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Program Structures & Algorithms

Fall 2021

Final Project

⊙ Task

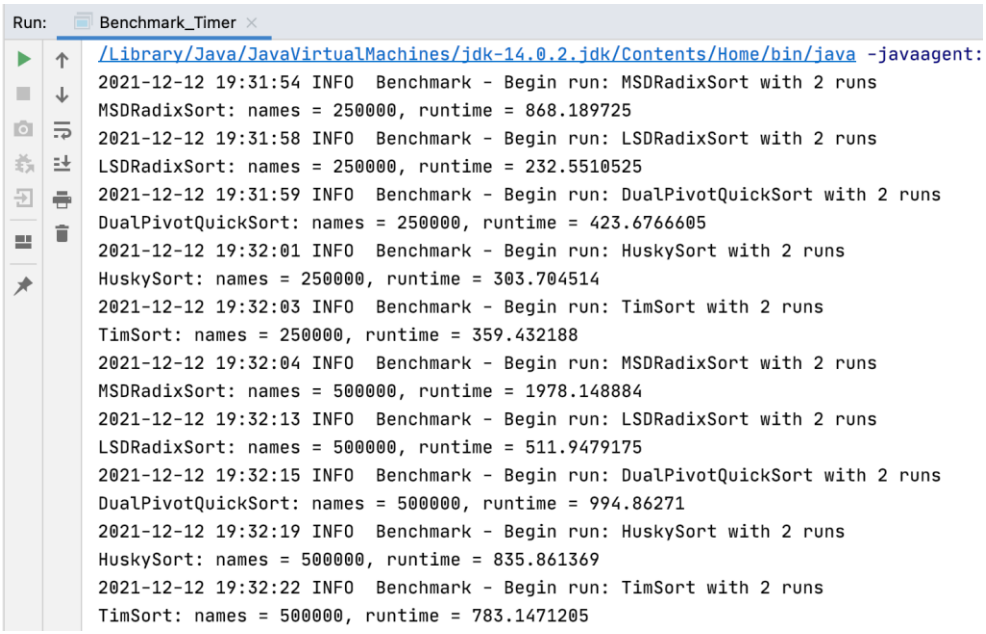
Your task is to implement MSD radix sort for a natural language which uses Unicode characters. You may choose your own language or (Simplified) Chinese. Additionally, you will complete a literature survey of relevant papers and you will compare your method with Timsort, Dual-pivot Quicksort, Huskysort, and LSD radix sort.

⊙ Introduction

We use Collator class to compare Chinese words by setting new Collator. We use 5 algorithms to sort 1M Chinese names and analyze the 5 algorithms. The sorting results of the algorithms are placed under the resource file.

⊙ Evidence to support the conclusion:

1. Output (Snapshot of Code output in the terminal)



```
2021-12-12 19:32:25 INFO  Benchmark - Begin run: MSDRadixSort with 2 runs
MSDRadixSort: names = 1000000, runtime = 3935.710022
2021-12-12 19:32:40 INFO  Benchmark - Begin run: LSDRadixSort with 2 runs
LSDRadixSort: names = 1000000, runtime = 1068.5325
2021-12-12 19:32:45 INFO  Benchmark - Begin run: DualPivotQuickSort with 2 runs
DualPivotQuickSort: names = 1000000, runtime = 1999.3868835
2021-12-12 19:32:53 INFO  Benchmark - Begin run: HuskySort with 2 runs
HuskySort: names = 1000000, runtime = 1440.9269485
2021-12-12 19:32:59 INFO  Benchmark - Begin run: TimSort with 2 runs
TimSort: names = 1000000, runtime = 1833.228236
2021-12-12 19:33:06 INFO  Benchmark - Begin run: MSDRadixSort with 2 runs
MSDRadixSort: names = 2000000, runtime = 5814.763113
2021-12-12 19:33:29 INFO  Benchmark - Begin run: LSDRadixSort with 2 runs
LSDRadixSort: names = 2000000, runtime = 1785.3717295
2021-12-12 19:33:37 INFO  Benchmark - Begin run: DualPivotQuickSort with 2 runs
DualPivotQuickSort: names = 2000000, runtime = 3516.1009845
2021-12-12 19:33:51 INFO  Benchmark - Begin run: HuskySort with 2 runs
HuskySort: names = 2000000, runtime = 3022.1146975
2021-12-12 19:34:03 INFO  Benchmark - Begin run: TimSort with 2 runs
TimSort: names = 2000000, runtime = 3642.9346485
```

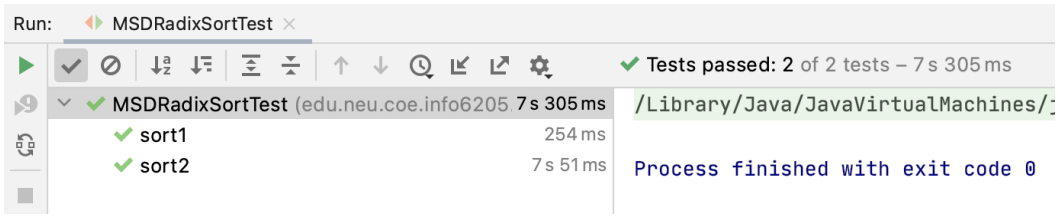
```
2021-12-12 19:34:17 INFO  Benchmark - Begin run: MSDRadixSort with 2 runs
MSDRadixSort: names = 4000000, runtime = 10938.6071585
2021-12-12 19:35:01 INFO  Benchmark - Begin run: LSDRadixSort with 2 runs
LSDRadixSort: names = 4000000, runtime = 3489.423097
2021-12-12 19:35:15 INFO  Benchmark - Begin run: DualPivotQuickSort with 2 runs
DualPivotQuickSort: names = 4000000, runtime = 9911.888967
2021-12-12 19:35:52 INFO  Benchmark - Begin run: HuskySort with 2 runs
HuskySort: names = 4000000, runtime = 7793.566302
2021-12-12 19:36:22 INFO  Benchmark - Begin run: TimSort with 2 runs
TimSort: names = 4000000, runtime = 8386.1037275

Process finished with exit code 0
```

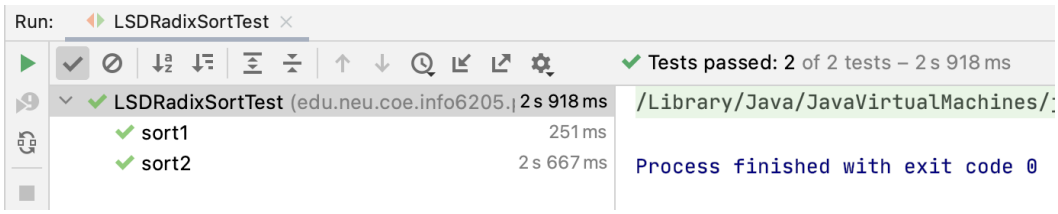
We use Benchmark_Timer class to test the running time of five algorithms for 250K, 500K, 1M, 2M, 4M names.

2. **Graphical Representation(Observations from experiments should be tabulated and analyzed by plotting graphs(usually in excel) to arrive on the relationship conclusion)**

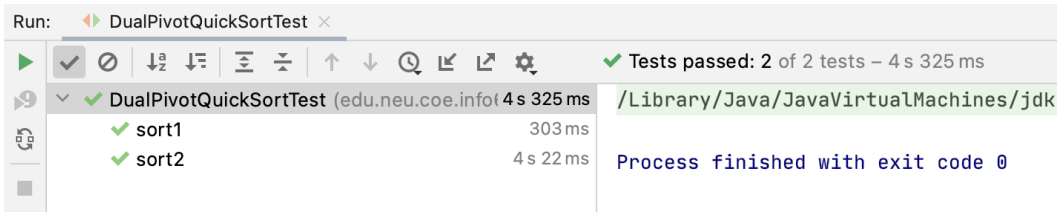
- **Unit tests result:(Snapshot of successful unit test run)**



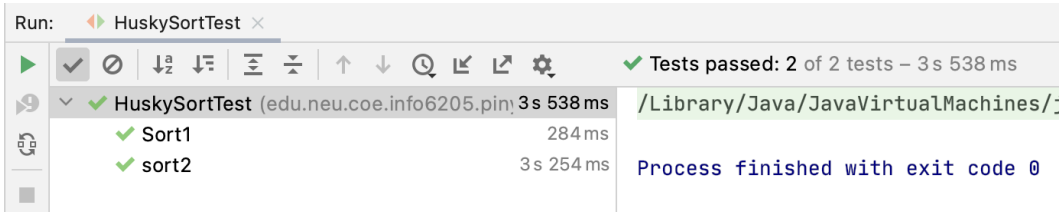
MSDRadixSort Test



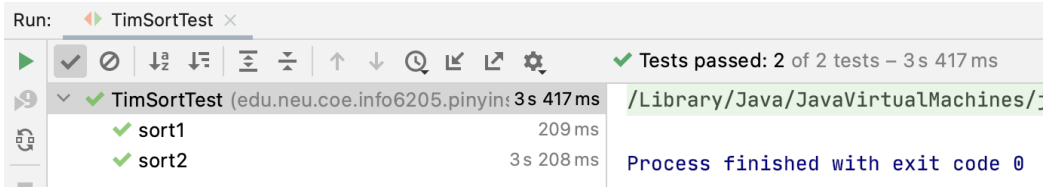
LSDRadixSort Test



DualPivotQuickSort Test



HuskySort Test



TimSort Test

⊙ Relationship Conclusion:

From the chart we can get the result of the running time:

LSDRadixSort < HuskySort < TimSort < DualPivotQuickSort < MSDRadixSort

The sorting time of five algorithms increases almost linearly with the increase of array length. MSDRadixSort has the longest sorting time and the worst performance. LSDRadixSort has the shortest sorting time and the best performance.