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Read Table: XCL

Package: INTERLISP

Format: XCCS

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(RPAQQ CMLARRAYCOMS

(;; Contains table driven macros

(DECLARE\ : DONTCOPY EVAL@COMPILE (EXPORT (FILES (SYSLOAD FROM VALUEOF DIRECTORIES)  
CMLARRAY-SUPPORT)))

;; User entry points

(FUNCTIONS CL:ADJUST-ARRAY CL:ADJUSTABLE-ARRAY-P CL:ARRAY-DIMENSION CL:ARRAY-DIMENSIONS  
CL:ARRAY-ELEMENT-TYPE CL:ARRAY-HAS-FILL-POINTER-P ARRAY-NEEDS-INDIRECTION-P CL:ARRAY-RANK  
CL:ARRAY-TOTAL-SIZE BIT CL:BIT-AND CL:BIT-ANDC1 CL:BIT-ANDC2 BIT-ARRAY-P CL:BIT-EQV CL:BIT-IOR  
CL:BIT-NAND CL:BIT-NOR CL:BIT-NOT CL:BIT-ORC1 CL:BIT-ORC2 CL:BIT-VECTOR-P CL:BIT-XOR CL:CHAR  
CL:ARRAYP CL:STRINGP COPY-ARRAY COPY-VECTOR DISPLACED-ARRAY-P EQUAL-DIMENSIONS-P  
EXTENDABLE-ARRAY-P FILL-ARRAY CL:FILL-POINTER FILL-VECTOR CL:MAKE-ARRAY MAKE-VECTOR  
READ-ONLY-ARRAY-P CL:SBIT CL:SCHAR SET-FILL-POINTER SIMPLE-ARRAY-P CL:SIMPLE-BIT-VECTOR-P  
CL:SIMPLE-STRING-P CL:SIMPLE-VECTOR-P STRING-ARRAY-P CL:SVREF CL::UPGRADED-ARRAY-ELEMENT-TYPE  
VECTOR-LENGTH CL:VECTOR-POP CL:VECTOR-PUSH CL:VECTOR-PUSH-EXTEND CL:VECTORP)  
(FNS CL:AREF CL:ARRAY-IN-BOUNDS-P CL:ARRAY-ROW-MAJOR-INDEX ASET CL:VECTOR)

;; New CLtL array functions

(COMS (FNS CL::ROW-MAJOR-AREF CL::ROW-MAJOR-ASET)  
(SETFS CL::ROW-MAJOR-AREF))

;; Setfs

(SETFS CL:AREF BIT CL:CHAR CL:FILL-POINTER CL:SBIT CL:SCHAR CL:SVREF)

;; Optimizers

(FUNCTIONS %AREF-EXPANDER %ASET-EXPANDER)  
(OPTIMIZERS CL:AREF ASET BIT CL:CHAR CL:SBIT CL:SCHAR CL:SVREF)

;; Vars etc

(VARIABLES CL:ARRAY-RANK-LIMIT CL:ARRAY-TOTAL-SIZE-LIMIT CL:ARRAY-DIMENSION-LIMIT  
\*DEFAULT-PUSH-EXTENSION-SIZE\*) ; \*PRINT-ARRAY\* is defined in APRINT

;; Run-time support

(FNS %ALTER-AS-DISPLACED-ARRAY %ALTER-AS-DISPLACED-TO-BASE-ARRAY %AREF0 %AREF1 %AREF2 %ARRAY-BASE  
%ARRAY-CONTENT-INITIALIZE %ARRAY-ELEMENT-INITIALIZE %ARRAY-OFFSET %ARRAY-TYPE-NUMBER %ASET0 %ASET1  
%ASET2 %CHECK-SEQUENCE-DIMENSIONS %COPY-TO-NEW-ARRAY %DO-LOGICAL-OP %EXTEND-ARRAY %FAST-COPY-BASE  
%FAT-STRING-ARRAY-P %FILL-ARRAY-FROM-SEQUENCE %FLATTEN-ARRAY %MAKE-ARRAY-WRITEABLE  
%MAKE-DISPLACED-ARRAY %MAKE-GENERAL-ARRAY %MAKE-ONED-ARRAY %MAKE-STRING-ARRAY-FAT %MAKE-TWOD-ARRAY  
%TOTAL-SIZE SHRINK-VECTOR)

(FNS %SET-ARRAY-OFFSET %SET-ARRAY-TYPE-NUMBER)

; For Interlisp string hack

(FNS %ONED-ARRAY-P %TWOD-ARRAY-P %GENERAL-ARRAY-P %THIN-STRING-ARRAY-P)

; Low level predicates

(OPTIMIZERS %ONED-ARRAY-P %TWOD-ARRAY-P %GENERAL-ARRAY-P)

; Real record defs on cmlarray-support

(INITRECORDS GENERAL-ARRAY ONED-ARRAY TWOD-ARRAY)

(SYSRECORDS GENERAL-ARRAY ONED-ARRAY TWOD-ARRAY)

(PROP DOPVAL %AREF1 %AREF2 %ASET1 %ASET2)

;; I/O

(FNS %DEFPRINT-ARRAY %DEFPRINT-BITVECTOR %DEFPRINT-GENERIC-ARRAY %DEFPRINT-VECTOR %DEFPRINT-STRING  
%PRINT-ARRAY-CONTENTS)

(P (DEFPRINT 'ONED-ARRAY '%DEFPRINT-VECTOR)

(DEFPRINT 'TWOD-ARRAY '%DEFPRINT-ARRAY)

(DEFPRINT 'GENERAL-ARRAY '%DEFPRINT-ARRAY))

;; Needed at run time. low level functions for accessing, setting, and allocating raw storage. also includes cml type to typenumber converters

(FNS %ARRAY-READ %ARRAY-WRITE %CML-TYPE-TO-TYPENUMBER %GET-CANONICAL-CML-TYPE %GET-ENCLOSING-SIGNED-BYTE  
%GET-ENCLOSING-UNSIGNED-BYTE %MAKE-ARRAY-STORAGE %REDUCE-INTEGERS %REDUCE-MOD %SLOW-ARRAY-READ  
%SLOW-ARRAY-WRITE)

(OPTIMIZERS %ARRAY-READ %ARRAY-WRITE)

;; Compiler options

(DECLARE\ : DONTEVAL@LOAD DOEVAL@COMPILE DONTCOPY (LOCALVARS . T))

(PROP FILETYPE CMLARRAY)

(DECLARE\ : DONTEVAL@LOAD DOEVAL@COMPILE DONTCOPY COMPILERVARS (ADDVARS (NLAMA)

(NLAML)

(LAMA CL:VECTOR ASET

CL:ARRAY-ROW-MAJOR-INDEX

CL:ARRAY-IN-BOUNDS-P CL:AREF)

)))

;; Contains table driven macros

(DECLARE\ : DONTCOPY EVAL@COMPILE

:: FOLLOWING DEFINITIONS EXPORTED

(FILESLOAD (SYSLOAD FROM VALUEOF DIRECTORIES)
CMLARRAY-SUPPORT)
)

:: END EXPORTED DEFINITIONS

:: User entry points

(CL:DEFUN CL:ADJUST-ARRAY (ADJUSTABLE-ARRAY DIMENSIONS &KEY (ELEMENT-TYPE NIL ELEMENT-TYPE-P)
(INITIAL-ELEMENT NIL INITIAL-ELEMENT-P)
(INITIAL-CONTENTS NIL INITIAL-CONTENTS-P)
(DISPLACED-TO NIL DISPLACED-TO-P)
(DISPLACED-TO-BASE NIL DISPLACED-TO-BASE-P)
(DISPLACED-INDEX-OFFSET 0 DISPLACED-INDEX-OFFSET-P)
(FILL-POINTER NIL FILL-POINTER-P)
FATP)

:: Do something wonderful

(CL:IF (NOT (EXTENDABLE-ARRAY-P ADJUSTABLE-ARRAY))
(CL:ERROR "Not an adjustable or extendable array: ~S" ADJUSTABLE-ARRAY))
(CL:IF (NOT (CL:LISTP DIMENSIONS))
(SETQ DIMENSIONS (LIST DIMENSIONS)))
(CL:IF (CL:DOLIST (DIM DIMENSIONS NIL)
(CL:IF (OR (< DIM 0)
(>= DIM CL:ARRAY-DIMENSION-LIMIT))
(RETURN T)))
(CL:ERROR "Dimensions out of bounds ~S" DIMENSIONS))
(LET ((ADJUSTABLE-ARRAY-ELEMENT-TYPE (CL:ARRAY-ELEMENT-TYPE ADJUSTABLE-ARRAY))
(NELTS (%TOTAL-SIZE DIMENSIONS))
(RANK (LENGTH DIMENSIONS))
(EXTENDABLE-P (NOT (CL:ADJUSTABLE-ARRAY-P ADJUSTABLE-ARRAY))))

:: Consistency checks

(CL:IF (>= RANK CL:ARRAY-RANK-LIMIT)
(CL:ERROR "Too many dimensions: ~A" RANK))
(CL:IF (>= NELTS CL:ARRAY-TOTAL-SIZE-LIMIT)
(CL:ERROR "Too many elements: ~A" NELTS))
(CL:IF (NOT (EQ RANK (CL:ARRAY-RANK ADJUSTABLE-ARRAY)))
(CL:ERROR "Rank mismatch: ~S" DIMENSIONS))
(CL:IF ELEMENT-TYPE-P
(CL:IF (NOT (EQUAL ELEMENT-TYPE ADJUSTABLE-ARRAY-ELEMENT-TYPE))
(CL:ERROR "ADJUSTABLE-ARRAY not of specified element-type: ~A" ELEMENT-TYPE))
(SETQ ELEMENT-TYPE ADJUSTABLE-ARRAY-ELEMENT-TYPE))
(CL:IF (AND FILL-POINTER-P (NULL FILL-POINTER)
(CL:ARRAY-HAS-FILL-POINTER-P ADJUSTABLE-ARRAY))
(CL:ERROR "ADJUSTABLE-ARRAY has fill pointer"))
(CL:IF (OR (AND DISPLACED-TO-P (OR INITIAL-ELEMENT-P INITIAL-CONTENTS-P DISPLACED-TO-BASE-P))
(AND DISPLACED-TO-BASE-P (OR INITIAL-ELEMENT-P INITIAL-CONTENTS-P DISPLACED-TO-P))
(AND FILL-POINTER-P FILL-POINTER (NOT (CL:ARRAY-HAS-FILL-POINTER-P ADJUSTABLE-ARRAY)))
(AND DISPLACED-INDEX-OFFSET-P (NOT (OR DISPLACED-TO-P DISPLACED-TO-BASE-P)))
(AND INITIAL-ELEMENT-P INITIAL-CONTENTS-P))
(CL:ERROR "Inconsistent options to adjust-array"))
(CL:IF DISPLACED-TO-P
(COND
((NOT (%ARRAYP DISPLACED-TO))
(CL:ERROR "Not displaced to an array: ~S" DISPLACED-TO))
((NOT (EQUAL ADJUSTABLE-ARRAY-ELEMENT-TYPE (CL:ARRAY-ELEMENT-TYPE DISPLACED-TO)))
(CL:ERROR "Not displaced to an array of the same element-type:"))
(> (+ DISPLACED-INDEX-OFFSET NELTS)
(CL:ARRAY-TOTAL-SIZE DISPLACED-TO))
(CL:ERROR "More elements than displaced-to array"))))
(CL:IF FILL-POINTER
(COND
((EQ FILL-POINTER T)
(SETQ FILL-POINTER NELTS))
((NOT (<= 0 FILL-POINTER NELTS))
(CL:ERROR "Fill pointer out of bounds: ~A" FILL-POINTER)))
(CL:IF (CL:ARRAY-HAS-FILL-POINTER-P ADJUSTABLE-ARRAY)
(SETQ FILL-POINTER (MIN (CL:FILL-POINTER ADJUSTABLE-ARRAY)
NELTS))))))
(CL:IF EXTENDABLE-P
(COND
((OR DISPLACED-TO-P DISPLACED-TO-BASE-P)
(CL:ERROR "Cannot adjust an extendable array to be displaced"))
((< NELTS (CL:ARRAY-TOTAL-SIZE ADJUSTABLE-ARRAY))
(CL:ERROR "Cannot extend an extendable array to have fewer elements"))))

:: Specs ready, do the surgery

(COND
(DISPLACED-TO-P (%ALTER-AS-DISPLACED-ARRAY ADJUSTABLE-ARRAY DIMENSIONS DISPLACED-TO
DISPLACED-INDEX-OFFSET FILL-POINTER))
(DISPLACED-TO-BASE-P (%ALTER-AS-DISPLACED-TO-BASE-ARRAY ADJUSTABLE-ARRAY DIMENSIONS ELEMENT-TYPE

```

DISPLACED-TO-BASE DISPLACED-INDEX-OFFSET FILL-POINTER FATP))
(T (CL:IF (EQUAL (CL:ARRAY-DIMENSIONS ADJUSTABLE-ARRAY)
                DIMENSIONS)
  (CL:IF FILL-POINTER (SET-FILL-POINTER ADJUSTABLE-ARRAY FILL-POINTER))
  (LET ((NEW-ARRAY (CL:MAKE-ARRAY DIMENSIONS :ELEMENT-TYPE ELEMENT-TYPE :FATP (
                                                    %FAT-STRING-ARRAY-P
                                                    ADJUSTABLE-ARRAY
                                                    ))))
    (COND
      (INITIAL-CONTENTS-P (%ARRAY-CONTENT-INITIALIZE NEW-ARRAY INITIAL-CONTENTS))
      (T (CL:IF INITIAL-ELEMENT-P (%ARRAY-ELEMENT-INITIALIZE NEW-ARRAY INITIAL-ELEMENT))
        (%COPY-TO-NEW-ARRAY (CL:ARRAY-DIMENSIONS ADJUSTABLE-ARRAY)
          (%FLATTEN-ARRAY ADJUSTABLE-ARRAY)
          0 DIMENSIONS (%FLATTEN-ARRAY NEW-ARRAY)
          0)))
      (%EXTEND-ARRAY ADJUSTABLE-ARRAY NEW-ARRAY DIMENSIONS FILL-POINTER))))))
;; Return the adjusted array
ADJUSTABLE-ARRAY))

```

```

(CL:DEFUN CL:ADJUSTABLE-ARRAY-P (ARRAY)
  (CL:IF (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER ADJUSTABLE-P) |of| ARRAY)
    (CL:ERROR "Not an array: ~S" ARRAY)))

```

```

(CL:DEFUN CL:ARRAY-DIMENSION (ARRAY DIMENSION)
  (COND
    ((%ONED-ARRAY-P ARRAY)
      (CL:IF (EQ 0 DIMENSION)
        (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY)
        (CL:ERROR "Dimension out of bounds: ~A" DIMENSION)))
    ((%TWOD-ARRAY-P ARRAY)
      (CASE DIMENSION
        (0 (|ffetch| (TWOD-ARRAY BOUND0) |of| ARRAY))
        (1 (|ffetch| (TWOD-ARRAY BOUND1) |of| ARRAY))
        (T (CL:ERROR "Dimension out of bounds: ~A" DIMENSION))))
    ((%GENERAL-ARRAY-P ARRAY)
      (LET* ((DIMS (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY))
            (RANK (LENGTH DIMS)))
        (CL:IF (NOT (< -1 DIMENSION RANK))
          (CL:ERROR "Dimension out of bounds: ~A" DIMENSION))
          (CL:IF (EQ RANK 1)
            (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY)
            (CL:NTH DIMENSION DIMS))))
      (T (CL:ERROR "Not an array: ~S" ARRAY))))

```

```

(CL:DEFUN CL:ARRAY-DIMENSIONS (ARRAY)
  (COND
    ((%ONED-ARRAY-P ARRAY)
      (LIST (|ffetch| (ONED-ARRAY TOTAL-SIZE) |of| ARRAY)))
    ((%TWOD-ARRAY-P ARRAY)
      (LIST (|ffetch| (TWOD-ARRAY BOUND0) |of| ARRAY)
            (|ffetch| (TWOD-ARRAY BOUND1) |of| ARRAY)))
    ((%GENERAL-ARRAY-P ARRAY)
      (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY))
      (T (CL:ERROR "Not an array: ~S" ARRAY))))

```

```

(CL:DEFUN CL:ARRAY-ELEMENT-TYPE (ARRAY)
  (CL:IF (%ARRAYP ARRAY)
    (%TYPENUMBER-TO-CML-TYPE (%ARRAY-TYPE-NUMBER ARRAY))
    (CL:ERROR "Not an array: ~S" ARRAY)))

```

```

(CL:DEFUN CL:ARRAY-HAS-FILL-POINTER-P (ARRAY)
  (CL:IF (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER FILL-POINTER-P) |of| ARRAY)
    (CL:ERROR "Not an array: ~S" ARRAY)))

```

```

(CL:DEFUN ARRAY-NEEDS-INDIRECTION-P (ARRAY)
  (COND
    ((OR (%ONED-ARRAY-P ARRAY)
         (%TWOD-ARRAY-P ARRAY))
      NIL)
    ((%GENERAL-ARRAY-P ARRAY)
      (|fetch| (ARRAY-HEADER INDIRECT-P) |of| ARRAY))
      (T (CL:ERROR "Not an array: ~S" ARRAY))))

```

```

(CL:DEFUN CL:ARRAY-RANK (ARRAY)
  (COND
    ((%ONED-ARRAY-P ARRAY)
      1)

```

```
( (%TWOD-ARRAY-P ARRAY)
  2)
( (%GENERAL-ARRAY-P ARRAY)
  (LENGTH (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY)))
(T (CL:ERROR "Not an array: ~S" ARRAY)))
```

```
(CL:DEFUN CL:ARRAY-TOTAL-SIZE (ARRAY)
  (CL:IF (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY)
    (CL:ERROR "Not an array: ~S" ARRAY)))
```

```
(CL:DEFUN BIT (BIT-ARRAY &REST INDICES)
  (CL:ASSERT (TYPEP BIT-ARRAY '(CL:ARRAY BIT))
    (BIT-ARRAY)
    "Not a bit-array: ~S" BIT-ARRAY)
  (CL:APPLY #'CL:AREF BIT-ARRAY INDICES))
```

```
(CL:DEFUN CL:BIT-AND (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP AND BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-ANDC1 (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP ANDC1 BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-ANDC2 (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP ANDC2 BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN BIT-ARRAY-P (ARRAY)
  (AND (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER BIT-P) |of| ARRAY)))
```

```
(CL:DEFUN CL:BIT-EQV (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP EQV BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-IOR (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP IOR BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-NAND (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP NAND BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-NOR (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP NOR BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-NOT (BIT-ARRAY &OPTIONAL RESULT-BIT-ARRAY)
  (CL:IF (NOT (BIT-ARRAY-P BIT-ARRAY))
    (CL:ERROR "BIT-ARRAY not a bit array"))
  (COND
    ((NULL RESULT-BIT-ARRAY)
     (SETQ RESULT-BIT-ARRAY (CL:MAKE-ARRAY (CL:ARRAY-DIMENSIONS BIT-ARRAY)
                                           :ELEMENT-TYPE
                                           'BIT)))
    ((EQ RESULT-BIT-ARRAY T)
     (SETQ RESULT-BIT-ARRAY BIT-ARRAY))
    ((NOT (AND (BIT-ARRAY-P RESULT-BIT-ARRAY)
              (EQUAL-DIMENSIONS-P BIT-ARRAY RESULT-BIT-ARRAY)))
     (CL:ERROR "Illegal result array")))
  (%DO-LOGICAL-OP 'NOT BIT-ARRAY RESULT-BIT-ARRAY)
  RESULT-BIT-ARRAY)
```

```
(CL:DEFUN CL:BIT-ORC1 (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP ORC1 BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-ORC2 (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP ORC2 BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```
(CL:DEFUN CL:BIT-VECTOR-P (VECTOR)
  (AND (%VECTORP VECTOR)
    (|fetch| (ARRAY-HEADER BIT-P) |of| VECTOR)))
```

```
(CL:DEFUN CL:BIT-XOR (BIT-ARRAY1 BIT-ARRAY2 &OPTIONAL BIT-RESULT)
  (%EXPAND-BIT-OP XOR BIT-ARRAY1 BIT-ARRAY2 BIT-RESULT))
```

```

{MEDLEY}<CLTL2>CMLARRAY.;1

(CL:DEFUN CL:CHAR (STRING INDEX)
  (CL:ASSERT (TYPEP STRING 'STRING)
    (STRING)
    "Not a string: ~S" STRING)
  (CL:AREF STRING INDEX))

(CL:DEFUN CL:ARRAYP (ARRAY)
  (%ARRAYP ARRAY))

(CL:DEFUN CL:STRINGP (STRING)
  (%STRINGP STRING))

(CL:DEFUN COPY-ARRAY (FROM-ARRAY &OPTIONAL TO-ARRAY)
  (CL:IF (NOT (%ARRAYP FROM-ARRAY))
    (CL:ERROR "Not an array: ~S" FROM-ARRAY))
  (COND
    ((NULL TO-ARRAY)
     (SETQ TO-ARRAY (CL:MAKE-ARRAY (CL:ARRAY-DIMENSIONS FROM-ARRAY)
      :ELEMENT-TYPE
      (CL:ARRAY-ELEMENT-TYPE FROM-ARRAY)
      :FATP
      (%FAT-STRING-ARRAY-P FROM-ARRAY))))
    ((NOT (EQUAL-DIMENSIONS-P FROM-ARRAY TO-ARRAY))
     (CL:ERROR "Dimensionality mismatch")))
  (CL:IF (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| TO-ARRAY)
    (%MAKE-ARRAY-WRITEABLE TO-ARRAY))
  (LET ((FROM-TYPE-NUMBER (%ARRAY-TYPE-NUMBER FROM-ARRAY))
        (TO-TYPE-NUMBER (%ARRAY-TYPE-NUMBER TO-ARRAY)))
    (CL:WHEN (AND (%FAT-CHAR-TYPE-P FROM-TYPE-NUMBER)
                  (%THIN-CHAR-TYPE-P TO-TYPE-NUMBER))
      (%MAKE-STRING-ARRAY-FAT TO-ARRAY)
      (SETQ TO-TYPE-NUMBER (%ARRAY-TYPE-NUMBER TO-ARRAY)))
    (%FAST-COPY-BASE (%ARRAY-BASE FROM-ARRAY)
      (%ARRAY-OFFSET FROM-ARRAY)
      FROM-TYPE-NUMBER
      (%ARRAY-BASE TO-ARRAY)
      (%ARRAY-OFFSET TO-ARRAY)
      TO-TYPE-NUMBER
      (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| FROM-ARRAY))
    TO-ARRAY))

(CL:DEFUN COPY-VECTOR (FROM-VECTOR TO-VECTOR &KEY (START1 0)
  END1
  (START2 0)
  END2)
  (LET ((FROM-LENGTH (VECTOR-LENGTH FROM-VECTOR))
        (TO-LENGTH (VECTOR-LENGTH TO-VECTOR)))
    (CL:IF (NULL END1)
      (SETQ END1 FROM-LENGTH))
    (CL:IF (NULL END2)
      (SETQ END2 TO-LENGTH))
    (CL:IF (NOT (<= 0 START1 END1 FROM-LENGTH))
      (CL:ERROR "Bad subsequence for FROM-VECTOR"))
    (CL:IF (NOT (<= 0 START2 END2 TO-LENGTH))
      (CL:ERROR "Bad subsequence for TO-VECTOR"))
    (CL:IF (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| TO-VECTOR)
      (%MAKE-ARRAY-WRITEABLE TO-VECTOR))
    (LET ((SUBLEN1 (- END1 START1))
          (SUBLEN2 (- END2 START2))
          (FROM-TYPE-NUMBER (%ARRAY-TYPE-NUMBER FROM-VECTOR))
          (TO-TYPE-NUMBER (%ARRAY-TYPE-NUMBER TO-VECTOR)))
      (CL:WHEN (AND (%FAT-CHAR-TYPE-P FROM-TYPE-NUMBER)
                    (%THIN-CHAR-TYPE-P TO-TYPE-NUMBER))
        (%MAKE-STRING-ARRAY-FAT TO-VECTOR)
        (SETQ TO-TYPE-NUMBER (%ARRAY-TYPE-NUMBER TO-VECTOR)))
      (%FAST-COPY-BASE (%ARRAY-BASE FROM-VECTOR)
        (+ START1 (%ARRAY-OFFSET FROM-VECTOR))
        FROM-TYPE-NUMBER
        (%ARRAY-BASE TO-VECTOR)
        (+ START2 (%ARRAY-OFFSET TO-VECTOR))
        TO-TYPE-NUMBER
        (MIN SUBLEN1 SUBLEN2))
      TO-VECTOR))

(CL:DEFUN DISPLACED-ARRAY-P (ARRAY)
  (CL:IF (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER DISPLACED-P) |of| ARRAY)
    (CL:ERROR "Not an array: ~S" ARRAY)))

(CL:DEFUN EQUAL-DIMENSIONS-P (ARRAY-1 ARRAY-2)
  (COND

```

```
( (%ONED-ARRAY-P ARRAY-1)
  (COND
    ( (%ONED-ARRAY-P ARRAY-2)
      (EQ (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY-1)
          (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY-2)))
    ( (%TWOD-ARRAY-P ARRAY-2)
      NIL)
    ( (%GENERAL-ARRAY-P ARRAY-2)
      (AND (EQ 1 (LENGTH (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY-2)))
            (EQ (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY-1)
                (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY-2))))
      (T NIL)))
  ( (%TWOD-ARRAY-P ARRAY-1)
    (COND
      ( (%ONED-ARRAY-P ARRAY-2)
        NIL)
      ( (%TWOD-ARRAY-P ARRAY-2)
        (AND (EQ (|fetch| (TWOD-ARRAY BOUND0) |of| ARRAY-1)
                  (|fetch| (TWOD-ARRAY BOUND0) |of| ARRAY-2))
              (EQ (|fetch| (TWOD-ARRAY BOUND1) |of| ARRAY-1)
                  (|fetch| (TWOD-ARRAY BOUND1) |of| ARRAY-2))))
        ( (%GENERAL-ARRAY-P ARRAY-2)
          (LET ((DIMS (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY-2)))
              (AND (EQ 2 (LENGTH DIMS))
                    (AND (EQ (|fetch| (TWOD-ARRAY BOUND0) |of| ARRAY-1)
                              (CAR DIMS))
                          (EQ (|fetch| (TWOD-ARRAY BOUND1) |of| ARRAY-1)
                              (CADR DIMS)))))))
          (T NIL)))
      ( (%GENERAL-ARRAY-P ARRAY-1)
        (LET ((DIMS (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY-1)))
            (COND
              ( (%ONED-ARRAY-P ARRAY-2)
                (AND (EQ 1 (LENGTH DIMS))
                      (EQ (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY-1)
                          (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY-2))))
              ( (%TWOD-ARRAY-P ARRAY-2)
                (AND (EQ 2 (LENGTH DIMS))
                      (AND (EQ (CAR DIMS)
                                (|fetch| (TWOD-ARRAY BOUND0) |of| ARRAY-2))
                            (EQ (CADR DIMS)
                                (|fetch| (TWOD-ARRAY BOUND1) |of| ARRAY-2))))))
              ( (%GENERAL-ARRAY-P ARRAY-2)
                (EQUAL DIMS (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY-2)))
              (T NIL))))
            (T NIL))))))
```

(CL:DEFUN **EXTENDABLE-ARRAY-P** (ARRAY)

(\* \*)

```
(COND
  ( (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER EXTENDABLE-P) |of| ARRAY))
  ((STRINGP ARRAY)
   NIL)
  (T (CL:ERROR "Not an array ~S" ARRAY)))
```

(CL:DEFUN **FILL-ARRAY** (ARRAY VALUE)

```
(CL:IF (NOT (%ARRAYP ARRAY))
  (CL:ERROR "Not an array: ~S" ARRAY))
(LET ((TOTAL-SIZE (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY))
      (TYPE-NUMBER (%ARRAY-TYPE-NUMBER ARRAY)))
  (CL:IF (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| ARRAY)
    (%MAKE-ARRAY-WRITEABLE ARRAY))
  (CL:WHEN (> TOTAL-SIZE 0)
    (CL:WHEN (AND (%THIN-CHAR-TYPE-P TYPE-NUMBER)
                  (%FAT-STRING-CHAR-P VALUE))
              (%MAKE-STRING-ARRAY-FAT ARRAY)
              (SETQ TYPE-NUMBER (%ARRAY-TYPE-NUMBER ARRAY)))
          (CL:IF (NOT (%LLARRAY-TYPEP TYPE-NUMBER VALUE))
            (CL:ERROR "Value of incorrect type for this array: ~S" VALUE))
            (LET ((BASE (%ARRAY-BASE ARRAY))
                  (OFFSET (%ARRAY-OFFSET ARRAY)))
                (%ARRAY-WRITE VALUE BASE TYPE-NUMBER OFFSET) ; Start things off
                (%FAST-COPY-BASE BASE OFFSET TYPE-NUMBER BASE (CL:1+ OFFSET)
                                TYPE-NUMBER
                                (CL:1- TOTAL-SIZE))))
              ARRAY)))
```

(CL:DEFUN **CL:FILL-POINTER** (VECTOR)

```
(COND
  ((AND (OR (%ONED-ARRAY-P VECTOR)
            (%GENERAL-ARRAY-P VECTOR))
```

```
(|fetch| (ARRAY-HEADER FILL-POINTER-P |of| VECTOR))
(|fetch| (ARRAY-HEADER FILL-POINTER) |of| VECTOR))
((%VECTORP VECTOR)
 (CL:ERROR "vector has no fill pointer"))
(T (CL:ERROR "Not a vector: ~S" VECTOR))))
```

```
(CL:DEFUN FILL-VECTOR (VECTOR VALUE &KEY (START 0)
                     END)
  (CL:IF (NOT (%VECTORP VECTOR))
    (CL:ERROR "Not a vector: ~S" VECTOR))
  (LET ((TOTAL-SIZE (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| VECTOR)))
    (CL:IF (NULL END)
      (SETQ END TOTAL-SIZE))
    (CL:IF (NOT (<= START END TOTAL-SIZE))
      (CL:ERROR "Invalid subsequence" END))
    (LET ((CNT (- END START))
          (TYPE-NUMBER (%ARRAY-TYPE-NUMBER VECTOR)))
      (CL:IF (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| VECTOR)
        (%MAKE-ARRAY-WRITEABLE VECTOR))
      (CL:WHEN (> CNT 0)
        (CL:WHEN (AND (%THIN-CHAR-TYPE-P TYPE-NUMBER)
                      (%FAT-STRING-CHAR-P VALUE))
          (%MAKE-STRING-ARRAY-FAT VECTOR)
          (SETQ TYPE-NUMBER (%ARRAY-TYPE-NUMBER VECTOR)))
        (CL:IF (NOT (%LLARRAY-TYPEP TYPE-NUMBER VALUE))
          (CL:ERROR "Value of incorrect type for this array: ~S" VALUE))
        (LET ((BASE (%ARRAY-BASE VECTOR))
              (OFFSET (+ START (%ARRAY-OFFSET VECTOR))))
          (%ARRAY-WRITE VALUE BASE TYPE-NUMBER OFFSET)
          (%FAST-COPY-BASE BASE OFFSET TYPE-NUMBER BASE (CL:1+ OFFSET)
                           TYPE-NUMBER (CL:1- CNT))))
          VECTOR)))
```

```
(CL:DEFUN CL:MAKE-ARRAY (DIMENSIONS &KEY (ELEMENT-TYPE T)
                                (INITIAL-ELEMENT NIL INITIAL-ELEMENT-P)
                                (INITIAL-CONTENTS NIL INITIAL-CONTENTS-P)
                                (DISPLACED-TO NIL DISPLACED-TO-P)
                                (DISPLACED-TO-BASE NIL DISPLACED-TO-BASE-P)
                                (DISPLACED-INDEX-OFFSET 0 DISPLACED-INDEX-OFFSET-P)
                                FILL-POINTER ADJUSTABLE EXTENDABLE FATP READ-ONLY-P)
```

;; String are by default thin unless FATP is T. DISPLACED-TO-BASE indicates displacement to a raw storage block. READ-ONLY-P indicates a read only array

```
(CL:IF (NOT (CL:LISTP DIMENSIONS))
  (SETQ DIMENSIONS (LIST DIMENSIONS)))
(CL:IF (CL:DOLIST (DIM DIMENSIONS NIL)
  (CL:IF (OR (< DIM 0)
            (>= DIM CL:ARRAY-DIMENSION-LIMIT))
    (RETURN T))
  (CL:ERROR "Dimensions out of bounds: ~S" DIMENSIONS))
(LET ((RANK (LENGTH DIMENSIONS))
      (NELTS (%TOTAL-SIZE DIMENSIONS))
      ARRAY)
  ;; Consistency checks
  (CL:IF (>= RANK CL:ARRAY-RANK-LIMIT)
    (CL:ERROR "Too many dimensions: ~A" RANK))
  (CL:IF (>= NELTS CL:ARRAY-TOTAL-SIZE-LIMIT)
    (CL:ERROR "Too many elements: ~A" NELTS))
  (CL:IF (OR (AND DISPLACED-TO-P (OR INITIAL-ELEMENT-P INITIAL-CONTENTS-P DISPLACED-TO-BASE-P))
            (AND DISPLACED-TO-BASE-P (OR INITIAL-ELEMENT-P INITIAL-CONTENTS-P DISPLACED-TO-P))
            (AND FILL-POINTER (NOT (EQ RANK 1)))
            (AND DISPLACED-INDEX-OFFSET-P (NOT (OR DISPLACED-TO-P DISPLACED-TO-BASE-P)))
            (AND INITIAL-ELEMENT-P INITIAL-CONTENTS-P)
            (AND ADJUSTABLE EXTENDABLE)
            (AND READ-ONLY-P (OR EXTENDABLE ADJUSTABLE)))
    (CL:ERROR "Inconsistent options to make-array"))
  (CL:IF DISPLACED-TO-P
    (COND
      ((NOT (%ARRAYP DISPLACED-TO))
       (CL:ERROR "Not displaced to an array: ~s" DISPLACED-TO))
      ((NOT (EQUAL (%GET-CANONICAL-CML-TYPE ELEMENT-TYPE)
                  (CL:ARRAY-ELEMENT-TYPE DISPLACED-TO)))
       (CL:ERROR "Not displaced to an array of the same element-type"))
      ((> (+ DISPLACED-INDEX-OFFSET NELTS)
         (CL:ARRAY-TOTAL-SIZE DISPLACED-TO))
       (CL:ERROR "Displaced array out of bounds"))))
  (CL:IF FILL-POINTER
    (COND
      ((EQ FILL-POINTER T)
       (SETQ FILL-POINTER NELTS))
      ((NOT (AND (>= FILL-POINTER 0)
```

```

        (<= FILL-POINTER NELTS)))
        (CL:ERROR "Fill pointer out of bounds ~A" FILL-POINTER)))
;; Specs ready, make the array by case
(SETQ ARRAY (COND
  (DISPLACED-TO-P (%MAKE-DISPLACED-ARRAY NELTS DIMENSIONS ELEMENT-TYPE DISPLACED-TO
    DISPLACED-INDEX-OFFSET FILL-POINTER READ-ONLY-P ADJUSTABLE
    EXTENDABLE))
  (DISPLACED-TO-BASE (CL:IF (OR (> RANK 1)
    ADJUSTABLE)
    (%MAKE-GENERAL-ARRAY NELTS DIMENSIONS ELEMENT-TYPE FILL-POINTER
    FATP READ-ONLY-P ADJUSTABLE EXTENDABLE DISPLACED-TO-BASE
    DISPLACED-INDEX-OFFSET)
    (%MAKE-ONED-ARRAY NELTS ELEMENT-TYPE FILL-POINTER FATP
    READ-ONLY-P EXTENDABLE DISPLACED-TO-BASE
    DISPLACED-INDEX-OFFSET)))
  ((AND (EQ RANK 1)
    (NOT ADJUSTABLE))
    (%MAKE-ONED-ARRAY NELTS ELEMENT-TYPE FILL-POINTER FATP READ-ONLY-P EXTENDABLE))
  ((AND (EQ RANK 2)
    (NOT ADJUSTABLE))
    (%MAKE-TWOD-ARRAY NELTS DIMENSIONS ELEMENT-TYPE FATP READ-ONLY-P EXTENDABLE))
  (T (%MAKE-GENERAL-ARRAY NELTS DIMENSIONS ELEMENT-TYPE FILL-POINTER FATP READ-ONLY-P
    ADJUSTABLE EXTENDABLE))))

;; Initialize the storage
(COND
  (INITIAL-CONTENTS-P (%ARRAY-CONTENT-INITIALIZE ARRAY INITIAL-CONTENTS))
  (INITIAL-ELEMENT-P (%ARRAY-ELEMENT-INITIALIZE ARRAY INITIAL-ELEMENT)))

;; Return the array
ARRAY))

(CL:DEFUN MAKE-VECTOR (SIZE &KEY (ELEMENT-TYPE T)
  (INITIAL-ELEMENT NIL INITIAL-ELEMENT-P)
  FATP)
  (CL:IF (OR (< SIZE 0)
    (>= SIZE CL:ARRAY-TOTAL-SIZE-LIMIT))
    (CL:ERROR "Size out of bounds: ~s" SIZE))
  (LET ((VECTOR (%MAKE-ONED-ARRAY SIZE ELEMENT-TYPE NIL FATP)))
    (CL:IF INITIAL-ELEMENT-P (FILL-ARRAY VECTOR INITIAL-ELEMENT))
    VECTOR))

(CL:DEFUN READ-ONLY-ARRAY-P (ARRAY)
  (CL:IF (%ARRAYP ARRAY)
    (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| ARRAY)
    (CL:ERROR "Not an array: ~S" ARRAY)))

(CL:DEFUN CL:SBIT (SIMPLE-BIT-ARRAY &REST INDICES)
  (CL:ASSERT (TYPEP SIMPLE-BIT-ARRAY ' (CL:SIMPLE-ARRAY BIT))
    (SIMPLE-BIT-ARRAY)
    "Not a bit-array: ~S" SIMPLE-BIT-ARRAY)
  (CL:APPLY #'CL:AREF SIMPLE-BIT-ARRAY INDICES))

(CL:DEFUN CL:SCHAR (SIMPLE-STRING INDEX)
  (CL:ASSERT (TYPEP SIMPLE-STRING 'CL:SIMPLE-STRING)
    (SIMPLE-STRING)
    "Not a simple-string: ~S" SIMPLE-STRING)
  (CL:AREF SIMPLE-STRING INDEX))

(CL:DEFUN SET-FILL-POINTER (VECTOR NEWVALUE)
  (COND
    ((AND (OR (%ONED-ARRAY-P VECTOR)
      (%GENERAL-ARRAY-P VECTOR))
      (|fetch| (ARRAY-HEADER FILL-POINTER-P) |of| VECTOR))
      (CL:IF (NOT (<= 0 NEWVALUE (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| VECTOR)))
        (CL:ERROR "Fill pointer out of bounds: ~S" NEWVALUE))
        (|replace| (ARRAY-HEADER FILL-POINTER) |of| VECTOR |with| NEWVALUE)
        NEWVALUE)
      ((%VECTORP VECTOR)
        (CL:ERROR "Vector has no fill pointer"))
      (T (CL:ERROR "Not a vector: ~S" VECTOR))))

(CL:DEFUN SIMPLE-ARRAY-P (ARRAY)
  (%SIMPLE-ARRAY-P ARRAY))

(CL:DEFUN CL:SIMPLE-BIT-VECTOR-P (VECTOR)
  (AND (%ONED-ARRAY-P VECTOR)
    (|fetch| (ARRAY-HEADER SIMPLE-P) |of| VECTOR)
    (|fetch| (ARRAY-HEADER BIT-P) |of| VECTOR)))

```



```
(CL:DEFUN CL:SIMPLE-STRING-P (STRING)
  (%SIMPLE-STRING-P STRING))
```

```
(CL:DEFUN CL:SIMPLE-VECTOR-P (VECTOR)
  (AND (%ONED-ARRAY-P VECTOR)
    (|fetch| (ARRAY-HEADER SIMPLE-P) |of| VECTOR)
    (EQ (CL:ARRAY-ELEMENT-TYPE VECTOR)
      T)))
```

```
(CL:DEFUN STRING-ARRAY-P (ARRAY)
  (%CHAR-TYPE-P (%ARRAY-TYPE-NUMBER ARRAY)))
```

```
(CL:DEFUN CL:SVREF (CL:SIMPLE-VECTOR INDEX)
  (CL:ASSERT (TYPEP CL:SIMPLE-VECTOR 'CL:SIMPLE-VECTOR)
    (CL:SIMPLE-VECTOR)
    "Not a simple-vector: ~S" CL:SIMPLE-VECTOR)
  (CL:AREF CL:SIMPLE-VECTOR INDEX))
```

```
(CL:DEFUN CL::UPGRADED-ARRAY-ELEMENT-TYPE (TYPE)
  (%GET-CANONICAL-CML-TYPE TYPE))
```

```
(CL:DEFUN VECTOR-LENGTH (VECTOR)
  (CL:IF (%VECTORP VECTOR)
    (|fetch| (ARRAY-HEADER FILL-POINTER) |of| VECTOR)
    (CL:ERROR "Not a vector: ~s" VECTOR)))
```

```
(CL:DEFUN CL:VECTOR-POP (VECTOR)
  (COND
    ((AND (OR (%ONED-ARRAY-P VECTOR)
      (%GENERAL-ARRAY-P VECTOR))
      (|fetch| (ARRAY-HEADER FILL-POINTER-P) |of| VECTOR))
      (LET ((FILL-POINTER (|fetch| (ARRAY-HEADER FILL-POINTER) |of| VECTOR)))
        (CL:IF (<= FILL-POINTER 0)
          (CL:ERROR "Can't pop from zero fill pointer")
          (SETQ FILL-POINTER (CL:1- FILL-POINTER))
          (|replace| (ARRAY-HEADER FILL-POINTER) |of| VECTOR |with| FILL-POINTER)
          (CL:AREF VECTOR FILL-POINTER)))
      (%VECTORP VECTOR)
      (CL:ERROR "Vector has no fill pointer")
      (T (CL:ERROR "Not a vector: ~S" VECTOR))))))
```

```
(CL:DEFUN CL:VECTOR-PUSH (NEW-ELEMENT VECTOR)
  (COND
    ((AND (OR (%ONED-ARRAY-P VECTOR)
      (%GENERAL-ARRAY-P VECTOR))
      (|fetch| (ARRAY-HEADER FILL-POINTER-P) |of| VECTOR))
      (LET ((FILL-POINTER (|fetch| (ARRAY-HEADER FILL-POINTER) |of| VECTOR)))
        (CL:WHEN (< FILL-POINTER (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| VECTOR))
          (ASET NEW-ELEMENT VECTOR FILL-POINTER)
          (|replace| (ARRAY-HEADER FILL-POINTER) |of| VECTOR |with| (CL:1+ FILL-POINTER)
            FILL-POINTER)))
      (%VECTORP VECTOR)
      (CL:ERROR "Vector has no fill pointer")
      (T (CL:ERROR "Not a vector: ~S" VECTOR))))))
```

```
(CL:DEFUN CL:VECTOR-PUSH-EXTEND (NEW-ELEMENT VECTOR &OPTIONAL (EXTENSION-SIZE
  *DEFAULT-PUSH-EXTENSION-SIZE*))
```

;; Like VECTOR-PUSH except if VECTOR is adjustable -- in which case a push beyond (array-total-size VECTOR ) will call adjust-array

```
(LET ((NEW-INDEX (CL:VECTOR-PUSH NEW-ELEMENT VECTOR)))
  (CL:IF (NULL NEW-INDEX)
    (COND
      (> EXTENSION-SIZE 0)
      (CL:ADJUST-ARRAY VECTOR (+ (CL:ARRAY-TOTAL-SIZE VECTOR)
        EXTENSION-SIZE))
      (CL:VECTOR-PUSH NEW-ELEMENT VECTOR))
    (T (CL:ERROR "Extension-size not greater than zero"))))
  NEW-INDEX))
```

```
(CL:DEFUN CL:VECTORP (VECTOR)
  (%VECTORP VECTOR))
```

(DEFINEQ

```
CL:AREF
  (LAMBDA ARGS
```

```
(CL:IF (< ARGS 1)
  (CL:ERROR "Aref takes at least one arg"))
(LET ((ARRAY (ARG ARGS 1)))
  (CASE ARGS
    (1 (%AREF0 ARRAY))
    (2 (%AREF1 ARRAY (ARG ARGS 2)))
    (3 (%AREF2 ARRAY (ARG ARGS 2)
                    (ARG ARGS 3)))
    (T (COND
        ((NOT (EQ (CL:ARRAY-RANK ARRAY)
                  (CL:1- ARGS)))
         (CL:ERROR "Rank mismatch"))
        (T ;; If we've gotten this far ARRAY must be a general array ; Check indices in bounds
          (CL:DO ((I 2 (CL:1+ I))
                 (DIMLIST (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY)
                  (CDR DIMLIST))
                 INDEX)
                (> I ARGS))
            (SETQ INDEX (ARG ARGS I))
            (CL:IF (NOT (< -1 INDEX (CAR DIMLIST)))
                    (CL:ERROR "Index out of bounds: ~s" INDEX)))
            ; Now proceed to extract the element
            (LET ((ROW-MAJOR-INDEX (CL:DO ((I 2 (CL:1+ I))
                                           (DIMLIST (CDR (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY)
                                                         (CDR DIMLIST))
                                           (TOTAL 0))
                                           (EQ I ARGS)
                                           (+ TOTAL (ARG ARGS ARGS))))
                  (SETQ TOTAL (CL:* (CAR DIMLIST)
                                    (+ TOTAL (ARG ARGS I))))))
                (BASE-ARRAY ARRAY))
              (%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY ROW-MAJOR-INDEX)
              (%ARRAY-READ (|ffetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
                           (|ffetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)
                           (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
                              ROW-MAJOR-INDEX))))))))))
```

**(CL:ARRAY-IN-BOUNDS-P**

; Edited 11-Dec-87 15:32 by jop

```
(LAMBDA ARGS
  (CL:IF (< ARGS 1)
    (CL:ERROR "Array-in-bounds-p takes at least one arg"))
  (LET ((ARRAY (ARG ARGS 1)))
    (CL:IF (EQ (CL:ARRAY-RANK ARRAY)
               (CL:1- ARGS))
            (%CHECK-INDICES ARRAY 2 ARGS)
            (CL:ERROR "Rank mismatch")))))
```

**(CL:ARRAY-ROW-MAJOR-INDEX**

; Edited 11-Dec-87 15:32 by jop

```
(LAMBDA ARGS
  (CL:IF (< ARGS 1)
    (CL:ERROR "Array-row-major-index takes at least one arg"))
  (LET ((ARRAY (ARG ARGS 1)))
    (COND
      ((NOT (EQ (CL:ARRAY-RANK ARRAY)
                (CL:1- ARGS)))
       (CL:ERROR "Rank mismatch"))
      ((NOT (%CHECK-INDICES ARRAY 2 ARGS))
       (CL:ERROR "Index out of bounds"))
      (T (CL:DO ((I 2 (CL:1+ I))
                 (TOTAL 0))
                 (EQ I ARGS)
                 (+ TOTAL (ARG ARGS ARGS)))
          (SETQ TOTAL (CL:* (CL:ARRAY-DIMENSION ARRAY (CL:1- I))
                            (+ TOTAL (ARG ARGS I))))))))))
```

**(ASET**

; Edited 11-Dec-87 15:33 by jop

```
(LAMBDA ARGS
  (CL:IF (< ARGS 2)
    (CL:ERROR "Aset takes at least two args"))
  (LET ((NEWVALUE (ARG ARGS 1))
        (ARRAY (ARG ARGS 2)))
    (CASE ARGS
      (2 (%ASET0 NEWVALUE ARRAY))
      (3 (%ASET1 NEWVALUE ARRAY (ARG ARGS 3)))
      (4 (%ASET2 NEWVALUE ARRAY (ARG ARGS 3)
                (ARG ARGS 4)))
      (T (COND
          ((NOT (EQ (CL:ARRAY-RANK ARRAY)
                    (- ARGS 2)))
           (CL:ERROR "Rank mismatch"))
          (T
            ;; Check indices
            (CL:DO ((I 3 (CL:1+ I))
```

; If we've gotten this far array must be a general array

```

(DIMLIST (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY)
(CDR DIMLIST))
INDEX)
(> I ARGS))
(SETQ INDEX (ARG ARGS I))
(CL:IF (NOT (< -1 INDEX (CAR DIMLIST)))
(CL:ERROR "Index out of bounds: ~s" INDEX)))
;; Now proceed to extract the element
(LET ((ROW-MAJOR-INDEX (CL:DO ((I 3 (CL:1+ I))
(DIMLIST (CDR (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY))
(CDR DIMLIST))
(TOTAL 0))
(EQ I ARGS)
(+ TOTAL (ARG ARGS ARGS)))
(SETQ TOTAL (CL:* (CAR DIMLIST)
(+ TOTAL (ARG ARGS I))))))
(BASE-ARRAY ARRAY))
(%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY ROW-MAJOR-INDEX)
(LET ((TYPE-NUMBER (|ffetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)))
(CL:IF (%CHECK-NOT-WRITEABLE ARRAY TYPE-NUMBER NEWVALUE)
(CL:APPLY 'ASET NEWVALUE ARRAY (CL:DO ((I ARGS (CL:1- I))
LST)
(< I 1)
LST)
(SETQ LST (CONS (ARG ARGS I)
LST))))
(%ARRAY-WRITE NEWVALUE (|ffetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
TYPE-NUMBER
(+ (%GET-ARRAY-OFFSET BASE-ARRAY)
ROW-MAJOR-INDEX)))))))))

```

**(CL:VECTOR**

```

(LAMBDA ARGS
(LET ((VECTOR (%MAKE-ONED-ARRAY ARGS T)))
(CL:DOTIMES (I ARGS)
(ASET (ARG ARGS (CL:1+ I))
VECTOR I))
VECTOR)))
)

```

; Edited 18-Dec-86 18:09 by jop

;; New CLtL array functions

(DEFINEQ

**(CL::ROW-MAJOR-ASET**

```

(LAMBDA (ARRAY INDEX NEWVALUE) ; Edited 11-Dec-87 15:54 by jop
(CL:IF (NOT (AND (>= INDEX 0)
(< INDEX (|ffetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY))))
(CL:ERROR "Index out of bounds: ~s" INDEX)
(LET ((ROW-MAJOR-INDEX INDEX)
(BASE-ARRAY ARRAY))
;; Now proceed to extract the element
(%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY ROW-MAJOR-INDEX)
(LET ((TYPE-NUMBER (|ffetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)))
(CL:IF (%CHECK-NOT-WRITEABLE ARRAY TYPE-NUMBER NEWVALUE)
(CL::ROW-MAJOR-ASET ARRAY INDEX NEWVALUE)
(%ARRAY-WRITE NEWVALUE (|ffetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
TYPE-NUMBER
(+ (%GET-ARRAY-OFFSET BASE-ARRAY)
ROW-MAJOR-INDEX)))))))))
)

```

(CL:DEFSETF **CL::ROW-MAJOR-AREF** CL::ROW-MAJOR-ASET)

;; Setfs

(CL:DEFSETF **CL:AREF** (ARRAY &REST INDICES) (NEWVALUE)
\ (ASET ,NEWVALUE ,ARRAY ,@INDICES))

(CL:DEFSETF **BIT** (ARRAY &REST INDICES) (NEWVALUE)
\ (ASET ,NEWVALUE ,ARRAY ,@INDICES))

(CL:DEFSETF **CL:CHAR** (ARRAY INDEX) (NEWVALUE)
\ (ASET ,NEWVALUE ,ARRAY ,INDEX))

(CL:DEFSETF **CL:FILL-POINTER** SET-FILL-POINTER)

(CL:DEFSETF **CL:SBIT** (ARRAY &REST INDICES) (NEWVALUE)
\ (ASET ,NEWVALUE ,ARRAY ,@INDICES))

(CL:DEFSETF **CL:SCHAR** (ARRAY INDEX) (NEWVALUE)
\ (ASET ,NEWVALUE ,ARRAY ,INDEX))

(CL:DEFSETF **CL:SVREF** (ARRAY INDEX) (NEWVALUE)
\ (ASET ,NEWVALUE ,ARRAY ,INDEX))

:: Optimizers

(CL:DEFUN **%AREF-EXPANDER** (ARRAY INDICES)
(CASE (LENGTH INDICES)
(1 \ (%AREF1 ,ARRAY ,@INDICES))
(2 \ (%AREF2 ,ARRAY ,@INDICES))
(T 'COMPILER:PASS))

(CL:DEFUN **%ASET-EXPANDER** (NEWVALUE ARRAY INDICES)
(CASE (LENGTH INDICES)
(1 \ (%ASET1 ,NEWVALUE ,ARRAY ,@INDICES))
(2 \ (%ASET2 ,NEWVALUE ,ARRAY ,@INDICES))
(T 'COMPILER:PASS))

(DEFOPTIMIZER **CL:AREF** (ARRAY &REST INDICES)
(%AREF-EXPANDER ARRAY INDICES))

(DEFOPTIMIZER **ASET** (NEWVALUE ARRAY &REST INDICES)
(%ASET-EXPANDER NEWVALUE ARRAY INDICES))

(DEFOPTIMIZER **BIT** (ARRAY &REST INDICES)
(%AREF-EXPANDER ARRAY INDICES))

(DEFOPTIMIZER **CL:CHAR** (STRING INDEX)
\ (%AREF1 ,STRING ,INDEX))

(DEFOPTIMIZER **CL:SBIT** (ARRAY &REST INDICES)
(%AREF-EXPANDER ARRAY INDICES))

(DEFOPTIMIZER **CL:SCHAR** (STRING INDEX)
\ (%AREF1 ,STRING ,INDEX))

(DEFOPTIMIZER **CL:SVREF** (CL:SIMPLE-VECTOR INDEX)
\ (%AREF1 ,CL:SIMPLE-VECTOR ,INDEX))

:: Vars etc

:: \*PRINT-ARRAY\* is defined in APRINT

(CL:DEFCONSTANT **CL:ARRAY-RANK-LIMIT** (EXPT 2 7))

(CL:DEFCONSTANT **CL:ARRAY-TOTAL-SIZE-LIMIT** 65534)

(CL:DEFCONSTANT **CL:ARRAY-DIMENSION-LIMIT** CL:ARRAY-TOTAL-SIZE-LIMIT)

(CL:DEFPARAMETER **\*DEFAULT-PUSH-EXTENSION-SIZE\*** 20)

:: Run-time support

(DEFINEQ

(**%ALTER-AS-DISPLACED-ARRAY**

(LAMBDA (ADJUSTABLE-ARRAY DIMENSIONS DISPLACED-TO DISPLACED-INDEX-OFFSET FILL-POINTER)
; Edited 18-Dec-86 17:11 by jop

:: Alter ADJUSTABLE-ARRAY to be displaced to displaced-to. ADJUSTABLE-ARRAY must be a general array

(CL:IF (NULL DISPLACED-INDEX-OFFSET)
(SETQ DISPLACED-INDEX-OFFSET 0))

(LET ((DISPLACED-TO-READ-ONLY-P (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| DISPLACED-TO))
(TOTAL-SIZE (%TOTAL-SIZE DIMENSIONS)))

```
(OFFSET (OR DISPLACED-INDEX-OFFSET 0))
BASE NEED-INDIRECTION-P)
(COND
  ((OR (%THIN-CHAR-TYPE-P (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| DISPLACED-TO))
    (|fetch| (ARRAY-HEADER EXTENDABLE-P) |of| DISPLACED-TO)
    (|fetch| (ARRAY-HEADER ADJUSTABLE-P) |of| DISPLACED-TO)
    (AND DISPLACED-TO-READ-ONLY-P (NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| DISPLACED-TO))))
    ; Provide for indirection
  (SETQ BASE DISPLACED-TO)
  (SETQ NEED-INDIRECTION-P T))
  (T
    ; Fold double displacement to single displacement
    (SETQ BASE (|fetch| (ARRAY-HEADER BASE) |of| DISPLACED-TO))
    (SETQ OFFSET (+ OFFSET (%GET-ARRAY-OFFSET DISPLACED-TO)))
    (CL:IF (|fetch| (ARRAY-HEADER INDIRECT-P) |of| DISPLACED-TO)
      (SETQ NEED-INDIRECTION-P T)))
    ; Don't need to touch the type-number since it can't change
  (UNINTERRUPTABLY
    (|freplace| (GENERAL-ARRAY STORAGE) |of| ADJUSTABLE-ARRAY |with| BASE)
    (|freplace| (GENERAL-ARRAY READ-ONLY-P) |of| ADJUSTABLE-ARRAY |with| DISPLACED-TO-READ-ONLY-P)
    (|freplace| (GENERAL-ARRAY INDIRECT-P) |of| ADJUSTABLE-ARRAY |with| NEED-INDIRECTION-P)
    (|freplace| (GENERAL-ARRAY DISPLACED-P) |of| ADJUSTABLE-ARRAY |with| T)
    (|freplace| (GENERAL-ARRAY FILL-POINTER-P) |of| ADJUSTABLE-ARRAY |with| FILL-POINTER)
    (|freplace| (GENERAL-ARRAY OFFSET) |of| ADJUSTABLE-ARRAY |with| OFFSET)
    (|freplace| (GENERAL-ARRAY FILL-POINTER) |of| ADJUSTABLE-ARRAY |with| (OR FILL-POINTER TOTAL-SIZE))
    (|freplace| (GENERAL-ARRAY TOTAL-SIZE) |of| ADJUSTABLE-ARRAY |with| TOTAL-SIZE)
    (|freplace| (GENERAL-ARRAY DIMS) |of| ADJUSTABLE-ARRAY |with| DIMENSIONS))
  ADJUSTABLE-ARRAY)))
```

**(%ALTER-AS-DISPLACED-TO-BASE-ARRAY**

```
(LAMBDA (ADJUSTABLE-ARRAY DIMENSIONS ELEMENT-TYPE DISPLACED-TO-BASE DISPLACED-INDEX-OFFSET FILL-POINTER FATP)
  ; Edited 18-Dec-86 17:12 by jop
```

:: Alter adjustable-array to be displaced to displaced-to-base

```
(LET ((TOTAL-SIZE (%TOTAL-SIZE DIMENSIONS))
      (TYPE-NUMBER (%CML-TYPE-TO-TYPENUMBER ELEMENT-TYPE FATP)))
  (UNINTERRUPTABLY
    (|freplace| (GENERAL-ARRAY STORAGE) |of| ADJUSTABLE-ARRAY |with| DISPLACED-TO-BASE)
    (|freplace| (GENERAL-ARRAY INDIRECT-P) |of| ADJUSTABLE-ARRAY |with| NIL)
    (|freplace| (GENERAL-ARRAY DISPLACED-P) |of| ADJUSTABLE-ARRAY |with| T)
    (|freplace| (GENERAL-ARRAY FILL-POINTER-P) |of| ADJUSTABLE-ARRAY |with| FILL-POINTER)
    (|freplace| (GENERAL-ARRAY TYPE-NUMBER) |of| ADJUSTABLE-ARRAY |with| TYPE-NUMBER)
    (|freplace| (GENERAL-ARRAY OFFSET) |of| ADJUSTABLE-ARRAY |with| (OR DISPLACED-INDEX-OFFSET 0))
    (|freplace| (GENERAL-ARRAY FILL-POINTER) |of| ADJUSTABLE-ARRAY |with| (OR FILL-POINTER TOTAL-SIZE))
    (|freplace| (GENERAL-ARRAY TOTAL-SIZE) |of| ADJUSTABLE-ARRAY |with| TOTAL-SIZE)
    (|freplace| (GENERAL-ARRAY DIMS) |of| ADJUSTABLE-ARRAY |with| DIMENSIONS))
  ADJUSTABLE-ARRAY)))
```

**(%AREFO**

```
(LAMBDA (ARRAY)
  ; Edited 11-Dec-87 15:33 by jop
```

:: Special aref for the zero dimensional case

```
(CL:IF (EQ (CL:ARRAY-RANK ARRAY)
  0)
  (LET ((INDEX 0)
        (BASE-ARRAY ARRAY))
    ; Must be a general array
    (%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY INDEX)
    (%ARRAY-READ (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
      (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)
      (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
        INDEX)))
    (CL:ERROR "Rank mismatch"))))
```

**(%AREF1**

```
(LAMBDA (ARRAY INDEX)
  ; Edited 11-Dec-87 15:50 by jop
```

:: specialized aref for the one-d case. Also the punt function for the aref1 opcode.

```
(COND
  ((NOT (EQ (CL:ARRAY-RANK ARRAY)
    1))
    (CL:ERROR "Rank mismatch"))
  ((NOT (AND (>= INDEX 0)
    (< INDEX (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY))))
    (CL:ERROR "Index out of bounds: ~A" INDEX))
  (T
    ; Now proceed to extract the element
    (LET ((BASE-ARRAY ARRAY)
          (%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY INDEX)
          (%ARRAY-READ (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
            (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)
            (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
              INDEX))))))
```

**(%AREF2**

```
(LAMBDA (ARRAY I J) ; Edited 11-Dec-87 15:33 by job
  ;; Specialized aref for the two-d case. Also the punt function for the aref 2 opcode.
  (CL:IF (EQ (CL:ARRAY-RANK ARRAY)
    2)
    (LET (BOUND0 BOUND1 OFFSET) ; ARRAY must be two-d or general
      ;; Get bounds and offset
      (COND
        ((%TWOD-ARRAY-P ARRAY) ; Twod array case
          (SETQ BOUND0 (|fetch| (TWOD-ARRAY BOUND0) |of| ARRAY))
          (SETQ BOUND1 (|fetch| (TWOD-ARRAY BOUND1) |of| ARRAY))
          (SETQ OFFSET 0))
        (T ; General array case
          (SETQ BOUND0 (CAR (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY)))
          (SETQ BOUND1 (CADR (|fetch| (GENERAL-ARRAY DIMS) |of| ARRAY)))
          (SETQ OFFSET (|fetch| (GENERAL-ARRAY OFFSET) |of| ARRAY)))
          ; Check indices
        (COND
          ((NOT (< -1 I BOUND0))
            (CL:ERROR "Index out of bounds: ~A" I))
          ((NOT (< -1 J BOUND1))
            (CL:ERROR "Index out of bounds: ~A" J)) ; Extract the element
          (LET ((ROW-MAJOR-INDEX (+ J (CL:* BOUND1 I)))
            (BASE-ARRAY ARRAY))
            (%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY ROW-MAJOR-INDEX)
            (%ARRAY-READ (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
              (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)
              (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
                ROW-MAJOR-INDEX))))
            (CL:ERROR "Rank mismatch")))))
```

**(%ARRAY-BASE**

```
(LAMBDA (ARRAY) ; Edited 18-Dec-86 17:20 by job
  (COND
    ((OR (%ONED-ARRAY-P ARRAY)
      (%TWOD-ARRAY-P ARRAY))
      (|fetch| (ARRAY-HEADER BASE) |of| ARRAY))
    ((%GENERAL-ARRAY-P ARRAY)
      (|fetch| (ARRAY-HEADER BASE) |of| (CL:LOOP (CL:IF (NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| ARRAY))
        (RETURN ARRAY))
          (SETQ ARRAY (|fetch| (ARRAY-HEADER BASE) |of| ARRAY))))))
    (T (CL:ERROR "Not an array: ~S" ARRAY))))
```

**(%ARRAY-CONTENT-INITIALIZE**

```
(LAMBDA (ARRAY INITIAL-CONTENTS) ; Edited 11-Dec-87 15:33 by job
  (CL:IF (EQ 0 (CL:ARRAY-RANK ARRAY))
    (%ARRAY-ELEMENT-INITIALIZE ARRAY INITIAL-CONTENTS)
    (LET ((DIMS (CL:ARRAY-DIMENSIONS ARRAY))
      (CL:IF (%CHECK-SEQUENCE-DIMENSIONS DIMS INITIAL-CONTENTS)
        (%FILL-ARRAY-FROM-SEQUENCE DIMS INITIAL-CONTENTS (%FLATTEN-ARRAY ARRAY)
          0)
        (CL:ERROR "Dimensionality mismatch for Initial-contents")))))
```

**(%ARRAY-ELEMENT-INITIALIZE**

```
(LAMBDA (ARRAY INITIAL-ELEMENT) ; Edited 11-Dec-87 15:33 by job
  ;; Initialize an array with a value
  (CL:UNLESS (EQ INITIAL-ELEMENT (%TYPENUMBER-TO-DEFAULT-VALUE (%ARRAY-TYPE-NUMBER ARRAY)))
    (FILL-ARRAY ARRAY INITIAL-ELEMENT)))
```

**(%ARRAY-OFFSET**

```
(LAMBDA (ARRAY) ; Edited 18-Dec-86 17:22 by job
  ;; Get the true offset for ARRAY
  (COND
    ((%ONED-ARRAY-P ARRAY)
      (|fetch| (ARRAY-HEADER OFFSET) |of| ARRAY))
    ((%TWOD-ARRAY-P ARRAY)
      0)
    ((%GENERAL-ARRAY-P ARRAY)
      (CL:DO ((OFFSET (|fetch| (ARRAY-HEADER OFFSET) |of| ARRAY)
        (+ OFFSET (%GET-ARRAY-OFFSET ARRAY))))
        ((NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| ARRAY))
          OFFSET)
        (SETQ ARRAY (|fetch| (ARRAY-HEADER BASE) |of| ARRAY))))
    (T (CL:ERROR "Not an array: ~S" ARRAY))))
```

**(%ARRAY-TYPE-NUMBER**

```
(LAMBDA (ARRAY) ; Edited 18-Dec-86 17:23 by job
  ;; Get the true array-typenumber for ARRAY
```

```
(COND
  ((OR (%ONED-ARRAY-P ARRAY)
        (%TWOD-ARRAY-P ARRAY))
    (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| ARRAY))
  ((%GENERAL-ARRAY-P ARRAY)
    (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| (CL:LOOP (CL:IF (NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| ARRAY))
                                                              (RETURN ARRAY))
                                                            (SETQ ARRAY (|fetch| (ARRAY-HEADER BASE) |of| ARRAY))))))
  (T (CL:ERROR "Not an array: ~S" ARRAY))))
```

**(%ASET0**

(LAMBDA (NEWVALUE ARRAY) ; Edited 11-Dec-87 15:33 by jop

```
;; Specialized aset for the zero-d case.
(CL:IF (EQ (CL:ARRAY-RANK ARRAY)
           0)
  (LET ((INDEX 0)
        (BASE-ARRAY ARRAY))
    ;; Must be a general array
    (%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY INDEX)
    (LET ((TYPE-NUMBER (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)))
      (CL:IF (%CHECK-NOT-WRITEABLE ARRAY TYPE-NUMBER NEWVALUE)
        (%ASET0 NEWVALUE ARRAY)
        (%ARRAY-WRITE NEWVALUE (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
                              TYPE-NUMBER
                              (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
                                 INDEX))))))
  (CL:ERROR "Rank mismatch")))
```

**(%ASET1**

(LAMBDA (NEWVALUE ARRAY INDEX) ; Edited 11-Dec-87 15:34 by jop

```
;; Specialized aset for the one-d case. Also the punt for the aset1 opcode.
(COND
  ((NOT (EQ (CL:ARRAY-RANK ARRAY)
            1))
    (CL:ERROR "Rank mismatch"))
  ((NOT (AND (>= INDEX 0)
             (< INDEX (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| ARRAY))))
    (CL:ERROR "Index out of bounds: ~s" INDEX))
  (T ;; Now proceed to extract the element
    (LET ((ROW-MAJOR-INDEX INDEX)
          (BASE-ARRAY ARRAY)
          (%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY ROW-MAJOR-INDEX)
          (LET ((TYPE-NUMBER (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)))
            (CL:IF (%CHECK-NOT-WRITEABLE ARRAY TYPE-NUMBER NEWVALUE)
              (%ASET1 NEWVALUE ARRAY INDEX)
              (%ARRAY-WRITE NEWVALUE (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
                                TYPE-NUMBER
                                (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
                                   ROW-MAJOR-INDEX)))))))
```

**(%ASET2**

(LAMBDA (NEWVALUE ARRAY I J) ; Edited 11-Dec-87 15:34 by jop

```
;; Specialized aset for the two-d case. Also the punt function for the aset2 opcode.
(CL:IF (EQ (CL:ARRAY-RANK ARRAY)
           2)
  (LET (BOUND0 BOUND1 OFFSET)
    ;; Get bounds and offset
    (COND
      ((%TWOD-ARRAY-P ARRAY) ; Twod case
        (SETQ BOUND0 (|ffetch| (TWOD-ARRAY BOUND0) |of| ARRAY))
        (SETQ BOUND1 (|ffetch| (TWOD-ARRAY BOUND1) |of| ARRAY))
        (SETQ OFFSET 0))
      (T ; General Case
        (SETQ BOUND0 (CAR (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY)))
        (SETQ BOUND1 (CADR (|ffetch| (GENERAL-ARRAY DIMS) |of| ARRAY)))
        (SETQ OFFSET (|ffetch| (GENERAL-ARRAY OFFSET) |of| ARRAY))))
    ;; Check indices
    (COND
      ((NOT (< -1 I BOUND0))
        (CL:ERROR "Index out of bounds ~s" I))
      ((NOT (< -1 J BOUND1))
        (CL:ERROR "Index out of bounds ~s" J)))
    ;; Set element
    (LET ((ROW-MAJOR-INDEX (+ J (CL:* BOUND1 I)))
          (BASE-ARRAY ARRAY))
```

```
(%GENERAL-ARRAY-ADJUST-BASE BASE-ARRAY ROW-MAJOR-INDEX)
(LET ((TYPE-NUMBER (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)))
  (CL:IF (%CHECK-NOT-WRITEABLE ARRAY TYPE-NUMBER NEWVALUE)
    (%ASET2 NEWVALUE ARRAY I J)
    (%ARRAY-WRITE NEWVALUE (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
      TYPE-NUMBER
      (+ (%GET-ARRAY-OFFSET BASE-ARRAY)
        ROW-MAJOR-INDEX))))))
(CL:ERROR "Rank mismatch")))
```

**(%CHECK-SEQUENCE-DIMENSIONS**

; Edited 11-Dec-87 15:34 by jop

```
(LAMBDA (DIM-LST SEQUENCE)
  ;; Returns NIL if there is a mismatch
  (CL:IF (EQ (CAR DIM-LST)
    (CL:LENGTH SEQUENCE))
    (OR (NULL (CDR DIM-LST))
      (CL:DOTIMES (I (CAR DIM-LST)
        T)
        (CL:IF (NOT (%CHECK-SEQUENCE-DIMENSIONS (CDR DIM-LST)
          (CL:ELT SEQUENCE I)))
          (RETURN NIL)))))))
```

**(%COPY-TO-NEW-ARRAY**

; Edited 13-Feb-87 15:52 by jop

```
(LAMBDA (OLD-DIMS OLD-ARRAY OLD-OFFSET NEW-DIMS NEW-ARRAY NEW-OFFSET)
  ;; It is assumed that OLD-ARRAY and NEW-ARRAY are of the same rank
  (LET ((SIZE (MIN (CAR OLD-DIMS)
    (CAR NEW-DIMS))))
    (CL:IF (CDR OLD-DIMS)
      (CL:DOTIMES (I SIZE)
        (%COPY-TO-NEW-ARRAY (CDR OLD-DIMS)
          OLD-ARRAY
          (CL:* (CADR OLD-DIMS)
            (+ OLD-OFFSET I))
          (CDR NEW-DIMS)
          NEW-ARRAY
          (CL:* (CADR NEW-DIMS)
            (+ NEW-OFFSET I))))))
    (%FAST-COPY-BASE (%ARRAY-BASE OLD-ARRAY)
      (+ (%ARRAY-OFFSET OLD-ARRAY)
        OLD-OFFSET)
      (%ARRAY-TYPE-NUMBER OLD-ARRAY)
      (%ARRAY-BASE NEW-ARRAY)
      (+ (%ARRAY-OFFSET NEW-ARRAY)
        NEW-OFFSET)
      (%ARRAY-TYPE-NUMBER NEW-ARRAY)
      SIZE))))
```

**(%DO-LOGICAL-OP**

; Edited 18-Dec-86 17:43 by jop

```
(LAMBDA (OP SOURCE DEST)
  (LET ((SOURCE-BASE (%ARRAY-BASE SOURCE))
    (SOURCE-OFFSET (%ARRAY-OFFSET SOURCE))
    (SOURCE-SIZE (CL:ARRAY-TOTAL-SIZE SOURCE))
    (DEST-BASE (%ARRAY-BASE DEST))
    (DEST-OFFSET (%ARRAY-OFFSET DEST))
    (GBBT (DEFERREDCONSTANT (|create| PILOTBBT
      PBTHEIGHT _ 1
      PBTDISJOINT _ T))))
    SOURCE-OP LOG-OP)
  (UNINTERRUPTABLY
    (|replace| (PILOTBBT PBTSOURCE) |of| GBBT |with| SOURCE-BASE)
    (|replace| (PILOTBBT PBTSOURCEBIT) |of| GBBT |with| SOURCE-OFFSET)
    (|replace| (PILOTBBT PBTDEST) |of| GBBT |with| DEST-BASE)
    (|replace| (PILOTBBT PBTDESTBIT) |of| GBBT |with| DEST-OFFSET)
    (|replace| (PILOTBBT PBTDESTBPL) |of| GBBT |with| SOURCE-SIZE)
    (|replace| (PILOTBBT PBTDESTBPL) |of| GBBT |with| SOURCE-SIZE)
    (|replace| (PILOTBBT PBTWIDTH) |of| GBBT |with| SOURCE-SIZE)
    (CASE OP
      (COPY
        (SETQ SOURCE-OP 0)
        (SETQ LOG-OP 0))
      (NOT
        (SETQ SOURCE-OP 1)
        (SETQ LOG-OP 0))
      (AND
        (SETQ SOURCE-OP 0)
        (SETQ LOG-OP 1))
      (CAND
        (SETQ SOURCE-OP 1)
        (SETQ LOG-OP 1))
      (OR
        (SETQ SOURCE-OP 0)
```



```

    (SETQ LOG-OP 2))
(COR
  (SETQ SOURCE-OP 1)
  (SETQ LOG-OP 2))
(XOR
  (SETQ SOURCE-OP 0)
  (SETQ LOG-OP 3))
(CXOR
  (SETQ SOURCE-OP 1)
  (SETQ LOG-OP 3))
(|replace| (PILOTBBT PBTsourcetype) |of| GBBT |with| SOURCE-OP)
(|replace| (PILOTBBT PBTOPERATION) |of| GBBT |with| LOG-OP)
; Execute the BLT
(\\PILOTBITBLT GBBT 0)
DEST)))

```

**(%EXTEND-ARRAY**

(LAMBDA (EXTENDABLE-ARRAY NEW-ARRAY DIMENSIONS FILL-POINTER) ; Edited 18-Dec-86 17:43 by jop  
 ;; Extend ADJUSTABLE-ARRAY, using the base provided by NEW-ARRAY

```

(LET ((TYPE-NUMBER (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| NEW-ARRAY))
      (TOTAL-SIZE (%TOTAL-SIZE DIMENSIONS))
      (BASE (|fetch| (ARRAY-HEADER BASE) |of| NEW-ARRAY)))
  (UNINTERRUPTABLY
    (|replace| (ARRAY-HEADER BASE) |of| EXTENDABLE-ARRAY |with| BASE)
    (|replace| (ARRAY-HEADER READ-ONLY-P) |of| EXTENDABLE-ARRAY |with| NIL)
    (|replace| (ARRAY-HEADER TYPE-NUMBER) |of| EXTENDABLE-ARRAY |with| TYPE-NUMBER)
    (|replace| (ARRAY-HEADER TOTAL-SIZE) |of| EXTENDABLE-ARRAY |with| TOTAL-SIZE)
    (COND
      ((%TWOD-ARRAY-P EXTENDABLE-ARRAY)
        (|replace| (TWOD-ARRAY BOUND0) |of| EXTENDABLE-ARRAY |with| (CAR DIMENSIONS))
        (|replace| (TWOD-ARRAY BOUND1) |of| EXTENDABLE-ARRAY |with| (CADR DIMENSIONS)))
      (T
        ; must be oned or general
        (|replace| (ARRAY-HEADER DISPLACED-P) |of| EXTENDABLE-ARRAY |with| NIL)
        (|replace| (ARRAY-HEADER FILL-POINTER-P) |of| EXTENDABLE-ARRAY |with| FILL-POINTER)
        (|replace| (ARRAY-HEADER OFFSET) |of| EXTENDABLE-ARRAY |with| 0)
        (|replace| (ARRAY-HEADER FILL-POINTER) |of| EXTENDABLE-ARRAY |with| (OR FILL-POINTER TOTAL-SIZE))
        (CL:WHEN (%GENERAL-ARRAY-P EXTENDABLE-ARRAY)
          (|replace| (GENERAL-ARRAY INDIRECT-P) |of| EXTENDABLE-ARRAY |with| NIL)
          (|replace| (GENERAL-ARRAY DIMS) |of| EXTENDABLE-ARRAY |with| DIMENSIONS))))))
  EXTENDABLE-ARRAY))

```

**(%FAST-COPY-BASE**

(LAMBDA (FROM-BASE FROM-OFFSET FROM-TYPENUMBER TO-BASE TO-OFFSET TO-TYPENUMBER CNT) ; Edited 11-Dec-87 15:34 by jop  
 ;; Bits one array into another of the same element-type

```

(CL:IF (OR (NOT (EQ FROM-TYPENUMBER TO-TYPENUMBER))
           (EQ (%TYPENUMBER-TO-GC-TYPE TO-TYPENUMBER)
               PTRBLOCK.GCT)))
  (CL:DO ((I FROM-OFFSET (CL:1+ I))
          (LIMIT (+ FROM-OFFSET CNT))
          (J TO-OFFSET (CL:1+ J)))
    (EQ I LIMIT))
    (%ARRAY-WRITE (%ARRAY-READ FROM-BASE FROM-TYPENUMBER I)
                  TO-BASE TO-TYPENUMBER J))
(LET ((BITS-PER-ELEMENT (%TYPENUMBER-TO-BITS-PER-ELEMENT TO-TYPENUMBER))
      (PBBT (DEFERREDCONSTANT (|create| PILOTBBT
                                       PBTDISJOINT _ T
                                       PBTsourcetype _ 0
                                       PBTOPERATION _ 0))))
  ;; Uses \\PILOTBITBLT instead of \\BLT because offsets might not be word aligned, and BITS-PER-ELEMENT may be greater than
  ;; BITSPERWORD (16).
  (UNINTERRUPTABLY
    (|replace| (PILOTBBT PBTsource) |of| PBBT |with| FROM-BASE)
    (|replace| (PILOTBBT PBTsourceBIT) |of| PBBT |with| (CL:* BITS-PER-ELEMENT FROM-OFFSET))
    (|replace| (PILOTBBT PBTDEST) |of| PBBT |with| TO-BASE)
    (|replace| (PILOTBBT PBTDESTBIT) |of| PBBT |with| (CL:* BITS-PER-ELEMENT TO-OFFSET))
    (|replace| (PILOTBBT PBTDESTBPL) |of| PBBT |with| BITS-PER-ELEMENT)
    (|replace| (PILOTBBT PBTsourceBPL) |of| PBBT |with| BITS-PER-ELEMENT)
    (|replace| (PILOTBBT PBTWIDTH) |of| PBBT |with| BITS-PER-ELEMENT)
    (|replace| (PILOTBBT PBTHEIGHT) |of| PBBT |with| CNT)
    (\\PILOTBITBLT PBBT 0))
  NIL)))

```

**(%FAT-STRING-ARRAY-P**

(LAMBDA (ARRAY) ; Edited 18-Dec-86 17:44 by jop  
 (%FAT-CHAR-TYPE-P (%ARRAY-TYPE-NUMBER ARRAY)))

**(%FILL-ARRAY-FROM-SEQUENCE**

(LAMBDA (DIMS SEQUENCE FLATTENED-ARRAY OFFSET) ; Edited 11-Dec-87 15:34 by jop  
 (CL:IF (CDR DIMS)

```
(CL:DOTIMES (I (CAR DIMS))
  (%FILL-ARRAY-FROM-SEQUENCE (CDR DIMS)
    (CL:ELT SEQUENCE I)
    FLATTENED-ARRAY
    (CL:* (CADR DIMS)
      (+ OFFSET I))))
(CL:DO ((I 0 (CL:1+ I))
  (J OFFSET (CL:1+ J))
  (LIMIT (CAR DIMS)))
  (EQ I LIMIT))
(ASET (CL:ELT SEQUENCE I)
  FLATTENED-ARRAY J)))))
```

**(%FLATTEN-ARRAY**

(LAMBDA (ARRAY) ; Edited 11-Dec-87 15:34 by jop

;; Make a oned-array that shares storage with array. If array is already oned then return array

```
(CL:IF (EQ 1 (CL:ARRAY-RANK ARRAY))
  ARRAY
  (CL:MAKE-ARRAY (CL:ARRAY-TOTAL-SIZE ARRAY)
    :ELEMENT-TYPE
    (CL:ARRAY-ELEMENT-TYPE ARRAY)
    :DISPLACED-TO ARRAY)))
```

**(%MAKE-ARRAY-WRITEABLE**

(LAMBDA (ARRAY) ; Edited 18-Dec-86 18:40 by jop

```
(CL:IF (NOT (%ARRAYP ARRAY))
  (CL:ERROR "Not an array: ~S" ARRAY))
(LET ((BASE-ARRAY ARRAY)
  NEW-BASE OFFSET TOTAL-SIZE TYPE-NUMBER)
  ;; Find the base array
  (CL:IF (|fetch| (ARRAY-HEADER INDIRECT-P) |of| ARRAY)
    (CL:LOOP (CL:IF (|fetch| (ARRAY-HEADER INDIRECT-P) |of| BASE-ARRAY)
      (SETQ BASE-ARRAY (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY))
      (RETURN NIL))))
    (CL:WHEN (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| BASE-ARRAY)
      ;; Allocate the new storage ; Be careful about offsets
      (SETQ TOTAL-SIZE (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| BASE-ARRAY))
      (SETQ OFFSET (%GET-ARRAY-OFFSET BASE-ARRAY))
      (SETQ TYPE-NUMBER (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY))
      (SETQ NEW-BASE (%MAKE-ARRAY-STORAGE (+ TOTAL-SIZE OFFSET)
        TYPE-NUMBER))
      ;; Initialize it
      (%FAST-COPY-BASE (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)
        OFFSET TYPE-NUMBER NEW-BASE OFFSET TYPE-NUMBER TOTAL-SIZE)
      ;; Smash the new base into the array-header
      (UNINTERRUPTABLY
        (|replace| (ARRAY-HEADER BASE) |of| BASE-ARRAY |with| NEW-BASE)
        (|replace| (ARRAY-HEADER READ-ONLY-P) |of| BASE-ARRAY |with| NIL)))
      ;; Declare the array (and all arrays on its access chain) readable
      (UNINTERRUPTABLY
        (CL:DO ((NEXT-ARRAY ARRAY (|fetch| (ARRAY-HEADER BASE) |of| NEXT-ARRAY)))
          ((NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| NEXT-ARRAY)))
          (|replace| (ARRAY-HEADER READ-ONLY-P) |of| NEXT-ARRAY |with| NIL)))
        ;; return the original array
        ARRAY)))
```

**(%MAKE-DISPLACED-ARRAY**

(LAMBDA (TOTALSIZE DIMENSIONS ELEMENT-TYPE DISPLACED-TO DISPLACED-INDEX-OFFSET FILL-POINTER READ-ONLY-P ADJUSTABLE EXTENDABLE) ; Edited 18-Dec-86 17:48 by jop

;; Make a displaced array

```
(LET ((DISPLACED-TO-TYPENUMBER (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| DISPLACED-TO))
  (DISPLACE-TO-READ-ONLY-P (|fetch| (ARRAY-HEADER READ-ONLY-P) |of| DISPLACED-TO))
  (OFFSET (OR DISPLACED-INDEX-OFFSET 0))
  BASE NEED-INDIRECTION-P)
  (COND
    ((OR (%THIN-CHAR-TYPE-P DISPLACED-TO-TYPENUMBER)
      (|fetch| (ARRAY-HEADER EXTENDABLE-P) |of| DISPLACED-TO)
      (|fetch| (ARRAY-HEADER ADJUSTABLE-P) |of| DISPLACED-TO)
      (AND DISPLACE-TO-READ-ONLY-P (NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| DISPLACED-TO))))
      ; Provide for indirection
      (SETQ BASE DISPLACED-TO)
      (SETQ NEED-INDIRECTION-P T))
    (T ; Fold double displacement to single displacement
      (SETQ BASE (|fetch| (ARRAY-HEADER BASE) |of| DISPLACED-TO))
      (SETQ OFFSET (+ OFFSET (%GET-ARRAY-OFFSET DISPLACED-TO)))
      (CL:IF (|fetch| (ARRAY-HEADER INDIRECT-P) |of| DISPLACED-TO)
        (SETQ NEED-INDIRECTION-P T))))))
```

```
(COND
  ((OR NEED-INDIRECTION-P ADJUSTABLE (> (LENGTH DIMENSIONS)
    1)) ; Indirect strings always have %FAT-CHAR-TYPENUMBER
    (%MAKE-GENERAL-ARRAY TOTALSIZE DIMENSIONS ELEMENT-TYPE FILL-POINTER (%CHAR-TYPE-P
      DISPLACED-TO-TYPENUMBER
      )
      (OR READ-ONLY-P DISPLACE-TO-READ-ONLY-P)
      ADJUSTABLE EXTENDABLE BASE OFFSET))
    (T (%MAKE-ONED-ARRAY TOTALSIZE ELEMENT-TYPE FILL-POINTER (%FAT-CHAR-TYPE-P DISPLACED-TO-TYPENUMBER
      )
      (OR READ-ONLY-P DISPLACE-TO-READ-ONLY-P)
      EXTENDABLE BASE OFFSET))))
```

**(%MAKE-GENERAL-ARRAY**

```
(LAMBDA (TOTAL-SIZE DIMENSIONS ELEMENT-TYPE FILL-POINTER FATP READ-ONLY-P ADJUSTABLE-P EXTENDABLE-P
  DISPLACED-TO DISPLACED-INDEX-OFFSET) ; Edited 11-Dec-87 15:35 by jop
```

;; General arrays cover all make-array cases, including those requiring indirection.

```
(LET ((TYPE-NUMBER (%CML-TYPE-TO-TYPENUMBER ELEMENT-TYPE FATP)))
  (|create| GENERAL-ARRAY
    STORAGE _ (OR DISPLACED-TO (%MAKE-ARRAY-STORAGE TOTAL-SIZE TYPE-NUMBER))
    READ-ONLY-P _ READ-ONLY-P
    INDIRECT-P _ (%ARRAYP DISPLACED-TO)
    BIT-P _ (%BIT-TYPE-P TYPE-NUMBER)
    STRING-P _ (AND (%CHAR-TYPE-P TYPE-NUMBER)
      (EQ 1 (LENGTH DIMENSIONS)))
    ADJUSTABLE-P _ ADJUSTABLE-P
    DISPLACED-P _ DISPLACED-TO
    FILL-POINTER-P _ FILL-POINTER
    EXTENDABLE-P _ (OR EXTENDABLE-P ADJUSTABLE-P)
    TYPE-NUMBER _ TYPE-NUMBER
    OFFSET _ (OR DISPLACED-INDEX-OFFSET 0)
    FILL-POINTER _ (OR FILL-POINTER TOTAL-SIZE)
    TOTAL-SIZE _ TOTAL-SIZE
    DIMS _ DIMENSIONS)))
```

**(%MAKE-ONED-ARRAY**

```
(LAMBDA (TOTAL-SIZE ELEMENT-TYPE FILL-POINTER FATP READ-ONLY-P EXTENDABLE-P DISPLACED-TO
  DISPLACED-INDEX-OFFSET) ; Edited 18-Dec-86 17:48 by jop
```

;; Oned-arrays cover all one dimensional cases, except adjustable and displaced-to when indirection is necessary

```
(LET ((TYPE-NUMBER (%CML-TYPE-TO-TYPENUMBER ELEMENT-TYPE FATP)))
  (|create| ONED-ARRAY
    BASE _ (OR DISPLACED-TO (%MAKE-ARRAY-STORAGE TOTAL-SIZE TYPE-NUMBER))
    READ-ONLY-P _ READ-ONLY-P
    BIT-P _ (%BIT-TYPE-P TYPE-NUMBER)
    STRING-P _ (%CHAR-TYPE-P TYPE-NUMBER)
    DISPLACED-P _ DISPLACED-TO
    FILL-POINTER-P _ FILL-POINTER
    EXTENDABLE-P _ EXTENDABLE-P
    TYPE-NUMBER _ TYPE-NUMBER
    OFFSET _ (OR DISPLACED-INDEX-OFFSET 0)
    FILL-POINTER _ (OR FILL-POINTER TOTAL-SIZE)
    TOTAL-SIZE _ TOTAL-SIZE)))
```

**(%MAKE-STRING-ARRAY-FAT**

```
(LAMBDA (ARRAY) ; Edited 11-Dec-87 15:35 by jop
```

;; Like Adjust-array for the special case of Thin-string arrays

```
(CL:IF (NOT (%ARRAYP ARRAY))
  (CL:ERROR "Not an array" ARRAY))
(LET ((BASE-ARRAY ARRAY)
  NEW-BASE OFFSET LIMIT)
  ;; Find the base array
  (CL:IF (|fetch| (ARRAY-HEADER INDIRECT-P) |of| ARRAY)
    (CL:LOOP (CL:IF (|fetch| (ARRAY-HEADER INDIRECT-P) |of| BASE-ARRAY)
      (SETQ BASE-ARRAY (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY))
      (RETURN NIL))))
  ;; Consistency check
  (CL:IF (NOT (%THIN-CHAR-TYPE-P (|fetch| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY)))
    (CL:ERROR "Not a thin string-char array: ~S" BASE-ARRAY))
  ;; Allocate the new storage ; Be careful about offsets
  (SETQ OFFSET (%GET-ARRAY-OFFSET BASE-ARRAY))
  (SETQ LIMIT (+ (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| BASE-ARRAY)
    OFFSET))
  (SETQ NEW-BASE (%MAKE-ARRAY-STORAGE LIMIT %FAT-CHAR-TYPENUMBER))
  ;; Initialize it ; Can't use %fast-copy-base because of the differing type
  ; numbers
  (CL:DO ((I OFFSET (CL:1+ I))
    (BASE-ARRAY-BASE (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)))
    ((EQ I LIMIT))
```

```
(%ARRAY-WRITE (%ARRAY-READ BASE-ARRAY-BASE %THIN-CHAR-TYPENUMBER I)
  NEW-BASE %FAT-CHAR-TYPENUMBER I))
;; Smash the new base into the array-header
(UNINTERRUPTABLY
  (|replace| (ARRAY-HEADER BASE) |of| BASE-ARRAY |with| NEW-BASE)
  (|replace| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY |with| %FAT-CHAR-TYPENUMBER))
;; return the original array
ARRAY)))
```

**(%MAKE-TWOD-ARRAY**

```
(LAMBDA (TOTAL-SIZE DIMENSIONS ELEMENT-TYPE FATP READ-ONLY-P EXTENDABLE-P)
  ; Edited 18-Dec-86 17:49 by jop
```

```
;; Two-d arrays are only simple or extendable twod-arrays
(LET ((BOUND0 (CAR DIMENSIONS))
      (BOUND1 (CADR DIMENSIONS))
      (TYPE-NUMBER (%CML-TYPE-TO-TYPENUMBER ELEMENT-TYPE FATP)))
  (|create| TWOD-ARRAY
    BASE _ (%MAKE-ARRAY-STORAGE TOTAL-SIZE TYPE-NUMBER)
    READ-ONLY-P _ READ-ONLY-P
    BIT-P _ (%BIT-TYPE-P TYPE-NUMBER)
    EXTENDABLE-P _ EXTENDABLE-P
    TYPE-NUMBER _ TYPE-NUMBER
    BOUND0 _ BOUND0
    BOUND1 _ BOUND1
    TOTAL-SIZE _ TOTAL-SIZE))))
```

**(%TOTAL-SIZE**

```
(LAMBDA (DIMS) ; Edited 18-Dec-86 17:53 by jop
```

```
(CL:DO ((DIM DIMS (CDR DIM))
        (PROD 1))
  ((NULL DIM)
   PROD)
  (SETQ PROD (CL:* (CAR DIM)
                  PROD))))
```

**(SHRINK-VECTOR**

```
(LAMBDA (VECTOR NEW-SIZE) ; Edited 18-Dec-86 18:08 by jop
```

```
(COND
  ((%VECTORP VECTOR)
   (CL:IF (OR (< NEW-SIZE 0)
              (> NEW-SIZE (|fetch| (ARRAY-HEADER TOTAL-SIZE) |of| VECTOR)))
    (CL:ERROR "Trying to shrink array ~s to bad size ~s" VECTOR NEW-SIZE))
    (|replace| (ARRAY-HEADER FILL-POINTER-P) |of| VECTOR |with| T)
    (|replace| (ARRAY-HEADER FILL-POINTER) |of| VECTOR |with| NEW-SIZE)
    VECTOR)
  (T (CL:ERROR "Not a vector: ~S" VECTOR))))
```

;; For Interlisp string hack

```
(DEFINEQ
```

**(%SET-ARRAY-OFFSET**

```
(LAMBDA (ARRAY NEWVALUE) ; Edited 18-Dec-86 17:51 by jop
```

```
;; Set the true offset for ARRAY
(COND
  ((%ONED-ARRAY-P ARRAY)
   (|replace| (ARRAY-HEADER OFFSET) |of| ARRAY |with| NEWVALUE))
  ((%TWOD-ARRAY-P ARRAY)
   (CL:ERROR "Twod-arrays have no offset"))
  ((%GENERAL-ARRAY-P ARRAY)
   (|replace| (ARRAY-HEADER OFFSET) |of| ARRAY |with| (- NEWVALUE (CL:DO* ((BASE-ARRAY ARRAY (|fetch| (ARRAY-HEADER
                                                                                                     BASE)
                                                                                                     |of| BASE-ARRAY))
                                                                                               (OFFSET 0 (+ OFFSET (%GET-ARRAY-OFFSET
                                                                                                     BASE-ARRAY))))
                                                                                               (NOT (|fetch| (ARRAY-HEADER INDIRECT-P)
                                                                                               |of| BASE-ARRAY))
                                                                                               OFFSET))))))
  (T (CL:ERROR "Not an array: ~S" ARRAY))
  NEWVALUE))
```

**(%SET-ARRAY-TYPE-NUMBER**

```
(LAMBDA (ARRAY NEWVALUE) ; Edited 18-Dec-86 17:52 by jop
```

```
;; Set the true type-number for array
(COND
```

```
( (OR (%ONED-ARRAY-P ARRAY)
      (%TWOD-ARRAY-P ARRAY))
  (|replace| (ARRAY-HEADER TYPE-NUMBER) |of| ARRAY |with| NEWVALUE))
(%GENERAL-ARRAY-P ARRAY)
  (CL:DO ((BASE-ARRAY ARRAY (|fetch| (ARRAY-HEADER BASE) |of| BASE-ARRAY)))
    ((NOT (|fetch| (ARRAY-HEADER INDIRECT-P) |of| BASE-ARRAY))
      (|replace| (ARRAY-HEADER TYPE-NUMBER) |of| BASE-ARRAY |with| NEWVALUE))))
  (T (CL:ERROR "Not an array ~S" ARRAY)))
NEWVALUE))
)
```

:: Low level predicates

(DEFINEQ

**(%ONED-ARRAY-P**

```
(LAMBDA (ARRAY)
  (EQ (NTYPX ARRAY)
      %ONED-ARRAY)))
```

; Edited 18-Dec-86 17:49 by jop

**(%TWOD-ARRAY-P**

```
(LAMBDA (ARRAY)
  (EQ (NTYPX ARRAY)
      %TWOD-ARRAY)))
```

; Edited 18-Dec-86 17:53 by jop

**(%GENERAL-ARRAY-P**

```
(LAMBDA (ARRAY)
  (EQ (NTYPX ARRAY)
      %GENERAL-ARRAY)))
```

; Edited 18-Dec-86 17:44 by jop

**(%THIN-STRING-ARRAY-P**

```
(LAMBDA (ARRAY)
  (%THIN-CHAR-TYPE-P (%ARRAY-TYPE-NUMBER ARRAY)))
```

; Edited 18-Dec-86 17:53 by jop

)

```
(DEFOPTIMIZER %ONED-ARRAY-P (ARRAY)
  `(AND ((OPCODES TYPEP 14)
        ,ARRAY)
        T))
```

```
(DEFOPTIMIZER %TWOD-ARRAY-P (ARRAY)
  `(AND ((OPCODES TYPEP 15)
        ,ARRAY)
        T))
```

```
(DEFOPTIMIZER %GENERAL-ARRAY-P (ARRAY)
  `(AND ((OPCODES TYPEP 16)
        ,ARRAY)
        T))
```

:: Real record def's on cmlarray-support

```
(/DECLAREDATATYPE 'GENERAL-ARRAY ' ((BITS 8)
  POINTER FLAG FLAG FLAG FLAG FLAG FLAG FLAG FLAG (BITS 8)
  WORD WORD WORD POINTER)
```

;; ---field descriptor list elided by lister---

' 8)

```
(/DECLAREDATATYPE 'ONED-ARRAY ' ((BITS 8)
  POINTER FLAG (BITS 1)
  FLAG FLAG (BITS 1)
  FLAG FLAG FLAG (BITS 8)
  WORD WORD WORD)
```

;; ---field descriptor list elided by lister---

' 6)

```
(/DECLAREDATATYPE 'TWOD-ARRAY ' ((BITS 8)
  POINTER FLAG (BITS 1)
  FLAG
  (BITS 4)
  FLAG
  (BITS 8)
  WORD WORD WORD)
```

;; ---field descriptor list elided by lister---

' 6)

(ADDTOVAR **SYSTEMRECLST**

```

(DATATYPE GENERAL-ARRAY ((NIL BITS 8)
  (STORAGE POINTER)
  (READ-ONLY-P FLAG)
  (INDIRECT-P FLAG)
  (BIT-P FLAG)
  (STRING-P FLAG)
  (ADJUSTABLE-P FLAG)
  (DISPLACED-P FLAG)
  (FILL-POINTER-P FLAG)
  (EXTENDABLE-P FLAG)
  (TYPE-NUMBER BITS 8)
  (OFFSET WORD)
  (FILL-POINTER WORD)
  (TOTAL-SIZE WORD)
  (DIMS POINTER)))
(DATATYPE ONED-ARRAY ((NIL BITS 8)
  (BASE POINTER)
  (READ-ONLY-P FLAG)
  (NIL BITS 1)
  (BIT-P FLAG)
  (STRING-P FLAG)
  (NIL BITS 1)
  (DISPLACED-P FLAG)
  (FILL-POINTER-P FLAG)
  (EXTENDABLE-P FLAG)
  (TYPE-NUMBER BITS 8)
  (OFFSET WORD)
  (FILL-POINTER WORD)
  (TOTAL-SIZE WORD)))
(DATATYPE TWOD-ARRAY ((NIL BITS 8)
  (BASE POINTER)
  (READ-ONLY-P FLAG)
  (NIL BITS 1)
  (BIT-P FLAG)
  (NIL BITS 4)
  (EXTENDABLE-P FLAG)
  (TYPE-NUMBER BITS 8)
  (BOUND0 WORD)
  (BOUND1 WORD)
  (TOTAL-SIZE WORD)))

```

(PUTPROPS **%AREF1 DOPVAL** (2 AREF1))

(PUTPROPS **%AREF2 DOPVAL** (3 AREF2))

(PUTPROPS **%ASET1 DOPVAL** (3 ASET1))

(PUTPROPS **%ASET2 DOPVAL** (4 ASET2))

:: I/O

(DEFINEQ

**(%DEFPRINT-ARRAY**

(LAMBDA (ARRAY STREAM)

; Edited 5-Feb-88 10:10 by job

:: This is the defprint for the array type

(COND

```

((%VECTORP ARRAY)
  (%DEFPRINT-VECTOR ARRAY STREAM))
((NOT *PRINT-ARRAY*)
  (%DEFPRINT-GENERIC-ARRAY ARRAY STREAM))
((AND *PRINT-LEVEL* (<= *PRINT-LEVEL* 0))
  (\\ELIDE.PRINT.ELEMENT STREAM)
  T)
(T (LET ((HASH (CL:CODE-CHAR (|fetch| (READTABLEP HASHMACROCHAR) |of| *READTABLE*)))
  (RANK (CL:ARRAY-RANK ARRAY))
  RANKSTR)
  (%CHECK-CIRCLE-PRINT ARRAY STREAM (SETQ RANKSTR (CL:PRINC-TO-STRING RANK))
  ; Make sure we have room for #na
  (.SPACECHECK. STREAM (+ (VECTOR-LENGTH RANKSTR)
  2))
  (CL:WRITE-CHAR HASH STREAM)
  (CL:WRITE-STRING RANKSTR STREAM)
  (CL:WRITE-CHAR (CONSTANT #\A)
  STREAM)
  (CL:IF (EQ RANK 0)
  (\\PRINDATUM (CL:AREF ARRAY)
  STREAM 0)
  (%PRINT-ARRAY-CONTENTS (%FLATTEN-ARRAY ARRAY)
  0
  (CL:ARRAY-DIMENSIONS ARRAY)
  STREAM)))
  T))))

```

T))))

(%DEFPRINT-BITVECTOR

(LAMBDA (CL:BIT-VECTOR STREAM)

; Edited 11-Dec-87 15:35 by jop

;; \*Print-level\* is handled in %defprint-vector

```

(LET ((HASH (CL:CODE-CHAR (|fetch| (READTABLEP HASHMACROCHAR) |of| *READTABLE*)))
      (SIZE (VECTOR-LENGTH CL:BIT-VECTOR))
      (END.INDEX FINAL.INDEX ELIDED SIZESTR)
      (SETQ END.INDEX (CL:1- SIZE))
      (%CHECK-CIRCLE-PRINT CL:BIT-VECTOR STREAM (CL:UNLESS (EQ SIZE 0)
                                                             (CL:DO ((I (CL:1- END.INDEX)
                                                             (CL:1- I))
                                                             (LAST.VALUE (CL:AREF CL:BIT-VECTOR END.INDEX)))
                                                             ((OR (< I 0)
                                                                (NOT (EQL (CL:AREF CL:BIT-VECTOR I)
                                                                LAST.VALUE))))
                                                             (SETQ END.INDEX I))))
      (SETQ FINAL.INDEX (COND
                          ((AND *PRINT-LENGTH* (>= END.INDEX *PRINT-LENGTH*))
                           (SETQ ELIDED T)
                           (CL:1- *PRINT-LENGTH*))
                          (T END.INDEX)))
      (CL:IF (NOT (EQ (CL:1- SIZE)
                     END.INDEX))
              (SETQ SIZESTR (CL:PRINC-TO-STRING SIZE)))
      (.SPACECHECK. STREAM (+ (PROGN
                               3)
                               (CL:IF SIZESTR
                                       (VECTOR-LENGTH SIZESTR)
                                       0)
                               FINAL.INDEX
                               (CL:IF ELIDED
                                       (PROGN
                                        3)
                                       0)))
              (CL:WRITE-CHAR HASH STREAM)
              (CL:IF SIZESTR (CL:WRITE-STRING SIZESTR STREAM))
              (CL:WRITE-CHAR (CONSTANT #\*)
                              STREAM)
              (CL:DO ((I 0 (CL:1+ I)))
                      ((> I FINAL.INDEX))
                      ((\OUTCHAR STREAM (+ (BIT CL:BIT-VECTOR I)
                                             (CONSTANT (CL:CHAR-CODE #\0))))))
              (CL:IF ELIDED ((ELIDE.PRINT.TAIL STREAM)))
      T)))

```

;# Plus 1 for final.index being 1 less than number bits printed

; Space for ...

(%DEFPRINT-GENERIC-ARRAY

(LAMBDA (ARRAY STREAM)

; Edited 18-Dec-86 17:40 by jop

;; Invoked when \*PRINT-ARRAY\* is NIL

```

(LET ((HASH (CL:CODE-CHAR (|fetch| (READTABLEP HASHMACROCHAR) |of| *READTABLE*)))
      (%CHECK-CIRCLE-PRINT ARRAY STREAM
      (.SPACECHECK. STREAM 2)
      (CL:WRITE-CHAR HASH STREAM)
      (CL:WRITE-CHAR (CONSTANT #\<)
                      STREAM)
      (CL:WRITE-STRING (CL:PRINC-TO-STRING 'CL:ARRAY)
                        STREAM)
      (CL:WRITE-CHAR (CONSTANT #\Space)
                      STREAM)
      (CL:WRITE-STRING (CL:PRINC-TO-STRING (CL:ARRAY-ELEMENT-TYPE ARRAY))
                        STREAM)
      (CL:WRITE-CHAR (CONSTANT #\Space)
                      STREAM)
      (CL:WRITE-STRING (CL:PRINC-TO-STRING (CL:ARRAY-DIMENSIONS ARRAY))
                        STREAM)
      (CL:WRITE-CHAR (CONSTANT #\Space)
                      STREAM)
      (CL:WRITE-CHAR (CONSTANT #\@)
                      STREAM)
      (CL:WRITE-CHAR (CONSTANT #\Space)
                      STREAM)
      ((\PRINTADDR ARRAY STREAM)
      (CL:WRITE-CHAR (CONSTANT #\>)
                      STREAM)
      T)))

```

; Make sure we have room for #<

(%DEFPRINT-VECTOR

(LAMBDA (VECTOR STREAM)

; Edited 5-Feb-88 10:11 by jop

;; Defprint for the oned-array type

```

(COND
  ((CL:STRINGP VECTOR)
   (%DEFPRINT-STRING VECTOR STREAM))
  ((NOT *PRINT-ARRAY*)

```

```
(%DEFPRINT-GENERIC-ARRAY VECTOR STREAM)
((AND *PRINT-LEVEL* (<= *PRINT-LEVEL* 0))
 (\ELIDE.PRINT.ELEMENT STREAM)
 T)
((CL:BIT-VECTOR-P VECTOR)
 (%DEFPRINT-BITVECTOR VECTOR STREAM))
(T (LET ((HASH (CL:CODE-CHAR (|fetch| (READTABLEP HASHMACROCHAR) |of| *READTABLE*)))
 (SIZE (VECTOR-LENGTH VECTOR))
 (END.INDEX FINAL.INDEX ELIDED SIZESTR)
 (SETQ END.INDEX (CL:1- SIZE))
 (%CHECK-CIRCLE-PRINT VECTOR STREAM (CL:UNLESS (EQ SIZE 0)
 (CL:DO ((I (CL:1- END.INDEX)
 (CL:1- I))
 (LAST.VALUE (CL:AREF VECTOR END.INDEX)))
 ((OR (< I 0)
 (NOT (EQL (CL:AREF VECTOR I)
 LAST.VALUE))))
 (SETQ END.INDEX I))))
 (SETQ FINAL.INDEX (COND
 ((AND *PRINT-LENGTH* (>= END.INDEX *PRINT-LENGTH*))
 (SETQ ELIDED T)
 (CL:1- *PRINT-LENGTH*))
 (T END.INDEX)))
 (CL:IF (NOT (EQ (CL:1- SIZE)
 END.INDEX))
 (SETQ SIZESTR (CL:PRINC-TO-STRING SIZE)))
 (.SPACECHECK. STREAM (+ (CL:IF SIZESTR
 (VECTOR-LENGTH SIZESTR)
 0)
 2))
 (CL:WRITE-CHAR HASH STREAM)
 (CL:IF SIZESTR (CL:WRITE-STRING SIZESTR STREAM))
 (CL:WRITE-CHAR (CONSTANT #\()
 STREAM)
 (LET ((*PRINT-LEVEL* (AND *PRINT-LEVEL* (CL:1- *PRINT-LEVEL*)))
 (CL:DO ((I 0 (CL:1+ I))
 (> I FINAL.INDEX))
 (CL:IF (> I 0)
 (CL:WRITE-CHAR (CONSTANT #\Space)
 STREAM)
 (\PRINDATUM (CL:AREF VECTOR I)
 STREAM 0)))
 (CL:IF ELIDED (\ELIDE.PRINT.TAIL STREAM))
 (CL:WRITE-CHAR (CONSTANT #\()
 STREAM)
 T))))))
```

**(%DEFPRINT-STRING**

(LAMBDA (STRING STREAM)

; Edited 11-Dec-87 15:36 by jop

:: May never get called since (IL:typename (make-string 10)) returns IL:stringp

```
(LET ((ESCAPECHAR (|fetch| (READTABLEP ESCAPECHAR) |of| *READTABLE*))
 (CLP (|fetch| (READTABLEP COMMONLISP) |of| *READTABLE*))
 (SIZE (VECTOR-LENGTH STRING)))
 (%CHECK-CIRCLE-PRINT STRING STREAM (.SPACECHECK. STREAM (CL:IF CLP
 2
 (+ 2 SIZE)))
 (CL:WHEN *PRINT-ESCAPE*
 (\OUTCHAR STREAM (CONSTANT (CL:CHAR-CODE #\"))))
 (CL:DO ((I 0 (CL:1+ I))
 (CH)
 ((EQ I SIZE))
 (SETQ CH (CL:CHAR-CODE (CL:CHAR STRING I)))
 (CL:WHEN (AND *PRINT-ESCAPE* (OR (EQ CH (CONSTANT (CL:CHAR-CODE #\"))
 (EQ CH ESCAPECHAR)))
 (\OUTCHAR STREAM ESCAPECHAR))
 (\OUTCHAR STREAM CH))
 (CL:WHEN *PRINT-ESCAPE*
 (\OUTCHAR STREAM (CONSTANT (CL:CHAR-CODE #\")))))
 T)))
```

**(%PRINT-ARRAY-CONTENTS**

(LAMBDA (FLAT-ARRAY OFFSET DIMENSIONS STREAM)

; Edited 5-Feb-88 10:11 by jop

```
(LET ((NELTS (CAR DIMENSIONS))
 (FINAL.INDEX ELIDED)
 (COND
 ((AND *PRINT-LENGTH* (> NELTS *PRINT-LENGTH*))
 (SETQ ELIDED T)
 (SETQ FINAL.INDEX (CL:1- *PRINT-LENGTH*)))
 (T (SETQ FINAL.INDEX (CL:1- NELTS))))
 (CL:WRITE-CHAR (CONSTANT #\()
 STREAM)
 (COND
 ((NULL (CDR DIMENSIONS))
 (CL:DO ((I OFFSET (CL:1+ I))
```

; Down to bottom level, print the elements



```

      (END-INDEX (+ OFFSET FINAL.INDEX)))
      (> I END-INDEX))
      (CL:IF (> I OFFSET)
        (CL:WRITE-CHAR (CONSTANT #\Space)
          STREAM)
        (\\PRINDATUM (CL:AREF FLAT-ARRAY I)
          STREAM 0)))
      ((EQ *PRINT-LEVEL* 1)
        (CL:DO ((I 0 (CL:1+ I))
          (> I FINAL.INDEX))
          (CL:IF (> I OFFSET)
            (CL:WRITE-CHAR (CONSTANT #\Space)
              STREAM)
            (\\ELIDE.PRINT.ELEMENT STREAM)))
        (T (LET ((*PRINT-LEVEL* (AND *PRINT-LEVEL* (CL:1- *PRINT-LEVEL*)))
          (CL:DO ((I 0 (CL:1+ I))
            (> I FINAL.INDEX))
            (CL:IF (> I 0)
              (CL:WRITE-CHAR (CONSTANT #\Space)
                STREAM)
              (%PRINT-ARRAY-CONTENTS FLAT-ARRAY (CL:* (CADR DIMENSIONS)
                (+ OFFSET I))
                (CDR DIMENSIONS)
                STREAM))))))
          (CL:IF ELIDED (\\ELIDE.PRINT.TAIL STREAM))
          (CL:WRITE-CHAR (CONSTANT #\))
            STREAM)))

```

; Elide at this level

)

(DEFPRINT 'ONED-ARRAY '%DEFPRINT-VECTOR)

(DEFPRINT 'TWOD-ARRAY '%DEFPRINT-ARRAY)

(DEFPRINT 'GENERAL-ARRAY '%DEFPRINT-ARRAY)