# Assignment 3

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1. To time an event that is smaller than or near the clock accuracy, repeat it many times and divide the overall time by the number of repetitions. You should obtain times that are accurate to within 1%.(please refer to the chapter 1.6 in the textbook)

* Total time should be more than 100\*100(for 1%) ticks. And in python, 1 tick is 1/100 seconds. So I set the total time > 100 seconds.

(on most Unix systems, the clock “ticks” only 50 or 100 times a second. - <https://docs.python.org/3/library/time.html>)

1. Results

|  |  |  |  |
| --- | --- | --- | --- |
|  | Quick sort | Insertion sort | Insertion\_quick |
| 0 | 0.00141 | 0.00173 | 0.00209 |
| 10 | 0.01601 | 0.00534 | 0.01483 |
| 20 | 0.03515 | 0.00919 | 0.02607 |
| 30 | 0.04918 | 0.0123 | 0.0358 |
| 40 | 0.05879 | 0.01801 | 0.06165 |
| 50 | 0.09816 | 0.02269 | 0.08142 |
| 60 | 0.12504 | 0.02663 | 0.09003 |
| 70 | 0.14888 | 0.03046 | 0.10829 |
| 80 | 0.15921 | 0.03229 | 0.12948 |
| 90 | 0.15853 | 0.03965 | 0.15281 |
| 100 | 0.20821 | 0.04372 | 0.17576 |
| 200 | 0.48769 | 0.04372 | 0.17576 |
| 300 | 0.6207 | 0.11408 | 0.50385 |
| 400 | 1.08862 | 0.17269 | 0.79876 |
| 500 | 1.30854 | 0.23253 | 0.90231 |
| 600 | 1.59442 | 0.29328 | 1.14742 |
| 700 | 1.74949 | 0.31885 | 1.46647 |
| 800 | 2.16186 | 0.38892 | 1.63797 |
| 900 | 2.16891 | 0.42355 | 1.79935 |
| 1000 | 2.60085 | 0.46926 | 1.85851 |
| 2000 | 5.36063 | 0.46926 | 1.85851 |
| 3000 | 9.62397 | 37.08978 | 6.55168 |
| 4000 | 11.80017 | 1670.5637 | 9.29055 |
| 5000 | 16.67002 | 2604.54798 | 10.83886 |

Times are in milliseconds

1. Plot

* Insertion sort is O(n^2) so the elapsed time fastly increases as N grows.
* Quick sort is  O(n^2) in worst case, but in average case O(nlogn). At N=4000 point the elapsed time in Quick sort is less than in Insertion sort.
* As the chart shown, Insertion\_quick chooses minimum time cost always.