

## CHAPTER 15

### DWIM

A surprisingly large percentage of the errors made by Interlisp users are of the type that could be corrected by another LISP programmer without any information about the purpose of the program or expression in question, e.g., misspellings, certain kinds of parentheses errors, etc. To correct these types of errors we have implemented in Interlisp a DWIM facility, short for Do-What-I-Mean. DWIM is called automatically whenever an error occurs in the evaluation of an Interlisp expression. (Currently, DWIM only operates on unbound atoms and undefined function errors.) DWIM then proceeds to try to correct the mistake using the current context of computation plus information about what the user had previously been doing, (and what mistakes he had been making) as guides to the remedy of the error. If DWIM is able to make the correction, the computation continues as though no error had occurred. Otherwise, the procedure is the same as though DWIM had not intervened: a break occurs, or an unwind to the last ERRORSET (page 9.15). The following protocol illustrates the operation of DWIM.

For example, suppose the user defines the factorial function (FACT N) as follows:

```
_DEFINEQ((FACT (LAMBDA (N) (COND
((ZEROP N9 1) ((T (ITIMS N (FACCT 8SUB1 N]
(FACT)
```

—

Note that the definition of FACT contains several mistakes: ITIMES and FACT have been misspelled; the 9 in N9 was intended to be a right parenthesis, but the shift key was not depressed; similarly, the 8 in 8SUB1 was intended to be a left parenthesis; and finally, there is an extra left parenthesis in front of the T that begins the final clause in the conditional.

```
_PRETTYPRNT((FACCT]
=PRETTYPRINT
=FACT
```

```
(FACT
 [LAMBDA (N)
 (COND
 ((ZEROP N9 1)
 ((T (ITIMS N (FACCT 8SUB1 N])
(FACT)
```

—

After defining FACT, the user wishes to look at its definition using PRETTYPRINT, which he unfortunately misspells. Since there is no function PRETTYPRNT in the system, an undefined function error occurs, and DWIM is called. DWIM invokes its spelling corrector, which searches a list of functions frequently used (by *this* user) for the best possible match. Finding one that is extremely close, DWIM proceeds on the assumption that PRETTYPRNT meant PRETTYPRINT, notices the user of this, and calls PRETTYPRINT.

At this point, PRETTYPRINT would normally print (FACCT NOT PRINTABLE) and exit, since FACCT has no definition. Note that this is *not* an Interlisp error condition, so that DWIM would not be called

as described above. However, it is obviously not what the user *meant*.

This sort of mistake is corrected by having PRETTYPRINT itself explicitly invoke the spelling corrector portion of DWIM whenever given a function with no EXPR definition. Thus, with the aid of DWIM PRETTYPRINT is able to determine that the user wants to see the definition of the function FACT, and proceeds accordingly.

```
_FACT(3)
N9 [IN FACT] -> N ) ? YES
[IN FACT] (COND -- ((T --))) ->
          (COND -- (T --))
ITIMS [IN FACT] -> ITIMES
FACCT [IN FACT] -> FACT
8SUB1 [IN FACT] -> ( SUB1 ? YES
6
_PP FACT
(FACT
  [LAMBDA (N)
    (COND
      ((ZEROP N)
       1)
      (T (ITIMES N (FACT (SUB1 N))
FACT
—
```

The user now calls FACT. During its execution, five errors occur, and DWIM is called five times. At each point, the error is corrected, a message is printed describing the action taken, and the computation is allowed to continue as if no error had occurred. Following the last correction, 6 is printed, the value of (FACT 3). Finally, the user prettyprints the new, now correct, definition of FACT.

In this particular example, the user was shown operating in TRUSTING mode, which gives DWIM carte blanche for most corrections. The user can also operate in CAUTIOUS mode, in which case DWIM will inform him of intended corrections before they are made, and allow the user to approve or disapprove of them. If DWIM was operating in CAUTIOUS mode in the example above, it would proceed as follows:

```
_FACT(3)
N9 [IN FACT] -> N ) ? YES
U.D.F. T [IN FACT] FIX? YES
[IN FACT] (COND -- ((T --))) ->
          (COND -- (T --))
ITIMS [IN FACT] -> ITIMES ? ...YES
FACCT [IN FACT] -> FACT ? ...YES
8SUB1 [IN FACT] -> ( SUB1 ? NO
U.B.A.
(8SUB1 BROKEN)
:
```

For most corrections, if the user does not respond in a specified interval of time, DWIM automatically proceeds with the correction, so that the user need intervene only when he does not approve. Note that the user responded to the first, second, and fifth questions; DWIM responded for him on the third and

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fourth.<sup>1</sup>

A great deal of effort has gone into making DWIM “smart”, and experience with a large number of users indicates that DWIM works very well; DWIM seldom fails to correct an error the user feels it should have, and almost never mistakenly corrects an error. However, it is important to note that even when DWIM *is* wrong, no harm is done:<sup>2</sup> since an error had occurred, the user would have had to intervene anyway if DWIM took no action. Thus, if DWIM mistakenly corrects an error, the user simply interrupts or aborts the computation, UNDOes the DWIM change using UNDO (page 8.11), and makes the correction he would have had to make without DWIM. It is this benign quality of DWIM that makes it a valuable part of Interlisp.

(DWIM *x*) [Function]  
Used to enable/disable DWIM. If *x* is the litatom *C*, DWIM is enabled in CAUTIOUS mode, so that DWIM will ask the user before making corrections. If *x* is *T*, DWIM is enabled in TRUSTING mode, so DWIM will make most corrections automatically. If *x* is *NIL*, DWIM is disabled. Interlisp initially has DWIM enabled in CAUTIOUS mode.

DWIM returns CAUTIOUS, TRUSTING or NIL, depending to what mode it has just been put into.

For corrections to expressions typed in by the user for immediate execution,<sup>3</sup> DWIM always acts as though it were in TRUSTING mode, i.e., no approval necessary. For certain types of corrections, e.g., run-on spelling corrections, 8-9 errors, etc., DWIM always acts like it was in CAUTIOUS mode, and asks for approval. In either case, DWIM always informs the user of its action as described below.

### 15.1 SPELLING CORRECTION PROTOCOL

One type of error that DWIM can correct is the misspelling of a function or a variable name. When an unbound litatom or undefined function error occurs, DWIM tries to correct the spelling of the bad litatom. If a litatom is found whose spelling is “close” to the offender, DWIM proceeds as follows:

If the correction occurs in the typed-in expression, DWIM prints =CORRECT- SPELLING <sup>CR</sup> and continues evaluating the expression. For example:

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<sup>1</sup>DWIM uses ASKUSER for its interactions with the user (page 6.57). Whenever an interaction is about to take place and the user has typed ahead, ASKUSER types several bells to warn the user to stop typing, then clears and saves the input buffers, restoring them after the interaction is complete. Thus if the user has typed ahead before a DWIM interaction, DWIM will not confuse his type ahead with the answer to its question, nor will his typeahead be lost. The bells are printed by the function PRINTBELLS, which can be advised or redefined for specialized applications, e.g. to flash the screen for a display terminal.

<sup>2</sup>Except perhaps if DWIM’s correction mistakenly caused a destructive computation to be initiated, and information was lost before the user could interrupt. We have not yet had such an incident occur.

<sup>3</sup>Typed into LISPX (see page 8.28).

## Spelling Correction Protocol

```
_(SETQ FOO (IPLUS 1 2))
=IPLUS
3
```

If the correction does not occur in type-in, DWIM prints<sup>4</sup>

```
BAD- SPELLING [ IN FUNCTION- NAME ] -> CORRECT- SPELLING
```

Then, if DWIM is in TRUSTING mode, it prints a carriage return, makes the correction, and continues the computation. If DWIM is in CAUTIOUS mode, it prints a few spaces and ? and then wait for approval. The user then has six options:

- (1) Type Y. DWIM types es, and proceeds with the correction.
- (2) Type N. DWIM types o, and does not make the correction.
- (3) Type ^. DWIM does not make the correction, and furthermore guarantees that the error will not cause a break.
- (4) Type control-E. For error correction, this has the same effect as typing N.
- (5) Do nothing. In this case DWIM waits for DWIMWAIT seconds, and if the user has not responded, DWIM will type . . . followed by the default answer.

The default on spelling corrections is determined by the value of the variable FIXSPELLDEFAULT, whose top level value is initially Y.

- (6) Type space or carriage-return. In this case DWIM will wait indefinitely. This option is intended for those cases where the user wants to think about his answer, and wants to insure that DWIM does not get “impatient” and answer for him.

The procedure for spelling correction on other than Interlisp errors is analogous. If the correction is being handled as type-in, DWIM prints = followed by the correct spelling, and returns it to the function that called DWIM. Otherwise, DWIM prints the incorrect spelling, followed by the correct spelling. Then, if DWIM is in TRUSTING mode, DWIM prints a carriage-return and returns the correct spelling. Otherwise, DWIM prints a few spaces and a ? and waits for approval. The user can then respond with Y, N, control-E, space, carriage return, or do nothing as described above.

Note that the spelling corrector itself is not ERRORSET protected like the DWIM error correction routines. Therefore, typing N and typing control-E may have different effects when the spelling corrector is called directly. The former simply instructs the spelling corrector to return NIL, and lets the calling function

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<sup>4</sup>The appearance of -> is to call attention to the fact that the user's function will be or has been changed.

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decide what to do next; the latter causes an error which unwinds to the last ERRORSET, however far back that may be.

### 15.2 PARENTHESES ERRORS PROTOCOL

When an unbound litatom or undefined error occurs, and the opening litatom contains 8 or 9, DWIM tries to correct errors caused by typing 8 for left parenthesis and 9 for right parenthesis.<sup>5</sup> In these cases, the interaction with the user is similar to that for spelling correction. If the error occurs in type-in, DWIM types =CORRECTION <sup>cr</sup>, and continues evaluating the expression. For example:

```
_(SETQ FOO 8IPLUS 1 2]
= ( IPLUS
3
```

If the correction does not occur in type-in, DWIM prints

```
BAD-ATOM [IN FUNCTION- NAME ] -> CORRECTION ?
```

and then waits for approval. The user then has the same six options as for spelling correction, except the waiting time is 3\*DWIMWAIT seconds. If the user types Y, DWIM then operates as if it were in TRUSTING mode, i.e., it makes the correction and prints its message.

### 15.3 U.D.F. T ERRORS PROTOCOL

When an undefined function error occurs, and the opening function is T, DWIM tries to correct certain types of parentheses errors involving a T clause in a conditional. DWIM recognizes errors of the following forms:

(COND --) (T --)	The T clause appears outside and immediately following the COND.
(COND -- (-- & (T --)))	The T clause appears inside a previous clause.
(COND -- ((T --)))	The T clause has an extra pair of parentheses around it.

For U.D.F. T errors that are not one of these three types, DWIM takes no corrective action at all, and the error will occur.

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<sup>5</sup>Actually, DWIM uses the value of the variables LPARKEY and RPARKEY to determine the corresponding lower case character for left and right parentheses. LPARKEY and RPARKEY are initially 8 and 9 respectively, but they can be reset for other keyboard layouts., e.g., on some terminals left parenthesis is over 9, and right parenthesis is over 0.

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If the error occurs in type-in, DWIM simply types T FIXED and makes the correction. Otherwise if DWIM is in TRUSTING mode, DWIM makes the correction and prints the message:

```
[ IN FUNCTION- NAME ] {BAD-COND} ->
                        {CORRECTED-COND}
```

If DWIM is in CAUTIOUS mode, DWIM prints

```
U.D.F. T
[ IN FUNCTION- NAME ]   FIX?
```

and waits for approval. The user then has the same options as for spelling corrections and parenthesis errors. If the user types Y or defaults, DWIM makes the correction and prints its message.

Having made the correction, DWIM must then decide how to proceed with the computation. In the first case, (COND --) (T --), DWIM cannot know whether the T clause would have been executed if it had been inside of the COND. Therefore DWIM asks the user CONTINUE WITH T CLAUSE (with a default of YES). If the user types N, DWIM continues with the form after the COND, i.e., the form that originally followed the T clause.

In the second case, (COND -- (-- & (T --))), DWIM has a different problem. After moving the T clause to its proper place, DWIM must return as the value of & as the value of the COND. Since this value is no longer around, DWIM asks the user, OK TO REEVALUATE and then prints the expression corresponding to &. If the user types Y, or defaults, DWIM continues by reevaluating &, otherwise DWIM aborts, and a U.D.F. T error will then occur (even though the COND has in fact been fixed).<sup>6</sup>

In the third case, (COND -- ((T --))), there is no problem with continuation, so no further interaction is necessary.

### 15.4 DWIM OPERATION

Whenever the interpreter encounters an atomic form with no binding, or a non-atomic form CAR of which is not a function or function object, it calls the function FAULTEVAL. Similarly, when APPLY is given an undefined function, FAULTAPPLY is called. When DWIM is enabled, FAULTEVAL and FAULTAPPLY are redefined to first call the DWIM package, which tries to correct the error. If DWIM cannot decide how to fix the error, or the user disapproves of DWIM's correction (by typing N), or the user types control-E, then FAULTEVAL and FAULTAPPLY cause an error or break.<sup>7</sup>

If DWIM can (and is allowed to) correct the error, it exits by performing RETEVAL of the corrected form, as of the position of the call to FAULTEVAL or FAULTAPPLY. Thus in the example at the beginning of the chapter, when DWIM determined that ITIMS was ITIMES misspelled, DWIM called RETEVAL

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<sup>6</sup>If DWIM can determine for itself that the form can safely be reevaluated, it does not consult the user before reevaluating. DWIM can do this if the form is atomic, or CAR of the form is a member of the list OKREEVALST, and each of the arguments can safely be reevaluated. For example, (SETQ X (CONS (IPLUS Y Z) W)) is safe to reevaluate because SETQ, CONS, and IPLUS are all on OKREEVALST.

<sup>7</sup>If the user types ^ to DWIM, DWIM exits by performing (RETEVAL 'FAULTEVAL '(ERROR!)), so that an error will be generated at the position of the call to FAULTEVAL.

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with `(ITIMES N (FACCT 8SUB1 N))`. Since the interpreter uses the value returned by `FAULTEVAL` exactly as though it were the value of the erroneous form, the computation will thus proceed exactly as though no error had occurred.

In addition to continuing the computation, DWIM also repairs the cause of the error whenever possible; in the above example, DWIM also changed (with `RPLACA`) the expression `(ITIMS N (FACCT 8SUB1 N))` that caused the error. Note that if the user's program had *computed* the form and called `EVAL`, it would not be possible to repair the cause of the error, although DWIM could correct the misspelling each time it occurred.

Error correction in DWIM is divided into three categories: unbound atoms, unneeded `CAR` of form, and unneeded function in `APPLY`. Assuming that the user approves DWIM's corrections, the action taken by DWIM for the various types of errors in each of these categories is summarized below.

### 15.4.1 DWIM Correction: Unbound Atoms

If DWIM is called as the result of an unbound atom error, it proceeds as follows:

(1) If the first character of the unbound atom is `'`, DWIM assumes that the user (intentionally) typed `'ATOM` for `(QUOTE ATOM)` and makes the appropriate change. No message is typed, and no approval is requested.

If the unbound atom is just `'` itself, DWIM assumes the user wants the *next* expression quoted, e.g., `(CONS X '(A B C))` will be changed to `(CONS X (QUOTE (A B C)))`. Again no message will be printed or approval asked. If no expression follows the `'`, DWIM gives up.<sup>8</sup>

(2) If CLISP (page 16.1) is enabled, and the atom is part of a CLISP construct, the CLISP transformation is performed and the result returned. For example, `N-1` is transformed to `(SUB1 N)`, and `(FOO_3)` is transformed into `(SETQ FOO 3)`.

(3) If the atom contains an `8` (actually `LPARKEY`, see page 15.12), DWIM assumes the `8` was intended to be a left parenthesis, and calls the editor to make appropriate repairs on the expression containing the atom. DWIM assumes that the user did not notice the mistake, i.e., that the entire expression was affected by the missing left parenthesis. For example, if the user types `(SETQ X (LIST (CONS 8CAR Y) (CDR Z)) Y)`, the expression will be changed to `(SETQ X (LIST (CONS (CAR Y) (CDR Z)) Y))`. Note that the `8` does not have to be the first character of the atom: DWIM will handle `(CONS X8CAR Y)` correctly.

(4) If the atom contains a `9` (actually `RPARKEY`, see page 15.12), DWIM assumes the `9` was intended to be a right parenthesis and operates as in the case above.

(5) If the atom begins with a `7`, the `7` is treated as a `'`. For example, `7FOO` becomes `'FOO`, and then `(QUOTE FOO)`.

(6) If the atom is an edit command (a member of `EDITCOMSA`), and the error occurred in type-in, the effect is the same as though the user typed `EDITF()`, followed by the atom, i.e., DWIM assumes the user wants to be in the editor editing the last thing he referred to. Thus, if the user defines the function

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<sup>8</sup>' is normally defined as a read-macro character which converts `'FOO` to `(QUOTE FOO)` on input, so DWIM will not see the `'` in the case of expressions that are typed-in.

## Unde ned CAR of Form

FOO and then types P, he will see =FOO, followed by EDIT, followed by the printout associated with the execution of the P command, followed by \*, at which point he can continue editing FOO.

(7) The expressions on DWIMUSERFORMS (see page 15.10) are evaluated in the order that they appear. If any of these expressions returns a non-NIL value, this value is treated as the form to be used to continue the computation, it is evaluated and its value is returned by DWIM.

(8) If the unbound atom occurs in a function, DWIM attempts spelling correction using the LAMBDA and PROG variables of the function as the spelling list.

(9) If the unbound atom occurred in a type-in to a break, DWIM attempts spelling correction using the LAMBDA and PROG variables of the broken function as the spelling list.

(10) Otherwise, DWIM attempts spelling correction using SPELLINGS3 (see page 15.14).

(11) If all of the above fail, DWIM gives up.

### 15.4.2 Unde ned CAR of Form

If DWIM is called as the result of an unde ned CAR of form error, it proceeds as follows:

(1) If CAR of the form is T, DWIM assumes a misplaced T clause and operates as described on page 15.5.

(2) If CAR of the form is F/L, DWIM changes the 'F/L' to 'FUNCTION(LAMBDA)'. For example, (F/L (Y) (PRINT (CAR Y))) is changed to (FUNCTION (LAMBDA (Y) (PRINT (CAR Y))). No message is printed and no approval requested. If the user omits the variable list, DWIM supplies (X), e.g., (F/L (PRINT (CAR X))) is changed to (FUNCTION (LAMBDA (X) (PRINT (CAR X))). DWIM determines that the user has supplied the variable list when more than one expression follows F/L, CAR of the rst expression is not the name of a function, and every element in the rst expression is atomic. For example, DWIM will supply (X) when correcting (F/L (PRINT (CDR X)) (PRINT (CAR X))).

(3) If CAR of the form is a CLISP word (IF, FOR, DO, FETCH, etc.), the indicated CLISP transformation is performed, and the result is returned as the corrected form. See page 16.1.

(4) If CAR of the form has a function de nition, DWIM attempts spelling correction on CAR of the de nition using as spelling list the value of LAMBDA SPLST, initially (LAMBDA NLAMBDA).

(5) If CAR of the form has an EXPR or CODE property, DWIM prints CAR- OF-FORM UNSAVED, performs an UNSAVEDEF, and continues. No approval is requested.

(6) If CAR of the form has a FILEDEF property, the de nition is loaded from a le.<sup>9</sup> If the value of the property is atomic, the entire le is to be loaded. If the value is a list, CAR is the name of the le and CDR the relevant functions, and LOADFNS will be used. For both cases, LDFLG will be SYSLOAD (see page 11.4). DWIM uses FINDFILE (page 15.20), so that the le can be on any of the directories on DIRECTORIES, initially (NIL NEWLISP LISP LISPUSERS). If the le is found, DWIM types SHALL I LOAD followed by the le name or list of functions. If the user approves, DWIM loads the function(s) or le, and continues the computation.

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<sup>9</sup>except when DWIMIFYing.



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- (7) If CLISP is enabled, and CAR of the form is part of a CLISP construct, the indicated transformation is performed, e.g., (N\_N-1) becomes (SETQ N (SUB1 N)).
- (8) If CAR of the form contains an 8, DWIM assumes a left parenthesis was intended e.g., (CONS8CAR X).
- (9) If CAR of the form contains a 9, DWIM assumes a right parenthesis was intended.
- (10) If CAR of the form is a list, DWIM attempts spelling correction on CAAR of the form using LAMBDA SPLST as spelling list. If successful, DWIM returns the corrected expression itself.
- (11) If CAR of the form is a small number, and the error occurred in type-in, DWIM assumes the form is really an edit command and operates as described for unbound atom errors above.
- (12) If CAR of the form is an edit command (a member of EDITCOMSL), DWIM operates as in the previous case.
- (13) The expressions on DWIMUSERFORMS are evaluated in the order they appear. If any returns a non-NIL value, this value is treated as the corrected form, it is evaluated, and DWIM returns its value.
- (14) Otherwise, DWIM attempts spelling correction using SPELLINGS2 as the spelling list (see page 15.14). When DWIMIFYing, DWIM also attempts spelling correction on function names not defined but previously encountered, using NOFIXFNLSLST as a spelling list (see page 16.16).
- (15) If all of the above fail, DWIM gives up.

### 15.4.3 Undefined Function in APPLY

If DWIM is called as the result of an undefined function in APPLY error, it proceeds as follows:

- (1) If the function has a definition, DWIM attempts spelling correction on CAR of the definition using LAMBDA SPLST as spelling list.
- (2) If the function has an EXPR or CODE property, DWIM prints FN UNSAVED, performs an UNSAVEDEF and continues. No approval is requested.
- (3) If the function has a property FILEDEF, DWIM proceeds as in case 6 of undefined CAR of form.
- (4) If the error resulted from type-in, and CLISP is enabled, and the function name contains a CLISP operator, DWIM performs the indicated transformation, e.g., the user types FOO\_(APPEND FIE FUM).
- (5) If the function name contains an 8, DWIM assumes a left parenthesis was intended, e.g., EDIT8FOO].
- (6) If the "function" is a list, DWIM attempts spelling correction on CAR of the list using LAMBDA SPLST as spelling list.
- (7) If the function is a number and the error occurred in type-in, DWIM assumes the function is an edit command, and operates as described in case 6 of unbound atoms, e.g., the user types (on one line) 3 -1 P.
- (8) If the function is the name of an edit command (on either EDITCOMSA or EDITCOMSL), DWIM operates as in the previous case, e.g., user types F COND.

## DWIMUSERFORMS

- (9) The expressions on DWIMUSERFORMS are evaluated in the order they appear, and if any returns a non-NIL value, this value is treated as the function used to continue the computation, i.e., it will be applied to its arguments.
- (10) DWIM attempts spelling correction using SPELLINGS1 as the spelling list.
- (11) DWIM attempts spelling correction using SPELLINGS2 as the spelling list.
- (12) If all fail, DWIM gives up.

### 15.5 DWIMUSERFORMS

The variable DWIMUSERFORMS provides a convenient way of adding to the transformations that DWIM performs. For example, the user might want to change atoms of the form \$X to (QA4LOOKUP X). Before attempting spelling correction, but after performing other transformations (F/L, 8, 9, CLISP, etc.), DWIM evaluates the expressions on DWIMUSERFORMS in the order they appear. If any expression returns a non-NIL value, this value is treated as the transformed form to be used. If DWIM was called from FAULTEVAL, this form is evaluated and the resulting value is returned as the value of FAULTEVAL. If DWIM is called from FAULTAPPLY, this form is treated as a function to be applied to FAULTARGS, and the resulting value is returned as the value of FAULTAPPLY. If all of the expressions on DWIMUSERFORMS return NIL, DWIM proceeds as though DWIMUSERFORMS = NIL, and attempts spelling correction. Note that DWIM simply takes the value and returns it; the expressions on DWIMUSERFORMS are responsible for making any modifications to the original expression.<sup>10</sup>

In order for an expression on DWIMUSERFORMS to be able to be effective, it needs to know various things about the context of the error. Therefore, several of DWIM's internal variables have been made SPECVARS (see page 12.4) and are therefore "visible" to DWIMUSERFORMS. Below are a list of those variables that may be useful.

FAULTX [Variable]  
For unbound atom and undefined car of form errors, FAULTX is the atom or form.  
For undefined function in APPLY errors, FAULTX is the name of the function.

FAULTARGS [Variable]  
For undefined function in APPLY errors, FAULTARGS is the list of arguments.  
FAULTARGS may be modified or reset by expressions on DWIMUSERFORMS.

FAULTAPPLYFLG [Variable]  
Value is T for undefined function in APPLY errors; NIL otherwise. The value of FAULTAPPLYFLG *after* an expression on DWIMUSERFORMS returns a non-NIL value determines how the latter value is to be treated. Following an undefined function in APPLY error, if an expression on DWIMUSERFORMS sets FAULTAPPLYFLG to NIL, the value returned is treated as a form to be evaluated, rather than a function to be applied.

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<sup>10</sup>The expressions on DWIMUSERFORMS should make the transformation permanent, either by associating it with FAULTX via CLISPTRAN, or by physically smashing FAULTX.

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FAULTAPPLYFLG is necessary to distinguish between unbound atom and unde ned function in APPLY errors, since FAULTARGS may be NIL and FAULTX atomic in both cases.

TAIL	[Variable]
	For unbound atom errors, TAIL is the tail of the expression CAR of which is the unbound atom. DWIMUSERFORMS expression can replace the atom by another expression by performing ( /RPLACA TAIL EXPR )
PARENT	[Variable]
	For unbound atom errors, PARENT is the form in which the unbound atom appears. TAIL is a tail of PARENT.
TYPE-IN?	[Variable]
	True if the error occurred in type-in.
FAULTFN	[Variable]
	Name of the function in which error occurred. FAULTFN is TYPE-IN when the error occurred in type-in, and EVAL or APPLY when the error occurred under an explicit call to EVAL or APPLY.
DWIMIFYFLG	[Variable]
	True if the error was encountered while DWIMIFYing (as opposed to happening while running a program).
EXPR	[Variable]
	De nition of FAULTFN, or argument to EVAL, i.e., the superform in which the error occurs.

The initial value of DWIMUSERFORMS is ( (MACROTRAN) (DWIMLOADFNS?) ). MACROTRAN is a package for running interpreted programs containing ASSEMBLE statements or calls to “functions” de ned only by MACRO properties (see page 5.19). DWIMLOADFNS? is a function for automatically loading functions from les. If DWIMLOADFNSFLG is T (its initial value), and CAR of the form is the name of a function, and the function is contained on a le that has been noticed by the le package, the function is loaded, and the computation continues.

### 15.6 DWIM FUNCTIONS AND VARIABLES

DWIMWAIT	[Variable]
	Value is the number of seconds that DWIM will wait before it assumes that the user is not going to respond to a question and uses the default response FIXSPELLDEFAULT.
	DWIM operates by dismissing for 250 milliseconds, then checking to see if anything has been typed. If not, it dismisses again, etc. until DWIMWAIT seconds have elapsed. Thus, there will be a delay of at most 1/4 second before DWIM responds to the user’s answer.

## DWIM Functions and Variables

FIXSPELLDEFAULT	[Variable]
If approval is requested for a spelling correction, and user does not respond, defaults to value of FIXSPELLDEFAULT, initially Y. FIXSPELLDEFAULT is rebound to N when DWIMIFYing.	
ADDSPELLFLG	[Variable]
If NIL, suppresses calls to ADDSPELL. Initially T.	
NOSPELLFLG	[Variable]
If T, suppresses <i>all</i> spelling correction. If some other non-NIL value, suppresses spelling correction in programs but not type-in. NOSPELLFLG is initially NIL. It is rebound to T when compiling from a le.	
RUNONFLG	[Variable]
If NIL, suppresses run-on spelling corrections. Initially T.	
DWIMLOADFNSFLG	[Variable]
If T, tells DWIM that when it encounters a call to an undefined function contained on a le that has been noticed by the le package, to simply load the function. DWIMLOADFNSFLG is initially T. See page 15.11.	
LPARKEY	[Variable]
RPARKEY	[Variable]
DWIM uses the value of the variables LPARKEY and RPARKEY (initially 8 and 9 respectively) to determine the corresponding lower case character for left and right parentheses. LPARKEY and RPARKEY can be reset for other keyboard layouts., For example, on some terminals left parenthesis is over 9, and right parenthesis is over 0.	
OKREEVALST	[Variable]
The value of OKREEVALST is a list of functions that DWIM can safely reevaluate. If a form is atomic, or CAR of the form is a member of OKREEVALST, and each of the arguments can safely be reevaluated, then the form can be safely reevaluated. For example, (SETQ X (CONS (IPLUS Y Z) W)) is safe to reevaluate because SETQ, CONS, and IPLUS are all on OKREEVALST.	
DWIMFLG	[Variable]
DWIMFLG= NIL, all DWIM operations are disabled. (DWIM 'C) and (DWIM T) set DWIMFLG to T; (DWIM NIL) sets DWIMFLG to NIL.	
APPROVEFLG	[Variable]
APPROVEFLG= T if DWIM should ask the user for approval before making a correction that will modify the definition of one of his functions; NIL otherwise.	
When DWIM is put into CAUTIOUS mode with (DWIM 'C), APPROVEFLG is set to T; for TRUSTING mode, APPROVEFLG is set to NIL.	
LAMBASPLST	[Variable]
DWIM uses the value of LAMBASPLST as the spelling list when correcting “bad” function definitions. Initially (LAMBDA NLAMBDA). The user may wish to add to LAMBASPLST if he elects to define new “function types” via an appropriate DWIMUSERFORMS entry. For example, the QLAMBDAs of SRI’s QLISP are handled	

## DWIM

in this way.

### 15.7 SPELLING CORRECTION

The spelling corrector is given as arguments a misspelled word (word means literal atom), a spelling list (a list of words), and a number: `XWORD`, `SPLST`, and `REL` respectively. Its task is to find that word on `SPLST` which is closest to `XWORD`, in the sense described below. This word is called a *respelling* of `XWORD`. `REL` specifies the minimum “closeness” between `XWORD` and a respelling. If the spelling corrector cannot find a word on `SPLST` closer to `XWORD` than `REL`, or if it finds two or more words equally close, its value is `NIL`, otherwise its value is the respelling. The spelling corrector can also be given an optional functional argument, `FN`, to be used for selecting out a subset of `SPLST`, i.e., only those members of `SPLST` that satisfy `FN` will be considered as possible respellings.

The exact algorithm for computing the spelling metric is described later, but briefly “closeness” is inversely proportional to the number of disagreements between the two words, and directly proportional to the length of the longer word. For example, `PRTTYPRNT` is “closer” to `PRETTYPRINT` than `CS` is to `CONS` even though both pairs of words have the same number of disagreements. The spelling corrector operates by proceeding down `SPLST`, and computing the closeness between each word and `XWORD`, and keeping a list of those that are closest. Certain differences between words are not counted as disagreements, for example a single transposition, e.g., `CONS` to `CNOS`, or a doubled letter, e.g., `CONS` to `CONSS`, etc. In the event that the spelling corrector finds a word on `SPLST` with *no* disagreements, it will stop searching and return this word as the respelling. Otherwise, the spelling corrector continues through the entire spelling list. Then if it has found one and only one “closest” word, it returns this word as the respelling. For example, if `XWORD` is `VONS`, the spelling corrector will probably return `CONS` as the respelling. However, if `XWORD` is `CONZ`, the spelling corrector will not be able to return a respelling, since `CONZ` is equally close to both `CONS` and `COND`. If the spelling corrector finds an acceptable respelling, it interacts with the user as described earlier.

In the special case that the misspelled word contains one or more `$s` (`<esc>s`, alt-mode on some terminals), the spelling corrector searches for those words on `SPLST` that match `XWORD`, where a `$` can match any number of characters (including 0), e.g., `FOO$` matches `FOO1` and `FOO`, but not `NEWFOO`. `$FOO$` matches all three. Both completion and correction may be involved, e.g. `RPRETTY$` will match `PRETTYPRINT`, with one mistake. The entire spelling list is always searched, and if more than one respelling is found, the spelling corrector prints `AMBIGUOUS`, and returns `NIL`. For example, `CON$` would be ambiguous if both `CONS` and `COND` were on the spelling list. If the spelling corrector finds one and only one respelling, it interacts with the user as described earlier.

For both spelling correction and spelling completion, regardless of whether or not the user approves of the spelling corrector’s choice, the respelling is moved to the front of `SPLST`. Since many respellings are of the type with no disagreements, this procedure has the effect of considerably reducing the time required to correct the spelling of frequently misspelled words.

#### 15.7.1 Synonyms

Spelling lists also provide a way of defining synonyms for a particular context. If a dotted pair appears on a spelling list (instead of just an atom), `CAR` is interpreted as the correct spelling of the misspelled word, and `CDR` as the antecedent for that word. If `CAR` is *identical* with the misspelled word, the

## Spelling Lists

antecedent is returned without any interaction or approval being necessary. If the misspelled word *corrects* to CAR of the dotted pair, the usual interaction and approval will take place, and then the antecedent, i.e., CDR of the dotted pair, is returned. For example, the user could make IFLG synonymous with CLISPFIPTANFLG by adding (IFLG . CLISPFIPTANFLG) to SPELLINGS3, the spelling list for unbound atoms. Similarly, the user could make OTHERWISE mean the same as ELSEIF by adding (OTHERWISE . ELSEIF) to CLISPFIPTANFLG, or make L be synonymous with LAMBDA by adding (L . LAMBDA) to LAMBDA\_SPLST. Note that L could also be used as a variable without confusion, since the association of L with LAMBDA occurs only in the appropriate context.

### 15.7.2 Spelling Lists

Any list of atoms can be used as a spelling list, e.g., BROKENFNNS, FILELST, etc. Various system packages have their own spellings lists, e.g., LISPXCOMS, CLISPFORWORDSPLST, EDITCOMSA, etc. These are documented under their corresponding sections, and are also indexed under “spelling lists.” In addition to these spelling lists, the system maintains, i.e., automatically adds to, and occasionally prunes, four lists used solely for spelling correction: SPELLINGS1, SPELLINGS2, SPELLINGS3, and USERWORDS. These spelling lists are maintained *only* when ADDSPELLFLG is non-NIL. ADDSPELLFLG is initially T.

SPELLINGS1

[Variable]

SPELLINGS1 is a list of functions used for spelling correction when an input is typed in apply format, and the function is undefined, e.g., EDITF(FOO). SPELLINGS1 is initialized to contain DEFINEQ, BREAK, MAKEFILE, EDITF, TCOMPL, LOAD, etc. Whenever LISPX is given an input in apply format, i.e., a function and arguments, the name of the function is added to SPELLINGS1 if the function has a definition.

For example, typing CALLS(EDITF) will cause CALLS to be added to SPELLINGS1. Thus if the user typed CALLS(EDITF) and later typed CALLLS(EDITV), since SPELLINGS1 would then contain CALLS, DWIM would be successful in correcting CALLLS to CALLS.

SPELLINGS2

[Variable]

SPELLINGS2 is a list of functions used for spelling correction for all other undefined functions. It is initialized to contain functions such as ADD1, APPEND, COND, CONS, GO, LIST, NCONC, PRINT, PROG, RETURN, SETQ, etc. Whenever LISPX is given a non-atomic form, the name of the function is added to SPELLINGS2. For example, typing (RETFROM (STKPOS (QUOTE FOO) 2)) to a break would add RETFROM to SPELLINGS2. Function names are also added to SPELLINGS2 by DEFINE, DEFINEQ, LOAD (when loading compiled code), UNSAVEDEF, EDITF, and PRETTYPRINT.

SPELLINGS3

[Variable]

SPELLINGS3 is a list of words used for spelling correction on all unbound atoms. SPELLINGS3 is initialized to EDITMACROS, BREAKMACROS, BROKENFNNS, and ADVISEDFNNS. Whenever LISPX is given an atom to evaluate, the name of the atom is added to SPELLINGS3 if the atom has a value. Atoms are also added to SPELLINGS3 whenever they are edited by EDITV, and whenever they are set via RPAQ or RPAQQ. For example, when a file is loaded, all of the variables set in the file are added to SPELLINGS3. Atoms are also added to SPELLINGS3 when they are set by a LISPX input, e.g., typing (SETQ FOO (REVERSE (SETQ FIE

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))) will add both FOO and FIE to SPELLINGS3.

USERWORDS

[Variable]

USERWORDS is a list containing both functions and variables that the user has referred to, e.g., by breaking or editing. USERWORDS is used for spelling correction by ARGLIST, UNSAVEDEF, PRETTYPRINT, BREAK, EDITF, ADVISE, etc. USERWORDS is initially NIL. Function names are added to it by DEFINE, DEFINEQ, LOAD, (when loading compiled code, or loading exprs to property lists) UNSAVEDEF, EDITF, EDITV, EDITP, PRETTYPRINT, etc. Variable names are added to USERWORDS at the same time as they are added to SPELLINGS3. In addition, the variable LASTWORD is always set to the last word added to USERWORDS, i.e., the last function or variable referred to by the user, and the respelling of NIL is defined to be the value of LASTWORD. Thus, if the user has just defined a function, he can then edit it by simply typing EDITF(), or prettyprint it by typing PP().

Each of the above four spelling lists are divided into two sections separated by a special marker. The first section contains the “permanent” words; the second section contains the temporary words. New words are added to the corresponding spelling list at the front of its temporary section (except that functions added to SPELLINGS1 or SPELLINGS2 by LISPX are always added to the end of the permanent section. If the word is already in the temporary section, it is moved to the front of that section; if the word is in the permanent section, no action is taken. If the length of the temporary section then exceeds a specified number, the last (oldest) word in the temporary section is forgotten, i.e., deleted. This procedure prevents the spelling lists from becoming cluttered with unimportant words that are no longer being used, and thereby slowing down spelling correction time. Since the spelling corrector usually moves each word selected as a respelling to the front of its spelling list, the word is thereby moved into the permanent section. Thus once a word is misspelled and corrected, it is considered important and will never be forgotten.

#SPELLINGS1

[Variable]

#SPELLINGS2

[Variable]

#SPELLINGS3

[Variable]

#USERWORDS

[Variable]

The maximum length of the temporary section for SPELLINGS1, SPELLINGS2, SPELLINGS3 and USERWORDS is given by the value of #SPELLINGS1, #SPELLINGS2, #SPELLINGS3, and #USERWORDS, initialized to 30, 30, 30, and 60 respectively.

Users can alter these values to modify the performance behavior of spelling correction.

### 15.7.3 Generators for Spelling Correction

For some applications, it is more convenient to *generate* candidates for a respelling one by one, rather than construct a complete list of all possible candidates, e.g., spelling correction involving a large directory of files, or a natural language data base. For these purposes, `SPLST` can be an array (of any size). The first element of this array is the generator function, which is called with the array itself as its argument. Thus the function can use the remainder of the array to store “state” information, e.g., the last position on a file, a pointer into a data structure, etc. The value returned by the function is the next candidate for respelling. If NIL is returned, the spelling “list” is considered to be exhausted, and the closest match is returned. If a candidate is found with no disagreements, it is returned immediately without waiting for

## Spelling Corrector Algorithm

the “list” to exhaust.

SPLST can also be a generator, i.e. the value of the function GENERATOR (page 7.13). The generator SPLST will be started up whenever the spelling corrector needs the next candidate, and it should return candidates via the function PRODUCE. For example, the following could be used as a “spelling list” which effectively contains all functions in the system:

```
[GENERATOR
  (MAPATOMS (FUNCTION (LAMBDA (X) (if (GETD X) then (PRODUCE X)
```

### 15.7.4 Spelling Corrector Algorithm

The basic philosophy of DWIM spelling correction is to count the number of disagreements between two words, and use this number divided by the length of the longer of the two words as a measure of their relative disagreement. One minus this number is then the relative agreement or closeness. For example, CONS and CONX differ only in their last character. Such substitution errors count as one disagreement, so that the two words are in 75% agreement. Most calls to the spelling corrector specify a relative agreement of 70, so that a single substitution error is permitted in words of four characters or longer. However, spelling correction on shorter words is possible since certain types of differences such as single transpositions are not counted as disagreements. For example, AND and NAD have a relative agreement of 100. Calls to the spelling corrector from DWIM use the value of FIXSPELLREL, which is initially 70. Note that by setting FIXSPELLREL to 100, only spelling corrections with “zero” mistakes, will be considered, e.g., transpositions, double characters, etc.

The central function of the spelling corrector is CHOOZ. CHOOZ takes as arguments: a word, a minimum relative agreement, a spelling list, and an optional functional argument, XWORD, REL, SPLST, and FN respectively.

CHOOZ proceeds down SPLST examining each word. Words not satisfying FN (if FN is non-NIL), or those obviously too long or too short to be sufficiently close to XWORD are immediately rejected. For example, if REL = 70, and XWORD is 5 characters long, words longer than 7 characters will be rejected.

Special treatment is necessary for words shorter than XWORD, since doubled letters are not counted as disagreements. For example, CONSSSS and CONS have a relative agreement of 100. (keyboard bounce on many different kinds of keyboards actually produce this sort of stuttering.) CHOOZ handles this by counting the number of doubled characters in XWORD before it begins scanning SPLST, and taking this into account when deciding whether to reject shorter words.

If TWORD, the current word on SPLST, is not rejected, CHOOZ computes the number of disagreements between it and XWORD by calling a subfunction, SKOR.

SKOR operates by scanning both words from left to right one character at a time. SKOR operates on the list of character codes for each word. This list is computed by CHOOZ before calling SKOR. Characters are considered to agree if they are the same characters; or appear on the same key (i.e., a shift mistake), for example, \* agrees with :, 1 with !, etc.; or if the character in XWORD is a lower case version of the character in TWORD. Characters that agree are discarded, and the SKORing continues on the rest of the characters in XWORD and TWORD.

If the first character in XWORD and TWORD do not agree, SKOR checks to see if either character is the same as one previously encountered, and not accounted-for at that time. (In other words, transpositions



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are not handled by lookahead, but by *lookback*.) A displacement of two or fewer positions is counted as a transposition; a displacement by more than two positions is counted as a disagreement. In either case, both characters are now considered as accounted for and are discarded, and SKORing continues.

If the *rst* character in *XW ORD* and *TW ORD* do not agree, and neither agree with previously unaccounted-for characters, and *TW ORD* has more characters remaining than *XW ORD*, SKOR removes and saves the *rst* character of *TW ORD*, and continues by comparing the rest of *TW ORD* with *XW ORD* as described above. If *TW ORD* has the same or fewer characters remaining than *XW ORD*, the procedure is the same except that the character is removed from *XW ORD*. In this case, a special check is *rst* made to see if that character is equal to the *previous* character in *XW ORD*, or to the *next* character in *XW ORD*, i.e., a double character typo, and if so, the character is considered accounted-for, and not counted as a disagreement. In this case, the “length” of *XW ORD* is also decremented. Otherwise making *XW ORD* sufficiently long by adding double characters would make it be arbitrarily close to *TW ORD*, e.g., XXXXXX would correct to PP.

When SKOR has finished processing both *XW ORD* and *TW ORD* in this fashion, the value of SKOR is the number of unaccounted-for characters, plus the number of disagreements, plus the number of transpositions, with two qualifications: (1) if both *XW ORD* and *TW ORD* have a character unaccounted-for in the same position, the two characters are counted only once, i.e., substitution errors count as only one disagreement, not two; and (2) if there are no unaccounted-for characters and no disagreements, transpositions are not counted. This permits spelling correction on very short words, such as edit commands, e.g., XRT->XTR. Transpositions are also not counted when FASTYPEFLG= T, for example, IPULX and IPLUS will be in 80% agreement with FASTYPEFLG= T, only 60% with FASTYPEFLG= NIL. The rationale behind this is that transpositions are much more common for fast typists, and should not be counted as disagreements, whereas more deliberate typists are not as likely to combine transpositions and other mistakes in a single word, and therefore can use more conservative metric. FASTYPEFLG is initially NIL.

### 15.7.5 Spelling Corrector Functions and Variables

(ADDSPELL *x* *SPLST* *N*) [Function]

Adds *x* to one of the four spelling lists as follows:

If *x* is already on the spelling list, and in its temporary section, ADDSPELL moves *x* to the front of that section.

If *SPLST* = NIL, adds *x* to USERWORDS and to SPELLINGS2. Used by DEFINEQ.

If *SPLST* = 0, adds *x* to USERWORDS. Used by LOAD when loading EXPRS to property lists.

If *SPLST* = 1, adds *x* to SPELLINGS1 (at end of permanent section). Used by LISPX.

If *SPLST* = 2, adds *x* to SPELLINGS2 (at end of permanent section). Used by LISPX.

If *SPLST* = 3, adds *x* to USERWORDS and SPELLINGS3.

*SPLST* can also be a spelling list, in which case *N* is the (optional) length of the temporary section.

ADDSPELL sets LASTWORD to *x* when *SPLST* = NIL, 0 or 3.

## Spelling Corrector Functions and Variables

If `x` is not a literal atom, `ADDSPELL` takes no action.

Note that the various systems calls to `ADDSPELL`, e.g. from `DEFINE`, `EDITF`, `LOAD`, etc., can all be suppressed by setting or binding `ADDSPELLFLG` to `NIL` (page 15.12).

`(MISSPELLED? XW ORD REL SPLST FLG TAIL FN)` [Function]

If `XW ORD = NIL` or `$ (<esc>)`, `MISSPELLED?` prints `=` followed by the value of `LASTWORD`, and returns this as the respelling, without asking for approval. Otherwise, `MISSPELLED?` checks to see if `XW ORD` is really misspelled, i.e., if `FN` applied to `XW ORD` is true, or `XW ORD` is already contained on `SPLST`. In this case, `MISSPELLED?` simply returns `XW ORD`. Otherwise `MISSPELLED?` computes and returns `(FIXSPELL XW ORD REL SPLST FLG TAIL FN)`.

`(FIXSPELL XW ORD REL SPLST FLG TAIL FN TIEFLG DONTMO VETOPFL G _ _)` [Function]

The value of `FIXSPELL` is either the respelling of `XW ORD` or `NIL`. If for some reason `XW ORD` itself is on `SPLST`, then `FIXSPELL` aborts and calls `ERROR!`. If there is a possibility that `XW ORD` is spelled correctly, `MISSPELLED?` should be used instead of `FIXSPELL`. `FIXSPELL` performs all of the interactions described earlier, including requesting user approval if necessary.

If `XW ORD = NIL` or `$ (<esc>)`, the respelling is the value of `LASTWORD`, and no approval is requested.

If `XW ORD` contains lowercase characters, and the corresponding uppercase word is correct, i.e. on `SPLST` or satisfies `FN`, the uppercase word is returned and no interaction is performed.

If `REL = NIL`, defaults to the value of `FIXSPELLREL` (initially 70).

If `FLG = NIL`, the correction is handled in type-in mode, i.e., approval is never requested, and `XW ORD` is not typed. If `FLG = T`, `XW ORD` is typed (before the `=`) and approval is requested if `APPROVEFLG = T`. If `FLG = NO-MESSAGE`, the correction is returned with no further processing. In this case, a run-on correction will be returned as a dotted pair of the two parts of the word, and a synonym correction as a list of the form `(WORD1 WORD2)`, where `WORD1` is (the corrected version of) `XW ORD`, and `WORD2` is the synonym. Note that the effect of the function `CHOOZ` can be obtained by calling `FIXSPELL` with `FLG = NO-MESSAGE`.

If `TAIL` is not `NIL`, and the correction is successful, `CAR` of `TAIL` is replaced by the respelling (using `/RPLACA`). In addition, `FIXSPELL` will correct misspellings caused by running two words together.<sup>11</sup> In this case, `CAR` of `TAIL` is replaced by the two words, and the value of `FIXSPELL` is the first one. For example, if `FIXSPELL` is called to correct the edit command `(MOVE TO AFTERCOND 3 2)` with `TAIL = (AFTERCOND 3 2)`, `TAIL` would be changed to `(AFTER COND`

---

<sup>11</sup>In this case, user approval is always requested. In addition, if the first word contains either fewer than 3 characters, or fewer characters than the second word, the default will be `N`. 'Run-on' spelling corrections can be suppressed by setting the variable `RUNONFLG` to `NIL` (initially `T`).

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2 3), and FIXSPELL would return AFTER (subject to user approval where necessary).<sup>12</sup>

If TIEFLG= NIL and a tie occurs, i.e., more than one word on SPLST is found with the same degree of “closeness”, FIXSPELL returns NIL, i.e., no correction. If TIEFLG= PICKONE and a tie occurs, the rst word is taken as the correct spelling. If TIEFLG= LIST, the value of FIXSPELL is a list of the respellings (even if there is only one), and FIXSPELL will not perform any interaction with the user, nor modify TAIL, the idea being that the calling program will handle those tasks. Similarly, if TIEFLG= EVERYTHING, a list of all candidates whose degree of closeness is above REL will be returned, regardless of whether some are better than others. No interaction will be performed.

If DONTMO VETOPFL G= T and a correction occurs, it will *not* be moved to the front of the spelling list.

The time required for a call to FIXSPELL with a spelling list of length 60 when the entire list must be searched is .5 seconds. If FIXSPELL determines that the rst word on the spelling list is the respelling and does not need to search any further, the time required is .02 seconds. In other words, the time required is proportional to the number of words with which XW ORD is compared, with the time for one comparison, i.e., one call to SKOR takes roughly .01 seconds (varies slightly with the number of characters in the words being compared).

(FNCHECK FN NOERR ORFL G SPELLFL G PR OPFL G TAIL) [Function]  
The task of FNCHECK is to check whether FN is the name of a function and if not, to correct its spelling. If FN is the name of a function or spelling correction is successful, FNCHECK adds the (corrected) name of the function to USERWORDS using ADDSPELL, and returns it as its value.

Since FNCHECK is called by many low level functions such as ARGLIST, UNSAVEDEF, etc., spelling correction only takes place when DWIMFLG= T, so that these functions can operate in a small Interlisp system which does not contain DWIM.

NOERR ORFL G informs FNCHECK whether or not the calling function wants to handle the unsuccessful case: if NOERR ORFL G is T, FNCHECK simply returns NIL, otherwise it prints fn NOT A FUNCTION and generates a non-breaking error.

If FN does not have a definition, but does have an EXPR property, then spelling correction is not attempted. Instead, if PR OPFL G= T, FN is considered to be the name of a function, and is returned. If PR OPFL G= NIL, FN is *not* considered to be the name of a function, and NIL is returned or an error generated, depending on the value of NOERR ORFL G.

FNCHECK calls MISSPELLED? to perform spelling correction, so that if FN= NIL, the value of LASTWORD will be returned. SPELLFL G corresponds to MISSPELLED?'s

---

<sup>12</sup>If TAIL= T, FIXSPELL will also perform run-on corrections, returning a dotted pair of the two words in the event the correction is of this type.

## Spelling Corrector Functions and Variables

fourth argument, `FLG`. If `SPELLFLG = T`, approval will be asked if `DWIM` was enabled in `CAUTIOUS` mode, i.e., if `APPROVEFLG = T`. `TAIL` corresponds to the fifth argument to `MISSPELLED?`.

`FNCHECK` is currently used by `ARGLIST`, `UNSAVEDEF`, `PRETTYPRINT`, `BREAK0`, `BREAKIN`, `ADVISE`, `CALLS`, and `EDITA`. For example, `BREAK0` calls `FNCHECK` with `NOERR ORFLG = T` since if `FNCHECK` cannot produce a function, `BREAK0` wants to define a dummy one. `CALLS` however calls `FNCHECK` with `NOERR ORFLG = NIL`, since it cannot operate without a function.

Many other system functions call `MISSPELLED?` or `FIXSPELL` directly. For example, `BREAK1` calls `FIXSPELL` on unrecognized atomic inputs before attempting to evaluate them, using as a spelling list a list of all break commands. Similarly, `LISPX` calls `FIXSPELL` on atomic inputs using a list of all `LISPX` commands. When `UNBREAK` is given the name of a function that is not broken, it calls `FIXSPELL` with two different spelling lists, first with `BROKENFNNS`, and if that fails, with `USERWORDS`. `MAKEFILE` calls `MISSPELLED?` using `FILELST` as a spelling list. Finally, `LOAD`, `BCOMPL`, `BRECOMPILE`, `TCOMPL`, and `RECOMPILE` all call `MISSPELLED?` if their input file(s) won't open.

```
(SPELLFILE FILE NOPRINTFL G NSFLG DIRLST ) [Function]
```

If `FILE` does not have a directory field, `SPELLFILE` looks on the directories given by the value of `DIRECTORIES`, initially `(NIL LISP)`. (`NIL` corresponds to login directory.) This correction will not require user approval, (but `SPELLFILE` will indicate the correction in the usual way, by printing `=` followed by the new file name). Otherwise, `SPELLFILE` attempts spelling correction against the files in the directory. In this case, user approval will be requested (except if `NOPRINTFLG = T`, see below). Returns corrected file, if any, otherwise `NIL`.

If `NOPRINTFLG = T`, `SPELLFILE` does not do any printing, nor ask for approval.

If `NSFLG = T` (or `NOSPELLFLG = T`), no spelling correction is attempted, though searching through `DIRECTORIES` will still be performed.

If `DIRLST` is non-`NIL`, it is used instead of the value of `DIRECTORIES`.

`ERRORTYPELST` (page 9.16) is initially

```
((23 (SPELLFILE (CADR ERRORMESS) NIL NOFILESPELLFLG)))
```

This causes `SPELLFILE` to be called in case of a `FILE NOT FOUND` error. If the variable `NOFILESPELLFLG` is `T` (its initial value), then spelling correction is not done on the file name, but `DIRECTORIES` is still searched. If `SPELLFILE` is successful, the operation will be reexecuted with the new (corrected) file name.

```
(FINDFILE FILE NSFLG DIRLST ) [Function]
```

If `FILE` is not the name of a file, calls `SPELLFILE` specifying no interaction or printing. `FINDFILE` could be defined as:

```
(if (INFILEP FILE)
    else (SPELLFILE FILE T NSFLG DIRLST ))
```