

LISP II DEBUGGING

by

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This memo describes several LISP II functions from which a debugging facility can be constructed. The debugging facility is specifically oriented towards selective tracing, that is, printing out arguments and values of functions under specified circumstances, and towards user examination and modification of values of variables during the actual execution of a program. The facility will be sufficiently flexible so that other effects can be achieved in combination with these.

The primitive function `RENAME(X,Y)` renames `X` and `Y`. `Y` assumes all properties of `X` except its name. In particular, if `X` is the name of a function, then a call to `Y` will have the same effect as a call to `X`. However, all compiled references to `X` will go to `X` rather than to `Y`. A backtrace involving `Y` should name `X`.

A second primitive function is `BACKFUNCTIONS(N)`, whose value is a list of the last `N` functions appearing on the push-down stack. `BACKFUNCTIONS` is implemented through a partial backtrace that merely looks for function names and doesn't change anything. If there are less than `N` functions on the stack then the list is truncated, but this situation is not considered to be an error.

The function `EMBED(F, DEF)` redefines `F` according to the definition `DEF`. However, any occurrences of `F` within `DEF` refer to the old `F`. The new `F` and the old `F` must agree in the type of value, number of arguments, and types of arguments. The definition is to be written in intermediate language, and the function being defined is also to be named `F`. `EMBED` is implemented by generating a new name for `F`, renaming `F` by the new name, and substituting the new name for any occurrence of `F`.

in an unquoted functional context within DEF. F is then redefined by DEF. Consequently all occurrences of F within the old F will refer to the new F.

It should be easy to keep sufficient information so that if the same function is embedded twice, then the first embedding is thrown away rather than placed inside the second one. Also, a DISEMBED function may be useful in order to remove an embedding; it uses RENAME to copy the old function definition back to the old function name.

A function FUNCTYPE(F) will also be needed. FUNCTYPE has the name of a function as argument; its value is a list of the types of the value and arguments of the function.

The standard LISP trace can be implemented quite easily in terms of these functions. In order to trace a function, we embed it in another function that prints out the arguments, calls the original function, prints out the value, and returns the value. The embedding function can of course be constructed in LISP, using FUNCTYPE, so that TRACE can be made available under that name to the user. This implementation of TRACE ought to be fairly efficient.

Selective tracing can be achieved by constructing an embedding function that will cause printing only under specified conditions. These conditions may involve the circumstances under which the function was called (to be obtained via BACKFUNCTIONS), the values of the arguments, or the state of fluid variables. The information to be printed can also be controlled. It is possible to construct functions that create embedding functions even for selective tracing, though consideration of these ought to be postponed. In order to examine and modify fluid variables, embedding functions involving the function LISP can be employed.

Although the function EMBED expects its definition in intermediate language, it is clearly easy to write a version

of it that accepts source language. The functions that automatically construct embedding functions will use intermediate language; the user will use source language.

The debugging techniques described here do not depend on having the original definitions of functions available. If the original definition is available, then there are many other things that could be done, such as TRACESET of LISP 1.5. Such additional features could work in conjunction with or independently of the features described here.