

z390 Open Source ZSORT Utility

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The z390 ZSORT internal sort facility is an open source component of z390 which supports sorting of any number of fixed or variable length records of any size up to the limits of memory and 64 bit file system.

ZSORT is implemented with the intent of being compatible with IBM DFSORT. The major components currently include the following:

- 1. SORT.MLC utility assembler program with following input files:**
 - a. SORTIN – unsorted input file with DCB options**
 - b. SORTOUT – sorted output file with DCB options**
 - c. SYSIN – sort field definitions**
- 2. Z390 ZSORT macro maps user calls into supervisor calls:**
 - a. ISORT – init internal sort with following parameters:**
 - i. Record format - F, FB, V, VB**
 - ii. Record length – maximum for V**
 - iii. Memory – number of records in single block defines the amount of memory available for sort table (If not specified, the maximum available contiguous memory block within the memory allocated to step by z390 MEM option will be used.)**
 - iv. Sort field offset, length, type, order**
 - 1. AC - ASCII characters (same as CH)**
 - 2. BI - unsigned binary (same as CH)**
 - 3. CH - EBCDIC characters (same as CH)**
 - 4. FI - signed binary such as half word, full word, or quad word integers**
 - 5. FL - floating point HFP, BFP, or DFP short, long, or extended**
 - 6. PD - packed decimal**
 - 7. ZD - zoned decimal**
 - v. Example: ZSORT**
ISORT,LRECL=80.MEMORY=10000000,FIELDS=(1,80,CH,A)
 - b. PUT,REC= – put unsorted record**
 - c. GET,REC= – get sorted record until RC=4 at end**
- 3. z390 SVC x'A1' written in J2SE Java with 3 ZSORT macro function calls:**

- a. Initialize internal sort request
 - b. Submit unsorted record
 - c. Retrieve sorted record
4. TESTSORT.MLC – test sort of simple 20 record ascii file
 5. TESTSRT1.MLC – create test file with 8 different sort field types.
 6. TESTSRT2.MLC - verify sorted file with 8 different sort field types.
 7. TESTSRT3.MLC – create large test file with descending keys
 8. TESTSRT4.MLC – verify sorted file with ascending keys
 9. RUNSORT.BAT – assemble, link, and execute all of the above test programs in sort directory

Unsorted records are loaded into dynamically allocated table in memory and sorted. If the unsorted records exceed size of table, then multiple blocks of sorted records are written to a work file and then merged. If all the records fit in table, then they are sorted and returned without requiring use of sort work files. When required, the merging is performed using two dynamically allocated sort work files with DDNAME's SORTWK01 and SORTWK02. The sorted strings are merged from one work file to another doubling the size of the sorted strings on each pass until all the records are sorted on last merge pass. All file I/O is blocked to minimize disk seeking on single disk systems. User can define location of SORTWK01 and SORTWK02 if multiple physical disk drives are available. Statistics on each sort execution are recorded on the statistics file if option STATS is specified. For example, here are statistics for 100,000 record sort using 4000 record memory table:

```
EZ390 ZSORT ID=1 started=09:26:57 ended=09:26:57
EZ390 ZSORT ID=1 lrecl=4 keys=1
EZ390 ZSORT ID=1 records=100000 memory= 4000
EZ390 ZSORT ID=1 record compares=1487600 moves=2123800
EZ390 ZSORT ID=1 sorted blocks=100 merge passes=7
EZ390 ZSORT ID=1 block writes=2503 reads=2302
```

The current sort method used to sort table is a shell sort. All comments, suggestions, and contributions for improving this open source sort utility are welcome. You can join z390 user group z390@googlegroups.com or send private email to don@higgins.net.

References:

1. www.z390.info - z390 Portable Mainframe Assembler and Emulator Downloads for Windows, Linux, and Mac PC's.
2. <http://www.zopcodes.info/zopcheck.pdf> - latest version of ZOPCHECK open source program which verifies all the opcodes supported by the z390 assembler including new SORTL instruction for DFSORT assist.
3. <https://www.ibm.com/support/pages/sites/default/files/inline-files/DFSORT%20User%20Guide%20for%20PH03207.pdf> DFSORT User Guide IBM Integrated Accelerator for IBM Z Sort (PH03207)
4. http://www.z390.org/z390_ZSORT_Internal_Sort_Utility.htm - the original webpage on May 23, 2012 announcing the z390 open source ZSORT utility. Note back then it took 3 seconds to sort 100,000 records compared to less than 1 second now.