ANALYSIS OF SORTING ALGORITHMS

Bubble Sort | Insertion Sort | Merge Sort | Quick Sort

ENVIRONMENT

- **OS**
  - macOS 10.15.1 (19B88)
- **Processor**
  - 2,8 GHz Quad-Core Intel Core i7
- **Memory**
  - 16 GB 2133 MHz LPDDR3

IMPLEMENTATIONS

- **Bubble Sort**
  - C + Clang
  - Time measurement via C
- **Insertion Sort**
  - C + Clang
  - Time measurement via C
- **Merge Sort**
  - Haskell + GHC
  - Time measurement via scripting
- **Quick Sort**
  - Haskell + GHC
  - Time measurement via scripting

RANDOM NUMBER GENERATION

- Custom-built pseudo random generator,
- Via bash scripting.

TEST DATA

- **A file set:**
  - Unordered
  - Ascending
  - Descending
- **Categories:** 10K, 20K, 30K, …, 100K
- **Set Count:** 30 / category
- **Total:** 3 x 30 x 10 = 900 singles files ~= 290 MB

SAMPLE TEST DATA

A chunk of the Bubble Sort results

FileName	KnownNumberArrangement	SecondsElapsed	NumberCount	OperationCount
data-set/10000-numbers-0-ordered-ascending.txt.csv	ascending	0.409916	10000	19997
data-set/10000-numbers-0-ordered-descending.txt.csv	descending	1.194424	10000	199963930
data-set/10000-numbers-0-unordered.txt.csv	unordered	1.330959	10000	100169463
data-set/10000-numbers-1-ordered-ascending.txt.csv	ascending	0.443937	10000	19998
data-set/10000-numbers-1-ordered-descending.txt.csv	descending	1.238136	10000	199963941
data-set/10000-numbers-1-unordered.txt.csv	unordered	1.315640	10000	99540563
data-set/10000-numbers-10-ordered-ascending.txt.csv	ascending	0.135241	10000	9998
data-set/10000-numbers-10-ordered-descending.txt.csv	descending	0.301652	10000	49993506

KNOWN ISSUES

- Number count is sporadicly wrong,
- File listing doesn’t account number magnitudes.

EXPERIMENT SUBJECT

Measuring and comparing the execution time performances of Bubble sort, Insertion sort, Merge sort, Quick sort

EXPERIMENT CASES

HYPOTHESES

- **H_0:**
  - Merge sort performs faster than Bubble sort,
  - t_exec(MS) < t_exec(BS).
- **H_0_alt:**
  - Merge sort doesn’t perform faster than Bubble sort,
  - t_exec(MS) >= t_exec(BS).

VARIABLES

- Known number arrangement
- Seconds elapsed
- Number count

TOTAL EXECUTION TIMES

- **Bubble Sort:** 8443.856 seconds ~= 140 minutes
- **Insertion Sort:** 2397.788 seconds ~= 40 minutes
- **Merge Sort:** 7.05s user 20.41s system 68% cpu 40.149 total
- **Quick Sort:** 6.77s user 18.37s system 67% cpu 37.253 total

THREATS TO VALIDITY

- Conclusion validity / isolating machine power in a virtual machine
- External validity / application by others