162286.551466806 1588162286.901651248
[78342.808803] [Project1] 25842 1588162286.901980066 1588162287.781925456
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FIFO-5

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[78427.638058] [Project1] 25868 1588162358.363168085 1588162372.606492794
[78436.509071] [Project1] 25869 1588162372.606825188 1588162381.477015519
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[78445.429811] [Project1] 25872 1588162388.615100113 1588162390.397261630
[78447.143954] [Project1] 25873 1588162390.397591211 1588162392.111309980
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RR-1

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[79110.652865] [Project1] 26004 1588163054.678622423 1588163055.580671429
[79111.537849] [Project1] 26005 1588163055.580993203 1588163056.465601397
[79112.422166] [Project1] 26006 1588163056.465941124 1588163057.349865260
[79113.306095] [Project1] 26007 1588163057.350202258 1588163058.233740513
[79114.184664] [Project1] 26008 1588163058.234070588 1588163059.112257096
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RR-2

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[79183.131409] [Project1] 26021 1588163115.217655175 1588163128.054854472
[79185.861810] [Project1] 26022 1588163116.124971150 1588163130.785091119
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RR-3

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[79358.109330] [Project1] 26044 1588163278.090428771 1588163303.022363089
[79360.664008] [Project1] 26042 1588163272.733975049 1588163305.576889973
[79361.635985] [Project1] 26043 1588163275.418772701 1588163306.548810621
[79375.831106] [Project1] 26047 1588163285.186813202 1588163320.743093076
[79379.335678] [Project1] 26046 1588163282.526690524 1588163324.247458300
[79381.275772] [Project1] 26045 1588163281.632507471 1588163326.187437397
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RR-4

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[79661.116427] [Project1] 26093 1588163598.995180496 1588163606.011708924
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[79663.892975] [Project1] 26095 1588163601.665128849 1588163608.788096296
[79677.158002] [Project1] 26092 1588163598.132798384 1588163622.052351093
[79684.210455] [Project1] 26096 1588163602.566355620 1588163629.104394853
[79686.895381] [Project1] 26091 1588163597.252020384 1588163631.789165502
[79691.840474] [Project1] 26090 1588163596.361311642 1588163636.733970402
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RR-5

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[79662.134121] [Project1] 26094 1588163599.890196967 1588163607.029344618
[79663.892975] [Project1] 26095 1588163601.665128849 1588163608.788096296
[79677.158002] [Project1] 26092 1588163598.132798384 1588163622.052351093
[79684.210455] [Project1] 26096 1588163602.566355620 1588163629.104394853
[79686.895381] [Project1] 26091 1588163597.252020384 1588163631.789165502
[79691.840474] [Project1] 26090 1588163596.361311642 1588163636.733970402
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SJF-1

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[79763.089512] [Project1] 26113 1588163704.858804768 1588163707.978874851
[79764.887487] [Project1] 26114 1588163708.012530693 1588163709.776745500
[79771.959044] [Project1] 26115 1588163709.777165748 1588163716.847892993
[79784.342500] [Project1] 26112 1588163707.979229522 1588163729.230631779
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SJF-2

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[79920.747438] [Project1] 26135 1588163865.492196683 1588163865.627685723
[79921.125193] [Project1] 26137 1588163865.683672681 1588163866.005418637
[79928.154802] [Project1] 26136 1588163865.628000959 1588163873.034622000
[79935.292474] [Project1] 26138 1588163873.034964088 1588163880.171882466
[79947.718697] [Project1] 26139 1588163880.172226272 1588163892.597388425
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SJF-3

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[79994.092747] [Project1] 26163 1588163934.021925231 1588163938.968766138
[79994.365794] [Project1] 26166 1588163939.224473778 1588163939.241796807
[79994.382125] [Project1] 26167 1588163939.242171440 1588163939.258128172
[80001.523155] [Project1] 26168 1588163939.259002660 1588163946.398746207
[80008.626765] [Project1] 26169 1588163946.399146579 1588163953.501946241
[80017.311319] [Project1] 26164 1588163938.969149776 1588163962.186000749
[80029.344872] [Project1] 26165 1588163962.186331602 1588163974.218860738
[80045.497219] [Project1] 26170 1588163974.219202680 1588163990.370278568
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SJF-4

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80109.836093] [Project1] 26191 1588164053.324039331 1588164054.705451998
80113.340114] [Project1] 26190 1588164054.705744694 1588164058.209271577
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SJF-5

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[80158.223822] [Project1] 26200 1588164099.508056406 1588164103.090400981
[80159.060454] [Project1] 26201 1588164103.090728021 1588164103.926984820
[80159.903567] [Project1] 26202 1588164103.927322939 1588164104.770049432
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PSJF-1

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[80230.902096] [Project1] 26221 1588164171.420735611 1588164175.764501771
[80238.639067] [Project1] 26220 1588164169.665623330 1588164183.501029633
[80248.632194] [Project1] 26219 1588164168.075873574 1588164193.493583317
[80264.042043] [Project1] 26218 1588164166.319756739 1588164208.902548512
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PSJF-2

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[80337.154821] [Project1] 26237 1588164280.242468669 1588164282.011134519
[80340.747299] [Project1] 26236 1588164278.495464849 1588164285.603407018
[80345.983844] [Project1] 26241 1588164287.310806755 1588164290.839651407
[80347.747425] [Project1] 26242 1588164290.840087796 1588164292.603132162
[80353.148590] [Project1] 26238 1588164285.603606755 1588164298.003987994
```

PSJF-3

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[80404.999615] [Project1] 26256 1588164348.960911873 1588164349.852041873
[80405.848828] [Project1] 26257 1588164349.852459790 1588164350.701206256
[80406.771191] [Project1] 26258 1588164350.714400839 1588164351.623516776
[80409.178046] [Project1] 26255 1588164348.075133403 1588164354.030233403
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PSJF-4

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[80439.879782] [Project1] 26270 1588164383.117306064 1588164384.730211765
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[80450.936325] [Project1] 26271 1588164388.368146675 1588164395.786121589
[80462.356111] [Project1] 26268 1588164384.730520667 1588164407.205253957
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PSJF-5

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[80507.586847] [Project1] 26283 1588164452.255972944 1588164452.433401560
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[80515.141366] [Project1] 26284 1588164452.433725636 1588164459.987487251
[80521.740813] [Project1] 26286 1588164459.987624901 1588164466.586557907
[80534.036092] [Project1] 26287 1588164466.586799495 1588164478.881132713
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Conclusion

造成實際時間和理論時間有誤差的原因，我認為主要來自於以下三點:

✧ 因為在切換不同 process 時，實際上還會耗去 context switch 的時間，因此在使用需要耗費 context switch 比較多的演算法時，就會有較明顯的誤差。

✧ scheduler 除了排程外，還有其他執行所花費的時間，例如動態調整各 process 的 priority、執行新的 process 與資料結構的操作等。

✧ 儘管我們假設 scheduler 和 process 跑完一個 unit 的時間相同，但同樣執行 1000000 次迴圈，scheduler 和 process 所占用的 CPU 所花費的時間不會完全一樣，因此也會造成些許誤差。