

File created: 11-Jun-90 16:24:56 {DSK}<usr>local>lde>lispcore>library>HASH-FILE.;2

changes to: (IL:VARS IL:HASH-FILECOMS)

previous date: 1-Mar-88 14:55:31 {DSK}<usr>local>lde>lispcore>library>HASH-FILE.;1

Read Table: XCL

Package: HASH-FILE

Format: XCCS

; Copyright (c) 1987, 1988, 1990 by Venue & Xerox Corporation. All rights reserved.

```
(IL:RPAQQ IL:HASH-FILECOMS
  ((IL:P (PROVIDE "HASH-FILE")
    (EXPORT ' (MAKE-HASH-FILE OPEN-HASH-FILE CLOSE-HASH-FILE COPY-HASH-FILE MAP-HASH-FILE
      GET-HASH-FILE REM-HASH-FILE HASH-FILE-P HASH-FILE-COUNT HASH-FILE)
      "HASH-FILE")))
  (IL:STRUCTURES HASH-FILE)
  (IL:FUNCTIONS %PRINT-HASH-FILE)
  (IL:VARIABLES BITS-PER-BYTE BYTES-PER-POINTER SIZE-POSITION COUNT-POSITION TABLE-POSITION
    THE-NULL-POINTER)
  (IL:COMS

;;; public code

  (IL:FUNCTIONS MAKE-HASH-FILE OPEN-HASH-FILE CLOSE-HASH-FILE COPY-HASH-FILE MAP-HASH-FILE
    GET-HASH-FILE PUT-HASH-FILE REM-HASH-FILE)
  (IL:SETFS GET-HASH-FILE)
  (IL:VARIABLES *DELETE-OLD-VERSION-ON-REHASH* *REHASH-SIZE* *REHASH-THRESHOLD*)

;;; internal code

  (IL:FUNCTIONS REHASH? REHASH KEY->TABLE-POINTER ADD-ENTRY ENSURE-STREAM-IS-OPEN NEXT-PRIME
    WRITE-SIZE READ-SIZE WRITE-COUNT READ-COUNT WRITE-POINTER READ-POINTER NULL-POINTER?)
  ;; conveniences
  (IL:FUNCTIONS HISTOGRAM CONVERT)
  (IL:COMS

;;; default user code

  (IL:FUNCTIONS HASH-OBJECT HASH-OBJECT-INTERNAL COMBINE)
  (IL:VARIABLES *HASH-DEPTH*)
  (IL:FUNCTIONS DEFAULT-READ-FN DEFAULT-PRINT-FN)
  (IL:VARIABLES *READER-ENVIRONMENT*))
  (IL:PROP (IL:FILETYPE IL:MAKEFILE-ENVIRONMENT)
    IL:HASH-FILE)))

(PROVIDE "HASH-FILE")

(EXPORT ' (MAKE-HASH-FILE OPEN-HASH-FILE CLOSE-HASH-FILE COPY-HASH-FILE MAP-HASH-FILE GET-HASH-FILE REM-HASH-FILE
  HASH-FILE-P HASH-FILE-COUNT HASH-FILE)
  "HASH-FILE")

(DEFSTRUCT (HASH-FILE (:COPIER COPY-HASH-FILE-INTERNAL)
  (:CONSTRUCTOR MAKE-HASH-FILE-INTERNAL)
  (:PRINT-FUNCTION %PRINT-HASH-FILE))
  "Like a hash-table but on a file instead of in memory"
  (STREAM NIL :TYPE STREAM)
  ;; open stream on the backing file
  (DIRECTION :INPUT :TYPE (MEMBER :INPUT :IO))
  ;; the direction that stream is open in
  (MONITOR (CREATE.MONITORLOCK "HASH-FILE")
    :TYPE MONITORLOCK)
  ;; should always be obtained before changing STREAM's position
  (SIZE NIL :TYPE INTEGER)
  ;; size of the table -- determines the range for key hashing
  (COUNT 0 :TYPE :INTEGER)
  ;; number of entries currently in the hash file
  (REHASH-SIZE *REHASH-SIZE* :TYPE FLOAT)
  ;; factor to increase size by when re-hashing
  (REHASH-THRESHOLD *REHASH-THRESHOLD* :TYPE FLOAT)
  ;; rehash when (= ENTRIES (* SIZE REHASH-THRESHOLD)
  (KEY-PRINT-FN 'DEFAULT-PRINT-FN :TYPE FUNCTION)
  ;; called with KEY and STREAM to write keys on the file
  (KEY-READ-FN 'DEFAULT-READ-FN :TYPE FUNCTION)
```

```

;; called with STREAM to read a key from the file
(KEY-HASH-FN 'HASH-OBJECT :TYPE FUNCTION)
;; called with KEY and SIZE to obtain an integer in {0 .. SIZE-1}
(KEY-COMPARE-FN 'EQUAL :TYPE FUNCTION)
;; called with two keys with same hash value to resolve collisions
(VALUE-PRINT-FN 'DEFAULT-PRINT-FN :TYPE FUNCTION)
;; called with VALUE and STREAM to print values on file
(VALUE-READ-FN 'DEFAULT-READ-FN :TYPE FUNCTION)
;; called with STREAM to read a value from the file
)

```

```

(DEFUN %PRINT-HASH-FILE (HASH-FILE STREAM DEPTH)
  (FORMAT STREAM "#<Hash-File on ~A>" (LET* ((STREAM (HASH-FILE-STREAM HASH-FILE))
                                           (NAMESTRING (NAMESTRING (PATHNAME STREAM))))
                                         (IF NAMESTRING
                                             NAMESTRING
                                             STREAM))))

```

```
(DEFCONSTANT BITS-PER-BYTE 8)
```

```
(DEFCONSTANT BYTES-PER-POINTER 4)
```

```
(DEFCONSTANT SIZE-POSITION (* BYTES-PER-POINTER 0))
```

```
(DEFCONSTANT COUNT-POSITION (* BYTES-PER-POINTER 1))
```

```
(DEFCONSTANT TABLE-POSITION (* BYTES-PER-POINTER 2))
```

```
(DEFCONSTANT THE-NULL-POINTER 0)
```

;;; public code

(DEFUN MAKE-HASH-FILE

```

;; MAKE-HASH-TABLE equivalent for hash files
;; creates and returns a new hash file.
(FILE-NAME SIZE &KEY (REHASH-SIZE *REHASH-SIZE*)
  (REHASH-THRESHOLD *REHASH-THRESHOLD*)
  (KEY-PRINT-FN 'DEFAULT-PRINT-FN)
  (KEY-READ-FN 'DEFAULT-READ-FN)
  (KEY-COMPARE-FN 'EQUAL)
  (KEY-HASH-FN 'HASH-OBJECT)
  (VALUE-PRINT-FN 'DEFAULT-PRINT-FN)
  (VALUE-READ-FN 'DEFAULT-READ-FN))
(LET ((STREAM (OPEN FILE-NAME :DIRECTION :IO :IF-EXISTS :NEW-VERSION :ELEMENT-TYPE '(UNSIGNED-BYTE
                                                                                       ,BITS-PER-BYTE))))
  (REAL-SIZE (NEXT-PRIME SIZE)))
;; write the size & entries
(WRITE-SIZE REAL-SIZE STREAM)
(WRITE-COUNT 0 STREAM)
;; initialize table -- fill it with null pointers
(DOTIMES (N REAL-SIZE)
  (WRITE-POINTER THE-NULL-POINTER STREAM))
;; make & return a HASH-FILE structure
(MAKE-HASH-FILE-INTERNAL :STREAM STREAM :DIRECTION :IO :SIZE REAL-SIZE :COUNT 0 :REHASH-SIZE REHASH-SIZE
  :REHASH-THRESHOLD REHASH-THRESHOLD :KEY-PRINT-FN KEY-PRINT-FN :KEY-READ-FN KEY-READ-FN
  :KEY-COMPARE-FN KEY-COMPARE-FN :KEY-HASH-FN KEY-HASH-FN :VALUE-PRINT-FN VALUE-PRINT-FN
  :VALUE-READ-FN VALUE-READ-FN))

```

(DEFUN OPEN-HASH-FILE

```

;; open an existing hash file
(FILE-NAME &KEY (DIRECTION :INPUT)
  (REHASH-SIZE *REHASH-SIZE*)
  (REHASH-THRESHOLD *REHASH-THRESHOLD*)
  (KEY-PRINT-FN 'DEFAULT-PRINT-FN)
  (KEY-READ-FN 'DEFAULT-READ-FN)
  (KEY-COMPARE-FN 'EQUAL))

```

```

(KEY-HASH-FN 'HASH-OBJECT)
(VALUE-PRINT-FN 'DEFAULT-PRINT-FN)
(VALUE-READ-FN 'DEFAULT-READ-FN))
(CASE DIRECTION
  ((:INPUT :IO) )
  (OTHERWISE (ERROR "~S illegal arg. Must be :INPUT or :IO" DIRECTION)))
(LET ((STREAM (OPEN FILE-NAME :DIRECTION DIRECTION :IF-EXISTS :OVERWRITE :ELEMENT-TYPE
  '(UNSIGNED-BYTE ,BITS-PER-BYTE))))
  ;; make & return a HASH-FILE structure
  (MAKE-HASH-FILE-INTERNAL :STREAM STREAM :DIRECTION DIRECTION :SIZE (READ-SIZE STREAM)
    :COUNT
    (READ-COUNT STREAM)
    :REHASH-SIZE REHASH-SIZE :REHASH-THRESHOLD REHASH-THRESHOLD :KEY-PRINT-FN KEY-PRINT-FN
    :KEY-READ-FN KEY-READ-FN :KEY-COMPARE-FN KEY-COMPARE-FN :KEY-HASH-FN KEY-HASH-FN :VALUE-PRINT-FN
    VALUE-PRINT-FN :VALUE-READ-FN VALUE-READ-FN)))

```

```

(DEFUN CLOSE-HASH-FILE (HASH-FILE &KEY ABORT)
  ;; close the stream
  (WITH-MONITOR (HASH-FILE-MONITOR HASH-FILE)
    (LET ((STREAM (HASH-FILE-STREAM HASH-FILE)))
      (CLOSE STREAM :ABORT ABORT)
      (PATHNAME STREAM))))

```

```

(DEFUN COPY-HASH-FILE (OLD-HASH-FILE NEW-FILE-NAME &OPTIONAL (NEW-SIZE NIL NEW-SIZE-SPECIFIED?))
  ;; make a new hashfile in NEW-FILE-NAME with the same contents as OLD-HASH-FILE. this will reclaim space lost in OLD-HASH-FILE. also used
  ;; by REHASH.
  (LET ((NEW-HASH-FILE (MAKE-HASH-FILE NEW-FILE-NAME (IF NEW-SIZE-SPECIFIED?
    NEW-SIZE
    ;; default NEW-SIZE to the size of OLD-HASH-FILE
    (HASH-FILE-SIZE OLD-HASH-FILE))
    ;; sure wish common lisp had a "using" construct...
    :REHASH-SIZE
    (HASH-FILE-REHASH-SIZE OLD-HASH-FILE)
    :REHASH-THRESHOLD
    (HASH-FILE-REHASH-THRESHOLD OLD-HASH-FILE)
    :KEY-PRINT-FN
    (HASH-FILE-KEY-PRINT-FN OLD-HASH-FILE)
    :KEY-READ-FN
    (HASH-FILE-KEY-READ-FN OLD-HASH-FILE)
    :KEY-COMPARE-FN
    (HASH-FILE-KEY-COMPARE-FN OLD-HASH-FILE)
    :KEY-HASH-FN
    (HASH-FILE-KEY-HASH-FN OLD-HASH-FILE)
    :VALUE-PRINT-FN
    (HASH-FILE-VALUE-PRINT-FN OLD-HASH-FILE)
    :VALUE-READ-FN
    (HASH-FILE-VALUE-READ-FN OLD-HASH-FILE))))
    (MAP-HASH-FILE #'(LAMBDA (KEY VALUE)
      (SETF (GET-HASH-FILE KEY NEW-HASH-FILE)
        VALUE))
      OLD-HASH-FILE)
    ;; write it out for safety
    (CLOSE-HASH-FILE NEW-HASH-FILE)
    ;; return the new hash file
    NEW-HASH-FILE))

```

```

(DEFUN MAP-HASH-FILE (FN HASH-FILE)
  ;; calls FN on every KEY & VALUE pair in HASH-FILE
  (WITH-MONITOR (HASH-FILE-MONITOR HASH-FILE)
    (LET* ((STREAM (ENSURE-STREAM-IS-OPEN HASH-FILE))
      (SIZE (HASH-FILE-SIZE HASH-FILE))
      (LAST-POINTER (+ TABLE-POSITION (* BYTES-PER-POINTER (1- SIZE))))
      NEXT-POINTER)
      ;; loop over table
      (DO ((TABLE-POINTER TABLE-POSITION (+ TABLE-POINTER BYTES-PER-POINTER))
        (> TABLE-POINTER LAST-POINTER))
          ;; loop down bucket
          (DO ((POINTER (READ-POINTER STREAM TABLE-POINTER)
            NEXT-POINTER)
            ((NULL-POINTER? POINTER)
              ; end of bucket or empty bucket
            )
            ;; read & save next pointer

```

```

    (SETQ NEXT-POINTER (READ-POINTER STREAM POINTER))
    ;; call FN on KEY and VALUE read from file
    (FUNCALL FN (FUNCALL (HASH-FILE-KEY-READ-FN HASH-FILE)
                        STREAM)
              (FUNCALL (HASH-FILE-VALUE-READ-FN HASH-FILE)
                        STREAM))))))

```

```

(DEFUN GET-HASH-FILE (KEY HASH-FILE &OPTIONAL (DEFAULT NIL))
  ;; GETHASH for hash files
  ;; returns the value stored under KEY in HASH-FILE, or DEFAULT if there is no value stored. second value is T iff a value was found
  (WITH-MONITOR (HASH-FILE-MONITOR HASH-FILE)
    (LET ((STREAM (ENSURE-STREAM-IS-OPEN HASH-FILE))
          NEXT-POINTER)
      ;; loop down linked list in bucket
      (DO ((POINTER (READ-POINTER STREAM (KEY->TABLE-POINTER KEY HASH-FILE))
                    NEXT-POINTER))
          ((NULL-POINTER? POINTER)
           ;; end of bucket (or empty bucket) - we lost
           (VALUES DEFAULT NIL))
           ;; read & save next pointer
           (SETQ NEXT-POINTER (READ-POINTER STREAM POINTER))
           (WHEN
            ;; read key from file and compare with KEY
            (FUNCALL (HASH-FILE-KEY-COMPARE-FN HASH-FILE)
                     KEY
                     (FUNCALL (HASH-FILE-KEY-READ-FN HASH-FILE)
                              STREAM))
              ;; they match -- we won!
              (RETURN
               ;; read & return value
               (VALUES (FUNCALL (HASH-FILE-VALUE-READ-FN HASH-FILE)
                               STREAM)
                       T))))))

```

```

(DEFUN PUT-HASH-FILE (KEY HASH-FILE VALUE)
  ;; SETF method for GET-HASH-FILE
  ;; stores a VALUE under KEY in HASH-FILE
  (WITH-MONITOR (HASH-FILE-MONITOR HASH-FILE)
    (LET ((TABLE-POINTER (KEY->TABLE-POINTER KEY HASH-FILE))
          (STREAM (ENSURE-STREAM-IS-OPEN HASH-FILE))
          NEXT-POINTER)
      ;; loop down bucket
      (DO* ((LAST-POINTER TABLE-POINTER POINTER)
            ;; LAST-POINTER is location of POINTER
            (POINTER (READ-POINTER STREAM TABLE-POINTER)
                     NEXT-POINTER))
          ((NULL-POINTER? POINTER)
           ;; end of bucket (or empty bucket) - nothing hashed under this key
           ;; time to add a new entry to the hash file
           (COND
            ((REHASH? HASH-FILE)
             ;; pointers are off if we rehashed -- have to start over
             (PUT-HASH-FILE KEY HASH-FILE VALUE))
            (T
             ;; just nconc a new entry onto the end of the bucket
             (ADD-ENTRY HASH-FILE KEY VALUE LAST-POINTER THE-NULL-POINTER)
             ;; increment and write out the count of objects
             (WRITE-COUNT (INCF (HASH-FILE-COUNT HASH-FILE))
                          STREAM))))
           ;; read & save the pointer to next in bucket
           (SETQ NEXT-POINTER (READ-POINTER STREAM POINTER))
           (WHEN
            ;; read key from file & compare with KEY
            (FUNCALL (HASH-FILE-KEY-COMPARE-FN HASH-FILE)
                     KEY
                     (FUNCALL (HASH-FILE-KEY-READ-FN HASH-FILE)
                              STREAM))
              ;; they match - already something hashed under this key
              ;; splice new entry into bucket, old entry out
              (ADD-ENTRY HASH-FILE KEY VALUE LAST-POINTER NEXT-POINTER)

```

```

      (RETURN))
    ;; return VALUE
  VALUE)))

```

```

(DEFUN REM-HASH-FILE (KEY HASH-FILE)
  ;; REMHASH for hash files
  ;; removes the entry (if any) for KEY from HASH-FILE. returns T if there was one to remove.
  (WITH-MONITOR (HASH-FILE-MONITOR HASH-FILE)
    (LET ((TABLE-POINTER (KEY->TABLE-POINTER KEY HASH-FILE))
          (STREAM (ENSURE-STREAM-IS-OPEN HASH-FILE))
          (NEXT-POINTER)
          ;; loop down bucket
          (DO* ((LAST-POINTER TABLE-POINTER POINTER)
               ;; LAST-POINTER is location of POINTER
               (POINTER (READ-POINTER STREAM TABLE-POINTER)
                        NEXT-POINTER))
              ((NULL-POINTER? POINTER)
               ;; end of bucket (or empty bucket) - nothing hashed under this key
               'NIL)
              ;; read & save the pointer to next in bucket
              (SETQ NEXT-POINTER (READ-POINTER STREAM POINTER))
              (WHEN ;; read key from file & compare with KEY
                (FUNCALL (HASH-FILE-KEY-COMPARE-FN HASH-FILE)
                          KEY
                          (FUNCALL (HASH-FILE-KEY-READ-FN HASH-FILE)
                                    STREAM))
                  ;; they match
                  ;; smash NEXT-POINTER into LAST-POINTER
                  (WRITE-POINTER NEXT-POINTER STREAM LAST-POINTER)
                  ;; decrement the count of entries in HASH-FILE
                  (WRITE-COUNT (DECF (HASH-FILE-COUNT HASH-FILE))
                                STREAM)
                  (RETURN 'T)))))))

```

```

(DEFSETF GET-HASH-FILE PUT-HASH-FILE)

```

```

(DEFVAR *DELETE-OLD-VERSION-ON-REHASH* NIL
  "if non-NIL then delete the old version of a hash file when rehashing")

```

```

(DEFVAR *REHASH-SIZE* 2.0
  "default REHASH-SIZE for hash files")

```

```

(DEFVAR *REHASH-THRESHOLD* 0.875
  "default REHASH-THRESHOLD for hash files")

```

;;; internal code

```

(DEFUN REHASH? (HASH-FILE)
  ;; check if it's time to rehash HASH-FILE. if it is, then do so and return non-NIL
  (WHEN (>= (1+ (HASH-FILE-COUNT HASH-FILE))
            (* (HASH-FILE-SIZE HASH-FILE)
              (HASH-FILE-REHASH-THRESHOLD HASH-FILE)))
    (REHASH HASH-FILE (ROUND (* (HASH-FILE-SIZE HASH-FILE)
                                (HASH-FILE-REHASH-SIZE HASH-FILE))))
    T))

```

```

(DEFUN REHASH (HASH-FILE NEW-SIZE)
  ;; caution: assumes we're under hash file monitor
  (LET* ((OLD-PATHNAME (PATHNAME (HASH-FILE-STREAM HASH-FILE)))
         (TEMP-HASH-FILE (COPY-HASH-FILE HASH-FILE (MAKE-PATHNAME :VERSION :NEWEST :DEFAULTS (PATHNAME
                                                                                               OLD-PATHNAME)
                                                                                               ))
                               NEW-SIZE)))
    ;; close the old stream (before we lose pointer to it)
    (CLOSE-HASH-FILE HASH-FILE)
    ;; smash TEMP-HASH-FILE into HASH-FILE

```

```

(UNINTERRUPTABLY
  (SETF (HASH-FILE-SIZE HASH-FILE) ; note: probably not the same as NEW-SIZE
        (HASH-FILE-SIZE TEMP-HASH-FILE))
  (SETF (HASH-FILE-COUNT HASH-FILE)
        (HASH-FILE-COUNT TEMP-HASH-FILE))
  (SETF (HASH-FILE-STREAM HASH-FILE)
        (HASH-FILE-STREAM TEMP-HASH-FILE)))
;; our caller [PUT-HASH-FILE] expects the stream to be open
(ENSURE-STREAM-IS-OPEN HASH-FILE)
(IF *DELETE-OLD-VERSION-ON-REHASH* (DELETE-FILE OLD-PATHNAME))
;; return the hash file
HASH-FILE))

```

```

(DEFMACRO KEY->TABLE-POINTER (KEY HASH-FILE)
  ;; return the file position for the head of the bucket which key hashes into. this is the guy who does the hashing.
  ;; caution: HASH-FILE is evaluated twice
  `(+ TABLE-POSITION (* BYTES-PER-POINTER (FUNCALL (HASH-FILE-KEY-HASH-FN ,HASH-FILE)
                                                    ,KEY
                                                    (HASH-FILE-SIZE ,HASH-FILE))))))

```

```

(DEFUN ADD-ENTRY (HASH-FILE KEY VALUE LAST-POINTER LINK-POINTER)
  ;; write an entry at end of file, putting a pointer to it in LAST-POINTER and make it point to LINK-POINTER as next in bucket.
  ;; caution: we presume we've got the hash-file-monitor.
  (LET* ((STREAM (HASH-FILE-STREAM HASH-FILE))
         (EOF-POINTER (FILE-LENGTH STREAM)))
    ;; first overwrite LAST-POINTER with a pointer to EOF
    (WRITE-POINTER EOF-POINTER STREAM LAST-POINTER)
    ;; write link to next bucket
    (WRITE-POINTER LINK-POINTER STREAM EOF-POINTER)
    ;; write the key
    (FUNCALL (HASH-FILE-KEY-PRINT-FN HASH-FILE)
             KEY STREAM)
    ;; write the value
    (FUNCALL (HASH-FILE-VALUE-PRINT-FN HASH-FILE)
             VALUE STREAM)
    ;; return value
    VALUE))

```

```

(DEFUN ENSURE-STREAM-IS-OPEN (HASH-FILE)
  ;; makes sure HASH-FILE's stream is open
  ;; caution: assumes we're under hash file monitor
  (LET ((STREAM (HASH-FILE-STREAM HASH-FILE))
        (IF (OPEN-STREAM-P STREAM)
            STREAM
            (SETF (HASH-FILE-STREAM HASH-FILE)
                  (OPEN STREAM :DIRECTION (HASH-FILE-DIRECTION HASH-FILE)
                          :IF-EXISTS :OVERWRITE))))))

```

```

(DEFUN NEXT-PRIME (N)
  ;; return the next prime number greater than N
  ;; algorithm stolen from CDL's FIND1STPRIME in old HASH library
  (LET (FOUND?)
    (DO ((P (LOGIOR N 1)
            (+ P 2))
        ((DO* ((I 3 (+ I 2))
              ((OR (AND (< I P)
                       (ZEROP (REM P I)))
                   (SETQ FOUND? (< P (* I I))))
              FOUND?))
        P))))

```

```

(DEFUN WRITE-SIZE (SIZE STREAM)
  ;; write SIZE to file as a pointer sized number
  (WRITE-POINTER SIZE STREAM SIZE-POSITION))

```

```

(DEFUN READ-SIZE (STREAM)
  ;; read size from file as written by WRITE-SIZE

```

(READ-POINTER STREAM SIZE-POSITION)

(DEFUN WRITE-COUNT (COUNT STREAM)
;; write COUNT to file as a pointer sized number
(WRITE-POINTER COUNT STREAM COUNT-POSITION))

(DEFUN READ-COUNT (STREAM)
;; read count as written by WRITE-COUNT
(READ-POINTER STREAM COUNT-POSITION))

(DEFUN WRITE-POINTER (POINTER STREAM &OPTIONAL POSITION)
;; write POINTER (a non-negative integer) as BYTES-PER-POINTER bytes on STREAM s.t. READ-POINTER can reconstruct it. if POSITION is
;; specified then set STREAM's file position to it first.
(WHEN (> (INTEGER-LENGTH POINTER)
(* BYTES-PER-POINTER BITS-PER-BYTE))
(ERROR "~S : pointer too large" POINTER))
(WHEN POSITION (FILE-POSITION STREAM POSITION))
(DOTIMES (N BYTES-PER-POINTER)
(WRITE-BYTE (LDB (BYTE BITS-PER-BYTE (* N BITS-PER-BYTE))
POINTER)
STREAM))
;; return POINTER
POINTER)

(DEFUN READ-POINTER (STREAM &OPTIONAL POSITION)
;; read from STREAM a positive integer written by WRITE-POINTER. if POSITION is specified the file position will be set to it first.
;; read BYTES-PER-POINTER bytes from stream and return them as an integer. this is the inverse of WRITE-P
(WHEN POSITION (FILE-POSITION STREAM POSITION))
(LET ((VALUE 0)
BYTE)
(DOTIMES (N BYTES-PER-POINTER)
(SETQ BYTE (READ-BYTE STREAM))
(WHEN (NOT (ZEROP BYTE))
;; optimization: DPB is really slow w/ high bytes
(SETQ VALUE (DPB BYTE (BYTE BITS-PER-BYTE (* N BITS-PER-BYTE))
VALUE))))
VALUE))

(DEFMACRO NULL-POINTER? (POINTER)
` (EQL ,POINTER THE-NULL-POINTER))

;; conveniences

(DEFUN HISTOGRAM (HASH-FILE)
;; return an ALIST of bucket depths dotted with number of occurrences
(WITH-MONITOR (HASH-FILE-MONITOR HASH-FILE)
(LET* ((STREAM (ENSURE-STREAM-IS-OPEN HASH-FILE))
(SIZE (HASH-FILE-SIZE HASH-FILE))
(LAST-POINTER (+ TABLE-POSITION (* BYTES-PER-POINTER (1- SIZE))))
NEXT-POINTER RESULT)
;; loop over table
(DO ((TABLE-POINTER TABLE-POSITION (+ TABLE-POINTER BYTES-PER-POINTER))
(> TABLE-POINTER LAST-POINTER))
;; loop down bucket
(DO ((POINTER (READ-POINTER STREAM TABLE-POINTER)
NEXT-POINTER)
(BUCKET-LENGTH 0 (1+ BUCKET-LENGTH)))
((NULL-POINTER? POINTER)
;; end of bucket or empty bucket
;; increment count for buckets of this length
(INCF (CDR (OR (ASSOC BUCKET-LENGTH RESULT)
(CAR (PUSH (CONS BUCKET-LENGTH 0)
RESULT))))))
(SETQ NEXT-POINTER (READ-POINTER STREAM POINTER))))
(SORT RESULT #'(LAMBDA (PAIR-1 PAIR-2)
(< (CAR PAIR-1)
(CAR PAIR-2))))))

```

(DEFUN CONVERT (IL-HASH-FILE CL-HASH-FILE)
  "convert a HASH hash file into a HASH-FILE hash file"
  ;; first make sure HASH is loaded
  (IL:FILESLOAD (IL:SYSLOAD IL:FROM IL:LISPUSERS)
    HASH)
  (LET* ((OLD-HASH-FILE (IL:OPENHASHFILE IL-HASH-FILE))
    (NEW-HASH-FILE (MAKE-HASH-FILE CL-HASH-FILE (IL:HASHFILEPROP OLD-HASH-FILE 'IL:SIZE)))
    (ABORT 'T))
    (UNWIND-PROTECT
      (PROGN (IL:MAPHASHFILE OLD-HASH-FILE #'(LAMBDA (KEY VALUE)
        (PUT-HASH-FILE KEY NEW-HASH-FILE VALUE)))
        (SETQ ABORT 'NIL))
      (IL:CLOSEHASHFILE OLD-HASH-FILE)
      (CLOSE-HASH-FILE NEW-HASH-FILE :ABORT ABORT))))

```

;;; default user code

```

(DEFUN HASH-OBJECT (OBJECT RANGE)
  ;; return an integer between 0 and (1- RANGE), inclusive
  ;; objects which are EQUAL will return the same integer
  (1- (HASH-OBJECT-INTERNAL OBJECT RANGE 0)))

```

```

(DEFUN HASH-OBJECT-INTERNAL (OBJECT RANGE DEPTH)
  ;; recursively descend OBJECT, combining characters & integers at leaves with multiplication modulo RANGE. never descend more than
  ;; *HASH-DEPTH* into a structure.
  ;; return an integer between 1 and RANGE, inclusive
  (IF (EQL DEPTH *HASH-DEPTH*)
    1
    (TYPECASE OBJECT
      (STRING (LET ((VALUE 1)
        (LENGTH (LENGTH OBJECT)))
          (DOTIMES (N (MIN LENGTH (- *HASH-DEPTH* DEPTH))
            (COMBINE RANGE VALUE LENGTH))
            (SETF VALUE (COMBINE RANGE VALUE (CHAR-CODE (CHAR OBJECT N)))))))
        (SYMBOL
          ;; combine hash values of name and package name
          (COMBINE RANGE (HASH-OBJECT-INTERNAL (LET ((PKG (SYMBOL-PACKAGE OBJECT)))
            (AND PKG (PACKAGE-NAME PKG)))
              RANGE
              (1+ DEPTH))
            (HASH-OBJECT-INTERNAL (SYMBOL-NAME OBJECT)
              RANGE
              (1+ DEPTH))))
          (CONS
            ;; combine hash values of CAR and CDR
            (COMBINE RANGE (HASH-OBJECT-INTERNAL (CAR OBJECT)
              RANGE
              (1+ DEPTH))
              (HASH-OBJECT-INTERNAL (CDR OBJECT)
              RANGE
              (1+ DEPTH))))
            (NUMBER (TYPECASE OBJECT
              (INTEGER (COMBINE RANGE (ABS OBJECT)))
              (FLOAT (MULTIPLE-VALUE-BIND (SIG EXPON)
                (INTEGER-DECODE-FLOAT OBJECT)
                (COMBINE RANGE SIG (ABS EXPON))))
              (RATIO (COMBINE RANGE (ABS (NUMERATOR OBJECT))
                (DENOMINATOR OBJECT)))
              (COMPLEX (COMBINE RANGE (HASH-OBJECT-INTERNAL (REALPART OBJECT)
                RANGE
                (1+ DEPTH))
                (HASH-OBJECT-INTERNAL (IMAGPART OBJECT)
                RANGE
                (1+ DEPTH))))))
              (CHARACTER (COMBINE RANGE (CHAR-CODE OBJECT)))
              (PATHNAME (HASH-OBJECT-INTERNAL (NAMESTRING OBJECT)
                RANGE
                (1+ DEPTH)))
              (BIT-VECTOR (LET ((VALUE 1)
                (LENGTH (LENGTH OBJECT)))
                  (DOTIMES (N (MIN LENGTH (- *HASH-DEPTH* DEPTH))
                    (COMBINE RANGE VALUE LENGTH))
                    (SETF VALUE (COMBINE RANGE VALUE (IF (ZEROP (BIT OBJECT N))
                      0
                      (EXPT 2 N))))))
                    (T ;; can't dependably read/print other objects

```


(ERROR "Can't hash a(n) ~S" (TYPE-OF OBJECT))))))

(DEFMACRO **COMBINE** (RANGE &REST INTEGERS)

;;; combine non-negative integers returning an integer between 1 and RANGE inclusive (zeros are bad when combining with multiplication). we don't do
;;; the obvious (1+ (mod (* . integers) range)) to avoid making bignums.

;;; caution: RANGE may be evaluated many times.

`(1+ (MOD , (IF (ENDP (REST INTEGERS))
 (FIRST INTEGERS)
 `(* , (FIRST INTEGERS)
 (**COMBINE** ,RANGE ,@(REST INTEGERS))))
 ,RANGE)))

(DEFVAR ***HASH-DEPTH*** 17)

(DEFUN **DEFAULT-READ-FN** (STREAM)

;; default reader for hash files
(WITH-READER-ENVIRONMENT *READER-ENVIRONMENT* (READ STREAM)))

(DEFUN **DEFAULT-PRINT-FN** (OBJECT STREAM)

;; default printer for hash files
(WITH-READER-ENVIRONMENT *READER-ENVIRONMENT*
 (LET ((*PRINT-PRETTY* 'NIL))
 (PRINT OBJECT STREAM)))
OBJECT)

(DEFVAR ***READER-ENVIRONMENT*** (MAKE-READER-ENVIRONMENT (FIND-PACKAGE "XCL")
 (FIND-READTABLE "XCL")
 10))

(IL:PUTPROPS **IL:HASH-FILE IL:FILETYPE** :COMPILE-FILE)

(IL:PUTPROPS **IL:HASH-FILE IL:MAKEFILE-ENVIRONMENT** (:READTABLE "XCL" :PACKAGE
 (DEFPACKAGE "HASH-FILE" (:USE "LISP" "XCL")
 (:IMPORT WITH-READER-ENVIRONMENT
 MAKE-READER-ENVIRONMENT FIND-READTABLE
 UNINTERRUPTABLY WITH-MONITOR
 CREATE-MONITORLOCK MONITORLOCK))))

(IL:PUTPROPS **IL:HASH-FILE IL:COPYRIGHT** ("Venue & Xerox Corporation" 1987 1988 1990))

FUNCTION INDEX

%PRINT-HASH-FILE	2	ENSURE-STREAM-IS-OPEN	6	NEXT-PRIME	6	REHASH?	5
ADD-ENTRY	6	GET-HASH-FILE	4	OPEN-HASH-FILE	2	REM-HASH-FILE	5
CLOSE-HASH-FILE	3	HASH-OBJECT	8	PUT-HASH-FILE	4	WRITE-COUNT	7
CONVERT	8	HASH-OBJECT-INTERNAL	8	READ-COUNT	7	WRITE-POINTER	7
COPY-HASH-FILE	3	HISTOGRAM	7	READ-POINTER	7	WRITE-SIZE	6
DEFAULT-PRINT-FN	9	MAKE-HASH-FILE	2	READ-SIZE	6		
DEFAULT-READ-FN	9	MAP-HASH-FILE	3	REHASH	5		

CONSTANT INDEX

BITS-PER-BYTE	2	COUNT-POSITION	2	TABLE-POSITION	2
BYTES-PER-POINTER	2	SIZE-POSITION	2	THE-NULL-POINTER	2

VARIABLE INDEX

DELETE-OLD-VERSION-ON-REHASH	5	*READER-ENVIRONMENT*	9	*REHASH-THRESHOLD*	5
HASH-DEPTH	9	*REHASH-SIZE*	5		

MACRO INDEX

COMBINE	9	KEY->TABLE-POINTER	6	NULL-POINTER?	7
---------------	---	--------------------------	---	---------------------	---

PROPERTY INDEX

IL:HASH-FILE	9
--------------------	---

SETF INDEX

GET-HASH-FILE	5
---------------------	---

STRUCTURE INDEX

HASH-FILE	1
-----------------	---
