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Project 4

1. What machine you ran this on

Dell inspiron 15 5000 Core i5

x64 Window 10 home

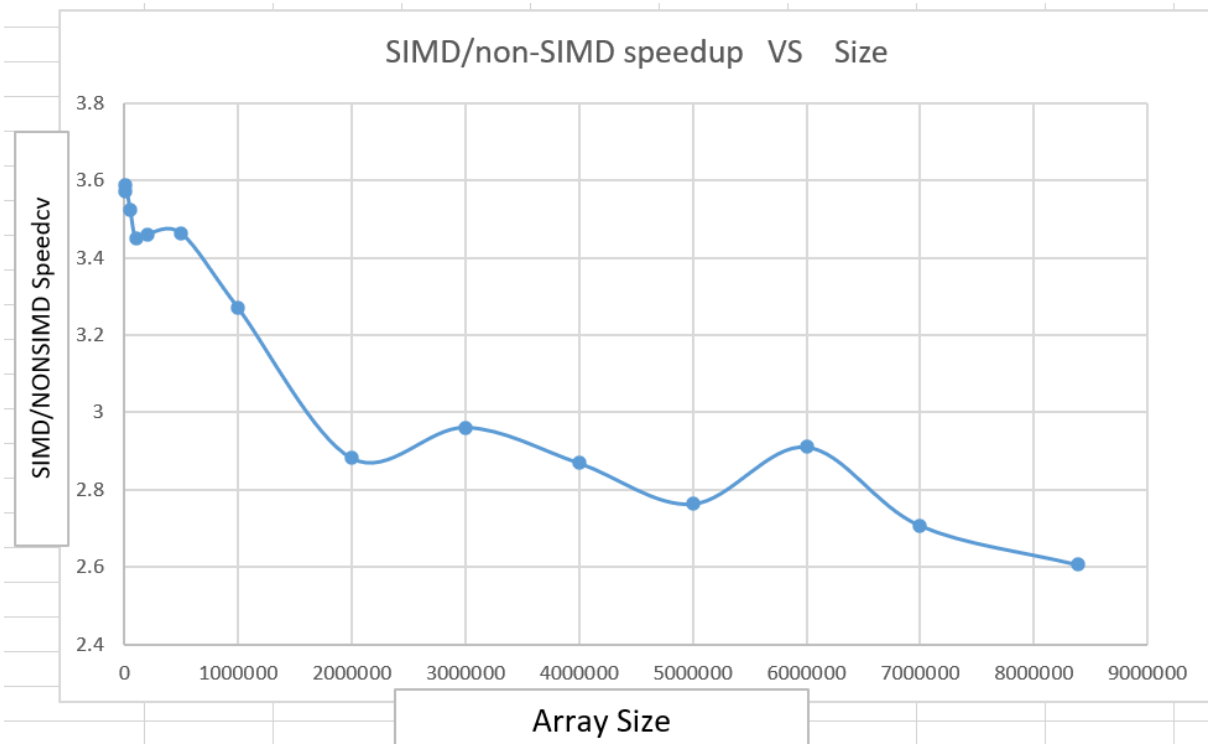
Test the data using the CMD command

2. Show the table of performances for each array size and the corresponding speedups

```
Size: 1000   Speed:3.570248   SIMD: 739.491614   NONSIMDZ: 207.126123
Size: 10000   Speed:3.587350   SIMD: 747.939415   NONSIMDZ: 208.493558
Size: 50000   Speed:3.523780   SIMD: 732.449606   NONSIMDZ: 207.859083
Size: 100000   Speed:3.449516   SIMD: 716.927171   NONSIMDZ: 207.834139
Size: 200000   Speed:3.460773   SIMD: 714.617797   NONSIMDZ: 206.490798
Size: 500000   Speed:3.462555   SIMD: 715.028957   NONSIMDZ: 206.503268
Size: 1000000   Speed:3.269529   SIMD: 669.174800   NONSIMDZ: 204.670082
Size: 2000000   Speed:2.881178   SIMD: 581.251184   NONSIMDZ: 201.740842
Size: 3000000   Speed:2.960735   SIMD: 596.674393   NONSIMDZ: 201.529154
Size: 4000000   Speed:2.868567   SIMD: 578.615878   NONSIMDZ: 201.709007
Size: 5000000   Speed:2.762631   SIMD: 555.339849   NONSIMDZ: 201.018466
Size: 6000000   Speed:2.909874   SIMD: 585.889344   NONSIMDZ: 201.345292
Size: 7000000   Speed:2.707047   SIMD: 545.000134   NONSIMDZ: 201.326437
Size: 8388608   Speed:2.605678   SIMD: 530.714113   NONSIMDZ: 203.676002
```

	1000	10000	50000	100000	200000	500000	1000000	2000000	3000000	4000000	5000000	6000000	7000000	8388608
SIMD/non-SIMD speedup	3.570248	3.58735	3.52378	3.449516	3.460773	3.462555	3.269529	2.881178	2.960735	2.868567	2.762631	2.909874	2.707047	2.605678

3. Show the graph of SIMD/non-SIMD speedup versus array size (one curve only)



4. What patterns are you seeing in the speedups?

I found that size between 1K and 8M, the speeds were all between 2.5 and 3.6, with the highest rate when the size was around 10000, and then gradually decreased.

5. Are they consistent across a variety of array sizes?

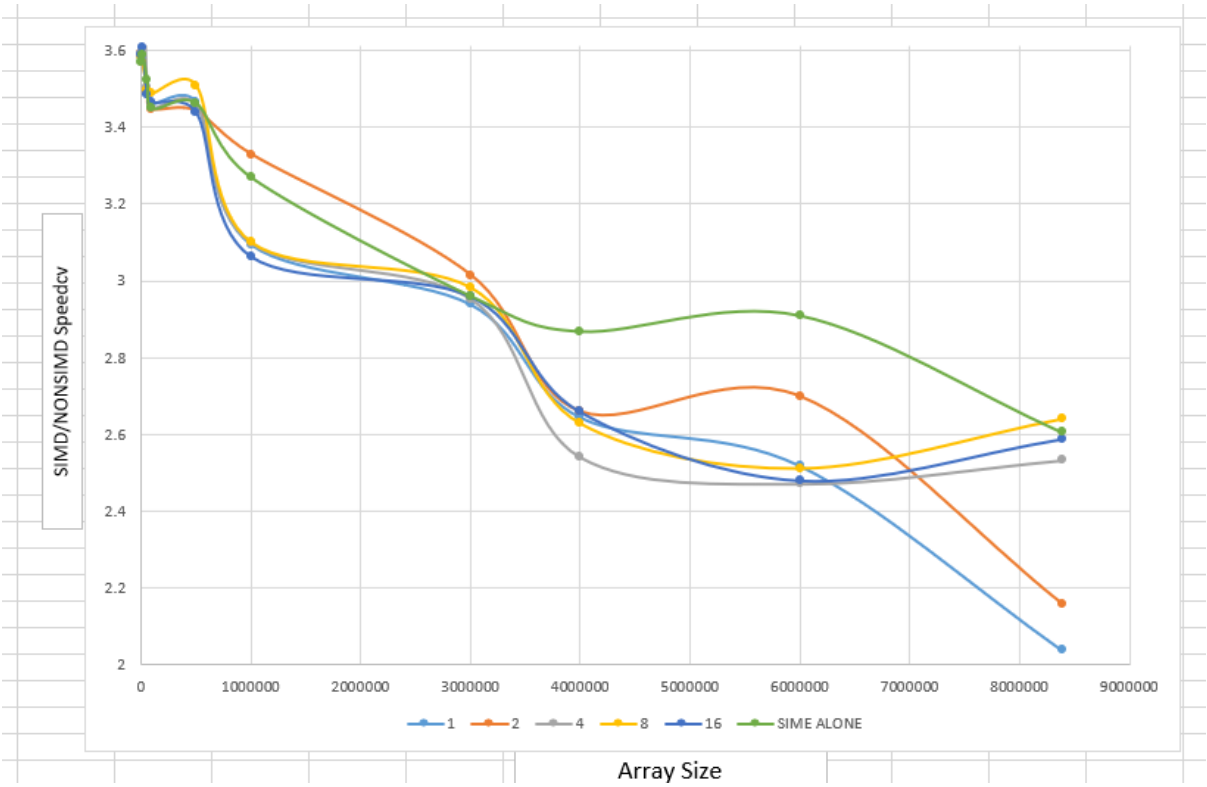
Not the same, but not much. The larger the size, the smaller the rate, is between 10000 and 8388608. And when the size is close to 8M, the rate decreases more slowly.

6. Why or why not, do you think?

I think the size is too large, and the requirements on the system and machine will be higher. In addition, caching can also have an impact on speed. Therefore, the overall trend of data decreases with the increase of size and gradually the speed decreases slowly.

Extra 5 point:

```
 1 Threads   Size: 1000   Speed:3.583573   SIMD: 773.589210   NONSIMDZ: 215.870893
 2 Threads   Size: 1000   Speed:3.592806   SIMD: 772.476132   NONSIMDZ: 215.006372
 4 Threads   Size: 1000   Speed:3.591367   SIMD: 772.476132   NONSIMDZ: 215.092513
 8 Threads   Size: 1000   Speed:3.585399   SIMD: 739.491614   NONSIMDZ: 206.250831
16 Threads   Size: 1000   Speed:3.589928   SIMD: 772.476132   NONSIMDZ: 215.178722
 1 Threads   Size: 10000   Speed:3.579314   SIMD: 779.882208   NONSIMDZ: 217.885922
 2 Threads   Size: 10000   Speed:3.583577   SIMD: 747.210733   NONSIMDZ: 208.509753
 4 Threads   Size: 10000   Speed:3.804673   SIMD: 779.089990   NONSIMDZ: 204.771879
 8 Threads   Size: 10000   Speed:3.571035   SIMD: 778.299380   NONSIMDZ: 217.947839
16 Threads   Size: 10000   Speed:3.608346   SIMD: 786.048187   NONSIMDZ: 217.841717
 1 Threads   Size: 50000   Speed:3.490607   SIMD: 758.356516   NONSIMDZ: 217.256372
 2 Threads   Size: 50000   Speed:3.490774   SIMD: 758.527949   NONSIMDZ: 217.295063
 4 Threads   Size: 50000   Speed:3.504936   SIMD: 761.475820   NONSIMDZ: 217.258131
 8 Threads   Size: 50000   Speed:3.497496   SIMD: 759.472220   NONSIMDZ: 217.147409
16 Threads   Size: 50000   Speed:3.486769   SIMD: 757.308176   NONSIMDZ: 217.194848
 1 Threads   Size: 100000   Speed:3.461588   SIMD: 752.225571   NONSIMDZ: 217.306497
 2 Threads   Size: 100000   Speed:3.447042   SIMD: 748.982857   NONSIMDZ: 217.282751
 4 Threads   Size: 100000   Speed:3.449488   SIMD: 749.641722   NONSIMDZ: 217.319691
 8 Threads   Size: 100000   Speed:3.487488   SIMD: 758.142333   NONSIMDZ: 217.389209
16 Threads   Size: 100000   Speed:3.465205   SIMD: 753.090816   NONSIMDZ: 217.329368
 1 Threads   Size: 500000   Speed:3.464883   SIMD: 732.072074   NONSIMDZ: 211.283318
 2 Threads   Size: 500000   Speed:3.441802   SIMD: 732.563541   NONSIMDZ: 212.842994
 4 Threads   Size: 500000   Speed:3.456691   SIMD: 734.646590   NONSIMDZ: 212.528883
 8 Threads   Size: 500000   Speed:3.506765   SIMD: 746.379691   NONSIMDZ: 212.839957
16 Threads   Size: 500000   Speed:3.437783   SIMD: 711.134396   NONSIMDZ: 206.858452
 1 Threads   Size: 1000000   Speed:3.094689   SIMD: 642.403708   NONSIMDZ: 207.582613
 2 Threads   Size: 1000000   Speed:3.328862   SIMD: 683.918088   NONSIMDZ: 205.451047
 4 Threads   Size: 1000000   Speed:3.097345   SIMD: 642.848314   NONSIMDZ: 207.548186
 8 Threads   Size: 1000000   Speed:3.100042   SIMD: 646.462461   NONSIMDZ: 208.533483
16 Threads   Size: 1000000   Speed:3.063116   SIMD: 640.561099   NONSIMDZ: 209.120758
 1 Threads   Size: 3000000   Speed:2.939263   SIMD: 600.405189   NONSIMDZ: 204.270669
 2 Threads   Size: 3000000   Speed:3.014885   SIMD: 613.951968   NONSIMDZ: 203.640251
 4 Threads   Size: 3000000   Speed:2.952936   SIMD: 609.862741   NONSIMDZ: 206.527576
 8 Threads   Size: 3000000   Speed:2.982875   SIMD: 607.750182   NONSIMDZ: 203.746463
16 Threads   Size: 3000000   Speed:2.959679   SIMD: 603.035573   NONSIMDZ: 203.750304
 1 Threads   Size: 4000000   Speed:2.645019   SIMD: 539.745326   NONSIMDZ: 204.061016
 2 Threads   Size: 4000000   Speed:2.659174   SIMD: 540.518058   NONSIMDZ: 203.265433
 4 Threads   Size: 4000000   Speed:2.541011   SIMD: 515.781385   NONSIMDZ: 202.982773
 8 Threads   Size: 4000000   Speed:2.629533   SIMD: 534.185030   NONSIMDZ: 203.148254
16 Threads   Size: 4000000   Speed:2.659371   SIMD: 542.455491   NONSIMDZ: 203.978891
 1 Threads   Size: 6000000   Speed:2.519439   SIMD: 508.077403   NONSIMDZ: 201.662915
 2 Threads   Size: 6000000   Speed:2.699074   SIMD: 544.598769   NONSIMDZ: 201.772459
 4 Threads   Size: 6000000   Speed:2.471524   SIMD: 500.726706   NONSIMDZ: 202.598378
 8 Threads   Size: 6000000   Speed:2.512744   SIMD: 506.029828   NONSIMDZ: 201.385321
16 Threads   Size: 6000000   Speed:2.480606   SIMD: 499.669750   NONSIMDZ: 201.430492
 1 Threads   Size: 8388608   Speed:2.039734   SIMD: 416.095997   NONSIMDZ: 203.995257
 2 Threads   Size: 8388608   Speed:2.159509   SIMD: 440.913350   NONSIMDZ: 204.172934
 4 Threads   Size: 8388608   Speed:2.532598   SIMD: 515.162395   NONSIMDZ: 203.412651
 8 Threads   Size: 8388608   Speed:2.641225   SIMD: 542.376592   NONSIMDZ: 205.350430
16 Threads   Size: 8388608   Speed:2.588404   SIMD: 532.313137   NONSIMDZ: 205.653050
```



The image shows the speed variation of different sizes for different threads.

As can be seen from the figure, the downward trend of Sime alone, thread 1 and 2 is more obvious than that of thread 4, 8 and 16.

But overall, the number of threads has little effect on the rate, and the size has more effect on the rate.