

# Exercise 4

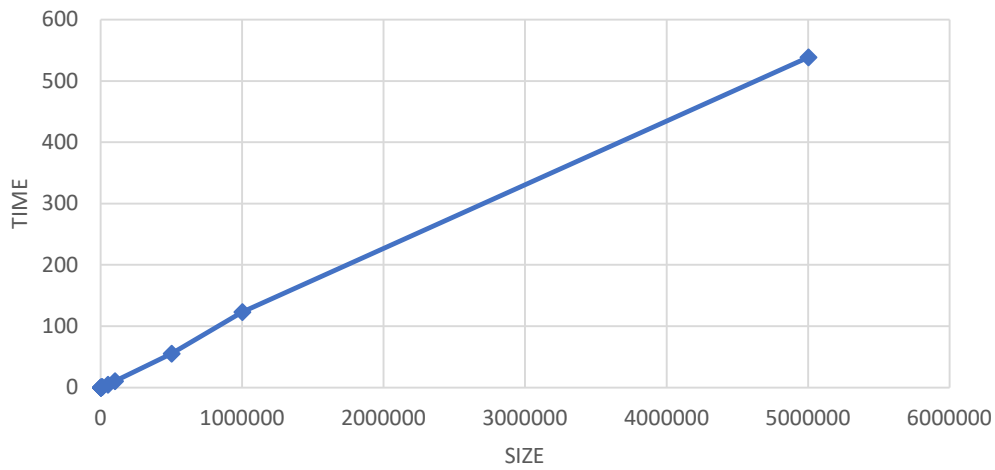
## NanoSeconds

| Array Size | Quick Sort | Merge Sort | Insertion Sort | Tests Performed |
|------------|------------|------------|----------------|-----------------|
| 10         | 41         | 165        | 26             | 10000000        |
| 50         | 261        | 1089       | 210            | 10000000        |
| 100        | 685        | 2307       | 652            | 1000000         |
| 500        | 3580       | 14089      | 15082          | 1000000         |
| 1000       | 17091      | 49872      | 61438          | 100000          |
| 5000       | 207874     | 325875     | 1533641        | 10000           |
| 10000      | 449200     | 761993     | 5954680        | 1000            |
| 50000      | 2556408    | 4764693    | 153067525      | 100             |
| 100000     | 5654260    | 10494550   | 612951910      | 10              |
| 500000     | 30291870   | 55085840   | 16284815570    | 10              |
| 1000000    | 62143366   | 123144033  | 65843558133    | 3               |
| 5000000    | 364819433  | 538635300  | null           | 3               |

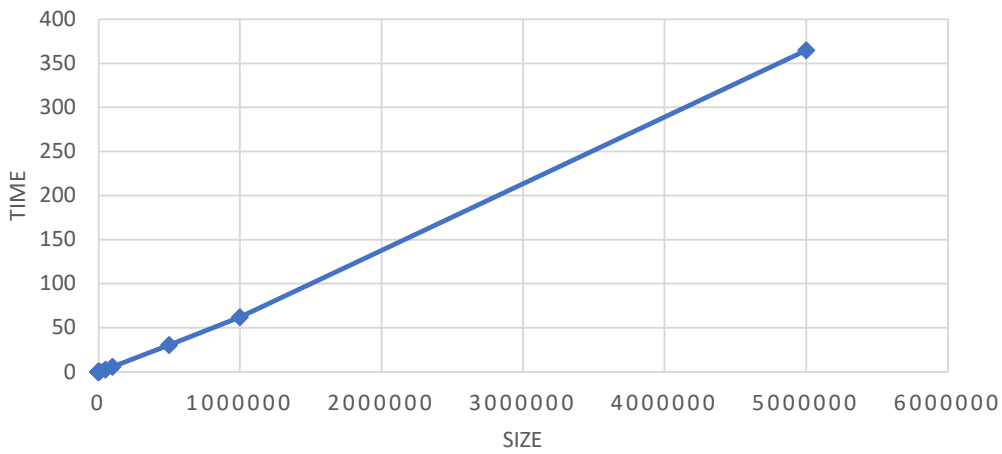
## Milliseconds

| Array Size | Quick Sort | Merge Sort | Insertion Sort |
|------------|------------|------------|----------------|
| 10         | 0,000041   | 0,000165   | 0,000026       |
| 50         | 0,000261   | 0,001089   | 0,00021        |
| 100        | 0,000685   | 0,002307   | 0,000652       |
| 500        | 0,00358    | 0,014089   | 0,015082       |
| 1000       | 0,017091   | 0,049872   | 0,061438       |
| 5000       | 0,207874   | 0,325875   | 1,533641       |
| 10000      | 0,4492     | 0,761993   | 5,95468        |
| 50000      | 2,556408   | 4,764693   | 153,067525     |
| 100000     | 5,65426    | 10,49455   | 612,95191      |
| 500000     | 30,29187   | 55,08584   | 16284,81557    |
| 1000000    | 62,143366  | 123,144033 | 65843,55813    |
| 5000000    | 364,819433 | 538,6353   |                |

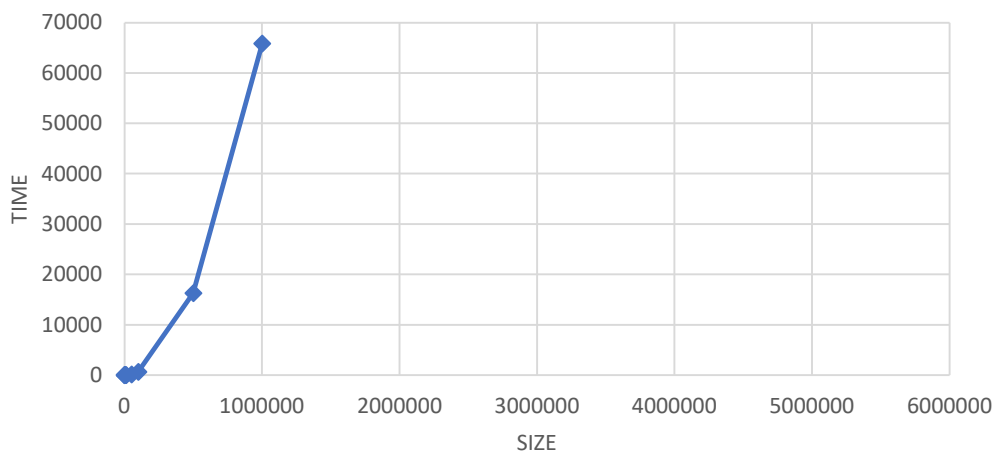
## MERGE SORT



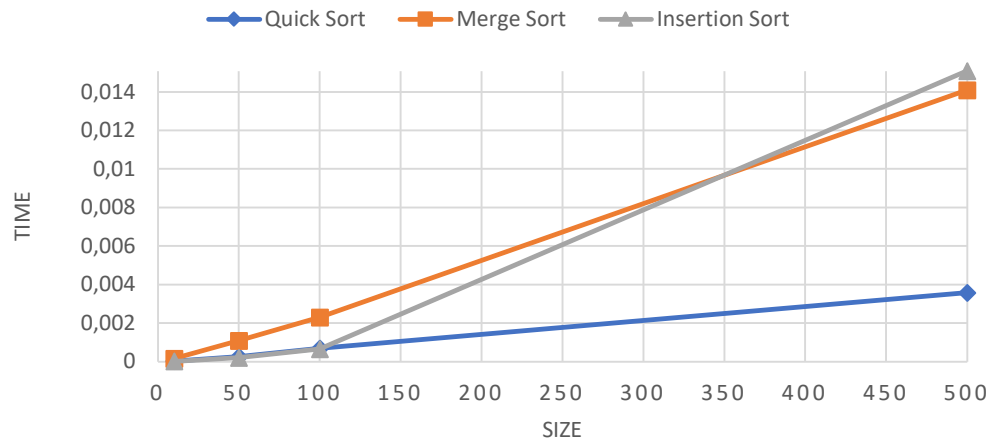
## QUICK SORT



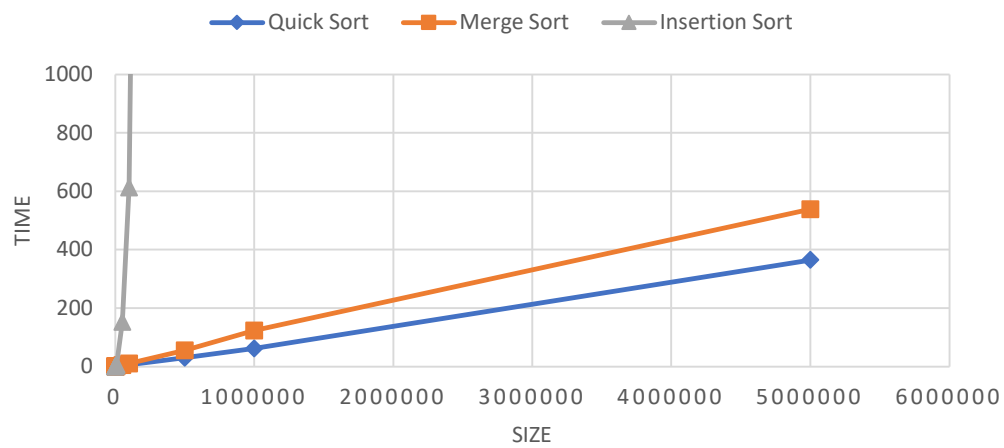
## INSERTION SORT



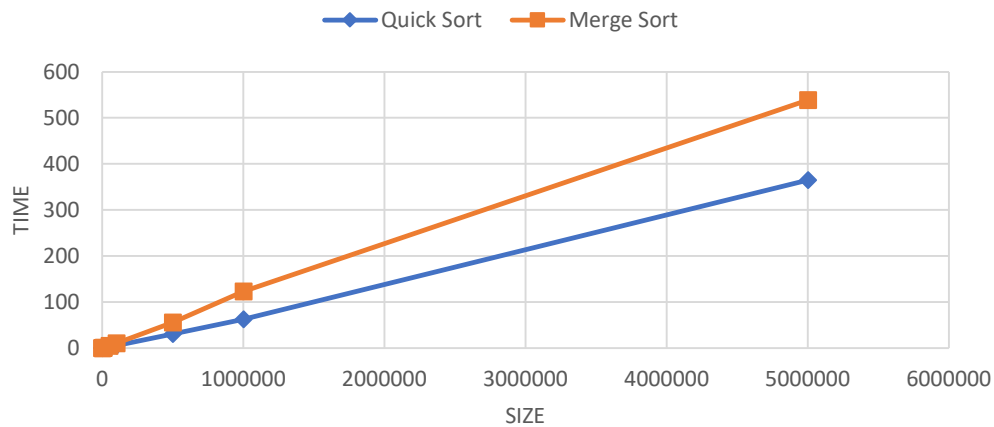
## COMPARISON



## COMPARISON



## MERGE AND QUICK SORT



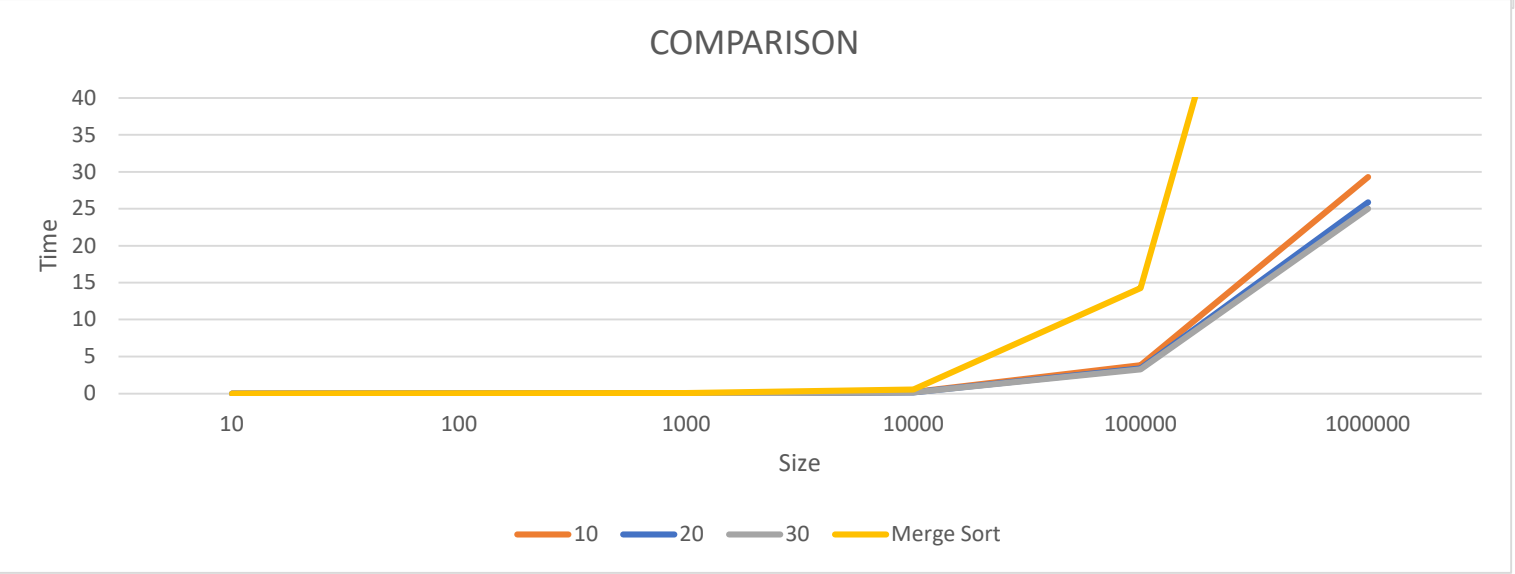
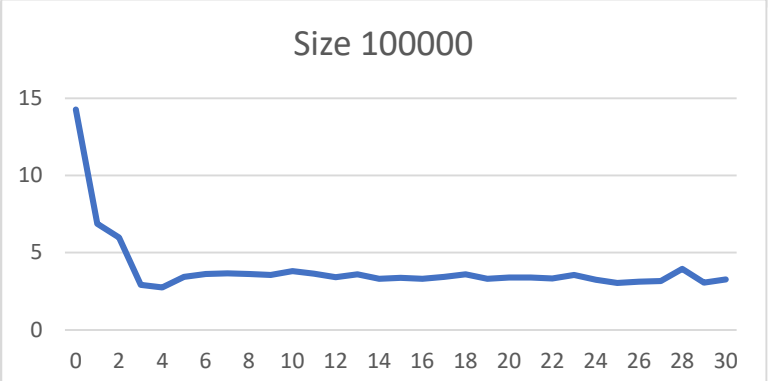
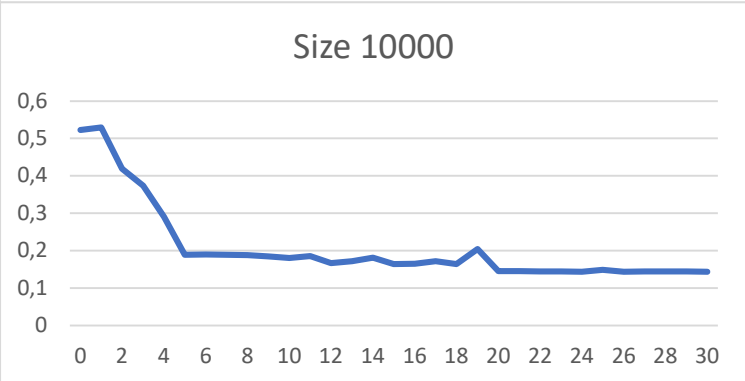
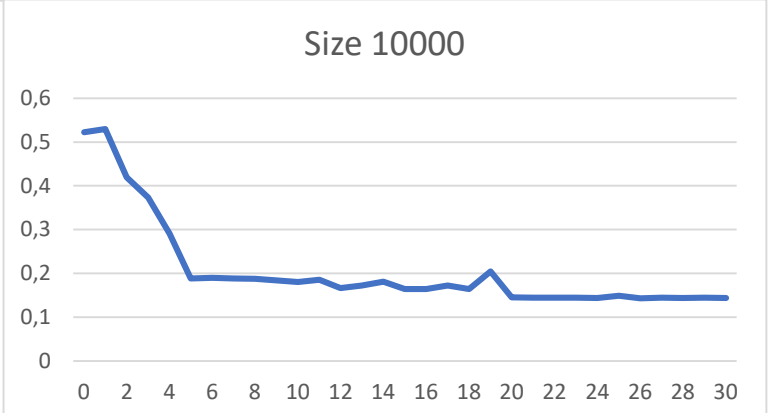
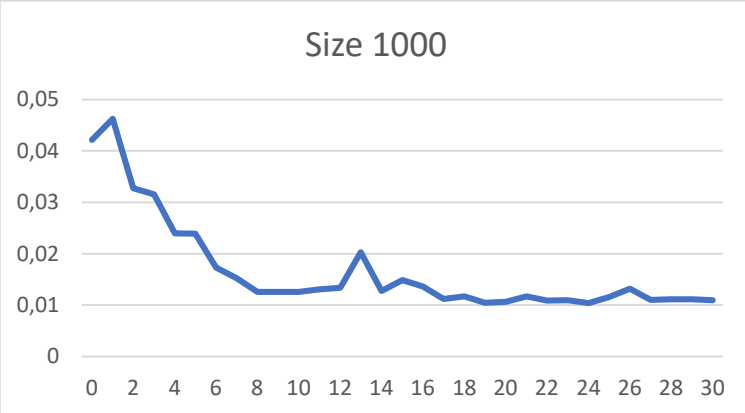
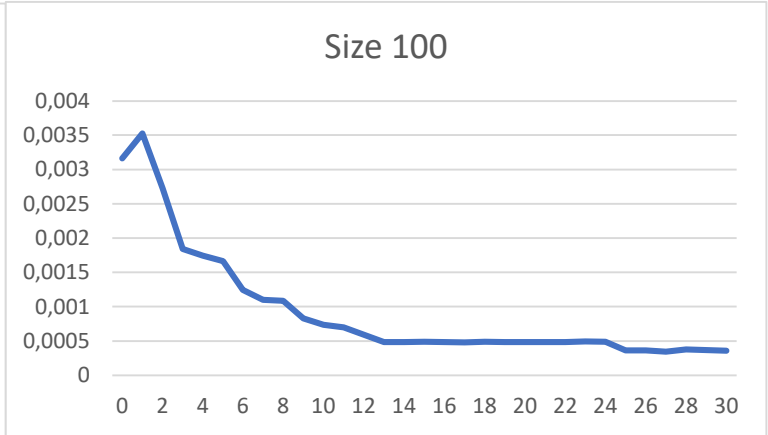
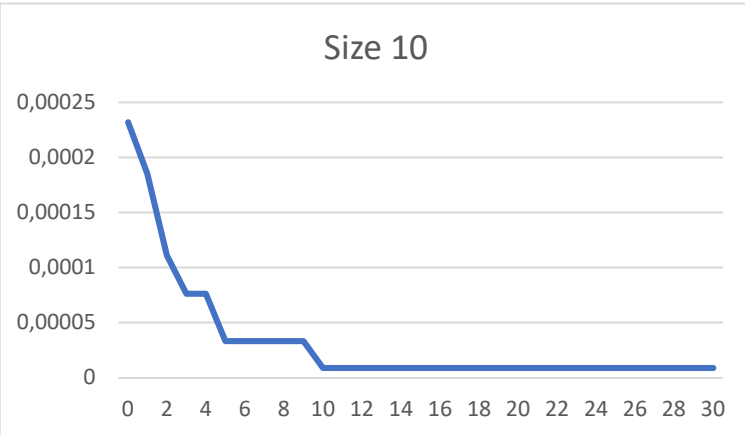
# Exercise 5

## NanoSeconds

| Cutoff Size | 10  | 100  | 1000  | 10000  | 100000   | 1000000   |
|-------------|-----|------|-------|--------|----------|-----------|
| 0           | 232 | 3160 | 42123 | 522044 | 14270700 | 122209200 |
| 1           | 185 | 3528 | 46313 | 529660 | 6874000  | 69877100  |
| 2           | 111 | 2728 | 32767 | 418981 | 5971900  | 58879800  |
| 3           | 76  | 1840 | 31546 | 373143 | 2919900  | 44283800  |
| 4           | 76  | 1742 | 23970 | 290741 | 2768100  | 34860200  |
| 5           | 33  | 1663 | 23890 | 188732 | 3433400  | 33987700  |
| 6           | 33  | 1247 | 17299 | 189667 | 3629900  | 33364300  |
| 7           | 33  | 1100 | 15255 | 188503 | 3655500  | 32376100  |
| 8           | 33  | 1088 | 12549 | 187755 | 3611400  | 30076400  |
| 9           | 33  | 832  | 12591 | 184127 | 3558800  | 29239300  |
| 10          | 9   | 736  | 12601 | 180413 | 3813100  | 29323700  |
| 11          | 9   | 699  | 13096 | 185794 | 3630400  | 30005100  |
| 12          | 9   | 592  | 13353 | 166239 | 3412700  | 29206400  |
| 13          | 9   | 483  | 20268 | 172061 | 3605700  | 29171400  |
| 14          | 9   | 483  | 12744 | 180908 | 3304200  | 29147400  |
| 15          | 9   | 491  | 14886 | 164321 | 3367400  | 27438900  |
| 16          | 9   | 484  | 13656 | 164476 | 3314300  | 26554100  |
| 17          | 9   | 482  | 11205 | 171968 | 3427400  | 25817100  |
| 18          | 9   | 489  | 11685 | 164184 | 3599500  | 26042600  |
| 19          | 9   | 484  | 10477 | 204560 | 3318600  | 25924400  |
| 20          | 9   | 487  | 10641 | 144960 | 3382900  | 25885900  |
| 21          | 9   | 486  | 11712 | 144866 | 3400400  | 26558600  |
| 22          | 9   | 485  | 10914 | 144423 | 3322700  | 25908800  |
| 23          | 9   | 493  | 10955 | 144278 | 3563400  | 25944700  |
| 24          | 9   | 488  | 10445 | 143539 | 3248000  | 26045500  |
| 25          | 9   | 362  | 11564 | 148842 | 3029800  | 26343900  |
| 26          | 9   | 365  | 13208 | 143499 | 3118100  | 27368900  |
| 27          | 9   | 348  | 10995 | 144693 | 3164100  | 27482100  |
| 28          | 9   | 377  | 11112 | 143966 | 3944000  | 27611100  |
| 29          | 9   | 366  | 11110 | 144228 | 3064800  | 27063800  |
| 30          | 9   | 357  | 10936 | 143730 | 3277300  | 25039200  |

Milliseconds

| Cutoff Size | Size 10  | Size 100 | Size 1000 | Size 10000 | Size 100000 | Size 1000000 |
|-------------|----------|----------|-----------|------------|-------------|--------------|
| 0           | 0,000232 | 0,00316  | 0,042123  | 0,522044   | 14,2707     | 122,2092     |
| 1           | 0,000185 | 0,003528 | 0,046313  | 0,52966    | 6,874       | 69,8771      |
| 2           | 0,000111 | 0,002728 | 0,032767  | 0,418981   | 5,9719      | 58,8798      |
| 3           | 0,000076 | 0,00184  | 0,031546  | 0,373143   | 2,9199      | 44,2838      |
| 4           | 0,000076 | 0,001742 | 0,02397   | 0,290741   | 2,7681      | 34,8602      |
| 5           | 0,000033 | 0,001663 | 0,02389   | 0,188732   | 3,4334      | 33,9877      |
| 6           | 0,000033 | 0,001247 | 0,017299  | 0,189667   | 3,6299      | 33,3643      |
| 7           | 0,000033 | 0,0011   | 0,015255  | 0,188503   | 3,6555      | 32,3761      |
| 8           | 0,000033 | 0,001088 | 0,012549  | 0,187755   | 3,6114      | 30,0764      |
| 9           | 0,000033 | 0,000832 | 0,012591  | 0,184127   | 3,5588      | 29,2393      |
| 10          | 0,000009 | 0,000736 | 0,012601  | 0,180413   | 3,8131      | 29,3237      |
| 11          | 0,000009 | 0,000699 | 0,013096  | 0,185794   | 3,6304      | 30,0051      |
| 12          | 0,000009 | 0,000592 | 0,013353  | 0,166239   | 3,4127      | 29,2064      |
| 13          | 0,000009 | 0,000483 | 0,020268  | 0,172061   | 3,6057      | 29,1714      |
| 14          | 0,000009 | 0,000483 | 0,012744  | 0,180908   | 3,3042      | 29,1474      |
| 15          | 0,000009 | 0,000491 | 0,014886  | 0,164321   | 3,3674      | 27,4389      |
| 16          | 0,000009 | 0,000484 | 0,013656  | 0,164476   | 3,3143      | 26,5541      |
| 17          | 0,000009 | 0,000482 | 0,011205  | 0,171968   | 3,4274      | 25,8171      |
| 18          | 0,000009 | 0,000489 | 0,011685  | 0,164184   | 3,5995      | 26,0426      |
| 19          | 0,000009 | 0,000484 | 0,010477  | 0,20456    | 3,3186      | 25,9244      |
| 20          | 0,000009 | 0,000487 | 0,010641  | 0,14496    | 3,3829      | 25,8859      |
| 21          | 0,000009 | 0,000486 | 0,011712  | 0,144866   | 3,4004      | 26,5586      |
| 22          | 0,000009 | 0,000485 | 0,010914  | 0,144423   | 3,3227      | 25,9088      |
| 23          | 0,000009 | 0,000493 | 0,010955  | 0,144278   | 3,5634      | 25,9447      |
| 24          | 0,000009 | 0,000488 | 0,010445  | 0,143539   | 3,248       | 26,0455      |
| 25          | 0,000009 | 0,000362 | 0,011564  | 0,148842   | 3,0298      | 26,3439      |
| 26          | 0,000009 | 0,000365 | 0,013208  | 0,143499   | 3,1181      | 27,3689      |
| 27          | 0,000009 | 0,000348 | 0,010995  | 0,144693   | 3,1641      | 27,4821      |
| 28          | 0,000009 | 0,000377 | 0,011112  | 0,143966   | 3,944       | 27,6111      |
| 29          | 0,000009 | 0,000366 | 0,01111   | 0,144228   | 3,0648      | 27,0638      |
| 30          | 0,000009 | 0,000357 | 0,010936  | 0,14373    | 3,2773      | 25,0392      |



# Exercise 6

## NanoSeconds

| Array Size | Quick Sort First Partitioning | Quick Sort Median Of Three | Tests Performed |
|------------|-------------------------------|----------------------------|-----------------|
| 10         | 226                           | 181                        | 1000000         |
| 50         | 1588                          | 1393                       | 100000          |
| 100        | 3966                          | 3259                       | 100000          |
| 500        | 21654                         | 18514                      | 100000          |
| 1000       | 50311                         | 43068                      | 10000           |
| 5000       | 287869                        | 234934                     | 10000           |
| 10000      | 675101                        | 569839                     | 1000            |
| 50000      | 3468186                       | 2861672                    | 1000            |
| 100000     | 7015810                       | 6862597                    | 100             |
| 500000     | 38306172                      | 35923792                   | 100             |
| 1000000    | 79677380                      | 73088230                   | 10              |
| 5000000    | 525862190                     | 377769060                  | 10              |

## Milliseconds

| Array Size | Quick Sort First Partitioning | Quick Sort Median Of Three |
|------------|-------------------------------|----------------------------|
| 10         | 0,000226                      | 0,000181                   |
| 50         | 0,001588                      | 0,001393                   |
| 100        | 0,003966                      | 0,003259                   |
| 500        | 0,021654                      | 0,018514                   |
| 1000       | 0,050311                      | 0,043068                   |
| 5000       | 0,287869                      | 0,234934                   |
| 10000      | 0,675101                      | 0,569839                   |
| 50000      | 3,468186                      | 2,861672                   |
| 100000     | 7,01581                       | 6,862597                   |
| 500000     | 38,306172                     | 35,923792                  |
| 1000000    | 79,67738                      | 73,08823                   |
| 5000000    | 525,86219                     | 377,76906                  |

