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# TECH MEMO



*a working paper*

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LISP II PROJECT

FUNCTIONAL ARGUMENTS

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## Abstract

This is the third memo of a series and contains the internal language, the compilation, and the source language.

## LISP II PROJECT

Memo No. 3

## FUNCTIONAL ARGUMENTS

## I. INTERNAL LANGUAGE

We note that in LISP II the special word FUNCTION serves as a combination of LAMBDA and LABEL, thus:

(LAMBDA <formal parameter list> <expression>)

and

(FUNCTION <identifier> <formal parameter list> <expression>)

are both instances of a <function>.

When a <function> is transmitted in the mode known as FUNCTIONAL, certain free variables must be given their values at transmission time. The way to specify this is to write as a functional argument:

(LAMBDA <formal parameter list> <expression> <free variable list>)

or

(FUNCTION <identifier> <formal parameter list> <expression>  
<free variable list>)

This is expanded by the MACRO expander into:

(CONS fn (ARRAYLIST  $V_1$  ...  $V_n$ ))

where the  $V_i$  are the elements of <free variable list>, and where fn is the S-expression:

```
(LAMBDA <new list> ((LAMBDA <free variable list> <expression>)
  (( FROM g 1) ... (FROM g m))))
      or
(FUNCTION <identifier> <new list> ((LAMBDA <free variable list>
  <expression>)
  ((FROM g 1) ... (FROM g m))))
```

In these expressions, *g* is a gensym, and the *<new list>* is composed of the *<formal parameter list>* plus an additional parameter which is *g*. Thus if *<formal parameter list>* is (A B C), then *<new list>* is (g A B C).

Finally, consider where the formal parameter is received. Suppose it corresponds with the dummy parameter *H*. Somewhere in this procedure we find (H <arg1> ... <argn>). This must be macro expanded to ((CAR H) (CDR H) <arg1> ... <arg2>).

This scheme does exactly the same thing as the McCarthy-Wooldridge proposal does. The user never sees the macro-expansion.

## II. COMPILATION

Compilation is straightforward. All necessary rewriting has been done by the macro-expansion. Functions need not be generated at run time. The only extra time required is that of loading the array with the local values of the free variables.

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### III. SOURCE LANGUAGE

Examples:

```
[@(X,Y); REAL X; GLOBAL Y; <expression>; <free variable list>]
```

```
[REAL FUNCTION FN(X,Y); REAL X; GLOBAL Y; <expression>;  
 <free variable list>]
```