**Project 4 Benchmark and Analysis Elton Vinh**

**Thien Van**

**CS 146**

**Anna Shaverdian**

**Hash Table Insertion Sort**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** | **Average** |
| Hamlet | 0.1618665 | 0.1620593 | 0.1620701 | 0.1700601 | 0.1660601 | 0.16442322 |
| Clarissa | 1.4039681 | 1.409396 | 1.4349659 | 1.4393151 | 1.4215141 | 1.42183184 |
| The-Tempest | 0.1499929 | 0.149757 | 0.1520545 | 0.1487179 | 0.147982 | 0.14970086 |
| Essays | 0.2450887 | 0.2521023 | 0.2500908 | 0.241342 | 0.248562 | 0.24743716 |
| Soled | 1.8986874 | 1.8514433 | 1.8796805 | 1.8786497 | 1.8854475 | 1.87878168 |
| The-New-Atlantis | 0.1350489 | 0.1293835 | 0.1400859 | 0.1347601 | 0.1320464 | 0.13426496 |
| King-James-Bible | 0.6938983 | 0.69724 | 0.6921361 | 0.6899267 | 0.6943227 | 0.69350476 |
| Alice | 0.1260581 | 0.1346028 | 0.1460512 | 0.1370266 | 0.138021 | 0.13635194 |

**Hash Table QuickSort**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** | **Average** |
| Hamlet | 0.1166245 | 0.1181124 | 0.1220456 | 0.1230329 | 0.1171785 | 0.11939878 |
| Clarissa | 0.4094273 | 0.4021197 | 0.4273366 | 0.4061405 | 0.408303 | 0.41066542 |
| The-Tempest | 0.1171009 | 0.120048 | 0.1230505 | 0.1170543 | 0.1243096 | 0.12031266 |
| Essays | 0.1280469 | 0.1316871 | 0.1360981 | 0.1351754 | 0.1381009 | 0.13382168 |
| Soled | 0.2790243 | 0.2738769 | 0.275109 | 0.2770855 | 0.2776611 | 0.27655136 |
| The-New-Atlantis | 0.114041 | 0.1131447 | 0.1090611 | 0.1150189 | 0.1095751 | 0.11216816 |
| King-James-Bible | 0.3331454 | 0.333802 | 0.3312916 | 0.3345773 | 0.3325464 | 0.33307254 |
| Alice | 0.1130333 | 0.1130697 | 0.1150473 | 0.1050639 | 0.114012 | 0.11204524 |

**Hash Table MergeSort**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** | **Average** |
| Hamlet | 0.1171112 | 0.1191582 | 0.1190428 | 0.1319312 | 0.1170597 | 0.12086062 |
| Clarissa | 0.4212776 | 0.4208346 | 0.4094006 | 0.4115662 | 0.415312 | 0.4156782 |
| The-Tempest | 0.1200466 | 0.1235185 | 0.1180438 | 0.1170216 | 0.1180519 | 0.11933648 |
| Essays | 0.1320521 | 0.1325504 | 0.1345509 | 0.1360618 | 0.136385 | 0.13432004 |
| Soled | 0.2840403 | 0.2766318 | 0.2770992 | 0.2731057 | 0.28235 | 0.2786454 |
| The-New-Atlantis | 0.1150996 | 0.1070797 | 0.116017 | 0.1110404 | 0.1167177 | 0.11319088 |
| King-James-Bible | 0.3344644 | 0.3290961 | 0.3354289 | 0.3306898 | 0.3291578 | 0.3317674 |
| Alice | 0.1118234 | 0.1154166 | 0.1139392 | 0.1120516 | 0.1130318 | 0.11325252 |

**Note:** All times in seconds

**Best Times**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Document** | **Best Time** | **Sort Method** | **Unique Words** | **Total Words** |
| Hamlet | 0.11939878 | QS | 4851 | 35064 |
| Clarissa | 0.41066542 | QS | 21209 | 996459 |
| The-Tempest | 0.11933648 | MS | 4291 | 25836 |
| Essays | 0.13382168 | QS | 7256 | 56431 |
| Soled | 0.27655136 | QS | 25356 | 259749 |
| The-New-Atlantis | 0.11216816 | QS | 3088 | 17729 |
| King-James-Bible | 0.3317674 | MS | 12895 | 795934 |
| Alice | 0.11204524 | QS | 3009 | 30419 |

**Runtimes of Sorting Algorithms**

Best Average Worst

Quicksort

|  |  |  |
| --- | --- | --- |
| O(n log(n)) | O(n log(n)) | O(n^2) |

Mergesort

|  |  |  |
| --- | --- | --- |
| O(n log(n)) | O(n log(n)) | O(n log(n)) |

Insertion Sort

|  |  |  |
| --- | --- | --- |
| O(n) | O(n^2) | O(n^2) |

**Conclusion**

Right away we can deduce from our data that insertion sort performs worst out of the three sorting algorithms we tested. Secondly, we see from our best times that quicksort out performs merge sort on most of our tests, with some exceptions where mergesort is the better performer. The theoretical running times of the various algorithms supports the results. Even though quicksort had the majority of “best times” the mergesort and quicksort times are very close.