

PB3.

```
sys      0m0.444s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 1

real      0m27.663s
user      0m27.324s
sys       0m0.196s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 10

real      0m21.290s
user      0m34.082s
sys       0m0.234s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 20

real      0m20.858s
user      0m33.043s
sys       0m0.242s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 30

real      0m20.749s
user      0m33.280s
sys       0m0.308s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 40

real      0m20.203s
user      0m32.928s
sys       0m0.334s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 50

real      0m20.508s
user      0m33.316s
sys       0m0.319s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 60

real      0m20.465s
user      0m33.380s
sys       0m0.316s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 70

real      0m20.474s
user      0m33.407s
sys       0m0.404s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 80

real      0m20.584s
user      0m33.245s
sys       0m0.592s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 90

real      0m20.097s
user      0m32.822s
sys       0m0.506s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 100

real      0m20.362s
user      0m33.423s
sys       0m0.456s
b07902126@linux5 [~/sp_hw4_code]
```

```

sys      0m0.138s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 3
real     0m22.434s
user     0m27.653s
sys      0m0.215s
b07902126@linux5 [~/sp_hw4_code] time ./hw4 X_train y_train X_test 6
real     0m21.842s
user     0m30.127s
sys      0m0.225s
b07902126@linux5 [~/sp_hw4_code]

```

Number of Threads	Execution time
1	27.663s
3	22.434s
6	21.842s
10	21.290s
20	20.858s
30	20.749s
40	20.203s
50	20.508s
60	20.465s
70	20.474s
80	20.584s
90	20.097s
100	20.362s

根據表格可以觀察出，**thread** 數量從 1 增加時，執行時間有明顯減少，然而減少的程度隨著 **thread** 數量增加而漸漸微弱，之後執行時間甚至還出現略為反升的現象，最後大略收斂在一個值上(此例大約收斂在 20.3~20.4)。

PB4.

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 10
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162654350833 35096925968 35096925968

Performance counter stats for './hw4 X_train y_train X_test 10':

162,654,350,833      instructions:u
                                #    0.00  stalled cycles per insn

21.628403333 seconds time elapsed

34.763842000 seconds user
0.198059000 seconds sys

b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 20
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162648715789 34247970461 34247970461

Performance counter stats for './hw4 X_train y_train X_test 20':

162,648,715,789      instructions:u
                                #    0.00  stalled cycles per insn

21.331859658 seconds time elapsed

33.869089000 seconds user
0.269306000 seconds sys

b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 30
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162643062668 34480403893 34480403893

Performance counter stats for './hw4 X_train y_train X_test 30':

162,643,062,668      instructions:u
                                #    0.00  stalled cycles per insn

21.184786266 seconds time elapsed

34.022985000 seconds user
0.331824000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 40
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162637529197 34572404607 34572404607
```

Performance counter stats for './hw4 X_train y_train X_test 40':

```
162,637,529,197      instructions:u
                                #      0.00  stalled cycles per insn

21.138692602 seconds time elapsed

34.049322000 seconds user
0.413602000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 50
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162631883700 33619071081 33619071081
```

Performance counter stats for './hw4 X_train y_train X_test 50':

```
162,631,883,700      instructions:u
                                #      0.00  stalled cycles per insn

20.529315492 seconds time elapsed

33.162271000 seconds user
0.359476000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 60
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162626154486 33814513548 33814513548
```

Performance counter stats for './hw4 X_train y_train X_test 60':

```
162,626,154,486      instructions:u
                                #      0.00  stalled cycles per insn

20.478872910 seconds time elapsed

33.334131000 seconds user
0.379049000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 70
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162612062857 33779997254 33779997254
```

Performance counter stats for './hw4 X_train y_train X_test 70':

```
162,612,062,857      instructions:u
                                #      0.00  stalled cycles per insn

20.558175377 seconds time elapsed

33.339942000 seconds user
0.343042000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 80
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162615001874 34068106873 34068106873
```

Performance counter stats for './hw4 X_train y_train X_test 80':

```
162,615,001,874      instructions:u
                                #      0.00  stalled cycles per insn

20.650984881 seconds time elapsed

33.281555000 seconds user
0.659094000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 90
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162558372369 33725215570 33725215570
```

Performance counter stats for './hw4 X_train y_train X_test 90':

```
162,558,372,369      instructions:u
                                #      0.00  stalled cycles per insn

20.141901331 seconds time elapsed

33.151417000 seconds user
0.509624000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code] perf stat -e instructions:u -v ./hw4 X_train y_train X_test 100
Using CPUID GenuineIntel-6-2D-7
alias offcore_response.corewb.any_response differs in field 'desc'
alias offcore_response.corewb.any_response differs in field 'long_desc'
instructions:u: 162603677603 33764820951 33764820951
```

Performance counter stats for './hw4 X_train y_train X_test 100':

```
162,603,677,603      instructions:u
                                #      0.00  stalled cycles per insn

20.115775632 seconds time elapsed

33.244521000 seconds user
0.455911000 seconds sys
```

```
b07902126@linux5 [~/sp_hw4_code]
```

Number of Threads	Number of Instructions
1	162,659,480,562
10	162,654,350,833
20	162,648,715,789
30	162,643,062,668
40	162,637,529,197
50	162,631,883,700
60	162,626,154,486
70	162,612,062,857
80	162,615,001,874
90	162,558,372,369
100	162,603,677,603

根據表格紀錄可以很明顯地觀察出，除了在 Number of Threads = 100 時比較特別以外，其餘分布幾乎完全符合 thread 數量越多，instruction 越少的特徵。