File created: 13-Oct-93 17:36:04 **{Pele:mv:envos}<LispCore>Sources>CLTL2>XCLC-PEEPHOLE.;1**

changes to: (IL:FUNCTIONS PEEPHOLE-OPTIMIZE PEEPHOLE-OPTIMIZE-CODE)

previous date: 16-Aug-91 18:52:23 {DSK}<mo>usr>users>sybalsky>cltl2>sources>XCLC-PEEPHOLE.;1

Read Table: XCL

Package: COMPILER

Format: XCCS


```
(IL:RPAQQ IL:XCLC-PEEPHOLECOMS
          (
```

;;; Peephole Optimization

```
           (IL:VARIABLES *REACHABLE-TAG-TABLE* *TAG-EQUIV-TABLE* *TAG-LOCATION-TABLE*)
           (IL:FUNCTIONS PEEPHOLE-OPTIMIZE FIND-ALL-TAGS FIND-REACHABLE-TAGS FIND-TAG-DUPLICATION
                  PEEPHOLE-OPTIMIZE-CODE)
```

;; Arrange to use the proper compiler

```
           (IL:PROP IL:FILETYPE IL:XCLC-PEEPHOLE)
```

;; Get the right reader environment

```
           (IL:PROP IL:MAKEFILE-ENVIRONMENT IL:XCLC-PEEPHOLE)))
```

;;; Peephole Optimization

```
(DEFVAR *REACHABLE-TAG-TABLE* NIL
```

;;; A hash-table of those tags that are reachable during execution. See FIND-REACHABLE-TAGS for details.

```
    )

(DEFVAR *TAG-EQUIV-TABLE* NIL
```

;;; Hash table mapping LAP tag identifiers into one of two things: 1) the keyword :REFERENCES paired with a list of the jump and push-tag instructions ;;; referring to this tag, or 2) the keyword :EQUIV paired with the identifier of the representative of the tags equivalent to this one. Used in the current, ad ;;; hoc peephole-optimizer.

```
    )

(DEFVAR *TAG-LOCATION-TABLE* NIL
```

;;; A hash-table mapping tag identifiers into the tails of code beginning with them.

```
    )

(DEFUN PEEPHOLE-OPTIMIZE (LAP-FN)
```

;; Extremely ad-hoc peephole optimizer for LAP code. It currently has two obligations:

;; -- Eliminate jumps to the very next location. Those screw up the jump-resolution algorithm in the D-machine assembler.

;; -- Eliminate unreachable code. This is necessary to make keep stack-analysis from barfing during assembly.

;;

;; First, optimize any local functions (e.g. FLET, LABELS, etc.):

```
    (DESTRUCTURING-BIND ((REQUIRED &KEY OPTIONAL REST KEY ALLOW-OTHER-KEYS OTHERS NAME ARG-TYPE BLIP CLOSED-OVER
                                   NON-LOCAL LOCAL-FUNCTIONS)
                         &REST BODY)
           (CDR LAP-FN)
           (IL:FOR LOCAL-FN IL:IN LOCAL-FUNCTIONS IL:DO (PEEPHOLE-OPTIMIZE (CADR LOCAL-FN))))
```

;; Now peephole-optimize the main-body code for this function:

```
    (LET ((*TAG-EQUIV-TABLE* (MAKE-HASH-TABLE :TEST 'EQL))
          (*REACHABLE-TAG-TABLE* (MAKE-HASH-TABLE :TEST 'EQL))
          (TAGS-USED NIL))
         (DECLARE (SPECIAL TAGS-USED))
         (FIND-REACHABLE-TAGS (CDDR LAP-FN))
         (MULTIPLE-VALUE-BIND (NEW-CODE CHANGED-P)
             (PEEPHOLE-OPTIMIZE-CODE (CDDR LAP-FN))
           (SETF (CDDR LAP-FN)
                 NEW-CODE)
           (SETQ TAGS-USED NIL)
           (IF CHANGED-P
               (PEEPHOLE-OPTIMIZE LAP-FN)
               LAP-FN))))

(DEFUN FIND-ALL-TAGS (CODE)
```

```
   (DO* ((TAIL CODE (CDR TAIL))
         (INST (CAR TAIL)
               (CAR TAIL)))
        ((ENDP TAIL))
      ;;
      (CASE (CAR INST)
          ((:TAG) (SETF (GETHASH (SECOND INST)
                                 *TAG-LOCATION-TABLE*)
                        TAIL))
          ((:CLOSE :LAMBDA) (FIND-ALL-TAGS (CDDR INST)))
          ((:CALL) (LET ((FN-TO-CALL (SECOND INST)))
                        (WHEN (AND (CONSP FN-TO-CALL)
                                   (EQ (FIRST FN-TO-CALL)
                                       :LAMBDA))
                              (FIND-ALL-TAGS (CDDR FN-TO-CALL))))))))
```

```
(DEFUN FIND-REACHABLE-TAGS (CODE)
```

;;; A tag is reachable if and only if

;;; -- It lies in the direct path of execution, starting at the first instruction in CODE.

;;; -- It is reachable from the beginning of the inner code of a reachable :CLOSE or :LAMBDA instruction.

;;; -- It is the object of a reachable :PUSH-TAG instruction.

```
   (LET ((*TAG-LOCATION-TABLE* (MAKE-HASH-TABLE :TEST 'EQL)))
        (FIND-ALL-TAGS CODE)
        (DO ((ROOTS (LIST CODE)))
            ((NULL ROOTS))
          ;; For each root found, seek out tags reachable form that root.
          (ASSERT (NOT (NULL (FIRST ROOTS)))
                  NIL "A tag was referred to but not found.")
          (DOLIST (INST (POP ROOTS))
              (CASE (FIRST INST)
                  ((:TAG)                                          ; This is a reachable tag.  If we already knew that, stop here.
                                                                   ; Else, mark it.
                     (IF (GETHASH (SECOND INST)
                                  *REACHABLE-TAG-TABLE*)
                         (RETURN)
                         (SETF (GETHASH (SECOND INST)
                                        *REACHABLE-TAG-TABLE*)
                               T)))
                  ((:JUMP :TJUMP :FJUMP :NTJUMP :NFJUMP :PUSH-TAG)
                                                                   ; The object of the instruction is reachable, so add it to the list of
                                                                   ; roots and keep seeking from this root.
                     (LET ((NEW-ROOT (GETHASH (SECOND INST)
                                              *TAG-LOCATION-TABLE*)))
                          (ASSERT (NOT (NULL NEW-ROOT))
                                  NIL "The tag ~S was referred to but not found." (SECOND INST))
                          (PUSH NEW-ROOT ROOTS))
                     (WHEN (EQ (FIRST INST)
                               :JUMP)
                           (RETURN)))
                  ((:RETURN)                                       ; No more reachable tags from this root, so stop here.
                     (RETURN))
                  ((:CLOSE :LAMBDA)                                ; Add the body of the instruction to the list of roots.
                     (PUSH (CDDR INST)
                           ROOTS))
                  ((:CALL) (LET ((FN-TO-CALL (SECOND INST)))
                                (WHEN (AND (CONSP FN-TO-CALL)
                                           (EQ (FIRST FN-TO-CALL)
                                               :LAMBDA))           ; Add the body of the directly called lambda to the list of roots.
                                      (PUSH (CDDR FN-TO-CALL)
                                            ROOTS)))))))))
```

```
(DEFUN FIND-TAG-DUPLICATION (CODE)
   (LET ((NEW-CODE NIL)
         (FIND-P NIL)
         INST)
        (IL:FOR TAIL IL:ON CODE IL:EACHTIME (SETQ INST (CAR TAIL))
           IL:DO ;; Check for unreachable code.
                 (UNLESS (AND (IL:FMEMB (FIRST (FIRST NEW-CODE))
                                        '(:JUMP :RETURN))
                              (NOT (AND (EQ (FIRST INST)
                                            :TAG)
                                        (GETHASH (SECOND INST)
                                                 *REACHABLE-TAG-TABLE*))))
                    (CASE (FIRST INST)
                        ((:TAG)
                           (IF (EQ (FIRST (FIRST NEW-CODE))
                                   :TAG)
```

```
                              (PROGN (SETQ FIND-P T)
                                     (RETURN)))
                           (PUSH INST NEW-CODE))
                        ((:CLOSE :LAMBDA)
                           (SETQ FIND-P (FIND-TAG-DUPLICATION (CDDR INST)))
                           (PUSH INST NEW-CODE))
                        ((:CALL) (LET ((FN-TO-CALL (SECOND INST)))
                                      (WHEN (AND (CONSP FN-TO-CALL)
                                                 (EQ (FIRST FN-TO-CALL)
                                                     :LAMBDA))
                                         (SETQ FIND-P (FIND-TAG-DUPLICATION (CDDR INST)))
                                         (PUSH INST NEW-CODE))))
                        (OTHERWISE (PUSH INST NEW-CODE)))))
        FIND-P))
```

(DEFUN **PEEPHOLE-OPTIMIZE-CODE** (CODE)

;;; Run through the given code collapsing adjacent TAGs into a single one and eliminating jumps to immediately following TAGs. Also eliminate code ;;; that cannot be reached. Return the new version of the code.

```
    (LET
     ((NEW-CODE NIL)
      (CHANGED-P NIL)
      (TAG-DUPLICATED-P (FIND-TAG-DUPLICATION CODE))
      INST)
     (IL:FOR TAIL IL:ON CODE IL:EACHTIME (SETQ INST (CAR TAIL))
        IL:DO ;; Check for unreachable code.
              ;; Code is unreachable if the last instruction was a JUMP or RETURN, and the next thing coming isn't a TAG that is reachable from
              ;; somewhere else.
              ;; (If dead code is removed here, that's worth a CHANGED-P indication)
              (UNLESS (AND (IL:FMEMB (FIRST (FIRST NEW-CODE))
                                     '(:JUMP :RETURN))
                           (NOT (AND (EQ (FIRST INST)
                                         :TAG)
                                     (GETHASH (SECOND INST)
                                              *REACHABLE-TAG-TABLE*)))
                           (SETQ CHANGED-P T))
                  (CASE (FIRST INST)
                      ((:JUMP :TJUMP :FJUMP :NTJUMP :NFJUMP :PUSH-TAG)
                         (LET ((LOOKUP (GETHASH (SECOND INST)
                                                *TAG-EQUIV-TABLE*)))
                              (PUSH INST NEW-CODE)
                              (ECASE (CAR LOOKUP)
                                  ((NIL)                          ; This tag is not yet in the table. Put it in there mapping to a list of
                                                                  ; references including only this one.
                                     (PUSHNEW (SECOND INST)
                                              TAGS-USED)
                                     (SETF (GETHASH (SECOND INST)
                                                    *TAG-EQUIV-TABLE*)
                                           (CONS :REFERENCES (LIST INST))))
                                  ((:REFERENCES)                  ; We haven't seen the TAG for this reference yet.  Add it to the
                                                                  ; list of references to that tag.
                                     (PUSHNEW (SECOND INST)
                                              TAGS-USED)
                                     (PUSH INST (CDR LOOKUP)))
                                  ((:EQUIV)                       ; We know what the right tag for this reference is now.
                                     (PUSHNEW (CDR LOOKUP)
                                              TAGS-USED)
                                     (SETF (SECOND INST)
                                           (CDR LOOKUP))))))
                      ((:TAG)
                         (LET ((LOOKUP (GETHASH (SECOND INST)
                                                *TAG-EQUIV-TABLE*)))
                              (IF (EQ (FIRST (FIRST NEW-CODE))
                                      :TAG)
                                  (PROGN ;; Mark this tag in the table as being equivalent either to the directly previous tag, if any, or to itself.
                                         (SETF (GETHASH (SECOND INST)
                                                        *TAG-EQUIV-TABLE*)
                                               (CONS :EQUIV (SECOND (FIRST NEW-CODE))))
                                         (PUSHNEW (SECOND (FIRST NEW-CODE))
                                                  TAGS-USED)
                                         ;; If there were forward references to this tag, update all of them to refer to the EQUIV-TAG.
                                         (IF (EQ (CAR LOOKUP)
                                                 :REFERENCES)
                                             (IL:FOR REFERENCE IL:IN (CDR LOOKUP)
                                                IL:DO (SETF (SECOND REFERENCE)
                                                            (SECOND (FIRST NEW-CODE))))
                                             (ASSERT (NULL LOOKUP)
                                                     NIL "This tag has been seen before!"))
                                         (SETQ CHANGED-P T))
                                  (COND
                                     ((AND (NOT TAG-DUPLICATED-P)
```

```
                (EQ (FIRST (SECOND TAIL))
                    :JUMP))
            (SETF (GETHASH (SECOND INST)
                           *TAG-EQUIV-TABLE*)
                  (CONS :EQUIV (SECOND (SECOND TAIL))))
            (IF (EQ (CAR LOOKUP)
                    :REFERENCES)
                (IL:FOR REFERENCE IL:IN (CDR LOOKUP)
                   IL:DO (WHEN (NOT (EQL (SECOND REFERENCE)
                                         (SECOND (SECOND TAIL))))
                           (SETF (SECOND REFERENCE)
                                 (SECOND (SECOND TAIL)))
                           (SETQ CHANGED-P T))))
            (PUSH INST NEW-CODE))
           (T (SETF (GETHASH (SECOND INST)
                             *TAG-EQUIV-TABLE*)
                    (CONS :EQUIV (SECOND INST)))
              (IF (EQ (CAR LOOKUP)
                      :REFERENCES)
                  (IL:FOR REFERENCE IL:IN (CDR LOOKUP) IL:DO (SETF (SECOND REFERENCE)
                                                                   (SECOND INST)))
                  (ASSERT (NULL LOOKUP)
                          NIL "This tag has been seen before!"))
              (PUSH INST NEW-CODE)))))
;; If the next instruction is not a :TAG, then it's time to check for useless jumps and to eliminate them.
(WHEN (OR (NULL (CDR TAIL))
          (NOT (EQ (FIRST (CDR TAIL))
                   :TAG)))
    (LOOP
          ;; Repeatedly examine the top 2 or 3 instructions, looking for sequences
          ;;   JUMP x - TAG x  or
          ;;   JUMP x - SET-STACK - TAG x
          ;;   cJUMP x - JUMP y - TAG x
          ;; and reducing them to just the TAG, with a POP if need be.
          (LET ((TAG-INST (FIRST NEW-CODE))
                (JUMP-INST (SECOND NEW-CODE))
                (SET-STACK-INST (THIRD NEW-CODE)))
               (IF (EQL (SECOND TAG-INST)
                        (SECOND JUMP-INST))
                   ;; Looks like something to eliminate.
                   (CASE (FIRST JUMP-INST)
                         ((:JUMP)
                            (SETF (CDR NEW-CODE)
                                  (CDDR NEW-CODE))
                            (SETQ CHANGED-P T))
                         ((:FJUMP :TJUMP)
                            (SETF (SECOND NEW-CODE)
                                  '(:POP))
                            (SETQ CHANGED-P T)
                            (RETURN))
                         ((:NTJUMP :NFJUMP) (ERROR "BUG: Non-popping jump to very next
                                                   location."))
                         (OTHERWISE
                            ;; The instruction before the :TAG was not a jump, so do nothing.
                            (RETURN)))
                   (IF (EQL (SECOND TAG-INST)
                            (SECOND SET-STACK-INST))
                       ;; Looks like it might be JUMP-SET-TAG or cJUMP - JUMP - TAG
                       (COND
                          ((EQ (FIRST JUMP-INST)
                               :DSET-STACK)
                           ;; YES, it's JUMP - SET - TAG
                           (ROTATEF JUMP-INST SET-STACK-INST)
                           (CASE (FIRST JUMP-INST)
                                 ((:JUMP)
                                    (SETF (CDR NEW-CODE)
                                          (CDDDR NEW-CODE))
                                    (SETQ CHANGED-P T))
                                 ((:FJUMP :TJUMP)
                                    (SETF (SECOND NEW-CODE)
                                          '(:POP))
                                    (SETF (CDDR NEW-CODE)
                                          (CDDDR NEW-CODE))
                                    (SETQ CHANGED-P T)
                                    (RETURN))
                                 ((:NTJUMP :NFJUMP) (ERROR "BUG: Non-popping jump to very
                                                           next location."))
                                 (OTHERWISE
                                    ;; The instruction before the :SET was not a jump, so do nothing.
```

```
                                        (RETURN))))
                                ((EQ (FIRST JUMP-INST)
                                     :JUMP)
                                 ;; YES, it's cJUMP - JUMP - TAG
                                 (CASE (FIRST SET-STACK-INST)
                                     ((:TJUMP)
                                        (RPLACA JUMP-INST :FJUMP)
                                        (SETF (CDDR NEW-CODE)
                                              (CDDDR NEW-CODE))
                                        (SETQ CHANGED-P T))
                                     ((:FJUMP)
                                        (RPLACA JUMP-INST :TJUMP)
                                        (SETF (CDDR NEW-CODE)
                                              (CDDDR NEW-CODE))
                                        (SETQ CHANGED-P T))
                                     (OTHERWISE
                                        ;; The instruction before the JUMP was not a cJUMP, so do nothing
                                        (RETURN))))
                                (T ;; The instruction before the :TAG was not a SET, so do nothing.
                                   (RETURN)))
                          ;; Nothing (more) to get rid of, so stop.
                          (RETURN)))))))
                ((:VAR)
                   ;; Eliminate any unnecesary POPs, e.g.:
                   ;; VAR_ x ; POP ;  VAR x
                   (LET ((SET-INST (SECOND NEW-CODE))
                         (POP-INST (FIRST NEW-CODE)))
                        (COND
                           ((AND (EQ (FIRST POP-INST)
                                     :POP)
                                 (EQ (FIRST SET-INST)
                                     :VAR_)
                                 (EQL (SECOND SET-INST)
                                      (SECOND INST)))
                            (SETF NEW-CODE (CDR NEW-CODE))
                            (SETQ CHANGED-P T))
                           (T (PUSH INST NEW-CODE)))))
                ((:CLOSE :LAMBDA)
                   (MULTIPLE-VALUE-BIND (CODE-SET CHANGED?)
                       (PEEPHOLE-OPTIMIZE-CODE (CDDR INST))
                     (SETF (CDDR INST)
                           CODE-SET)
                     (SETQ CHANGED-P (OR CHANGED-P CHANGED?)))
                   (PUSH INST NEW-CODE))
                ((:CALL)
                   (LET ((FN-TO-CALL (SECOND INST)))
                        (WHEN (AND (CONSP FN-TO-CALL)
                                   (EQ (FIRST FN-TO-CALL)
                                       :LAMBDA))
                           (MULTIPLE-VALUE-BIND (CODE-SET CHANGED?)
                               (PEEPHOLE-OPTIMIZE-CODE (CDDR FN-TO-CALL))
                             (SETF (CDDR FN-TO-CALL)
                                   CODE-SET)
                             (SETQ CHANGED-P (OR CHANGED-P CHANGED?)))))
                   (PUSH INST NEW-CODE))
                (OTHERWISE (PUSH INST NEW-CODE)))))
    ;; Now remove unused tags, and put things back into first-to-last order.
    (VALUES (NREVERSE (IL:FOR INST IN NEW-CODE IL:WHEN (OR (IL:NEQ (FIRST INST)
                                                                   :TAG)
                                                           (IL:FMEMB (SECOND INST)
                                                                     TAGS-USED)
                                                           (NOT (SETQ CHANGED-P T)))
                                                       IL:COLLECT INST))
            CHANGED-P)))

;; Arrange to use the proper compiler

(IL:PUTPROPS IL:XCLC-PEEPHOLE IL:FILETYPE COMPILE-FILE)

;; Get the right reader environment

(IL:PUTPROPS IL:XCLC-PEEPHOLE IL:MAKEFILE-ENVIRONMENT (:READTABLE "XCL" :PACKAGE (DEFPACKAGE "COMPILER"
                                                                                   (:USE "LISP" "XCL"))))

(IL:PUTPROPS IL:XCLC-PEEPHOLE IL:COPYRIGHT ("Xerox Corporation" 1986 1987 1988 1990 1991 1993))
```

FUNCTION INDEX

FIND-ALL-TAGS 1
FIND-REACHABLE-TAGS 2
FIND-TAG-DUPLICATION 2
PEEPHOLE-OPTIMIZE 1
PEEPHOLE-OPTIMIZE-CODE 3

VARIABLE INDEX

REACHABLE-TAG-TABLE 1
TAG-EQUIV-TABLE 1
TAG-LOCATION-TABLE 1

PROPERTY INDEX

IL:XCLC-PEEPHOLE 5