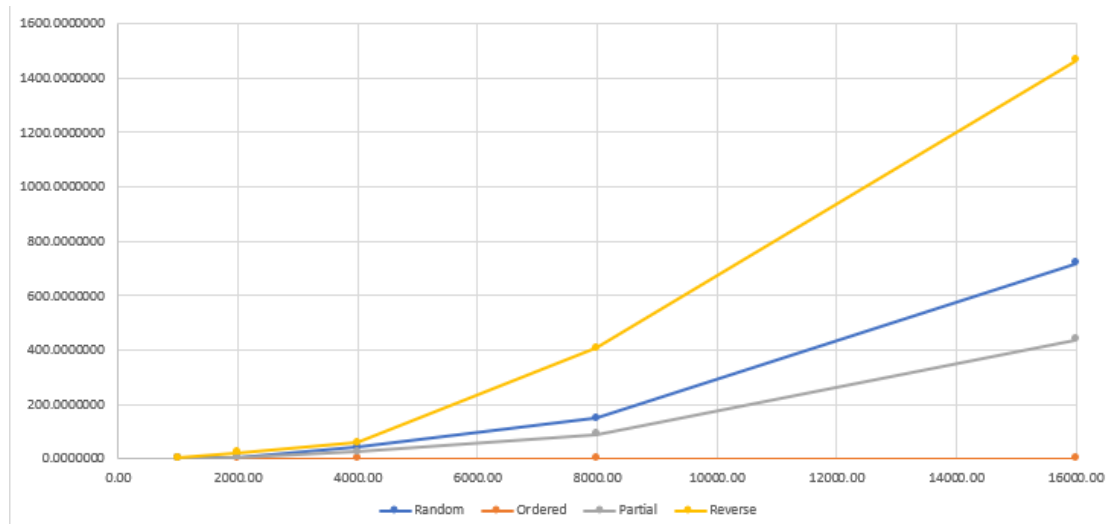


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Program Structures & Algorithms  
Spring 2021  
Assignment No. 2

**Task:** Implement three methods in class Timer. Implement InsertionSort method in InsertionSort class. Implement a main program to run the benchmarks: measure the running times of this sort, using four different initial array ordering situations: random, ordered, partially-ordered and reverse-ordered at least 5 values of n.

**Conclusion:** Each type of sorts was run 50 times at 5 different array size of n values which doubles after each run. The result output is made in graph as shown below. The graph concludes that the relationship between array size and the time taken to sort the array is linear. From observation, the reverse-ordered array took the longest time to sort and the second longest is the random array.

n	Random	Ordered	Partial	Reverse
1000.00	3.0600000	0.0000000	1.6000000	4.3600000
2000.00	7.5400000	0.0200000	5.7600000	23.7400000
4000.00	43.6200000	0.0400000	25.9600000	60.3800000
8000.00	148.9600000	0.0600000	91.4600000	407.5600000
16000.00	717.6600000	0.1600000	437.3000000	1463.5200000



## Output:

```
"C:\Program Files\Java\jdk1.8.0_111\bin\java.exe" ...
2021-02-05 00:30:58 INFO Benchmark_Timer - Begin run: Random Array of length 1000 with 50 runs
Insertion Sort of Random Array of length 1000 with 50 reps: 3.06 millisecs
2021-02-05 00:30:58 INFO Benchmark_Timer - Begin run: Ordered Array of length 1000 with 50 runs
Insertion Sort of Ordered Array of length 1000 with 50 reps: 0.0 millisecs
2021-02-05 00:30:58 INFO Benchmark_Timer - Begin run: Partial Ordered Array of length 1000 with 50 runs
Insertion Sort of Partial Ordered Array of length 1000 with 50 reps: 1.6 millisecs
2021-02-05 00:30:58 INFO Benchmark_Timer - Begin run: Reverse Ordered Array of length 1000 with 50 runs
Insertion Sort of Reverse Ordered Array of length 1000 with 50 reps: 4.36 millisecs
2021-02-05 00:30:59 INFO Benchmark_Timer - Begin run: Random Array of length 2000 with 50 runs
Insertion Sort of Random Array of length 2000 with 50 reps: 7.54 millisecs
2021-02-05 00:30:59 INFO Benchmark_Timer - Begin run: Ordered Array of length 2000 with 50 runs
Insertion Sort of Ordered Array of length 2000 with 50 reps: 0.02 millisecs
2021-02-05 00:30:59 INFO Benchmark_Timer - Begin run: Partial Ordered Array of length 2000 with 50 runs
Insertion Sort of Partial Ordered Array of length 2000 with 50 reps: 5.76 millisecs
2021-02-05 00:30:59 INFO Benchmark_Timer - Begin run: Reverse Ordered Array of length 2000 with 50 runs
Insertion Sort of Reverse Ordered Array of length 2000 with 50 reps: 23.74 millisecs
2021-02-05 00:31:01 INFO Benchmark_Timer - Begin run: Random Array of length 4000 with 50 runs
Insertion Sort of Random Array of length 4000 with 50 reps: 43.62 millisecs
2021-02-05 00:31:03 INFO Benchmark_Timer - Begin run: Ordered Array of length 4000 with 50 runs
Insertion Sort of Ordered Array of length 4000 with 50 reps: 0.04 millisecs
2021-02-05 00:31:03 INFO Benchmark_Timer - Begin run: Partial Ordered Array of length 4000 with 50 runs
Insertion Sort of Partial Ordered Array of length 4000 with 50 reps: 25.96 millisecs
2021-02-05 00:31:05 INFO Benchmark_Timer - Begin run: Reverse Ordered Array of length 4000 with 50 runs
Insertion Sort of Reverse Ordered Array of length 4000 with 50 reps: 60.38 millisecs
2021-02-05 00:31:08 INFO Benchmark_Timer - Begin run: Random Array of length 8000 with 50 runs
Insertion Sort of Random Array of length 8000 with 50 reps: 148.96 millisecs

2021-02-05 00:31:16 INFO Benchmark_Timer - Begin run: Ordered Array of length 8000 with 50 runs
Insertion Sort of Ordered Array of length 8000 with 50 reps: 0.06 millisecs
2021-02-05 00:31:16 INFO Benchmark_Timer - Begin run: Partial Ordered Array of length 8000 with 50 runs
Insertion Sort of Partial Ordered Array of length 8000 with 50 reps: 91.46 millisecs
2021-02-05 00:31:21 INFO Benchmark_Timer - Begin run: Reverse Ordered Array of length 8000 with 50 runs
Insertion Sort of Reverse Ordered Array of length 8000 with 50 reps: 407.56 millisecs
2021-02-05 00:31:43 INFO Benchmark_Timer - Begin run: Random Array of length 16000 with 50 runs
Insertion Sort of Random Array of length 16000 with 50 reps: 717.66 millisecs
2021-02-05 00:32:23 INFO Benchmark_Timer - Begin run: Ordered Array of length 16000 with 50 runs
Insertion Sort of Ordered Array of length 16000 with 50 reps: 0.16 millisecs
2021-02-05 00:32:23 INFO Benchmark_Timer - Begin run: Partial Ordered Array of length 16000 with 50 runs
Insertion Sort of Partial Ordered Array of length 16000 with 50 reps: 437.3 millisecs
2021-02-05 00:32:46 INFO Benchmark_Timer - Begin run: Reverse Ordered Array of length 16000 with 50 runs
```

## Tests:

