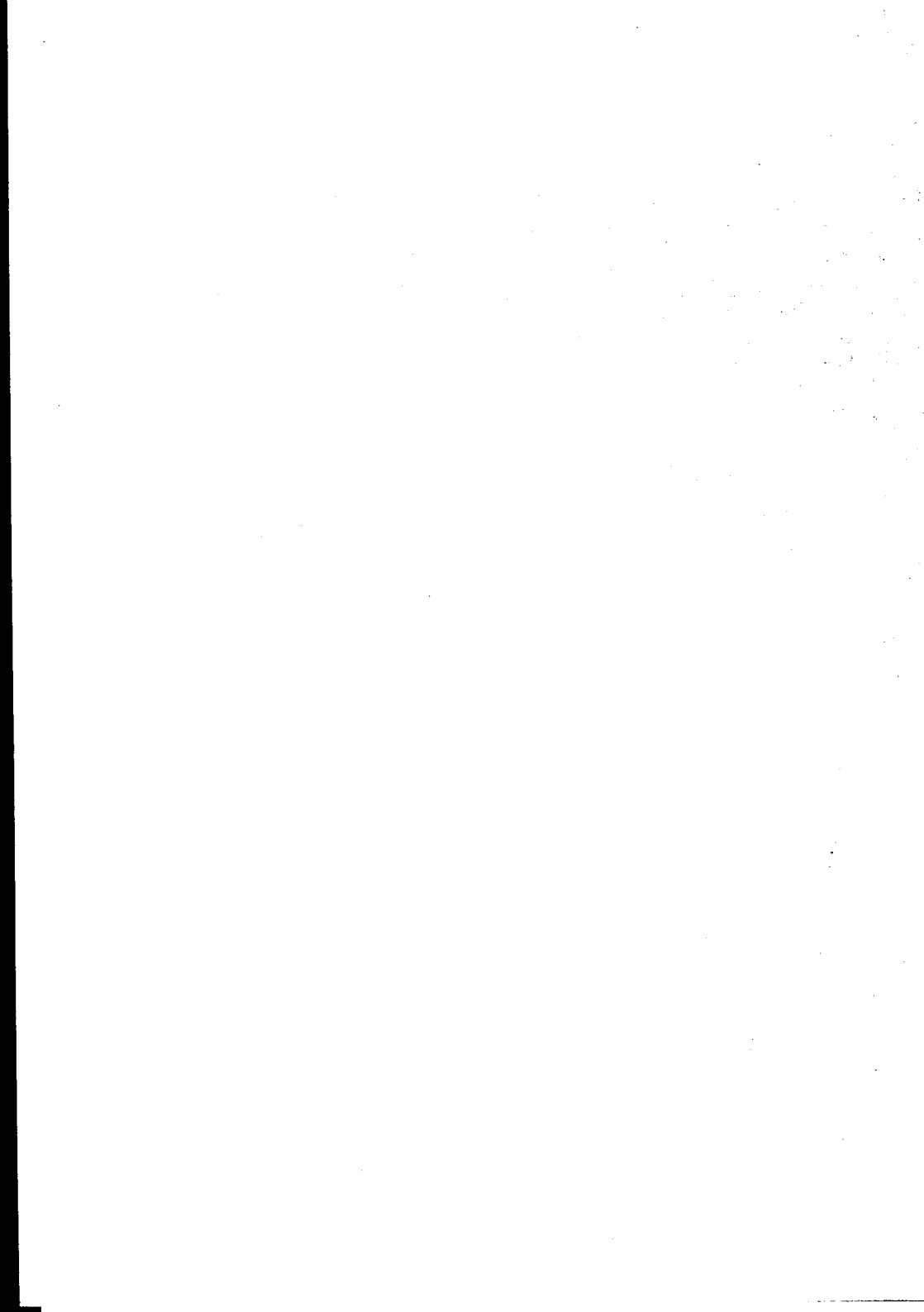


CAMBRIDGE LISP



REFERENCE
MANUAL



CAMBRIDGE LISP



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Part I



1 Introducing Acorn Cambridge LISP

The Acorn 32000 Cambridge LISP system runs under Panos, the operating system for Acorn Cambridge Series computers, with a minimum of 512K of memory. This section describes the main features of the Acorn Cambridge 32000 LISP, and comments on the facilities provided. Please note that this manual is not a tutorial; appendix B contains several references to such texts. Throughout this manual, except where an alternative meaning is obvious, 'LISP' refers to the Acorn 32000 implementation of Cambridge LISP.

1.1 Installing LISP

Details of installation are given in the *User Guide*, supplied with the system. Note that even though the LISP system is supplied on DFS formatted floppy disc, it must still be installed as described.

1.2 A Short Introduction to Acorn Cambridge LISP

Cambridge LISP was originally developed to provide support for an ongoing research project in computer algebra. It is intended for running experimental programs, and so it makes a policy of checking for exceptional cases (e.g. car or cdr of atoms) and tries hard to provide clear and concise diagnostics. The expectation that the system would be used for writing parts of algebra systems has led to the inclusion of an arithmetic package that puts consistency above efficiency: integers can grow to be any size, the normal arithmetic primitives accommodate rational numbers, and there is a well-defined interface between exact and floating point number representations. The system provides a number of character handling facilities, can select and use several input/output streams, and has a built-in LISP prettyprinter.

To a large extent, the system is compatible with a proposal for a LISP standard that was put forward by Professor A.C.Hearn and others of the University of Utah and the Rand Corporation. A short bibliography is provided in appendix B.

For users coming to Cambridge LISP from other dialects of LISP, your attention is drawn to the following points:

1. Function definition is performed with the functions `de` or `df`;
2. The function associated with an identifier is its value;
3. The distinct value and function definition cells of other LISP dialects are not supported.

1.3 Running LISP

To run LISP, type

```
-> Lisp -image <image file name>
```

to the Panos prompt. The keyword `'-image'` must be supplied, followed by the full (or relative) pathname of the directory which contains the image files. On the distributed LISP system, the image directory is `':0.i'` on the DFS, and `'$.PanosLib.LispImage'` on the AD/NFS.

Panos locates the executable LISP program `'Lisp-rif'` by searching in the directories given as values to the global string variable `'Cli$Path'`. See the *Panos Guide to Operations* for a description of global variables. On the distributed system, `'Cli$Path'` is initialised to search firstly in PanosLib on the AD/NFS, (and each drive in turn, starting with drive 0 on the DFS) and then in the current working directory for all runnable programs.

If `-identify` is specified, you will be given an indication of the store in use, then an initial store image is loaded from the directory image. As more complex use is made of LISP, the various store preservation functions can be used to produce customised versions. For example, if the REDUCE system is available and is in the current directory, typing:

```
-> LISP -image reduce
```

will run REDUCE.

The process of customisation takes the form:

```
LISP -image oldimage -dump newimage
```

Then, when the LISP function (`preserve`) is called, the store image in `oldimage` is copied to `newimage`, together with updates made before the call to (`preserve`)

1.3.1 Start-up Options

The options available at the point of starting LISP are:

-from

If present expects a file name to use as the standard input to LISP. The default is the terminal.

-to

If present expects a file name to use as the standard output to LISP. The default is the terminal.

-image

If present expects the name of a directory in which to find the initial store image and fast load modules. The default is \$.i.

-dump

If present expects the name of a directory in which to put the store image and fast load modules generated in the run, by use of module and preserve. The default is the image directory.

-imageroot -dumproot

These options specify a directory for the root section of saved files. This is useful for use with the DFS where a complete image may overflow one disc.

-leave

Expects a number of bytes (in units of 1024) that LISP will leave for the Panos to use as workspace. This should normally not be needed. The default is 20.

-store

Expects a number of bytes (in units of 1024) that LISP will use for this run. It is useful to give exactly reproducible runs, or to see how well some program would behave if used with a smaller computer than the one you have.

-identify

This option enables a few lines of start-up information to be displayed on entering LISP. This gives the version number, the amount of space used up by LISP, the image size, the date and time the store image was created, and how much store was used.

-help

Displays help information: a brief synopsis of the start-up options.

1.4 Use of Space

LISP will attempt to acquire as much space as it can, leaving a little behind for other operating system activities. This behaviour can be changed by use of options as described above. If `-identify` has been specified, messages produced at the start and finish of each run give some indication of how much store is used and how much was available. If garbage collection becomes too frequent, more store is needed. There is no need to tell LISP how to allocate the store it is given - it has its own flexible scheme so that, for example, neither stack nor freestore can run out while there is some of the other left. Note also that the LISP compiler does not take up much space until it is used, and it can be removed using `excise` when it is finished with.

1.5 An example session with Cambridge LISP

The following example shows the dialogue during a short session with LISP. A few variables to configure the environment are set, a short LISP function is defined and tested, and some function definitions are read in from a file.

The prompt '`->`' signifies the Panos prompt.

The sign '`>`' is not a LISP prompt, but a signal that what follows is an evaluation returned by LISP.

```
->Lisp -image $.PanosLib.LispImage -identify
Acorn Cambridge Lisp entered in about 680 Kbytes
Store image was made at 11:38:27 on 10 May 85
Lisp version - 1.0 Apr 85 image size = 125244 bytes

Started at 15:33:45 on 14 Jun 85 after 0.01+9.15 secs - 31.8% store used

(setq !*comp nil)
> nil

(de flatten (L)(cond
```

```

((null L) nil)
((atom L)(list L))
(t(inconc (flatten (car L))
         (flatten (cdr L))))

> flatten

(flatten 'a)

> (a)

(compile '(flatten))
> **128 bytes 170 ms compiling flatten
> (flatten)

(flatten '(a))
> (a)

(flatten '((a)((1 2 3)1(((1)
> (a 1 2 3 1 1)

> *** End of file detected

> *** END OF RDF

(stop)

> End of Lisp run after 19.50+14.49 secs - 66.1% store used
->

```

1.6 Finding out what is available

There are three ways of finding out what is available in Cambridge LISP. The first is to try something and see if it works. Many of the functions provided have the same specifications as those in other LISP dialects as described in various textbooks and reference manuals. In particular, the Standard Lisp is close to this implementation. See the references in Appendix B.

The second suggestion for checking what might be available is to look at the object list. LISP keeps the names of all atoms - and hence all functions - that it knows about in a structure known as the object list.

The function `obl ist` which does not need any arguments, returns a list of all items held in this structure. It is a sort of index to the collection of available functions.

The third and best method is to consult Part II of this manual. Particular incompatible or especially useful features of the Cambridge system are noted below. See also appendix B for references to other documents which describe similar Cambridge LISP systems, for example, most of the functions provided have essentially the same specification as the versions defined in either the *LISP 1.5 users manual* or the *Stanford LISP reference manual*.

1.7 Compatibility with Acornsoft LISP

Acornsoft LISP (see appendix B) is a small version of LISP for the BBC Microcomputer. You will find that most Acornsoft LISP programs run under Cambridge LISP after modest changes are made.

Acornsoft uses upper case identifiers and accordingly `*lower` should be set to `t` in Cambridge LISP:

```
(setq !*lower t)
```

Acornsoft uses `defun` to define both `eval/spread` and `noeval/nospread` functions; the distinction being made by the format of the parameters in the definition. You may equate functions by typing:

```
(setq defun de)
```

Lastly, the hyphen '-' in Acornsoft LISP is not defined as a break character. You may wish to edit your source or to use `setsyntax` to redefine this. Using `PRIN` in Acornsoft LISP to tidy up the use of break characters in your program text is advised.

2 Preparing Programs

2.1 General Remarks

2.1.1 Special Characters

LISP is normally used in an interactive fashion with program material being entered on line. When it is desired to import program material from other LISP systems, or to generate material off line, it is important to remember that many characters have a meaning assigned to them by the read functions of the system.

See `setsyntax` for a description of the initial definitions. `!` used as a prefix causes the character immediately following to be accepted without special interpretation. This is useful, for example, in specifying pathnames which include a dot, e.g.

```
(rdf 'lspdir!.tsp)
```

Enclosing a file name in double quotes will also cause the following name to be taken literally, e.g.

```
(rdf "lspdir.tsp")
```

If an identifier is desired which includes a hyphen, there are two courses of action:

- (a) write it as a double!-barrelled!-word
- (b) call `(setsyntax "-" break!-character nil)` then write the double-barrelled-name without the need for the exclamation marks.

2.1.2 Case

Cambridge LISP is case sensitive and all supplied functions are named in lower case. When handling program material referencing store LISP functions it may be advantageous to set the variable `*lower` to `t` to enable continued references to the upper case versions of their names:

```
(setq !*lower t)
(SETQ F00 T)      this now equivalent to (setq foo t)
```

2.1.3 Defining Functions

The function `rdf` will read in a source text file and execute the statements found there. The particular functions used to define functions and macros e.g. `de` `df` may not prove compatible with LISP source text from all other LISP systems.

The normal way of defining functions will be to use `(de ...)` and `(df ...)`. The format for these is:

```
(de <function name> (arg1 arg2)
  <body>)
```

as in

```
(de mycons (a b) (cons a b))
```

As well as functions that have their arguments spread out, it is possible to define functions which expect an evaluated list. These are sometimes known as `lexprs`. In Cambridge LISP they are defined (for example) by

```
(de mylfunc l
  (mapcar l (function print)))
```

If the LISP compiler is available in the image directory and the global flag `*comp` is non-nil, `de` automatically invokes the compiler. Note that `de` is a special form, and you do not have to put quote marks in front of its arguments.

Functions which do not evaluate their arguments can be defined using `df` or `dcf`: for details see section 10.2.

2.1.4 Macros

As well as functions, there are also macros. The body of a macro is evaluated to give a form that is then evaluated. For example:

```
(dm if (u)
  (list 'cons
    (list (cadr u) (caddr u))
    (list 't 'caddr u))))
```

is an approximation to the definition of the `if` conditional.

The functions that define new functions (i.e. `de`, `df` and `dm`) will print a warning message when they redefine an existing function or macro.

Note that some other LISP systems use constructions built around the word `fexpr`, to achieve the effect of `df`. `fexpr` is not part of Cambridge LISP.

A bound variable list that is in fact a single (non-nil) atom is treated specially by both `lambda` and `lambdaq`. The variable is bound to the complete list of arguments given to the function, and there is no check or constraint on how many arguments are given. This makes it reasonably easy to define functions like `list` and `plus` which can cope with any number of arguments. An atomic variable list for a `lambdaq` is illegal; the only valid format for the parameter field is a list with a single entry.

2.1.5 Error Recovery

Some errors cause entry into an iterative break-loop, which prompts for a character which will determine a variety of ways of exiting the loop. These are explained in the prompt:

```
Lisp break>
Q to quit, A to Abort, C to Continue, or . <expression>
```

2.2 The LISP Editor

2.2.1 Introduction

The Cambridge LISP full-screen editor described in this document is a powerful structure editor written entirely in LISP. It may be invoked via two functions: the first of these, `sedit`, edits the s-expression given as its argument. The edited copy is returned. `fedit` edits the definition of a function given the function's name as an argument; the display portion of the editor has been especially tuned for editing function definitions.

As well as edit existing functions, `fedit`

can be used to create new ones, specifying the type of the function as an optional second argument, i.e.

```
(fedit myfunction fexpr)
```

The editor sets up a template for the function, and the user fills in its definition using the normal editor commands. If `myfunction` already exists, the second argument is ignored, and the editor entered as normal.

On exit from `fedit`, the edited function is compiled if the variable `*comp` is currently set to a non-nil value. The function is also checked to see if it has been changed from an `expr/lexpr` to a `fexpr` (or vice-versa), and if so a warning message is printed that unexpected effects might occur on calls to the function from compiled code.

2.2.2 General background

The editor commands are designed around the concept of the 'current s-expression', which is visible on the screen at all times, the first character of which is highlighted by an inverse-video block (the 'edit pointer'). The current s-expression can be any one of the following:

- (1) an atom;
- (2) a LISP list starting with an opening parenthesis.
- (3) The `cdr` (tail) of a LISP list; in this case the inverse-video block is over the blank immediately before the `car` (head) of the current s-expression.

Initially, on entry to the editor, the current s-expression is the whole of the structure being edited, and the screen will resemble figure 1.

```

h|ead| t|ail| u|p| b|egin| l|oo|k-|for| ma|rk|-mo|ve| z|oom|i|n|-z|oom|o|ut|
d|elete| r|eplace| s|plice| i|nser|t| [u|n|do| c|hange| |c|x|plode| #|hash|
e|val| w|indup| q|uit|      ?|redraw|

```

```

(lambda(a b)
  (cond
    ((null a) b)
    (t
     (cons
      (car a)
      (append & b) ) ) ) )

```

Figure 1 The Lisp Editor

The three lines at the top of the screen form a menu containing the more important (mostly single character) editor commands; then the structure being edited is displayed (in this case a function definition). The ampersands (&) indicate detail that has had to be suppressed for the structure to fit on the vdu screen.

2.2.3 Editor commands

Elementary moving

When the arrow keys are pressed, the edit pointer does not move from character to character like a cursor in a text editor (e.g. the Panos editor), but jumps from one s-expression to the next. The best way to familiarise yourself with the edit pointer's style of movement is to experiment.

In addition to using the arrow keys, there are several commands to move the edit pointer around, and thus make other parts of the structure the current s-expression. They are: