**Project Evaluation:**

The project completion took quite a bit less with both people working on it than I originally anticipated. There were a few difficulties with overriding changes with branch merges in GIT, but were easily overcome and made communication much better in the process.

Our results were very close to the Knuth predicted average in searches when the load factors were high, but as the hash table size increase and brought the load factor down, the chain has method became wildly more inefficient than the linear probe and double hash method. The assumed reason for this is due to the cost of overhead required in the chain method; while the linear probe and double hash used arrays that can be brought into page sizes, the chain hash requires maintenance of multiple linked lists.

**Test Results:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | **Linear Probe** | **Double Hashing** | **Chained Hashing** |
| **Load Factor 0.25 (19997)** | **Run 1** | **Actual** | 1.0432 | 1.0096 | 1.0552 |
| **Knuth** | 1.1667 | 1.15076 | 1.12502 |
| **** | -0.1235 | -0.14116 | -0.06982 |
| **Run 2** | **Actual** | 1.0424 | 1.006 | 1.0608 |
| **Knuth** | 1.1667 | 1.15076 | 1.12502 |
| **** | -0.1243 | -0.14476 | -0.06422 |
| **Run 3** | **Actual** | 1.0428 | 1.008 | 1.0616 |
| **Knuth** | 1.1667 | 1.15076 | 1.12502 |
| **** | -0.1239 | -0.14276 | -0.06342 |
| **Run 4** | **Actual** | 1.7192 | 1.71 | 1.06 |
| **Knuth** | 1.1667 | 1.15076 | 1.12502 |
| **** | 0.5525 | 0.55924 | -0.06502 |
| **Run 5** | **Actual** | 1.0392 | 1.0056 | 1.0632 |
| **Knuth** | 1.1667 | 1.15076 | 1.12502 |
| **** | -0.1275 | -0.14516 | -0.06182 |
|  |  |  |  |  |  |
|  | | | **Linear Probe** | **Double Hashing** | **Chained Hashing** |
| **Load Factor 0.5 (10007)** | **Run 1** | **Actual** | 1.6704 | 1.6468 | 1.1572 |
| **Knuth** | 1.4993 | 1.38587 | 1.24983 |
| **** | 0.1711 | 0.26093 | -0.09263 |
| **Run 2** | **Actual** | 1.1488 | 1.138 | 1.1528 |
| **Knuth** | 1.4993 | 1.38587 | 1.24983 |
| **** | -0.3505 | -0.24787 | -0.09703 |
| **Run 3** | **Actual** | 2.1884 | 1.6412 | 1.1708 |
| **Knuth** | 1.4993 | 1.38587 | 1.24983 |
| **** | 0.6891 | 0.25533 | -0.07903 |
| **Run 4** | **Actual** | 1.1716 | 1.128 | 1.1632 |
| **Knuth** | 1.4993 | 1.38587 | 1.24983 |
| **** | -0.3277 | -0.25787 | -0.08663 |
| **Run 5** | **Actual** | 1.6516 | 1.6512 | 1.1572 |
| **Knuth** | 1.4993 | 1.38587 | 1.24983 |
| **** | 0.1523 | 0.26533 | -0.09263 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  | | | **Linear Probe** | **Double Hashing** | **Chained Hashing** |
| **Load Factor 0.714 (7001)** | **Run 1** | **Actual** | 2.95 | 2.4948 | 1.2648 |
| **Knuth** | 2.24938 | 1.75362 | 1.35709 |
| **** | 0.70062 | 0.74118 | -0.09229 |
| **Run 2** | **Actual** | 2.0776 | 2.2888 | 1.266 |
| **Knuth** | 2.24938 | 1.75362 | 1.35709 |
| **** | -0.17178 | 0.53518 | -0.09109 |
| **Run 3** | **Actual** | 3.1332 | 2.0328 | 1.2788 |
| **Knuth** | 2.24938 | 1.75362 | 1.35709 |
| **** | 0.88382 | 0.27918 | -0.07829 |
| **Run 4** | **Actual** | 2.2244 | 1.6748 | 1.2832 |
| **Knuth** | 2.24938 | 1.75362 | 1.35709 |
| **** | -0.02498 | -0.07882 | -0.07389 |
| **Run 5** | **Actual** | 2.26 | 4.904 | 1.2732 |
| **Knuth** | 2.24938 | 1.75362 | 1.35709 |
| **** | 0.01062 | 3.15038 | -0.08389 |