

EDITOR USER MANUAL

Version 2.2

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Disclaimer

NOTICE: This software was developed by the author at the National Center for Supercomputing Applications (NCSA) at the University of Illinois in Urbana-Champaign between 1988 and 1990, and later by the author at the Institute for Computational Astrophysics at Saint Mary's University in Halifax, NS. It and this manual are offered "as is" by the author to anyone for non-profit, educational use with no expressed or implied warranty or suitability. It is requested that the author's name and this disclaimer remain associated with this manual and software, as well as any descendants of this software that may be developed by a third party.

EDITOR USER MANUAL

Version 2.2, David A. Clarke, ICA, June 2011

1 Introduction

1.1 VERSION 2.1

EDITOR is a highly portable text manipulator written in *FORTRAN77* designed to manage and compile large computer codes, and placed in the public domain by the author (see *Disclaimer* on page *iii*). Version 2.1 is available as part of the *ZEUS-3D* tar file `zeus35.tar.gz`, available at zeus3d.ca/zeus3d/version3.5, including a user manual with instructions to install and use *EDITOR* on the user's home platform.

EDITOR is designed for source code written in *FORTRAN*, although some of its functionality is independent of the contents of the ASCII text it manipulates. It was born, in part, out of the author's frustration in porting software from *CTSS* to *UNICOS* in 1988 when the NCSA switched the operating system on its Cray machines. For those familiar with the *CTSS* environment, *EDITOR* was initially designed to mimic the *CTSS* precompiler, *HISTORIAN*, much of whose functionality was not carried into *MPPL*, the first precompiler under *UNICOS*. Since then, *EDITOR* has blossomed into a rather sophisticated package in excess of 13,000 lines of *FORTRAN* capable of a variety of text manipulations. Each of these functionalities shall be referred to as a *job*, of which there are seven in this release. These include:

1. precompiling source code, including inserting modules (*e.g.*, common block declarations) into source code, selecting source code to be compiled, replacing `namelist` statements and their associated reads/writes with calls to subroutines in a portable library, "micro-tasking" nested do-loops, and splitting up the source code into modules (`PRECOM`, §2);
2. generating a multi-columned source code listing complete with a table of contents (`NUMBER`, §3);
3. merging a "change deck" with a source code, thereby upgrading the source code without making changes directly to the master file (`MERGE`, §4);
4. tidying up *FORTRAN* source code including relabelling targets, indentation, renumbering continuation characters, alphabetising modules, *etc.* (`TARGET`, §5);
5. comparing two ASCII files and reporting the differences found (`COMPARE`, §6), overlooking some differences of specified type;
6. splitting a long file into subroutine modules (`SPLIT`, §7); and

7. concatenating all files with a common suffix found in the current directory and all its subdirectories into a single file (`CONCAT`, §8).

These jobs are all described in the sections indicated. In addition to describing *EDITOR*'s most important task (precompilation), §2 introduces the first-time user to language of *EDITOR*. Finally, §9 describes how *EDITOR* may be installed on a new platform.

DAC, November, 1992.

1.2 VERSION 2.2

This is the first new release in almost 20 years. In addition to half a dozen bugs found and corrected in that time, the main difference to version 2.2 is correcting (finally) the mistaken notion that differences in specific *FORTRAN* calls (*e.g.*, timing functions) had to do with the OS, and not the compiler specifically. In this version, all mention of *SUNOS*, *LINUX*, *etc.*, are replaced in favour of compiler names, such as *G95*, *IFORT*, *etc.*

Supported compilers in this release include:

1. *CF77* (Cray, nearest former OS “equivalent”: *UNICOS*);
2. *F90* (Sun, nearest former OS “equivalent”: *SUNOS*);
3. *G95* (g95.org);
4. *GFORTRAN* (Gnu);
5. *IFORT* (Intel);
6. *PGF77* (Portland Group);
7. *PGFORTRAN* (Portland Group);
8. *XLF* (IBM, nearest former OS “equivalent”: *AIX*),

with some being tested more thoroughly than others. Former OS designations *LINUX* and *CONVEXOS* have no specific replacements. Some warnings:

- *CF77* and *XLF* have not been tested *at all*; they are carried over directly from *UNICOS* and *AIX* in Version 2.1.
- There were certain peculiarities for *f77* under *SUNOS* (*SOLARIS*) such as requiring a double backslash in subroutine *UPDATE*, and non-standard *OpenMP* statements in subroutine *PARALLEL* that may or may not still be true for Sun's *f90 -f77* compiler.
- *G95*, *GFORTRAN*, and *IFORT* are the three best-tested compilers.

Other changes include:

1. Parallelisation commands `c*shared` and `c*private` have been added (§2.3);
2. The `do-enddo` problem has been fixed in TARGET; `enddos` no longer need to include the do-loop index.
3. COMPARE now recognises `!` as a comment, and ignores differences behind it.
4. Complex variables are now scoped by PARALLEL.
5. PARALLEL can now scope reductions if namelist parameter `scpred` is set to 1.
6. Three “default” compiler options for `coptions` have been introduced: `debug`, `optimise`, and `openmp`. These will trigger certain compiler and loader options depending on the compiler chosen.
7. EDITOR now has its own web site: zeus3d.ca/dclarke/editor.

DAC, June 2011; modified 7/14, 4/26.

2 PRECOM: Precompiling source code

2.1 Basic precompiling

The main purpose of *EDITOR* is to precompile large *FORTRAN* source codes. By default, the *EDITOR* precompiler creates a separate file (whose name is the same as the original file with the extension `.f` appended) containing the precompiled source listing. The file containing the original source code is left as is. *EDITOR* was designed to mimic *HISTORIAN*, the precompiler available under the Cray Time Sharing System (*CTSS*) which was widely used on Cray machines before 1989 and, in the opinion of the author, one of the most useful and flexible precompilers of its day. In the years since, *EDITOR* has undergone many changes that has taken it beyond *HISTORIAN* and it remains the precompiler for the *ZEUS* family of astrophysical MHD codes (zeus3d.ca/zeus3d).

To use *EDITOR*, one must insert various types of *EDITOR* commands, all relatively unobtrusive, into an existing *FORTRAN* source code. All *EDITOR* commands go on separate lines and begin with an asterisk (*) in the first column. There may be one *EDITOR* command per line. Depending on the task chosen, *EDITOR* will make from 1 to 7 passes through the source code carrying out various directives as specified by the *EDITOR* commands. During precompilation, the resulting source code will be standard *FORTRAN*, void of any *EDITOR* commands and ready for the compiler.

It is unlikely that users with small, easily managed source codes will want to bother with any precompiler. But curators of particularly large codes which offer a variety of features, work for a variety of compilers, and are modified by several people simultaneously will want to consider some sort of preprocessor such as *EDITOR*. For example, codes which need to work with more than one compiler will almost certainly require a separate version for each compiler to accommodate the different extensions (*e.g.*, timing routines). The last thing a curator of a large code wants is to have multiple versions of the same code to upgrade for every change. The precompiler in *EDITOR* will allow these disparate versions to be merged into a single master code, and thus upgrades need be implemented only once.

EDITOR considers a source code as being made up of separate “decks” (a throw-back from the days when computer programs consisted of decks of cards), which may or may not be grouped into designated “groups”. There are two types of decks that *EDITOR* recognises. “Ordinary decks” normally consist of individual program modules, such as subroutines, functions, and the main program. “Common decks” are pieces of code which are to appear *verbatim* in one or more ordinary deck(s). Common decks can be thought of as *EDITOR*’s answer to `include` statements which is a common though not ANSI-standard extension of many *FORTRAN* compilers. Normally, common decks consist of common block definitions which are required by more than one program module. Common decks could also be used as a way of “in-lining” a segment of code into more than one place throughout the master code.

The first thing a user should do in preparing a source code for *EDITOR* is to insert `*deck` and `*cdeck` statements at the beginning of all source code modules. The syntax is as follows:

```
*cdeck deckname  
*cd deckname
```

***deck** *deckname*

***dk** *deckname*

where *deckname* is a user-designated name for the deck unique from all other decknames. ***cdeck** (or equivalently, ***cd** for short) tells *EDITOR* that everything that follows up to but not including the next ***cdeck**, ***cd**, ***deck**, or ***dk** statement belongs to the common deck so named. Similarly, ***deck** (***dk**) indicates an ordinary deck. One is free, for example, to give an ordinary deck the same name as the module (*i.e.* program, subroutine, or function name) it contains.

Optionally, the user may designate “groups” of decks with the ***group** (or ***gp** for short) statement:

***group** *groupname*

***gp** *groupname*

where *groupname* is a user-designated name for the group, not necessarily unique from those named in other group statements. All ordinary decks will then be considered part of the group named in the most recent group statement. The ***group** command is designed for user convenience; it has no effect on how the program is compiled. They allow, for example, the *FORTRAN* tidy-up routine (**TARGET**, see §5) to re-alphabetise all decks within a certain group, then arrange the groups themselves alphabetically. In some sense, one can think of groups as analogous to “directories” aiding the user to locate a particular module within a large source code.

Having designated the decks (and perhaps groups), one may now insert the various precompiler commands which will be carried out during the first two passes the precompiler makes through the code. The first pass establishes which decks the user has defined, their extent, and which *EDITOR* “macros” have been set. The second pass precompiles the source code according to the macro settings. In this way, the compiler will only see that portion of the code which the user has deemed relevant to the problem at hand.

There are two types of *EDITOR* macros – “definitions” and “aliases”. Setting macros is done by inserting any number of the following *EDITOR* commands *anywhere* in the master source file, or in the change deck if **MERGE** is being used in tandem with **PRECOM** (§4). Note that these statements are *global* in that they will have effect throughout the code no matter where in the code they appear. There is, for example, no way to impose a macro for part of the source code, then “turn it off” for the rest.

***define** *def1, def2, ...*

***def** *def1, def2, ...*

***alias** *alias1 alias2*

***al** *alias1 alias2*

where *def1, def2, etc.* are user-selected alpha-numeric keywords which determine “active” segments of the source code. The ***alias** statement instructs *EDITOR* to replace all occurrences of the alpha-numeric keyword *alias1* with *alias2* (except for those which appear in comment statements). Note that ***define** and ***def** are synonyms, as are ***alias** and ***al**.

Having determined which *EDITOR* macros have been set, the precompiler makes a second pass through the source code to look for ***if define** or ***if alias** statements. These

determine which segments of the program are to be included in the precompiled version of the source code which is ultimately sent to the compiler. The following lists the legal syntax for *EDITOR* `*if` statements.

1. `*if define,macro` – the following source code is kept provided the macro is defined by a `*define` statement somewhere in the file.
Note that the comma following “`*if define,`” is optional. It was introduced in order to mimic *HISTORIAN* where it is *not* optional. Note to *HISTORIAN* users: the `alias` feature has no analogue in *HISTORIAN*.
2. `*if -define,macro` – the following source code is kept provided the macro is *not* defined by a `*define` statement somewhere in the file.
3. `*if def,.not.macro` – same as 2. Note that `def` is an acceptable abbreviation for `define`.
4. `*if def,macro1.and.macro2` – the following source code is kept provided both macros are defined by a `*def` statement somewhere in the file.
5. `*if def,macro1.or.macro2` – the following source code is kept provided either macro is defined by a `*def` statement somewhere in the file.
6. `*if def,-macro1.and.macro2` – the following source code is kept provided *macro1* is not defined anywhere in the file, and *macro2* is.
7. `*if def,-macro1.or.macro2` – the following source code is kept provided *macro1* is not defined anywhere in the file, or *macro2* is.
8. `*if alias macro.eq.phrase` – the following source code is kept provided the alias *macro* has been set to the character string *phrase* by an `*alias` statement somewhere in the file.
9. `*if al macro.ne.phrase` – the following source code is kept provided the alias *macro* has *not* been set to the character string *phrase* by an `*alias` statement somewhere in the file. Note that `*al` is an acceptable abbreviation for `*alias`.
10. `*else` – the following source code is kept if the source code following the previous `*if` (and all the way to this `*else` statement) was not kept, *i.e.* if the truth value of the previous `*if` is false. Note that `*el` is an acceptable abbreviation.
11. `*endif` – closes the previous `*if`, `*else` structure. All source code following the `*endif` statement is not affected by the previous `*if` or `*else` statements. For every `*if` statement, there must be an `*endif` statement which follows. Note that `*ei` is an acceptable abbreviation.
12. `*call deckname` – includes the contents of the common deck *deckname* at the location of the `*call` statement. Note that `*ca` is an acceptable abbreviation for `*call`.

Note: the *EDITOR* feature allowing for *compound* `*if def` statements (e.g., `*if def, macro1.and.macro2`) is not particularly sophisticated, and can be easily defeated. A good rule of thumb is to cut off the number of macros in a compound statement once the lack of parentheses () can introduce an ambiguity (since *EDITOR* does not support the use of parentheses in such statements). Thus, `*if def,macro1.and.macro2.and.macro3` is OK, but `*if def,macro1.and.macro2.or.macro3` is not, since `macro1.and.(macro2.or.macro3)` and `(macro1.and.macro2).or.macro3` are not logically equivalent.

Finally, one may insert comment statements if desired by putting an asterisk in both columns 1 and 2. These comments will appear in the master source code where the user places them, but will not be copied over to the file which *EDITOR* prepares for the compiler.

Following is a simple example showing how these statements can be used. The function of the program is simply to return the time of day. Note that the line numbers in the first five columns are included for reference only, and are not modifications made by the *EDITOR* precompiler.

Master source file:

```

1  **
2  **  Select compiler.  Choices are: CF77, PGF77, or XLF
3  **
4  *define PGF77
5  **
6  **  Select i/o subroutine by setting an alias for WRITE.
7  **
8  *alias WRITE write1
9  *cdeck implicit
10     implicit      none
11 *cdeck common
12 *if define,CF77
13     character*8    tod
14 *endif CF77
15 *if define,PGF77
16     character*24   tod
17 *endif PGF77
18 *if define,XLF
19     character*26   tod
20 *endif XLF
21     common / com1 / tod
22 *cdeck declare
23 *call implicit
24 *call common
25 *deck tod
26 c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
27 c
28     program tod
29 c
30 c  PURPOSE: This program returns the time of day on various systems.
31 c
32 c-----
33 c
34 *call declare
35 *if define,PGF77
36     character*24   fdate
37 *endif PGF77

```

```
38          external      WRITE
39 c
40 c-----
41 c
42 c  Get time of day ("tod").
43 c
44 *if define,CF77
45     call date ( tod )
46 *endif CF77
47 *if define,PGF77
48     tod = fdate ( )
49 *endif PGF77
50 *if define,XLF
51     call fdate_( tod )
52 *endif XLF
53 c
54 c  Write result to CRT using desired i/o routine aliased to WRITE.
55 c
56     call WRITE
57     stop
58     end
59 c
60 *deck write1
61 c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
62 c
63 c      subroutine write1
64 *if alias WRITE.eq.write1
65 c
66 c  PURPOSE: This subroutine writes "tod" to the CRT.
67 c
68 c-----
69 c
70 *call declare
71 c
72 c-----
73 c
74     write(6,2000) tod
75 *if define,CF77
76 2000  format('Time of day according to Cray''s CF77 is: ',a)
77 *endif CF77
78 *if define,PGF77
79 2000  format('Time of day according to Portland Group''s PGF77 is: ',a)
80 *endif PGF77
81 *if define,XLF
82 2000  format('Time of day according to IBM''s XLF is: ',a)
83 *endif XLF
84 *endif
85     return
86     end
87 c
88 *deck write2
89 c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
90 c
91     subroutine write2
92 *if alias WRITE.eq.write2
93 c
94 c  PURPOSE: This subroutine writes "tod" to the CRT using a different
95 c      format than WRITE1.
96 c
```

```

97 c-----
98 c
99 *call declare
100 c
101 c-----
102 c
103     write(6,2000) tod
104 2000  format('Time of day is: ',a)
105 *endif
106     return
107     end

```

With the *EDITOR* macros settings as defined in lines 4 and 8, the precompiler would convert this code into the following form (e.g., see `tod.s` at the end of §2.5) which would be read by the compiler. Note that the line numbers from the master code have been preserved.

Precompiled source file:

```

26 c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
27 c
28 c     program tod
29 c
30 c  PURPOSE: This program returns the time of day on various systems.
31 c
32 c-----
33 c
10     implicit      none
16     character*24  tod
21     common / com1 / tod
36     character*24  fdate
38     external     writel
39 c
40 c-----
41 c
42 c  Get time of day ("tod").
43 c
48     tod = fdate ()
53 c
54 c  Write result to CRT using desired i/o routine aliased to WRITE.
55 c
56     call writel
57     stop
58     end
59 c
61 c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
62 c
63 c     subroutine writel
64 c
65 c
66 c  PURPOSE: This subroutine writes "tod" to the CRT.
67 c
68 c-----
69 c
10     implicit      none
16     character*24  tod
21     common / com1 / tod
71 c
72 c-----

```

```

73  c
74      write(6,2000) tod
79  2000  format('Time of day according to Portland Group's PGF77 is: ',a)
85      return
86      end
87  c
89  c====+====1====+====2====+====3====+====4====+====5====+====6====+====7====
90  c
91      subroutine write2
106     return
107     end

```

In this example, the *EDITOR* definitions are used to account for the differences in system calls for different compilers (*e.g.*, lines 12–20 in the master code). They may also be used to tailor a code so that the compiler will generate a binary code optimised for the problem to be solved. For example, if the master source code is one which computes self-gravitating hydrodynamical flows and it has been determined that self-gravity is irrelevant to the problem at hand, one does not want to waste memory by declaring gravitational variables, nor does one want to perform the computations necessary to evolve the unwanted gravitational potential. *EDITOR* definitions may be used to eliminate those portions of the code peculiar to the self-gravity feature, thereby streamlining the code for a non-self-gravitating problem.

Note the two uses for alias macros illustrated in this example. Aliases can be used to select the module to which execution is passed without having to change the body of the source code itself (line 56). They can also be used to prevent an unwanted segment of the code from being compiled (line 92). While the latter function may be performed by the definition macros, the former may not and thus the alias feature represents a real extension of the functionality of *HISTORIAN*.

Common decks (such as `implicit`, `common`, and `declare` beginning on lines 9, 11, 22 respectively) appear in the precompiled version of the code only if they are inserted in the code by a `*call` statement (*e.g.*, line 34). Common decks not referred to by a `*call` statement will not appear in the precompiled version of the code and, in particular, the common decks themselves are not echoed to the precompiled version as separate modules. Common decks may call other common decks (*e.g.*, lines 23 and 24), but they may not call themselves. Calls to common decks may be nested (*i.e.*, common deck 1 calls common deck 2 which calls common deck 3, *etc.*) as many as 10 deep, so long as none of the common decks in the nest are the same (no closed loops!).

2.2 The NAMELIST extension

Namelists first appeared at the Lawrence Livermore Labs around 1980 and were incorporated as a *CTSS FORTRAN* extension. Since then, most operating systems offer *FORTRAN 77* compilers with namelist extensions, and namelist has become a standard feature of *FORTRAN 90* (f90). However, until the arrival of f90 (sometime in 1994!), there was no namelist standard, and this caused great headaches for the *ZEUS* development project which, in 1990, had to operate under three different compilers. Thus, a portable namelist emulator was developed and *EDITOR* can be instructed to replace all namelist syntax in the code with calls

to a namelist library, which includes features that the `f90` namelist does not (*e.g.*, ability to assign values to 2D arrays, allowing variables passed by a subroutine argument list to be namelist variables). The discussion in this subsection, therefore, is restricted to the *EDITOR* flavour of namelists.

Namelists provide an extremely useful and flexible way of supplying user-determined data to a program. Traditionally, *FORTTRAN* source codes have relied upon prompting users for data and/or formatted reads to disc files. For many input parameters, the former can tax the user's patience while the latter can be frustrating because of the need to comply with a strict format for the input data. Namelists eliminate these problems, as illustrated in the following example:

```

1      integer      in, jn
2      parameter   ( in=100, jn=100 )
3  c
4      character*128 cscalar, cvector(in), carray(in,jn)
5      integer     iscalar, ivector(in), iarray(in,jn)
6      real        rscalar, rvector(in), rarray(in,jn)
7      logical     lscalar, lvector(in), larray(in,jn)
8  c
9      ...
10     ...
11  c
12  c  Open the ASCII file "infile" which contains the namelist data and
13  c  ASCII file "outfile" to which a namelist summary may be written.
14  c
15     open (51, file='indata', status='old')
16     open (52, file='outdata', status='unknown')
17  c
18  c  Define list of parameters which may be set by namelist "data1".
19  c
20     namelist / data1 / cscalar, iscalar, rscalar, lscalar
21                    , cvector, ivector, rvector, lvector
22                    , carray , iarray , rarray , larray
23  c
24  c  Default values for namelist parameters
25  c
26     cscalar = ' '
27     iscalar = 0
28     rscalar = 0.0e00
29     lscalar = .false.
30     do 10 i=1,in
31         cvector(i) = ' '
32         ivector(i) = 0
33         rvector(i) = 0.0e00
34         lvector(i) = .false.
35 10    continue
36     do 30 j=1,jn
37         do 20 i=1,in
38             carray(i) = ' '
39             iarray(i) = 0
40             rarray(i) = 0.0e00
41             larray(i) = .false.
42 20    continue
43 30    continue
44  c
45  c  Read namelist from logical unit 51.

```

```

46 c
47     read ( 51, data1 )
48 c
49 c Write a namelist summary to logical unit 52.
50 c
51     write ( 52, data1 )

```

Namelists read data from an ASCII namelist input data file (named `indata` in this example) which the user prepares before executing the binary. Line 15 is an ordinary `open` statement appropriate for linking an existing ASCII disc file to the program at execution time. Unit 51 was chosen arbitrarily. Most any unit number other than 5 or 6 may be chosen. The namelist statement on line 20 defines which variables belong to the namelist `data1` and thus which variables may be assigned values in the namelist input data file `indata`. Line 47 is where the data in the namelist `data1` are read from `indata`. As many namelists as desired may be so defined and read throughout the program and for every namelist defined, there should be a corresponding entry in the namelist input data file `indata`, as described below. Line 51 writes a summary of the namelist settings to unit 52. This is not a necessary part of the namelist structure, and many users may not want to bother with this feature. Indeed, many implementations of namelist don't even offer the option to write a summary of the namelist settings. The *EDITOR* namelist does, however, support the `write` (or equivalently, `print`) statement.

While it is not necessary, it may be useful to assign all the namelist parameters default values before the `read` statement (lines 26 through 43). This is so that in case the user does not assign values to all the parameters in the namelist input data file (by no means a requirement), all parameters will be initialised to *something* and hopefully to a useful default value.

To use the *EDITOR* namelist, one must abide by the following rules:

1. Do not use `namelist` as a variable name in any module that reads data from namelists.
2. Do not name any subroutines `nlstdacnn`, where `nn` varies from 01 to 24.
3. Link the library `namelist.a` for single precision applications, and `dnamelist.a` for double precision applications to your code during the link step. The `namelist.f` and `dnamelist.f` source codes and the script files to build the libraries are in the directory `nmlst` of `dzeus35.tar` downloaded from www.ap.smu.ca/~dclarke/zeus3d).

Otherwise, use namelists as indicated above, and prepare your namelist input data file as in the following example:

```

1 c ==+====1====+====2====+====3====+====4====+====5====+====6====+====7==
2 $data1 rscalar=1.0, iscalar=1, lscalar=.true., cscalar='abcdefg'
3       , ivector=3*1,2,3, ivector(20:30)=2, ivector(40)=4*3
4 c     , ivector(1)=1,1,1,2,3, ivector(20)=11*2, ivector(40)=3,3,3,3
5       , iarray(1:100,1:100)=1, iarray(1:10,91:100)=2
6       , cvector(3)="abcdefghijklmnopqrstuvwxyz01234567890ABCDEFGHIJKL
7 MNOPQRSTUVWXYZ", lvector(98)=.t.,.false.,.f. $

```

Various aspects of this data file warrant discussion. Again, line numbers are *not* part of the data file; they are included for reference only.

1. Each line in a namelist input data file may be at most 72 characters wide. Anything beyond the 72nd column will be ignored. Thus, one might consider including a number line, such as line 1, which will allow one to see at a glance whether the data extend beyond the 72nd column.
2. Only one of three characters are allowed in column 1: `c`, `C` (for “commenting out” lines as in lines 1 and 4), or a blank. Anything else will cause an error message to be generated and execution to abort. Note that all lines commented out will be echoed to the CRT at execution time.
3. Only one of two characters are allowed in column 2: the `$` sentinel (for opening a namelist), or a blank. Anything else will cause an error message to be generated and execution to abort.
4. The first word to appear after the opening `$` sentinel should be the namelist name as defined in the program—in this case, `data1`. There may be spaces between the opening `$` sentinel and the namelist name, but nothing else.
5. After the namelist name, the user is free to set whichever variables within the namelist to whatever values are desired. Note that the order in which the variables are set need not be the same as the order in which they are listed in the namelist statement. One does not need to set all the variables listed either. However, any variable set in the data file which is not listed in the corresponding namelist statement in the program will generate an error message and abort execution.
6. Variable assignments may appear anywhere between and including columns 3 and 72. Variable assignments are separated by a comma and as many (including none) blanks as desired.
7. Variables are set by typing the variable name, followed by an equals sign (`=`), followed by the desired value in a format consistent with the variable type.
8. Legal values which may be assigned to a logical variable are `.true.`, `.t.`, `.false.`, or `.f.`, where the first two and last two are synonyms. Note that the periods must be included.
9. Character strings are set by enclosing the desired text inside a pair of single quotes or a pair of double quotes. If a character string is too long to fit within the 72 column constraint, one may type all the way to the 72nd column and resume the string in the third column on the following line. Note that even with the character string so split, only one opening and one closing quote should be used (*e.g.*, lines 6 and 7). This “wrap-around” feature is supported by the *EDITOR* namelist for character variable assignments only.
10. Hollerith strings are *not* supported by the *EDITOR* namelist. Use true character variables.

11. Setting values for vectors may be done in a number of ways, as illustrated on lines 3 and 4. Thus `ivector=3*1,2,3` will set `ivector(1)=1`, `ivector(2)=1`, `ivector(3)=1`, `ivector(4)=2`, and `ivector(5)=3`; `ivector(20:30)=2` will set inclusively the 20th through 30th elements of `ivector` to 2; and `ivector(40)=4*3` will set the 40th through 43rd elements of `ivector` to 3. Note that line 4 which is commented out would perform the identical assignments. Note that `ivector=3*1,2,3` is, by convention, identical to `ivector(1)=3*1,2,3`. The redundancy in notation for assigning vector values is so that namelist input data files prepared for the *CTSS* namelist may be read by the *EDITOR* namelist.
12. Setting values for rank 2 arrays may be done only by using the full colon notation (line 5). This notation is peculiar to the *EDITOR* namelist and, so far as is known by the author, is not supported by *f90* namelist. Setting values for arrays of greater rank than 2 is not supported.
13. The last character on the last line of a namelist assignment must be the closing `$` sentinel. Be careful that this does not go beyond the 72nd column. If it is left out or inadvertently placed beyond the 72nd column, an error message will be generated, and execution will abort.
14. One is free to define as many namelists as desired in the source code. However, once one namelist is defined, it must be read from the namelist input data file by a `read` statement (line 47 above) before a new namelist is defined. Thus, only one namelist may be pending at a time. This is not a restriction of *f90* namelist.
15. The order of the namelists (not the variables, but the namelists themselves) must be the same in the namelist input data file as they are read by the source code. Thus, if the source code is written so that namelist `data2` is read after namelist `data1`, then the variable assignments for `data2` must appear *after* the variable assignments for `data1` in the namelist input data file. If `data2` should appear before `data1` in the namelist input data file, the read to `data1` will cause the data for `data2` to be skipped. Thus, when it comes time to read `data2`, these data will not be found and an error message will ensue.
16. For every namelist read by the source code, there must be an entry with the same namelist name in the namelist input data file. If, for example, none of the parameters for namelist `data2` are to be assigned values, it is still necessary to include a minimal entry in the namelist input data file of the form:

```
$data2 $
```

Failure to do so will generate an error message and abort execution.

Should any of these rules be broken, namelist error messages are generated at run time. These are discussed in §A.4.

2.3 Inserting micro-tasking directives

While single processor speed is still increasing with each new technology released, most of the progress in raw compute power over the past decade has been through parallelisation. Two paradigms for parallel computing have emerged. The “Beowulf” is an example of a *distributed* multi-processing environment in which memory is distributed over the constituent processors. A great deal of thought must be given to how the processors communicate with each other, and for many applications this can be a very time-consuming task. *Shared* multi-processing (SMP) is the second and more expensive parallel environment, but can simplify enormously the task of parallelising a code. On an SMP, all processors have access to the same memory and communication among the processors is greatly reduced. The “auto-parallelisation” feature of *EDITOR* is designed for applications on SMP architectures.

There are two basic strategies to “multi-tasking” (*i.e.*, parallelising) a source code. One may “macro-task” a code by arranging for the individual processors to work on individual calls to one or more subroutine(s) whose results are independent of each other, and/or one may “micro-task” a code by sending separate iterations through a do-loop to separate processors. Of the two micro-tasking is really the only way to fully exploit the inherent parallelism in a code.

Critical to micro-tasking a code is the concept of “private” and “shared” variables. Private variables are those for which each processor has a separate and independent copy. Shared variables are those which all processors read from and perhaps write to. The rules for determining which variables are private and which are shared are fairly straight forward. A variable is private if:

1. The first time it appears within a do-loop structure, it appears on the left hand side of an equals sign; and
2. It is not indexed by the outer do-loop index.

Otherwise the variable is shared. The key to micro-tasking is to identify correctly which variables are private and which are shared—a task known as “scoping”. Only if the variables are scoped properly can a micro-tasked code be generated which yields the same results as the original serial code (a condition known as being *thread-safe*). A number of platforms offer compiler options to help users macro-task and micro-task their codes. In developing the *ZEUS* code, for example, the author found that the auto-tasking features provided by Cray around 1990 often made scoping errors, and/or were too timid in some of the loops they attempted to scope and a more aggressive and accurate auto-scoping feature was incorporated into *EDITOR*.

After scoping the variables in a nested loop, *EDITOR* inserts the appropriate “`cmic$`” auto-tasking directives recognised by Cray’s CF77 and Sun’s f90 compilers or “`c$omp`” for *OpenMP* at the beginning of the scoped loop. Should the code then be passed through the compiler’s auto-tasker, the presence of these `cmic$` or `c$omp` statements will tell the auto-tasker that these loops have already been scoped and parallelised, and can be passed over. Similarly, an existing `cmic$` or `c$omp` statement also tells *EDITOR* to pass over the loop without making any further modifications.

For all other parallelisation opportunities, the vendor's auto-tasking tools should be used. Indeed, the auto-scoping features of most vendors compilers may by now be superior to *EDITOR*'s and it may be better to use the vendor's auto-parallelisation features exclusively.

Note that the *EDITOR* auto-scoper will only scope those variables declared at the beginning of the program module. Undeclared scalars (allowed when `implicit none` is *not* used) will *probably* be scoped correctly by the compiler's auto-tasker by virtue of the `autoscope` (`default(_auto)`) directive included in all *EDITOR*-supplied `cmic$` (`c$omp`) statements but, in the author's experience, not necessarily.

Below are some examples using Cray's `cmic$` syntax to illustrate the use of the *EDITOR* auto-scoper. There is a one-to-one correspondence between all `cmic$` and `c$omp` commands which can be gleaned from the code (`edit22`) or from any *OpenMP* manual if the reader is interested. Note, however, that the actual syntax of the `cmic$` and `c$omp` commands is not germane to this discussion, since it is *EDITOR*'s job to insert these into the code. The examples below, then, are provided to illustrate what *EDITOR* does to the code when auto-scoping, and what *EDITOR* syntax is available to assist the auto-scoper should it run into difficulty scoping what the user knows to be thread-safe loops.

For all examples, assume that all variables including scalars have been specifically declared as real, integer, *etc.* at the beginning of the program module. Note that the line numbers in the first 5 columns are included for reference and are not modifications made by the *EDITOR* precompiler to the source code.

Example 1: In a straight-forward thread-safe nested loop, *EDITOR* should scope all variables correctly and inserts the appropriate `cmic$` directives in front of the outer-most do-loop. Only the outer loop is micro-tasked; on a vector machine such as a Cray, the inner loop can be vectorised.

```

1  cmic$ do all private ( k, kp1, j, jp1, i, ip1, b1av, b2av, b3av )
2  cmic$1      shared ( kmax, jmax, imax, b1, b2, b3, btot )
3  cmic$1      autoscope
4      do 30 k=1,kmax
5          kp1 = k + 1
6          do 20 j=1,jmax
7              jp1 = j + 1
8              do 10 i=1,imax
9                  ip1      = i + 1
10                 b1av     = b1(i,j,k) + b1(ip1,j ,k )
11                 b2av     = b2(i,j,k) + b2(i ,jp1,k )
12                 b3av     = b3(i,j,k) + b3(i ,j ,kp1)
13                 btot(i,j,k) = 0.25 * ( b1av**2 + b2av**2 + b3av**2 )
14                 btot(i,j,k) = amax1 ( sqrt(btot(i,j,k)), tiny )
15 10          continue
16 20          continue
17 30          continue

```

The variable `tiny` (line 14) was not scoped (*i.e.*, *EDITOR* did not include it in either the private or the shared lists in lines 1 and 2) because in the program from which this example was extracted, `tiny` is a *parameter* and not a *variable*. Parameters are not scoped since the compiler replaces parameters with their assigned numerical values.

Functions and subroutines should *not* be scoped. Note that the *EDITOR* auto-scoper is able to distinguish between proper arrays with argument lists (such as `btot` in lines 13

and 14) which are declared and scoped, and intrinsic functions (such as `sqrt` in line 14) which are not declared, nor scoped. Similarly, user-written functions whose attribute (real, integer, *etc.*) is not declared will not be scoped. User-written functions whose attribute is declared will not be scoped *provided they are also declared as external*. A user-written function with declared attribute not declared external will be scoped, and this may or may not have deleterious effects.

Example 2: I/O and character operations within a loop will prevent parallelisation, and thus these operations should, if possible, be isolated from any large loop that would otherwise be parallelisable. Their presence will cause *EDITOR* to declare the loop non-parallelisable in which case it inserts a NO CMIC\$-DIRECTIVE REPORT below the loop (in comments) and adds no `cmic$` statement before it:

```

1      do 130 j=j1,j2
2          do 120 i=i1,i2
3              chqty(i,j) = char ( iqty(i,j) )
4 120      continue
5          write (iodmp) ( chqty(i,j), i=i1,i2 )
6 130      continue
7 c*****
8 c***** EDITOR NO-CMIC$-DIRECTIVE REPORT FOR LOOP 130 *****
9 c*****
10 c** Char. operations prevented parallel directives from being issued. **
11 c** I/O prevented parallel directives from being issued.          **
12 c*****

```

Example 3: Two commonly occurring coding constructs that can prevent parallelisation are *reductions* and *dependencies*.

reduction: the value assigned to a private variable depends on the value of that variable as determined by a previous iteration (*e.g.*, `imax` below).

dependency: a variable is first used as a shared variable, then as a private variable (*e.g.*, `ival` below); an array element indexed by the outer loop index (shared) depends upon an array element with a different value of the outer loop index.

A loop containing either a reduction or a dependency will, in general, generate different answers depending upon whether it is run in serial or in parallel and thus is non-parallelisable. Sometimes, one can rewrite the loop to eliminate a reduction or dependency. If this is not possible then, upon its detection, *EDITOR* will declare the loop non-parallelisable and insert a NO CMIC\$-DIRECTIVE REPORT below it. Further, no `cmic$` statements are added before the loop either, allowing the compiler to have a crack at parallelising the loop if its auto-parallelisation feature is enabled. Thus, and for example:

```

1      imax = 0
2      ival = i1
3      do 40 j=j1,j2
4          do 30 i=i1,i2
5              iarray(i,j) = ival
6              ival = i + 1

```

```

7           imax = max0 ( imax, iarray(i,j) )
8 30       continue
9 40       continue
10 c*****
11 c***** EDITOR NO-CMIC$-DIRECTIVE REPORT FOR LOOP 40 *****
12 c*****
13 c** No parallel directives issued because the following variable(s) **
14 c** was/were found to generate dependencies or reductions: **
15 c**           ival           (dependency) **
16 c**           imax           (reduction) **
17 c*****

```

New since July, 2014: By setting the namelist parameter `scpred` to 1, *EDITOR* will try to scope simple reductions. Only reductions involving operators `+`, `-`, `*`, `min`, `max` will be attempted; all other reductions will render the loop non-parallelisable. The following gives an example of a loop with two reductions successfully scoped.

```

1       nin = 0
2       nout = 0
3 c$omp parallel do private ( k, j )
4 c$omp1      shared ( kmax, jmax, arr )
5 c$omp1      reduction ( min: nin )
6 c$omp1      reduction ( +: nout )
7 c$omp1      default ( none )
8       do 20 k=1,kmax
9         do 10 j=1,jmax
10          nin = min ( nin, arr(j,k) )
11          if (arr(j,k) .eq. 0.0) nout = nout + 1
12 10       continue
13 20       continue

```

It is essential that reductions appear in simple arithmetic expressions, and that there is no more than one operator associated with each reduction variable per loop. Excess complexity can easily defeat *EDITOR*'s ability to scope reductions accurately, and may result in non-thread-safe code. If *EDITOR* insists on scoping a reduction inaccurately, one can always preface that loop with a `c*nopar` directive instructing *EDITOR* to skip that particular loop (example 6 below).

Example 4: At times, *EDITOR* may detect what it thinks is a reduction or dependency, but in practise is not:

```

1 c*ipdep
2       do 10 j=2,jmax-1,2
3         arr(j) = 0.5d0 * ( arr(j-1) + arr(j+1) )
4 10       continue

```

Formally, the assignment of `arr(j)` (indexed by `j`, and thus shared) depends on elements of the same array that are presumably set by different threads. Formally, this constitutes a dependency. However, because only array elements with even index are being set exclusively to array elements of odd index, the odd-index elements are never set by this loop and the loop is thread-safe. As *EDITOR* is not sophisticated enough to determine this (by examining the do-loop statement), we can tell *EDITOR* to ignore any dependencies it may find by inserting the directive `c*ipdep` immediately before the loop (line 1).

In all, there are four *EDITOR* statements that can be used to tell the auto-scoper to ignore reductions and/or dependencies should the user know for certain such occurrences are inconsequential:

```

c*ipdep      ignore parallel dependencies
c*ipred      ignore parallel reductions
c*ipdepipred ignore parallel dependencies and reductions
c*ipredipdep same as above

```

Note that if there is one dependency or reduction that is ignorable but another that is not, the loop is not thread-safe and the `c*ipdep` should not be used.

Example 5: Occasionally, the *EDITOR* autotasker needs help auto-scoping a nested loop. In the following example, `q1` and `q2` are scoped correctly as shared since these are indexed explicitly on lines 4 and 5 by the outer do-loop index `j`. However, *EDITOR* is not smart enough to realise that `jp1` is really an alias for `j+1`, and scopes `q3` incorrectly as private:

```

cmic$ do all private ( j, jp1, i, q3 )
cmic$1      shared ( jmax, imax, q1, q2 )
cmic$1      autoscope
1          do 20 j=1,jmax
2            jp1 = j + 1
3            do 10 i=1,imax
4              q1(i,j ) = ...
5              q2(i,j+1) = ...
6              q3(i,jp1) = ...
7 10        continue
8 20        continue

```

We can help *EDITOR* by scoping such variables manually using the `c*shared` and `c*private` commands (new to Version 2.2) inserted immediately before the loop to be scoped. Thus, the nested do-loop above can be scoped properly by inserting:

```
c*shared ( q3 )
```

immediately before line 1. With this directive added, *EDITOR* inserts the directives:

```

cmic$ do all private ( j, jp1, i )
cmic$1      shared ( jmax, imax, q1, q2, q3 )
cmic$1      autoscope

```

with all scoping now correct.

If more than one variable is to be scoped manually, they can be put in the same argument list separated by commas;

```
c*shared ( x, y, z )
```

with spaces optional. If there are too many variables to fit on a single line, close the list with a close-parenthesis, then begin a new line immediately following. As many `c*shared` and `c*private` lines may be inserted above the loop as needed, but there should be no *FORTRAN* statements (including comments) among the `c*shared` and `c*private` statements nor between the last `c*shared` or `c*private` statement and the opening line of the loop.

Alternately, incorrectly scoped variables can be scoped correctly by use of an *EDITOR* “dummy statement” heralded by the characters `c**` in columns 1-3 of the statement. While *FORTRAN* treats them as comments, the two asterisks tell *EDITOR* to use them in scoping the variables. Thus, in the present example,

```

      c*ipdep
1      do 20 j=1,jmax
2          jp1 = j + 1
3          do 10 i=1,imax
4              q1(i,j ) = ...
5              q2(i,j+1) = ...
6      c**          q3(i,j ) = 0.0
7          q3(i,jp1) = ...
8 10      continue
20      continue

```

the insertion of the dummy statement before line 6 causes the auto-scoper to recognise `q3` as a shared variable since there, the outer loop index `j` is explicit.

Now, according to the definition of a dependency in example 3, the dummy statement (establishing `q3` as shared) followed by statement 6 (using `q3` as a private variable) together constitute a dependency. This is a false dependency, to be sure, but *EDITOR* is not smart enough to recognise that. Thus, the addition of the *EDITOR* statement `c*ipdep` (example 4) immediately before line 1 tells *EDITOR* to ignore any dependencies it may find in the loop so that together, these two statements render the loop parallelisable.

This strategy was first introduced in Version 2.1 and, while largely obviated by the `c*private` and `c*shared` commands described above, is still supported by *EDITOR* for compatibility.

Example 6: The *EDITOR* auto-scoper can fail if a `goto` statement appears within the nested do-loop structure. If a `goto` statement redirects execution to somewhere else within the loop, parallelism is not affected and multi-tasking is desirable. However, if execution is taken outside the nested loop structure, parallelism is destroyed, and the loop should not be multi-tasked. The *EDITOR* auto-scoper has not been endowed with the ability to distinguish where execution is redirected, and so blindly scopes the loop. In this way, the *EDITOR* auto-scoper is perhaps overly aggressive. Thus, the user should be aware of nested loops with `goto` statements which redirect execution outside the loop and instruct the *EDITOR* auto-scoper to pass over the loop. This is done with the `c*nopar` directive.

```

1  c*nopar
2      do 30 i=i1,i2
3          do 20 k=k1,k2
4              do 10 j=j1,j2
5                  if (d(i,j,k) .gt. factor*d(ism1,j,k)) go to 40
6 10      continue
7 20      continue
8 30      continue
9 40      continue

```

Note that the `c*nopar` is interpreted only by *EDITOR*. Thus, if source code unscoped by the *EDITOR* auto-scoper is passed through the compiler’s auto-tasker, an attempt may still be made by the compiler to generate the appropriate `cmic$` directives.

Example 7: The final example of where the *EDITOR* auto-scoper can fail is more subtle. The *EDITOR* auto-scoper will scope nested loops in which there is a call to a subroutine. If the user determines that the subroutine call destroys parallelism, the loop should not be scoped, and the user should place a `c*nopar` directive before the outer loop.

If, on the other hand, the subroutine call does not destroy parallelism, one still has to be careful. There may still be the problem of scoping the variables in the subroutine argument list. In the example below, the variable `vp` is assigned values by the subroutine `x3zc1d` and not by an assignment statement explicitly in the loop itself. Without looking in the subroutine (and *EDITOR* is not sophisticated enough to do this), *EDITOR* declares `vp` to be shared since its first appearance on line 6 is *not* to the left of an equals sign. If `vp` is, in fact, shared, there is no need to intervene. Conversely, if `vp` is private, line 1 in the example below assures that it is scoped as such.

```

1  c*private ( vp )
2      do 60 j=j1,j2
3          do 20 i=i1,i2
4              vtmp(i) = v2(i,j) - vg2(j)
5  20      continue
6          call x3zc1d ( vtmp, vp )
7          do 30 i=i1,i2
8              v2star(i,j) = vp(i) * qty(i)
9  30      continue
10 60     continue

```

There is still a potential trap, however. Normally, local variables within a subroutine are considered private for the purpose of multitasking loops that contain calls to that subroutine. This is as it should be. However, if any of the subroutine's local variables are placed in common or equivalenced to variables in common, this will cause those variables to act as though they were *shared*, and this invariably leads to incorrect and irreproducible results that are notoriously difficult to dig out with a debugger. Unless you know such constructs will not cause conflicts, it is best to avoid calls to routines that use common blocks inside a loop you wish to micro-task, or avoid micro-tasking such a loop altogether.

2.4 Splitting a source code; generating a makefile

For code developers who prefer to work with a single master file containing all the program modules, *UNIX* often poses a dilemma. Two useful *UNIX* facilities, `MAKE` and `DBX`, work best if the source code is split into individual files, one for each program module. Using `FSPLIT` is unsatisfactory because it pays no attention to which modules have been changed and which have not, forcing `MAKE` to recompile *all* the program modules, not just the ones that were changed.

The *EDITOR* precompiler offers an easy way around this problem. One may instruct the precompiler to make yet another pass through the master source file and this time split it into individual files for each module. The naming convention for these files is as one might hope—the name of the module with a specified extension (default is `.f`). One can even specify in which directory these files should be placed. Before writing a file to disc, the precompiler will check to see if there is already a file by that name on disc in the specified directory. If there is not, a new file is created. If there is, the precompiler compares line for

line the version of the module it just split off the master file with the disc file. If the two differ, the disc file is updated. If the two are identical, the disc file is *not* updated leaving its “timestamp” unaltered. In this way, **MAKE** will not recompile unaltered program modules. For large source codes and slow compilers, this is no small consideration.

At the same time, the *EDITOR* preprocessor will generate a makefile if **make** name is specified (see §2.5). The user may tell *EDITOR* which compiler, compiler options, loader, and loader options to use in the makefile, or to use “sensible” defaults. If you need to compile a few routines with different compiler options than the majority, you may specify these special compiler options as well as the routines for which these special options apply. In addition, the desired name for the binary executable may be specified. Thus, once the *EDITOR* preprocessor has processed the master source code, the code may be compiled simply by typing:

```
make -f makename
```

where *make*name is the name of the makefile specified by the user.

Finally, if the user forgets from one precompilation to the next which compiler and/or options were used, the updated files could be compiled differently from those not updated, possibly generating an unusable executable (object files created by different compilers will generally not load properly). To safeguard against this, when the file is split and a makefile is generated, *EDITOR* automatically writes to the same directory in which the split files are written a short text file called **COMPILER.COMD** which stores the compiler and the options used to compile the files. At a later time when a modified file is updated, *EDITOR* reads any existing file **COMPILER.COMD** and compares its contents with the current compiler and options. If the two are not identical, *EDITOR* issues a warning message asking the user if execution should continue. At this juncture, the user could select ‘no’ causing *EDITOR* to abort and allow the user to reset the compiler and/or its options to those used in the original precompilation.

2.5 The precom.s script file

A precompiled version of a *FORTRAN* source code may be generated by issuing the following command:

```
csh -v precom.s
```

where **precom.s** is an ordinary C-shell script file as follows:

```

1 #---+---1---+---2---+---3---+---3---+---2---+---1---+---#
2 #===== SCRIPT FILE TO PRECOMPILE A SOURCE CODE =====#
3 #                                                                 #
4 # User sets: DIRECTORY, SOURCECODE, MAKEFILE, EXECUTABLE, COMPILER, #
5 #           LIBRARIES                                           #
6 #                                                                 #
7 # Supported compilers have preset "debug", "optimise", and "openmp" #
8 # settings:                                                       #
9 #                                                                 #
10 # compiler  debug                                               #
11 # cf77      -g                                                    #
12 # f90 -f77  -g -C -ftrap=common                                  #

```

```

13 # g95      -g -fbounds-check -ftrace=full          #
14 # gfortran -g -fbounds-check -ffpe-trap=i,z,o      #
15 # ifort    -g -debug-parameters -check -fpe1 -traceback #
16 # pgf77    -g -Ktrap=fp -Mbounds -Mbackslash       #
17 # pgortran -g -Ktrap=fp -Mbounds                  #
18 # xlf      -g -C -qextchk -qflttrap -qsigtrap     #
19 #                                                  #
20 # compiler  optimise                               openmp          #
21 # cf77      -O4                                   -O4 -h omp              #
22 # f90 -f77  -O4                                   -O4 -xopenmp           #
23 # g95       -O2                                   (not supported)        #
24 # gfortran  -O2                                   -O2 -fopenmp           #
25 # ifort     -O2 -diag-disable remark -O2 -diag-disable remark -openmp #
26 # pgf77     -fast -Mbackslash                    -fast -Mbackslash -mp  #
27 # pgortran  -fast                                  -fast -mp              #
28 # xlf       -O4                                   -O4 -qsmp              #
29 #                                                  #
30 # otherwise, user sets compiler, coptions, loader, loptions directly. #
31 #                                                  #
32 #=====> Get files from home directory.
33 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
34 #=====> If necessary, create the directory "DIRECTORY".
35 if(! -e ./DIRECTORY) mkdir ./DIRECTORY
36 #-----> Create the input deck for EDITOR, and execute.
37 rm -f ./inedit
38 cat << EOF > ./inedit
39 \$editpar  inname='SOURCECODE', ibanner=1, job=4, idump=1
40           , inmlst=1, iutask=0, scpred=0, iupdate=0, ext='.f'
41           , branch='DIRECTORY', makename='MAKEFILE', xeq='EXECUTABLE'
42           , compiler='COMPILER', coptions='debug'
43           , libs='LIBRARIES'                      \$
44 EOF
45 chmod 755 ./xedit22
46 ./xedit22
47 #=====> Tidy up directory.
48 rm -f ./editlp ./inedit ./output ./xedit22

```

A softcopy of `precom.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor. Note that the line numbers in the first five columns are not part of the file and are included only for reference.

Comments for C-shell script files are indicated by a `#` in column 1. For all *EDITOR* C-shell script files listed in this manual, there are, by convention, two types of comments. Those lead by a double line (`=====>`) indicate that the following portion of the script file should rarely, if ever, require changing. Those lead by a single line (`----->`) indicate segments of the script file which will probably have to be altered every time the script file is used.

After the header listing the various compiler options, the first segment of `precom.s` copies the necessary files (in this case, just the `edit22`—*EDITOR*, Version 2.2—executable) to the present working directory. Note that the *UNIX* phrase “`if(! -e ...)`” on line 33 ensures that the named file will *not* be retrieved if it already exists in the `pwd`.

The second segment creates a directory on disc into which all source files split from the master code during precompilation (§2.4) and all corresponding object and listing files are placed, should this option be used.

The third segment is where the input parameters for *EDITOR* are specified. Input parameters are read in by a “namelist”, as discussed in §2.2. Specifying the parameters in the namelist `editpar` is how *EDITOR* is controlled. In the example, `DIRECTORY`, `SOURCECODE` and all words in allcaps have to be specified by the user. Note that the `$` sentinel is preceded by a backslash (`\`). This prevents the script file from interpreting the `$` as a control character and instead treats it as an ASCII character to be passed (without the leading backslash) to the text file `inedit`.

There are 47 valid namelist parameters in `editpar`, but only 22 are relevant for precompiling source code. These include six general parameters which all or most *EDITOR* jobs use, and 15 additional parameters peculiar to *PRECOM*.

parameter	description	default
GENERAL		
<code>inname</code>	name of source code to be edited (character*64).	
<code>ibanner</code>	=1 => print banner to screen at beginning of execution =0 => no banner	0
<code>job</code>	=1 => number lines in source code =2 => tidy source code (retarget, indent, alphabetise) =3 => update source code with change decks =4 => prepare source code for compilation. =5 => compares two files and reports location of first "ndiff" differences. =6 => splits master file into module files. =7 => concatenates module files to master file.	1
<code>idump</code>	=1 => diagnostic dumps are written to "output". =0 => no diagnostic dumps.	0
<code>safety</code>	Memory management parameter. k2*safety lines of "inname" are read at a time. 0.0 => 0.9 (job=1,2,5,6,7), 0.4 (job=3,4)	0.0
<code>outname</code>	name of outfile. If unspecified, outfile will be named according to internal naming convention (character*64).	
PRECOM (job=4)		
<code>swcase</code>	=0 => Switches (but not aliases) are case-insensitive; *def MHD and *def mhd are identical =1 => Switches are case-sensitive; *def MHD and *def mhd are different	0
<code>inmlst</code>	=0 => leave NAMELIST and associated I/O alone. >0 => substitute all occurrences of NAMELIST and associated I/O for calls to subroutines in (D)NAMELIST.A. A maximum of "inmlst" assignments can be made in the input deck per NAMELIST. "inmlst"=1 => 1000.	0
<code>iutask</code>	=0 => no microtasking attempted =1 => insert Cray microtasking directives (cmic\$) in front of parallelisable nested do-loops. =2 => insert OpenMP parallelisation directives (c\$omp) in front of parallelisable nested do-loops. =-1, -2 => same as 1, 2, except directives are inserted before single (non-nested) loops too.	0
<code>scpred</code>	=0 => do not scope reductions =1 => scope "thread-safe" reductions	0
<code>iupdate</code>	=0 => PRECOMpiled source code is dumped to one file.	0

```

=1 => PRECOMpiled subroutines stored to separate files.
      Subroutine is written only if different from
      version on disc, or if it doesn't exist on disc.
branch  character*32 string indicating default directory in      blank
        which to write subroutine files.
ext     desired extension for files (character*8)                '.f'
makename name of makefile to be created (character*16). If      blank
        blank, no makefile is created. The files compiled by
        MAKE are those in the directory 'branch'.
compiler overrides default compiler used by MAKE to compile    see chart
        "iname" (character*16). The default compiler depends
        on how EDITOR itself was compiled, which depends on
        which EDITOR compiler macro was defined in edit22.s.
        There is no requirement that EDITOR create the
        makefile for "iname" with the same compiler with which
        it was compiled. The compiler that compiled EDITOR
        just serves as a reasonable default.
    
```

macro	default compiler	origin
none	gfortran	GNU
CF77	cf77	Cray
F90	f90 -f77	SUN
G95	g95	g95.org
GFORTTRAN	gfortran	GNU
IFORT	ifort	Intel
PGF77	pgf77	Portland Group
PGFORTRAN	pgfortran	Portland Group
XLF	xlf	IBM

```

options  compiler options (character*128). For convenience,      optimise
         three generic compiler options, 'debug', 'optimise',
         and 'openmp' are supported, where:
    
```

```

compiler | debug =>
-----+-----
cf77     | -g
f90 -f77 | -g -C -ftrap=common
g95     | -g -fbounds-check -ftrace=full
gfortran | -g -fbounds-check -ffpe-trap=i,z,o
ifort   | -g -debug-parameters -check -fpel -traceback
pgf77   | -g -Ktrap=fp -Mbounds -Mbackslash
pgfortran | -g -Ktrap=fp -Mbounds
xlf     | -g -C -qextchk -qfltttrap -qsigtrap
    
```

```

compiler | optimise => | openmp =>
-----+-----+-----
cf77     | -O4          | -O4 -h omp
f90 -f77 | -O4          | -O4 -xopenmp
g95     | -O2          | (not supported)
gfortran | -O2          | -O2 -fopenmp
ifort   | -O2 -diag-disable remark | -O2 -openmp
pgf77   | -fast -Mbackslash | -fast -Mbackslash -mp
pgfortran | -fast        | -fast -mp
xlf     | -O4          | -O4 -qsmp
    
```

where the openmp options are in addition to the optimise options. All are in addition to '-c -o \$*.o' (or equiv.) that suppress the link step and give the object file

the same name as the module, and which are included automatically in PRECOM for each default compiler. If a different compiler is used, the equivalent of '-c -o \$*.o' should be included with "coptions".

speccopt specifies compiler options for special decks named in array specdk. Occasionally, one needs to compile a few routines with special compiler options in order for the computations to be done correctly (character*128).

specdk those decks to be compiled with compiler options speccopt (character*16(k4)).

loader specifies loader to be used by MAKE (character*16; blank => "compiler"; 'segldr' if compiler='cf77').

loptions loader options (character*128). For convenience, three generic compiler options, 'debug', 'optimise', and 'openmp' are supported, where:

compiler	debug =>	optimise =>	openmp =>
cf77	-g	-O4	-O4 -h omp
f90 -f77	-g	-O4	-O4 -xopenmp
g95	-g	-O2	(not supported)
gfortran	-g	-O2	-O2 -fopenmp
ifort	-g	-O2	-O2 -openmp
pgf77	-g	-fast	-fast -mp
pgfortran	-g	-fast	-fast -mp
xlf	-g	-O4	-O4 -qsmp

These are appended in PRECOM to '-o \$(EXE)', which is needed for the makefile (default = no options).

libs are the libraries to be linked by the loader. As many libraries can be specified as will fit in character*512.

xeq name of executable to be created by MAKE (character*64 to allow for directory specification as well, blank => 'iname' with extension '.x').

Some notes:

1. Default name for precompiled disc file (outname) is inname with extension .f.
2. *EDITOR* is unable to interpret tab characters. For programmers who habitually use tabs in their source code, these should all be replaced manually with the appropriate number of blanks before attempting to preprocess it with *EDITOR*.
3. Should the *EDITOR* precompiler detect any *EDITOR* syntax errors, *EDITOR* will insert an error message immediately following the offending statement in the precompiled file (with the .f extension). Detection of error message will render the precompiled file unusable for compilation purposes, and may prevent additional passes through the code requested by the user (replacing namelists, for example). The user will be told that errors were detected and how to find them in the precompiled disc file. Once the errors are corrected in the master file, the user can attempt to precompile the file again. See §A for a description of the error messages generated by *EDITOR*.
4. Incidentally, the following and very simplified script file (`csH -v tod.s`) precompiles the program `tod` in §2.1 to create `tod.f`.

```
1 #===== SCRIPT FILE TO PRECOMPILE TOD USING XEDIT22 =====#
2 #=====> Prepare input deck inedit.
3 rm -f ./inedit
4 cat << EOF > ./inedit
5 \ $editpar inname='tod', job=4 \$
6 EOF
7 #=====> Retrieve xedit22 and execute.
8 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
9 chmod 755 ./xedit22
10 ./xedit22
11 rm ./editlp ./inedit ./xedit22
```

3 NUMBER: Generating a numbered listing

3.1 Reformatting a file

The NUMBER feature of *EDITOR* will take as input any ordinary ASCII source code and reformat it so that each line of the source code appears with various labels. By default, a separate file (whose name is the same as the input file with the extension `.n` appended) is created containing the reformatted source listing. The original file is left as is.

Each line is labelled with as many as 6 labels. The first and third columns of the reformatted file is the line number since the beginning of the file, with the source code itself (72 characters wide) in the second column. The fourth column is the number of *executable* statements (*i.e.*, not including comments and continuation lines) since the beginning of the current module. The statement number takes into account the number of statements implied by each `*call` statement (§2.1). This is useful, for example, if compiler and/or debugger diagnostics refer to the executable statement number within a module, rather than the ASCII line number as more modern compilers and debuggers do. The fifth column is the number of lines since the beginning of the current module (see `inumber` below). The sixth column is the “group” name in which the current module is grouped (§2.1), while the seventh column lists the name of the current module. The user has some control over what labels are put on each line (see `inumber` below) and how the number of executable statements since the beginning of the current module is computed (see `ixclude` below). A full compliment of labels will expand an ordinary 72 column *FORTTRAN* source listing to 132 columns, so an appropriate printer must be used to print out the reformatted listing. In addition, *EDITOR* may be instructed to place a table of contents at the beginning of the listing. To aid in locating a module rapidly, the table of contents list the modules both sequentially and alphabetically.

3.2 The `number.s` script file

A source listing may be reformatted with NUMBER by issuing the following command:

```
csh -v number.s
```

where `number.s`, is as follows:

```
1 #---+----1----+----2----+----3----+---+----3----+----2----+----1----+---#
2 #===== SCRIPT FILE TO CREATE A NUMBERED LISTING =====#
3 #                                                                 #
4 # User sets: SOURCECODE                                         #
5 #                                                                 #
6 #=====> Get files from home directory.
7 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
8 #-----> Create the input deck for EDITOR, and execute.
9 rm -f ./inedit
10 cat << EOF > ./inedit
11 \ $editpar   inname='SOURCECODE'
12             , ibanner=1, job=1, inumber=3, itable=1, ixclude=1     \$
13 EOF
14 chmod 755 ./xedit22
15 ./xedit22
16 #=====> Tidy up directory.
17 rm -f ./editlp ./inedit ./output ./xedit22
```

A softcopy of `number.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor.

The first segment gets `xedit22` from the user's home directory, if needed. The second segment prepares the input deck for *EDITOR* appropriate for reformatting a source listing. In addition to the general namelist parameters described in §2.5, there are three namelist parameters which may be used specifically to control `NUMBER`.

parameter	description	default
<code>NUMBER (job=1)</code>		
<code>inumber</code>	<code>=1 => sequential numbering of source code only.</code> <code>=2 => sequential, statement, and by subroutine.</code> <code>=3 => sequential, statement, and by deck.</code>	3
<code>itable</code>	<code>=1 => creates a table of contents (inumber=3 only)</code> <code>=0 => no table of contents</code>	1
<code>ixclude</code>	<code>=1 => won't label line with statement number if excluded</code> <code>by *if, *else, *endif logic (inumber=3 only)</code> <code>=0 => labels all executable statements.</code>	1

Some notes:

1. Selecting `inumber=3` specifies that line numbering in the fifth column will be done relative to `*deck` and `*cdeck` statements, rather than *FORTRAN* module statements such as `program`, `subroutine`, `function`, *etc.* (`inumber=2`).
2. Setting `ixclude=1` will exclude “dormant” parts of the source code (as determined by the settings of the *EDITOR* macro definitions; see §2.1) from the computation of the current statement number (fourth column).

4 MERGE: Merging source code

4.1 Change decks

One important feature of *EDITOR* is the ability to merge a “change deck” into an existing source code. This feature is useful from the standpoint of keeping the changes to a working version of a source code separate from the source code itself. Further, change decks are useful to code development projects in which there are several contributors. In principle, a curator of a code may gather in all change decks and let *EDITOR* merge these change decks into the current master code, thereby generating the next version. Finally, each code developer may independently and temporarily merge their own change deck into the current version of the code in order to develop and debug their changes.

Change decks consist largely of the new lines of *FORTTRAN* that the user wishes to place into an existing code, along with any *EDITOR* precompiler statements that may be required. These code segments may either be inserted into the code at a specified location, or replace a specified part of existing code. There are four *EDITOR* commands that control a MERGE:

1. ***insert** *deckname.n* – inserts text immediately following the ***insert** command into the source code directly after line *n* in (c)deck *deckname*.
2. ***delete** *deckname.n,m* – deletes lines *n* through *m* in (c)deck *deckname*, and replaces it with the text immediately following the ***delete** command, if any. Note that *m* must be greater than *n*. If *m* is missing altogether, then *m = n* will be assumed.
3. ***ident** *changedeckname* – identifies the name of the change deck to the code developer. It has no internal (to *EDITOR*) function, and is included for the sole purpose of preserving backward compatibility with *HISTORIAN*. In practise, it never needs to be used.
4. ***read** *filename* – replaces the statement with the contents of the named file. This is how more than one change deck may be merged with a source file at the same time.

The line numbers *m* and *n* are relative to the most recent ***(c)deck** statement, where the ***(c)deck** statement itself is line 1. The line numbers may be attained most easily from the fifth column of a listing of the source code reformatted by **NUMBER** (§3).

Note that ***i**, ***d**, ***id** and ***r** are valid abbreviations of ***insert**, ***delete**, ***ident** and ***read** respectively. For those who don't like the fact that the *delete* command can actually be used to *replace* text, the command ***replace** (or ***rp** for short) is a recognised synonym for ***delete**. Use the two interchangeably. Together, ***delete**, ***insert**, and ***replace** commands shall be referred to as “MERGE edits”.

EDITOR's MERGE may be given *one* master source file and *one* change deck (containing an arbitrary number of ***reads** to other change decks if desired) and creates a new merged file whose name, by default, is the same as the input master source file with the extension **.m** appended. The merger also generates an amalgamated change deck with all the ***read** commands, if any, carried out. This change deck has the same name as the user-specified

change deck with the extension `.m` appended and is where error messages, if any, are inserted. The original files are not changed.

An example might be appropriate at this point. Following is another version of the time-of-day program used in §2, a change deck, and the result of having the two merged by *EDITOR*.

Master source file (named, for example, `tod`):

```

1  *deck tod
2  c====+====1====+====2====+====3====+====4====+====5====+====6====+====7==
3  c
4      program tod
5  c
6  c  PURPOSE: This program returns the time of day on various systems.
7  c
8  c-----
9  c
10     implicit      none
11  *if define,CF77
12     character*8   tod
13  *endif CF77
14  *if define,XLF
15     character*26  tod
16  *endif XLF
17  c
18  c-----
19  c
20  c  Get time of day ("tod").
21  c
22  *if define,CF77
23     call date ( tod )
24  *endif CF77
25  *if define,XLF
26     call fdate_( tod )
27  *endif XLF
28  c
29  c  Write result to CRT.
30  c
31     write ( 6, 2000 ) tod
32 2000  format('Time of day is: ',a)
33     stop
34     end

```

Change deck (named, for example, `chgtod`):

```

1  *define XLF
2  *delete tod.32
3  *if define,CF77
4 2000  format('Time of day according to Cray's CF77 is: ',a)
5  *endif CF77
6  *if define,XLF
7 2000  format('Time of day according to IBM's XLF is: ',a)
8  *endif XLF
9  *insert tod.6
10 c      Supported compilers include Cray's CF77 and IBM's XLF.

```

Master source file (tod) merged with change deck (chgtod) to form new master source file (tod.m):

```

1  *deck tod
2  c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
3  c
4      program tod
5  c
6  c  PURPOSE: This program returns the time of day on various systems.
7  c      Supported compilers include Cray's CF77 and IBM's XLF.      *
8  c
9  c-----
10 c
11      implicit      none
12 *if define,CF77
13      character*8   tod
14 *endif CF77
15 *if define,XLF
16      character*26  tod
17 *endif XLF
18 c
19 c-----
20 c
21 c  Get time of day ("tod").
22 c
23 *if define,CF77
24      call date ( tod )
25 *endif CF77
26 *if define,XLF
27      call fdate_( tod )
28 *endif XLF
29 c
30 c  Write result to CRT.
31 c
32      write ( 6, 2000 ) tod
33 *if define,CF77
34 2000 format('Time of day according to Cray's CF77 is: ',a)
35 *endif CF77
36 *if define,XLF
37 2000 format('Time of day according to IBM's XLF is: ',a)
38 *endif XLF
39      stop
40      end
41 *define XLF

```

Some notes:

1. MERGE commands may *not* appear in the master file, only in the change deck.
2. Anything before the first MERGE edit will be placed at the end of the merged file (*e.g.*, line 41 of tod.m).
3. An asterisk (*) is placed in the 74th column of every line put into the merged master source file by the change deck. This asterisk is only to aid the user to see at a glance which lines are new to this version of the code. If the .m file is then passed through PRECOM (§2), NUMBER (§3), or TARGET (§5), the asterisk in column 74 is not copied to the .f, .n, or .t file respectively.

4. Note that the line numbers used in the `MERGE` edit statements are *always* those of the original master file. That is to say, the user does not have to worry that a `MERGE` edit made somewhere else in the change deck might affect the line numbering for other `MERGE` edits. By the same token, one may not make a `MERGE` edit on a `MERGE` edit in the current change deck. Changes to `MERGE` edits should be done directly in the change deck(s).
5. Obviously, care should be taken to ensure that `MERGE` edits do not refer to lines in the master source that have been deleted by other `MERGE` edits. Such a conflict will generate a (non-fatal) error message (see §A.2).
6. All the punctuation in the `MERGE` commands is optional. “`*d tod 1 3`” is just as valid as “`*d tod.1,3`”. The punctuation used in these examples reflects *HISTORIAN* syntax which *EDITOR* permits for the sake of compatibility.

As a source code preprocessor, *EDITOR* is probably in its most useful state when the `MERGE` and `PRECOM` features are used in tandem which is accomplished by setting the appropriate input parameter (§4.2). One can take a master file and a change deck, merge them together to produce a `.m` file, precompile the `.m` file to generate a `.f` file, replace all the namelists, micro-task it, update only those modules that were affected by whatever change you might have made to the change deck, and generate the new makefile, all with one execution of *EDITOR*. It is in this mode that the author uses *EDITOR* to manage the *ZEUS-3D* code (zeus3d.ca/zeus3d), and therefore the mode which is probably the most debugged and robust. The second sample script file in §4.2 is a template for using *EDITOR* in just this way.

Curators of large codes should be warned that change decks can become too cumbersome and numerous to make this strategy practical. As a first guide, one might consider permanently merging a change deck with the master code once it has grown to 25% the size of the master code. Then a new change deck may be started with references to line numbers in the new version of the master source file.

4.2 The `merge.s` and `merge_precom.s` script files

A merged source listing may be generated by issuing the following command:

```
csch -v merge.s
```

where `merge.s`, is as follows:

```

1 #---+---1---+---2---+---3---+---3---+---2---+---1---+---#
2 #===== SCRIPT FILE TO MERGE A CHANGE DECK INTO A SOURCE CODE =====#
3 #                                                                 #
4 # User sets: CHANGEDECK, SOURCECODE, OUTNAME                       #
5 #                                                                 #
6 #=====> Get files from home directory.
7 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
8 #-----> Create change deck.
9 rm -f ./changes
10 cat << EOF > ./changes
11 *ident changes

```

```

12 *read CHANGEDECK
13 EOF
14 #-----> Create the input deck for EDITOR, and execute.
15 rm -f ./inedit
16 cat << EOF > ./inedit
17   \$editpar   inname='SOURCECODE', outname='OUTNAME'
18             , ibanner=1, job=3, idump=1, inum=0, ipre=0, chgdk='changes' \$
19 EOF
20 chmod 755 ./xedit22
21 ./xedit22
22 #=====> Tidy up directory.
23 rm -f ./editlp ./inedit ./output ./xedit22 ./changes ./changes.m

```

A softcopy of `merge.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor.

The first segment retrieves `xedit22` from the user's home directory, if needed. You could add lines here to retrieve the source code and change deck from their home directory as well.

The second segment generates the change deck to be merged with the master file. The script file will create a disc file called `changes` *after* it has removed any such disc file which may already exist. Thus, don't run this script file *verbatim* within a directory in which there is a file called `changes` that you can't live without! The file `changes` contains the inert `*ident` command, followed by a `*read` command which copies the contents of the user-supplied file `CHANGEDECK` (with the changes required to the master file) onto the file `changes`.

Finally, the third segment creates the input deck for *EDITOR* appropriate for the merge being performed, and then executes *EDITOR*. In addition to the general namelist parameters described in §2.5, there are three namelist parameters which are peculiar to `MERGE`.

parameter	description	default
MERGE (job=3)		
chgdk	name of change deck to be merged with "inname" (character*64).	
inum	=1 => a NUMBERed file will be created. =0 => no NUMBERed file	0
ipre	=1 => a PRECOMpiled file will be created. =0 => no PRECOMpiled file	0

One can use `MERGE` in tandem with either or both `NUMBER` and `PRECOM`. In the case of the former, `inum` should be set to 1 and all the input parameters peculiar to `NUMBER` (3.2) become applicable. If the case of the latter, `ipre` should be set to 1 and all the input parameters peculiar to `PRECOM` (§2.5) become applicable.

Probably the most useful function performed by *EDITOR* is the `MERGE` and `PRECOM` features used in tandem. A precompiled version of a merged *FORTRAN* source code may be generated by issuing the following command:

```
csh -v merge_precom.s
```

where `merge_precom.s`, is as follows:

```
1 #---+----1---+----2---+----3---+---+---3---+----2---+----1---+---#
```

```

2 #===== SCRIPT FILE TO MERGE TWO FILES AND PRECOMPILE THE RESULT =====#
3 #
4 # User sets: DIRECTORY, CHANGEDECK, SOURCECODE, MAKEFILE, EXECUTABLE, #
5 #           COMPILER, LIBRARIES                                     #
6 #                                                                 #
7 # See precom.s for list of compilers and preset compiler options. #
8 #                                                                 #
9 #=====> Get files from home directory.
10 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
11 #=====> If necessary, create the directory DIRECTORY.
12 if(! -e ./DIRECTORY) mkdir ./DIRECTORY
13 #-----> Create change deck.
14 rm -f ./changes
15 cat << EOF > ./changes
16 *ident changes
17 *delete par.3
18     parameter ( idim=100, jdim=100, kdim=100 )
19 *read CHANGEDECK
20 EOF
21 #-----> Create the input deck for EDITOR, and execute.
22 rm -f ./inedit
23 cat << EOF > ./inedit
24   \$editpar   inname='SOURCECODE', chgdk='changes'
25               , ibanner=1, job=3, idump=1, inum=0, ipre=1
26               , inmlst=1, iutask=0, scpred=0, iupdate=1, ext='.f'
27               , branch='DIRECTORY', makename='MAKEFILE', xeq='EXECUTABLE'
28               , compiler='COMPILER', coptions='debug'
29               , libs='LIBRARIES'                                     \$
30 EOF
31 chmod 755 ./xedit22
32 ./xedit22
33 #=====> Tidy up directory.
34 rm -f ./editlp ./inedit ./output ./xedit22 ./changes ./changes.m

```

A softcopy of `merge_precom.s` may be found in the file `edit22.tar` downloaded from the `EDITOR` website: zeus3d.ca/dclarke/editor.

There are a three differences of note between `merge.s` and `merge_precom.s`. First, the second segment creates the directory `DIRECTORY` in anticipation of precompiled subroutines (§2.5).

Second, in the now third segment, lines 17 and 18 have been added which replace line 3 of a deck named `par` with a parameter statement setting `idim`, *etc.* to 100. This illustrates a structure that the author finds very useful, and is why this specific example has been included in this otherwise general template. In this case, a program has been written with all the parameter statements placed together in a common deck called `par`. Every subroutine that requires knowledge of the parameter values then has a `*call par` statement at the beginning of the declaration list. If for every job run, a different set of parameter values is required, the easiest and most accessible place to make this change is right in the script file which merges and precompiles the source code. Thus, right in `merge_precom.s`, one might include the most often-needed changes using the `MERGE` edit structures described in this section. Then, as before, one can issue a `*read` command to bring in the bulk of the changes contained in the user-supplied file `CHANGEDECK`.

Third, the now fourth segment includes settings to the input parameters peculiar to `PRECOM`, as discussed in §2.5.

Some notes:

1. Should the *EDITOR* merger detect any *EDITOR* syntax errors, *EDITOR* will insert an error message immediately following the offending statement in the amalgamated change deck (.m extension). The user will be told that errors were detected and how to find them. Once the errors are corrected in the *original* change deck (*i.e.*, not the .m file where the errors were reported), the user can attempt to merge the files again. See §A.2 for a description of the non-fatal error messages generated by *EDITOR*.
2. If, on the one hand, **MERGE** and **PRECOM** are performed together on the file **myprog**, then *EDITOR* will generate two additional source files, namely **myprog.m** and **myprog.f**. The former will be the result of the merger with all the precompiler commands, if any, remaining while the latter will be a precompiled version ready for the compiler containing nothing but *FORTTRAN* (having had all the precompiler commands carried out and then expunged). If, on the other hand, **MERGE** is used with **ipre=0**, then only a .m file will be generated. Then, if **myprog.m** is passed through the precompiler using **precom.s**, the precompiled file will be named **myprog.m.f**. Note that if the *EDITOR* namelist parameters in the two scenarios have the same values, then the files **myprog.f** and **myprog.m.f** will be *identical*.

5 TARGET: *FORTRAN* tidy-up

The TARGET feature of *EDITOR* was designed to rewrite a user's source code with uniform origin-target labels, continuation characters, and indentation, as well as rearranging the various decks and groups alphabetically. TARGET can also be instructed to replace `do-enddo` structures with targeted do-loops (but not the reverse—reflecting the author's bias!). By default, a separate file (whose name is the same as the input file with the extension `.t` appended) is created containing the tidied source listing. The original file is left as is.

TARGET's primary function is to resequence numbered statements (“targets”) and their corresponding “origins” to regain the order that the writer may have originally intended. Examples of origin and target statements are as follows:

```
1          do 10 i=1,imax
2          ...
3          go to 20
4          ...
5 20      continue
6          ...
7 10      continue
```

Lines 1 and 3 are origins while lines 7 and 5 are their respective targets.

TARGET can recognise virtually all *FORTRAN* structures in which origins and targets may lurk. These include:

1. (nested) do-loops with numbered targets

```
          do 100 i=1,imax
          do 100 j=1,jmax
100      ...
```

2. go to statements

```
          go to 20
20      ...
```

3. computed go to statements

```
          go to (10,20,30) i
10      ...
20      ...
30      ...
```

4. if statements

```
          if (j.eq.1) go to (10,20) i
10      ...
20      ...
```

5. computed if statements,

```
          if (10,20,30) x
10      ...
20      ...
30      ...
```

6. i/o statements (`write`, `print`, `encode`, `read`, `decode`, `open`)

```

        write (6,1000) x
1000   format(f5.2)
        read (lu,end=20,err=100) x
20    ...
100   ...
        open (unit=lu,file=infile,status='old',err=10,form='unformatted')
10    ...

```

As mentioned, **TARGET** may be instructed to convert all `do-enddo` structures into targeted `do`-loops. **TARGET** will scan each program module (*i.e.* deck, program, function, subroutine) for origin and targets and reassign the numerical values of the labels so that the targets (not the origins) appear sequentially (with a specified increment between each consecutive target). Three levels of targets are identified and are resequenced independently. All `do`-loop and `goto` targets (including the `end` and `err` options in the parameter lists of `read` and `open` statements) are considered together and by default, are assigned labels between 10 and 990. All input statements (`read`, `decode`) are resequenced between 1010 and 1990, and all output statements (`write`, `print`, `encode`) are resequenced between 2010 and 2990. This allows one to identify, at a glance, which targets belong to `do/goto` statements, which belong to input statements, and which belong to output statements.

As part of the resequencing process, **TARGET** will force all `do`-loop and `goto` statements to “land” on a `continue` statement, thus displacing the original targeted statement by one line. For `do`-loop targets, the `continue` statement is put *after* the original targeted statement while for `goto` statements, the `continue` statement is placed *before* the original targeted statement. This leaves the logical intent of the code intact.

Besides resequencing origin-target statements, **TARGET** may be instructed to relabel continuation statements and force uniform indentation. These three features are illustrated in the following example:

Original code:

```

        subroutine sub1 (in, jn, x, y, array, irect)
c
c      real x(in), y(jn), array(in,jn)
c
        go to (1,31) irect
31    continue
        do 10 j=1,jn
        do 10 i=1,in
10    array(i,j) = x(i)**2
        .           + 2.0 * x(i) * y(j)
        .           + y(j)**2
        if (imax.le.100) then
        imax = 100
        else
        imax = 200
        endif
1    continue
        return
        end

```

Tidied code:

```

      subroutine (in, jn, x, y, array, irect)
c
      real x(in), y(jn), array(in,jn)
c
      go to (40,10) irect
10     continue
      do 30 j=1,jn
         do 20 i=1,in
            array(i,j) = x(i)**2
1             + 2.0 * x(i) * y(j)
2             + y(j)**2
20     continue
30     continue
      if (imax.le.100) then
         imax = 100
      else
         imax = 200
      endif
40     continue
      return
      end

```

Indentation is applied to both (nested) do-loops and if-else-endif structures as illustrated above. Note that applying uniform indentation forces the source code to begin in column 8, rather than column 7, the minimum allowed by *FORTRAN* syntax. Starting in column 8 means that there will always be at least one space between a continuation character in column 6 and the first character in the statement, thus improving readability. Note also that applying uniform indentation will preserve any vertical structure imposed by the user. Thus, in the example above, the +s remain under the =. If the application of uniform indentation (or resequencing origins) causes the line to extend beyond the 72nd column, **TARGET** will break the line at the 72nd column (without regard to word breaks) and generate a continuation statement with an ampersand (&) in column 6. This will not affect the logic of the source code, but may offend the user's notion of aesthetics. Thus, after **TARGET** has finished with the source code, one merely needs to search the tidied version for an & in column 6 and then make the desired changes manually.

Resequencing continuation characters will cause continuation statements to be given numerical continuation characters in the following sequence: 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 2, 3, etc. Zero (0) is not used, since it is an illegal continuation character in *FORTRAN*.

Finally, **TARGET** can be instructed to rearrange the modules alphabetically according to the full deck name which consists of the group name (as determined by the most recent ***group** statement; §2.1) followed by the deck name (as determined by the most recent ***deck** or ***cdeck** statement; §2.1). Common decks will be placed before ordinary decks. The user may single out a few decks to be placed before all else regardless of where they belong alphabetically. Thus, for example, if there were a deck containing opening comments, or if it was desired to place the program before the subroutines, this may be accommodated by setting the appropriate namelist parameters, as described in the next subsection.

5.1 The target.s script file

A source listing may be tidied by issuing the following command:

```
csch -v target.s
```

where `target.s`, is as follows:

```

1 #---+----1----+----2----+----3----+---+----3----+----2----+----1----+----#
2 #===== SCRIPT FILE TO TIDY UP FORTRAN SOURCE CODE =====#
3 #                                                                 #
4 # User sets: SOURCECODE, FIRST, SECOND, FIRSTCD, FIRSTDK        #
5 #                                                                 #
6 #======> Get files from home directory.
7 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
8 #-----> Create the input deck for EDITOR, and execute.
9 rm -f ./inedit
10 cat << EOF > ./inedit
11  \ $editpar  inname='SOURCECODE', ibanner=1, job=2, idump=1
12             , ibegdo= 10, ienddo= 990, ibegre=1010, iendre=1990
13             , ibegwr=2010, iendwr=2990
14             , inc=10, irepl=1, ireseq=1, indent=2, ialpha=1
15             , first='FIRST', secnd='SECOND', firstcd='FIRSTCD'
16             , firstdk='FIRSTDK'                                     \$
17 EOF
18 chmod 755 ./xedit22
19 ./xedit22
20 #======> Tidy up directory.
21 rm -f ./editlp ./inedit ./output ./xedit22

```

A softcopy of `target.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor.

The first segment retrieves `xedit22` from the user's home directory, if needed. The second segment prepares the input deck for *EDITOR* appropriate for tidying up a source listing. In addition to the general namelist parameters described in §2.5, there are 15 namelist parameters peculiar to *TARGET*. These are described below.

parameter	description	default
TARGET (job=2)		
ibegdo	lowest target value for "goto" and "do" stmts.	10
ienddo	highest target value for "goto" and "do" stmts.	990
ibegre	lowest target value for "read" and "decode" stmts.	1010
iendre	highest target value for "read" and "decode" stmts.	1990
ibegwr	lowest target value for "write" and "encode" stmts.	2010
iendwr	highest target value for "write" and "encode" stmts.	2990
inc	increment between successive targets.	10
irepl	=1 => replace "do-enddo"s with targeted "do"s. =0 => do not replace "do-enddo"s.	1
ireseq	=1 => resequence 6th character in continuation stmts. =0 => no resequence.	1
indent	=0 => no uniform indentation is imposed. >0 => impose uniform indentation of "indent" spaces.	2
ialpha	=0 => no alphabetisation of decks. =1 => modulo specification of "first" etc., "common decks" and "ordinary "decks" are arranged	1

alphabetically. "Common decks" are listed
 before "ordinary decks".

first name of "deck" (common or ordinary) to be listed before
 all others (character*16).

secnd name of "deck" (common or ordinary) to be listed right
 after "first" (character*16).

firstcd name of "common deck" to be listed before all other
 "common decks" but after "secnd" (character*16).

firstdk name of ordinary "deck" to be listed before all other
 ordinary "decks" but after "secnd" (character*16).

It should be noted that TARGET is particularly sensitive to tab characters. *EDITOR* is known to make mistakes and even crash if it encounters a tab character during a TARGET session and so, as mentioned in §2.5, all tab characters should be replaced with the appropriate number of blanks.

6 COMPARE: Comparing similar ASCII files

6.1 Comparing entire files

EDITOR may be instructed to compare two ASCII files character for character and report the differences found in the two files. The locations of where the files diverge and reconverge are reported. Obviously, for two totally dissimilar files, such a report may become unwieldy as chance alignments of the two files are discovered.

What makes *EDITOR*'s **COMPARE** different from **diff** on most *UNIX* platforms is that it may be instructed to ignore superficial or unimportant differences such as those found in *FORTRAN* comments (*i.e.*, lines with a **c** or **C** in the first column), the number of blanks left between "words", and the *FORTRAN* continuation characters chosen (character in column 6). This is an attempt to get beyond the most common differences in programming style and uncover only those differences which may alter the logic of the program. **COMPARE** is also much better at finding where the files reconverge than **diff**. Finally, if there are an unruly number of differences, one may instruct *EDITOR* to stop searching after a specified number of differences have been found.

EDITOR reports the differences by dumping the portion of the line from both files where the difference was found and points to the very character which triggered the report. It also tells the user on which line the two files reconverge. Below is an example of two files with some differences, and the *EDITOR COMPARE* reports generated by comparing these two files un various ways.

File 1 (tod1):

```
1      program tod
2  c-----> This program returns the time of day on various systems.
3      character*8  tod
4  c
5      call date (tod)
6      write (6,10) tod
7  10  format('Time of day is: ',a)
8      stop
9      end
```

File 2 (tod2):

```
1  c===+====1====+====2====+====3====+====4====+====5====+====6====+====7==
2  c
3      program tod
4  c
5  c  PURPOSE: This program returns the time of day on various systems.
6  c
7  c-----
8  c
9      implicit      none
10     character*8  tod
11  c
12     external      date
13  c
14  c-----
15  c
```

```

16 c Get time of day ("tod").
17 c
18     call date ( tod )
19 c
20 c Write result to CRT.
21 c
22     write ( 6, 2000 ) tod
23 2000 format('Time of day is: ',a)
24     stop
25     end

```

These two versions of (presumably) the same program show different programming styles. The task is to find all important differences between these two files, if any. In the report that follows, no superficial differences were ignored and COMPARE behaves much like diff.

```

COMPARE :
COMPARE : diff          "tod1          " "tod2          "
COMPARE :              line          context          line          context
COMPARE : -----
COMPARE : 1 diff @      1              progra          1          c====+====1==
COMPARE :      same @      4              ^              2              ^
COMPARE : 2 diff @      5              call date (t          3              program tod
COMPARE :
COMPARE : Number of differences reported = 2
COMPARE :

```

First the anatomy of this report. The first column (headed by `diff`) labels the differences sequentially. The second column (headed by `tod1`, the name of the first file) gives the line number and a segment of the indicated line in which the difference was discovered for the first file. The third column (headed by `tod2`, the name of the second file) gives similar information for the second file. Each difference report consists of two lines; where the files diverge (`diff @`) and where the files reconverge (`same @`). The “`diff @`” line gives the context of the file in which the difference was discovered centred over a carat (^) which indicates the first character found to be different. For entirely different lines, this will generally be the first character in the line. The “`same A`” line indicates on which line in each file the files reconverge, and contains the carats.

This particular report is of little use. It basically states that the two files differ right from the start (note that one file is indented with six blanks, the other with seven), happen to be the same again where both files have an empty comment line, then differ throughout the rest of the files. Since the files never reconverge, the “`same at`” line for the second difference report is never issued, and thus neither are the carats. These two files are basically too different for an all-difference report to be of much use.

In the second report which follows, differences stemming from blanks were ignored. It is a bit more useful than the first report since reported differences are more localised.

```

COMPARE :
COMPARE : diff          "tod1          " "tod2          "
COMPARE :              line          context          line          context
COMPARE : -----
COMPARE : 1 diff @      1              program          1          c====+====1==
COMPARE :      same @      1              ^              3              ^
COMPARE : 2 diff @      2              c-----          4              c

```

```

COMPARE :      same @      4      ^      4      ^
COMPARE :    3 diff @      5      ^    call dat    5      c  PURPOSE:
COMPARE :      same @      5      ^      18      ^
COMPARE :    4 diff @      6      ^    write (6    19      c
COMPARE :      same @      8      ^      24      ^
COMPARE :
COMPARE : Number of differences reported =    4
COMPARE :

```

The first difference reports that the first two lines of each file are different (`tod2` begins with a comment, `tod1` begins with the program statement) and that the two files reconverge again at line 1 of `tod1` and line 3 of `tod2`. Still, there is chaff amongst the wheat if one is not interested in the differences generated by comment statements.

Finally, the third report which follows was generated with differences in comments and blanks overlooked.

```

COMPARE :
COMPARE : diff          "tod1          " "tod2          "
COMPARE :              line          context          line          context
COMPARE : -----
COMPARE :    1 diff @      3          character*8      9          implicit
COMPARE :              same @      3          ^            10         ^
COMPARE :    2 diff @      5          call date (t    12          external
COMPARE :              same @      5          ^            18         ^
COMPARE :    3 diff @      6  write (6,10) tod    22  rite ( 6, 2000 ) tod
COMPARE :              same @      8          ^            24         ^
COMPARE :
COMPARE : Number of differences reported =    3
COMPARE :

```

In this case, COMPARE reports that `tod2` has an `implicit` statement and an `external` statement whereas `tod1` does not, and that the target for the write statement differs in the two versions (10 in `tod1`, 2000 in `tod2`). This is perhaps the most useful of all reports, and illustrates the power of being able to ignore selectively various types of differences.

6.2 Comparing declaration contents

The second way *EDITOR* may compare two files is by comparing the contents of their respective declaration lists *without regard to format*. This mode of comparison does not extend into the body of the *FORTRAN* module containing the *FORTRAN* executables. The utility of this feature is perhaps best illustrated by an example. In an attempt to align a subroutine with a particular coding style, suppose one wishes to reformat all the declarations at the beginning of a program module from the style illustrated in the file `dec1` to that in file `dec2` below:

Style 1 (file `dec1`):

```

implicit none
integer idim, jdim
parameter (idim=100,jdim=100)
integer i,j,is,ie,js,je,ieqs(10)
real s1,v1(idim),w1(jdim),a1(idim,jdim),s2,v2(idim),w2(jdim),

```

```

.a2(idim,jdim)s3,v3(idim),w3(jdim)s4,s5,s6,s7,s8,s9,s10,
.reqs(10),reqv(3*idim+3*jdim)
c
  equivalence (ieqs(1),i),(ieqs(2),is),(ieqs(3),ie),(ieqs(4),j),
.(ieqs(5),js),(ieqs(6),je)
  equivalence (reqs(1),s1),(reqs(2),s2),(reqs(3),s3),(reqs(4),s4),
.(reqs(5),s5),(reqs(6),s6),(reqs(7),s7),(reqs(8),s8),(reqs(9),s9),
.(reqs(10),s10),(reqv(1),v1(1)),(reqv(idim+1),v2(1)),
.(reqv(2*idim+1),v3(1)),(reqv(3*idim+1),w1(1)),
.(reqv(jdim+3*idim+1),w2(1)),(reqv(2*jdim+3*idim+1),w3(1))
  common /comi/ ieqs
  common /comr/ reqs,reqv,a1,a2

```

Style 2 (file dec2):

```

c-----
c----- IMPLICIT STATEMENT -----
c-----
      implicit      none
c-----
c----- PARAMETERS -----
c-----
      integer      idim      , jdim
      parameter    ( idim = 100, jdim = 100 )
c-----
c----- VARIABLES -----
c-----
      integer      i          , is          , ie
      1            , j          , js          , je
      real         s1         , s2         , s3         , s4         , s5
      1            , s6         , s7         , s8         , s9         , s10
      2            , s11        , s12
c
      real         v1         (idim), v2         (idim), v3         (idim)
      1            w1         (jdim), w2         (jdim), w3         (jdim)
c
      real         a1         (idim,jdim), a2         (idim,jdim)
c-----
c----- EQUIVALENCE STATEMENTS -----
c-----
      integer      ieqs      ( 10)
      equivalence
      1 (ieqs( 1),i          ),(ieqs( 2),is          ),(ieqs( 3),ie          )
      2 ,(ieqs( 4),j          ),(ieqs( 5),js          ),(ieqs( 6),je          )
c
      real         reqs      ( 20)
      equivalence
      1 (reqs( 1),s1          ),(reqs( 2),s2          ),(reqs( 2),s3          )
      2 ,(reqs( 4),s4          ),(reqs( 5),s5          ),(reqs( 6),s6          )
      3 ,(reqs( 7),s7          ),(reqs( 8),s8          ),(reqs( 9),s9          )
      4 ,(reqs(10),s10         ),(reqs(11),s11         ),(reqs(12),s12         )
c
      real         reqv      (3*idim+3*jdim)
      equivalence ( reqv      (          1), v1          (1) )
      1            , ( reqv      (          idim+1), v2          (1) )
      2            , ( reqv      (          2*idim+1), v3          (1) )
      3            , ( reqv      (          3*idim+1), w1          (1) )
      4            , ( reqv      (          jdim+3*idim+1), w1          (1) )

```

```

      5          , ( reqv (2*jd+3*id+1), w3 (1) )
c-----
c----- COMMON BLOCKS -----
c-----
      common /      comi / ieqs
      common /      comr / reqs , reqv , a1 , a2

```

Upon comparing these two declaration modules, *EDITOR* would issue the following difference report:

```

COMPARE :
COMPARE : The following declarations were not found in file "dec1      "
COMPARE :      real      s11
COMPARE :      real      s12
COMPARE :      real      reqs(20)
COMPARE :      equivalence (reqs(2),s3)
COMPARE :      equivalence (reqs(11),s11)
COMPARE :      equivalence (reqs(12),s12)
COMPARE :      equivalence (reqv(jd+3*id+1),w1(1))
COMPARE :
COMPARE : The following declarations were not found in file "dec2      "
COMPARE :      real      reqs(10)
COMPARE :      equivalence (reqs(3),s3)
COMPARE :      equivalence (reqv(jd+3*id+1),w2(1))
COMPARE :

```

Obviously, several changes other than formatting changes were introduced when `dec1` was recast into `dec2`. Some of the changes may have been deliberate (the addition of variables `s11` and `s12`, increasing the dimension of `reqs` from 10 to 20) while the remainder are probably typos (in the equivalence statements in `dec2`, `reqs(2)` and `w1` appear twice while `reqs(3)` and `w2` do not appear at all).

6.3 The compare.s script file

Two source listings may be compared by issuing the following command:

```

csh -v compare.s

```

where `compare.s`, is as follows:

```

1 #---+---1---+---2---+---3---+---3---+---2---+---1---+---#
2 #===== SCRIPT FILE TO COMPARE TWO LISTINGS =====#
3 #                                                                 #
4 # User sets: SOURCECODE1, SOURCECODE2                          #
5 #                                                                 #
6 #=====> Get files from home directory.
7 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
8 #-----> Create the input deck for EDITOR, and execute.
9 rm -f ./inedit
10 cat << EOF > ./inedit
11 \ $editpar inname='SOURCECODE1', in2name='SOURCECODE2'
12           , ibanner=1, job=5, icompar=1, ndiff=100, ignore=0,0,0 \ $
13 EOF
14 chmod 755 ./xedit22
15 ./xedit22
16 #=====> Tidy up directory.
17 rm -f ./editlp ./inedit ./output ./xedit22

```

A softcopy of `compare.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor.

The first segment retrieves `xedit22` from the user's home directory, if needed. You may wish to add two similar lines to retrieve from their home directories the two files to be compared (`SOURCECODE1` and `SOURCECODE2`). The second segment prepares the input deck for *EDITOR* appropriate for comparing two source listings. In addition to the general namelist parameters described in §2.5, there are four namelist parameters peculiar to *COMPARE*. These are described below.

parameter	description	default
<code>COMPARE (job=5)</code>		
<code>in2name</code>	name of file to be compared with "iname" (char*64).	
<code>icompar</code>	=1 => report first "ndiff" differences =2 => list discrepancies in declarations	1
<code>ndiff</code>	maximum number of differences to report (<code>icompar=1</code> only).	100
<code>ignore</code>	integer vector indicating types of differences to report (0) or ignore (1). <code>ignore(1)</code> : continuation characters; <code>ignore(2)</code> : blanks; <code>ignore(3)</code> : comments (<code>icompar=1</code> only).	0,0,0

Some notes:

1. `ignore` is a vector with 3 elements. The first, second, and third elements pertain to continuation characters, blanks, and comments respectively. If any element is 1, that type of difference is ignored, otherwise, it is reported. So, for example, if one wanted to find the differences between two files with differences in continuation characters and comments overlooked (but differences in the number of blanks between words reported), one would set `ignore=1,0,1`.
2. Comparison of declarations may cause an overflow to occur if *EDITOR* was compiled with parameter `k9` set too small. See §9.3 and §A.1.

7 SPLIT: Splitting source code

7.1 Splitting a file

As part of the precompilation process, splitting up a file was discussed in §2.4. One can perform the split outside PRECOM using `SPLIT`, but it does not include the checking feature that the precompilation split allows. That is to say, no effort is made to check if the file being overwritten *needs* to be updated.

This feature of *EDITOR* is very similar to `fsplit`. The *EDITOR* `SPLIT` names each file it creates with the module name and the user-specified extension appended. It will allow the user to specify in which directory all files are to be placed.

7.2 The `split.s` script file

A source listing may be split by issuing the following command:

```
csch -v split.s
```

where `split.s`, is as follows:

```
1 #---+---1---+---2---+---3---+---3---+---2---+---1---+---#
2 #==== SCRIPT FILE TO SPLIT A SOURCE CODE INTO FILES FOR EACH DECK ====#
3 #                                                                 #
4 # User sets: DIRECTORY, SOURCECODE                               #
5 #                                                                 #
6 #=====> Get files from home directory.
7 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
8 #=====> If necessary, create the directory "DIRECTORY".
9 if(! -e ./DIRECTORY) mkdir ./DIRECTORY
10 #-----> Create the input deck for EDITOR, and execute.
11 rm -f ./inedit
12 cat << EOF > ./inedit
13 \${editpar  inname='SOURCECODE', ibanner=1, job=6, idump=1, ext='.f'
14           , branch='DIRECTORY'                                     \${
15 EOF
16 chmod 755 ./xedit22
17 ./xedit22
18 #=====> Tidy up directory.
19 rm -f ./editlp ./inedit ./output ./xedit22
```

A softcopy of `split.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor.

The first segment retrieves `xedit22` from the user's home directory, if needed. The second segment prepares the input deck for *EDITOR* appropriate for splitting a source listing. In addition to the general namelist parameters described in §2.5, two of the namelist parameters used to control PRECOM are also used by `SPLIT`. These are described below.

parameter	description	default
<code>SPLIT (job=6)</code>		
<code>branch</code>	character*32 string indicating directory in which separate files are written.	blank
<code>ext</code>	desired extension for files (character*8)	' <code>.src</code> '

8 CONCAT: Concatenating files

EDITOR's `CONCAT` goes beyond the UNICOS utility `cat` by bringing together all files with the same specified extension located in the specified directory *or any of its subdirectories* into a single source file.

8.1 The `concat.s` script file

Source listings may be concatenated by issuing the following command:

```
    csh -v concat.s
```

where `concat.s`, is as follows:

```
1 #---+---1---+---2---+---3---+---3---+---2---+---1---+---#
2 #===== SCRIPT FILE TO CONCATENATE FILES INTO ONE FILE =====#
3 #                                                                 #
4 # User sets:  OUTFILE, DIRECTORY                                #
5 #                                                                 #
6 #=====> Get files from home directory.
7 if(! -e ./xedit22) cp ~dclarke/editor/version2.2/xedit22 .
8 #-----> Create the input deck for EDITOR, and execute.
9 rm -f ./inedit
10 cat << EOF > ./inedit
11  \${editpar  outname='OUTFILE', ibanner=1, job=7, idump=1, ext='.f'
12           , branch='DIRECTORY'                                     \$
13 EOF
14 chmod 755 ./xedit22
15 ./xedit22
16 #=====> Tidy up directory.
17 rm -f ./editlp ./inedit ./output ./xedit22
```

A softcopy of `concat.s` may be found in the file `edit22.tar` downloaded from the *EDITOR* website: zeus3d.ca/dclarke/editor.

The first segment retrieves `xedit22` from the user's home directory, if needed. The second segment prepares the input deck for *EDITOR* appropriate for concatenating source listings. In addition to the general namelist parameters described in §2.5, two of the namelist parameters used to control `PRECOM` are also used by `CONCAT`. These are described below.

parameter	description	default
CONCAT (job=7)		
branch	character*32 string indicating top directory from which files are sought.	blank
ext	common extension of files (character*8).	' <code>.src</code> '

9 Installing *EDITOR*

9.1 Installation

This section describes how to install *EDITOR* on your *UNIX*-based system.

From the website zeus3d.ca/dclarke/editor, download the “gzipped” file `edit22.tar.gz` into a directory you wish to contain the *EDITOR* directory. Then, upon issuing the commands:

```
gunzip edit22.tar.gz
tar -xvf edit22.tar
cd editor_v2.2_ICA
ls -FC *
```

the following should appear on your screen:

```
README          bldlib2*

editor:
compare.s          edit22.GFORTRAN.f      merge_precom.s
concat.s           edit22.IFORT.f         number.s
edit22             edit22.PGF77.f        precom.s
edit22.CF77.f     edit22.XLF.f          split.s
edit22.F90.f      edit22.s               target.s
edit22.G95.f      merge.s

manuals:
edit22_man.pdf

nmlst:
dnamelist          dnamelist.s          namelist            namelist.s
```

These are all the files needed to run and operate the program `edit22`, version 2.2 of *EDITOR*.

EDITOR actually manages itself. That is, peppered throughout *EDITOR* are numerous *EDITOR* commands described in §2.1. Other than the `*dk` and `*cd` statements, these are mostly `*if def...*endif` constructs to account for the various compilers *EDITOR* supports. Therefore, to get things started, precompiled versions of `edit22` for each supported compiler (named `edit22.<comp>.f`, where `<comp>` is one of `CF77`, `F90`, ..., `XLF`) are provided in the directory `editor`, each stripped of all *EDITOR* commands and tailored for the named compiler.

The following instructions are written assuming Gnu’s `gfortran` is being used. For other compilers, make the appropriate substitutions.

Step 1: Create a preliminary `edit22` executable, `xedit22`. Since `edit22` manages itself, in principle one needs the `edit22` executable in order to compile it! Thus, a bit of a “bootstrap” process is required to complete the compilation.

Go to directory `editor`.

1.1) If using one of the supported compilers (*e.g.*, `gfortran`), type:

```
gfortran -o xedit22 edit22.GFORTRAN.f
```

This creates the preliminary `xedit22` executable. Move on to step 2.

1.2) If using a compiler not supported by `edit22` (let's call it `FCOMP`), you will have to modify `edit22.GFORTRAN.f` as follows. Type:

```
cp edit22.GFORTRAN.f edit22.FCOMP.f
FCOMP -o xedit22 edit22.FCOMP.f
```

If this fails (and it may not!), it will likely do so by citing calls to unknown subroutines such as `cpu_time`, `date_and_time`, and `system`. For many compilers, these subroutines do the following:

<code>cpu_time</code>	returns the cpu time since the beginning of the run in seconds;
<code>date_and_time</code>	returns eight integers giving the year, month, day, <i>etc.</i> Search for <code>date_and_time</code> in <code>edit22</code> for details.
<code>system</code>	executes a systems call (such as removing a disc file) at run time.

You will have to find the equivalents to these functionalities for your compiler. Once determined, open up `edit22.FCOMP.f` in a text editor, find the offending system calls, and make the necessary replacements. Then, once again, type:

```
FCOMP -o xedit22 edit22.FCOMP.f
```

remembering to replace `FCOMP` with the actual name of your compiler. This should produce a preliminary `edit22` executable (`xedit22`) needed through step 4.

Step 2: From directory `editor_v2.2_ICA`, open the script file `blplib2` in your text editor. The entire file should be platform independent with the possible exception of line 21 which invokes the `gfortran` compiler whose given options create object files without linking (`-c`), and uses the fastest safe optimisation level (`-O2`). If a compiler other than `gfortran` is being used, line 21 must be changed appropriately. Options for other commonly used compilers (for optimising and debugging) are given in the header.

Step 3: From the directory `nmlst`, issue the following commands:

```
csh -v namelist.s
csh -v dnamelist.s
```

These commands will create single- and double-precision versions of the platform-independent namelist libraries (`libnmlst.a` and `libdnmlst.a` respectively). The former is required for `edit22` while the latter is included to link to double precision software that the user may wish to manage with *EDITOR*.

Step 4: If you are using one of the seven supported compilers, go to step 5. If not, you must put all the changes you made to create `edit22.FCOMP.f` into the “master copy” of *EDITOR*, namely `edit22`.

From the directory `editor`, open `edit22.FCOMP.f` in one text editing window, `edit22` in another. Without deleting any lines in `edit22`, add your system-dependent changes to `edit22`. Make sure each addition is bracketed with:

```
*if def FCOMP
...
*endif FCOMP
```

using the other compiler options (CF77, GFORTRAN, *etc.*) as a template.

It may be that some of the compiler-dependent calls in `edit22.GFORTRAN.f` worked just fine for your compiler. Find these by searching for “`if def,GFORTRAN`”, and add your compiler name to the list of compilers in the “`if def,`” statements surrounding the segments of code that work for your compiler. Thus, change “`if def,GFORTRAN`” for “`if def,GFORTRAN.or.FCOMP`”, *etc.*

Step 5: From the directory editor, open `edit22.s` (described in §9.2) and, for compilers other than `gfortran`, replace `gfortran` in line 9 with the desired compiler. Then type:

```
csch -v edit22.s
```

which creates your final working version of `xedit22` (replacing the temporary executable created in step 1), and leaves it in the directory editor. You are now ready to go.

9.2 The script file `edit22.s`

The script file `edit22.s` used in the previous section to install *EDITOR* serves as a good example of how the author uses *EDITOR* in practise. For the purposes of this discussion, the file is reproduced below, with an electronic copy of the same file in the directory editor of `edit22.tar` downloaded from zeus3d.ca/dclarke/editor.

```
1 #---+-----1-----+-----2-----+-----3-----+-----3-----+-----2-----+-----1-----+-----#
2 #===== SCRIPT FILE TO CREATE THE EDITOR EXECUTABLE =====#
3 #-----> Select FORTRAN compiler.
4 #
5 # Supported compilers include:
6 #   cf77 (Cray), f90 (Sun), g95 (g95.org), gfortran (Gnu), ifort
7 #   (Intel), pgf77 (Portland Group), xlf (IBM)
8 #
9 setenv FCOMP gfortran
10 #-----> Get files from home directory.
11 if(! -e ./libnmlst.a) cp ../nmlst/libnmlst.a .
12 #-----> If necessary, create the directory "editor2.2".
13 if(! -e ./editor2.2) mkdir ./editor2.2
14 #-----> Create the change deck.
15 rm -f ./chgedit
16 cat << EOF > ./chgedit
17 *define $FCOMP
18 *delete par.10,11
19     parameter      ( k1=1000, k2=100000, k3=2000, k4=2000, k5=2000
20     1                , k6=128, k7=1000, k8=1000, k9=4000 )
21 EOF
22 #-----> Create the input deck for EDITOR, and execute.
23 rm -f ./inedit
24 cat << EOF > ./inedit
25 \ $editpar   inname='edit22', chgdk='chgedit', safety=0.4
26             , idump=1 ,job=3, ipre=1, inmlst=1, iupdate=1, iutask=0
27             , ext='.f', branch='editor2.2', xeq='xedit22'
```

```

28             , compiler='$FCOMP', makename='makeedit'
29 c           , coptions='debug'
30             , coptions='optimise'
31             , libs='libnmlst.a'                \$
32 EOF
33 chmod 755 ./xedit22
34 ./xedit22
35 #=====> MAKE the EDITOR executable.
36 make -f ./makeedit
37 #=====> Tidy up directory.
38 rm -f ./inedit ./output ./editlp ./chgedit ./chgedit.m ./libnmlst.a

```

On line 9 of the first segment, the desired *FORTRAN* compiler is selected. Here, *FCOMP* is a “system variable” (no longer representing the user’s hypothetical *FORTRAN* compiler in §9.1) set by the *UNIX* *setenv* command, and is used in two places. First, on line 17 it serves as the *EDITOR* macro to tailor *edit22* to the chosen compiler. Second, on line 28 it is the setting for the namelist parameter *compiler* in the input deck *inedit* which determines which compiler is used to compile *edit22*.

Line 11 of the second segment retrieves the namelist library *libnmlst.a* from the directory *./nmlst*.

Line 13 of the third segment creates the directory *editor2.2* into which all files split from the master source file *edit22* and object files once compiled are placed.

The fourth segment (lines 14–21) generates the change deck *chgedit* which gets merged with the master file *edit22*. Line 17 sets the compiler by defining the appropriate *EDITOR* definition and, if there were any other *EDITOR* definitions or aliases to set, they could be set here too. Next, the change deck sets values for the parameters described in §9.3. Because of the memory management built into *EDITOR*, it is unlikely that these values would ever have to be changed from those given.

If there were numerous *EDITOR* macro settings, one might consider placing them all in a separate file (called, for example, *edit22.mac*) and then replace line 17 with the statement **read edit22.mac*. In this way, the script file will remain concise, and only those changes which need to be the most accessible (setting the parameter values, for example) would remain in the script file itself. Similarly, if there were numerous changes to be merged into the code before precompilation, these could be put into a separate file called *chged22*, say, then the statement **read chged22* would be inserted after line 20. Again, this keeps the file *edit22.s* uncluttered.

The fifth segment generates the namelist input data file *inedit* which instructs the current version of the *EDITOR* binary executable *xedit22* how to preprocess *edit22*. In this example, the namelist parameters are set so that *chgedit* will first be merged into *edit22* which is then precompiled (since *ipre=1*) for *gfortran* with the namelist replacement feature *on* (*inmlst=1*), the conditional splitting feature *on* (*iupdate=1*), and the micro-tasking feature *off* (*iutask=0*). All files split from the merged master source code will be placed in the directory *editor2.2* and will have the extension *.f*, appropriate for *FORTRAN* source code. Since *iupdate=1* and *makename* is set to a non-blank character string in the input deck, a makefile with the name *makeedit* will be generated. The makefile will use the compiler *gfortran -c* and loader *gfortran* with the highest safe optimisation (*coptions='optimise'* not commented out). The library *libnmlst.a* will be linked

with the *EDITOR* object code to generate a binary executable called `xedit22`. Finally, the current version of `xedit22` is launched by line 34, and `edit22` is preprocessed.

Line 36 in the sixth segment fires up the makefile `makeedit` generated in the previous segment. This compiles and links the new *EDITOR* code generating a new version of `xedit22`, overwriting the version of `xedit22` which did the preprocessing.

Finally, line 38 of the last segment removes some of the intermediate files no longer needed. A few of the intermediate files (*e.g.*, `edit22.f`, `edit22.m`, and `makeedit`) are left intact, as these can be useful for debugging should something go awry.

9.3 *EDITOR* parameters

As *FORTRAN* uses static memory, there are numerous parameters that *EDITOR* requires to set internal array sizes. For the most part, the default settings should be fine for any application with any compiler. However, in case the user needs to change any of them, an exhaustive list of *EDITOR*'s parameters, what they limit, and their default values are given below.

parameter	interpretation	default
k1	maximum number of errors to be reported	1,000
k2	maximum number of lines in source code to be processed	100,000
k3	maximum number of origins per module (TARGET)	2,000
k4	maximum number of decks in source code	2,000
k5	maximum number of targets per module (TARGET)	2,000
k6	maximum number of characters per line of source code	128
k7	maximum number of <i>EDITOR</i> definitions	1,000
k8	maximum number of <i>EDITOR</i> aliases	1,000
k9	maximum number of variables within a module	4,000

The purpose of the last parameter `k9` depends on the *EDITOR* function. When comparing declaration lists of two files (§6.2), `COMPARE` will only allow as many `k9` variables of *each* type (real, integer, *etc.*). The namelist replacement feature (§2.2) will allow as many as `k9` variables to be defined in each namelist. Finally, the micro-tasking feature (§2.3) will scope as many as `k9` variables in each nested loop structure it encounters. The default values listed above should be more than adequate for most purposes.

The parameter `k2` sets the maximum number of lines read *at a time* from the user's source file being processed. A source file of *any* arbitrary size may be read. However, if the source code is too long, the file will be read in pieces rather than all at once in order to avoid surpassing the memory available on your machine. Thus, *EDITOR* is built with an effort made toward memory management, and this should be entirely transparent to the user. A 100,000 line source code may be read in and processed all at once (with `k2` set as high as need be) or in various pieces. The end result will be identical. There are a few factors to be considered in choosing the appropriate value of `k2`.

1. *EDITOR* is *slightly* faster if `k2` is large enough to read the entire input file at once, but only slightly.
2. The amount of memory required by *EDITOR* is largely dictated by `k2`. There are four `character*128` arrays dimensioned with `k2`. Thus, the memory required by these

arrays for `k2=100000` (the default) is 51.2 Mbytes. It turns out that the size of the *EDITOR* executable with `k2=100000` is 52.4 Mbytes, so it is clear that the `k2` arrays are the dominant sink of memory. Use these numbers to guide your selection for `k2` and choose as large a value as may be conveniently handled by your machine.

3. The number of lines read by *EDITOR* at a time will be at most `safety*k2`. The variable `safety` may be set in the namelist input data file `inedit` (§2.5 and §9.2) and reflects the fact that the source code is apt to expand during preprocessing. For `NUMBER`, the expansion is minimal (table of contents only), and so `safety=0.9` is probably OK. For `TARGET`, the same. However, for `MERGE` the amount of expansion depends on how much extra coding is being merged with the original file. For `PRECOM` the `*call` statements can result in *substantial* expansion of the source file. Thus, setting `safety=0.4` or smaller may be appropriate. If `safety` is set too high and an overflow results, execution will be aborted and the user will be asked to use a smaller value for `safety` (see §A.1). Since *EDITOR* reads only complete decks and in general, a deck won't happen to end after exactly `safety*k2` lines, *EDITOR* will usually read less than `safety*k2` lines at a time. If there are individual decks with more than `safety*k2` lines, this will create an overflow condition, and execution will abort (§A.1). The user must then do one or more of the following: resubmit the *EDITOR* job with a larger value of `safety` (at the risk of generating overflows when the new files expand); rewrite the source code with smaller decks; or recompile *EDITOR* with a larger value of `k2`. If none of these can be done, *EDITOR* may not be used for the desired task on the chosen machine.

A Error messages

Error messages come in four flavours. The most serious cause *EDITOR* to abort execution and usually require it to be recompiled with higher values for one or more parameters. The second type consist of error messages caused by incorrect *EDITOR* syntax in the files being processed. These are not fatal to *EDITOR* itself, but will mean that the files processed by *EDITOR* will be unusable for their intended purpose. *EDITOR* will insert these error messages directly below the offending line in the output file. Note that original input files supplied by the user are *never* altered by *EDITOR*. The third type are warning messages which are echoed on the terminal screen. In this release, there is only one warning, and it is completely innocuous. Finally, if the user's program is preprocessed with the namelist replacement feature (§2.2), syntax errors in the user's namelist input data file will generate fatal error messages at run time.

A.1 Fatal errors

Fatal error messages which abort *EDITOR* arise under two conditions. Either an overflow has occurred (in which case *EDITOR* may have to be recompiled with one of its parameters set to a higher value), or the file that *EDITOR* was trying to read was not found or was found to be corrupted. All fatal error messages indicate which *EDITOR* subroutine found the problem (of no real use except possibly to *EDITOR* programmers) and what the problem is, followed by the unwelcome message: **ABORTS!**. Internally, the **ABORTS!** message is always followed by a **stop** statement, so this message really means what it says.

These messages are listed here alphabetically, with some descriptive text interleaved where necessary. The first set of messages come from **COMPARE** (§6) and, in particular, when the declarations of two files are being compared. These all require that *EDITOR* be recompiled with a larger value of **k9** (§9.3). Note that *n* indicates the current value of **k9** as already compiled.

```
COMPARE : Number of character variables exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

```
COMPARE : Number of data assignments exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

```
COMPARE : Number of equivalences exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

```
COMPARE : Number of externals declared exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

```
COMPARE : Number of integer variables exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

```
COMPARE : Number of logical variables exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

```
COMPARE : Number of parameters exceeded n. Increase parameter k9.  
COMPARE : ABORTS!
```

COMPARE : Number of real variables exceeded n. Increase parameter k9.
COMPARE : ABORTS!

COMPARE : Number of variables in common exceeded n. Increase parameter k9.
COMPARE : ABORTS!

CONCAT (§8) has one trap which will abort execution should it have trouble reading a particular line (*i*) in a named file (*filename*). This indicates that the file may be corrupted or is shorter than *EDITOR* anticipated. Check the contents of the file, particularly around the indicated line.

CONCAT : Problem reading line i in file "filename"
CONCAT : ABORTS!

If a user-specified input file isn't actually there, the following message will be issued. Check that *filename* was spelled correctly, or that the file is in the proper directory.

OFFILE : Problem opening file "filename"
OFFILE : ABORTS!

While *EDITOR* has been designed with considerable effort toward memory management (§9.3), it is still possible for overflows to occur. There are two types of overflow. One can be corrected only by recompiling *EDITOR* with a larger value for the parameter *k2* (§9.3). The other may be corrected by resetting the parameter *safety* in the namelist input data file *indata* (§2.5 and §9.2) to a lower value, then executing *EDITOR* again. Note that the latter case does *not* require recompiling *EDITOR*.

The overflowed text is not written to the intended file, but to an emergency file called "OVERFLOW.TXT" that the subroutine *OVERFLOW* opens, writes to, and closes before it aborts execution. It may help to examine the contents of this file, but in all likelihood, all one can do is to reset *k2* and/or *safety*. Following are the *OVERFLOW* fatal error messages. They indicate which subroutine originally detected the overflow and whether to recompile with a higher value for *k2* or to resubmit with a lower value of *safety*. The last message is probably trouble since it implies that enough error messages were inserted to exceed array bounds.

OVERFLOW: File overflow in CDECKS. Increase parameter "k2"
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

OVERFLOW: File overflow in MERGE. Increase parameter "k2"
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

OVERFLOW: File overflow in MERGE. Specify lower value for "safety" than x
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

OVERFLOW: File overflow in NMLST. Specify lower value for "safety" than x
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

OVERFLOW: File overflow in PARALLEL. Increase parameter "k2"
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"

OVERFLOW: ABORTS!

OVERFLOW: File overflow in PRECOM. Specify lower value for "safety" than x
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

OVERFLOW: File overflow in TARGET. Specify lower value for "safety" than x
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

OVERFLOW: In ERRMSG, attempt to insert error message causes a file overflow
OVERFLOW: Overflowed text file written to file "OVERFLOW.TXT"
OVERFLOW: ABORTS!

Finally, the subroutine which reads text once a text file is opened (RFILE) can fall into traps. *EDITOR* will always attempt to read entire decks or modules of a source code (§9.3). If it cannot (that is, if `safety*k2` is *less* than the number of lines in the largest deck), then execution will abort. In addition, if the file being read is corrupted or smaller than anticipated, a fatal error message will be generated.

RFILE : A module in file "filename" is longer than i lines
RFILE : Increase parameter "k2"
RFILE : ABORTS!

RFILE : Array bounds exceeded while reading file "filename"
RFILE : Increase parameter "k2"
RFILE : ABORTS!

RFILE : Problem reading line i in file "filename"
RFILE : ABORTS!

A.2 Non-fatal errors

There are a variety of error messages that *EDITOR* inserts into the output files should it uncover any *EDITOR* syntax errors or some selected *FORTRAN* syntax errors. These errors do not abort execution. *EDITOR* simply notes the error, leaves the errant line in the output file (as opposed to syntactically correct *EDITOR* statements which once carried out are expunged from the output file), and moves on. Every effort has been made to ensure that the error message will appear immediately after the offending line in the output file. This requires a rather elaborate accounting scheme which keeps track of every line added or deleted from the file so that the pointers which indicate where the error messages should be inserted are kept up to date. This logic is prone to flaws and, while the author hasn't noted a single case of a misplaced error message in several years of constant use, it is still conceivable that the occasional error message will appear out of context.

Non-fatal error messages may be generated only by PRECOM (§2), MERGE (§4), or TARGET (§5). The appropriate section should be consulted for the correct syntax of the desired operation. Note that the input files are *never* altered by *EDITOR*. Thus, error messages appear in the `.f`, `.m`, or `.t` output files only, not the input files. Nevertheless, corrections should be made to the original input files—making them to the output files where the error messages appear will have no effect.

CDECKS : **** ERROR 1 **** > 10 nested *calls. Does a *cdeck call itself?

This indicates that the user has exceeded the internal *EDITOR* limit of 10 nested *calls to common decks. Since it is unlikely such a complex structure would be deliberate, the message suggests that perhaps the calling tree is closed. *e.g.*, perhaps, common deck 1 calls common deck 2 which calls common deck 3 which calls common deck 1, or something to that effect. If so, this should be corrected.

CDECKS : **** ERROR 2 **** Call made to an unknown common deck.

A call has been made to an undefined common deck. Misspelling a common deck name in a *call statement is the most probable cause for this error.

COLLECT : **** ERROR 3 **** Expecting a character expression.

If a *call statement appears without a common deck named, or if any other *EDITOR* command is incomplete, this error message will result. Check syntax.

COLLECT : **** ERROR 4 **** Too many switches defined.

This indicates that the user has specified more switches (definitions) than allowed by the array bounds. One either needs to define fewer macros, or to recompile *EDITOR* with a larger value of *k7*.

COLLECT : **** ERROR 5 **** Too many aliases defined.

This indicates that the user has specified more aliases than allowed by the array bounds. One either needs to set fewer aliases, or to recompile *EDITOR* with a larger value of *k8*.

COLLECT : **** ERROR 6 **** Too many common decks defined.

This indicates that the user has specified more common decks than allowed by the array bounds. One either needs to define fewer common decks, or to recompile *EDITOR* with a larger value of *k4*.

COPY : **** ERROR 7 **** Syntax! First character is illegal.

This message is a combined *EDITOR-FORTRAN* syntax error message, and indicates that the only allowed characters in the first column of legal *FORTRAN/EDITOR* statements is a blank, a digit (0 through 9), *c*, *C*, or ***.

COPY : **** ERROR 8 **** Syntax! *EDITOR* sentinel (*) not in column 1.

This message indicates that the *EDITOR* command does not begin in the first column. *EDITOR* will not attempt to read statements that do not adhere to the precise syntax.

COPY : **** ERROR 9 **** Syntax! Extra space after *EDITOR* sentinel (*).

This message indicates that the *EDITOR* sentinel (*) is not followed immediately by the rest of the command. Again, strict compliance with the syntax is required.

CTOI : **** ERROR 10 **** A non-numeric character detected.

Some *EDITOR* commands have fields inside which integers are expected. Thus, if a user inadvertently types `*delete sub1.io` where the `io` should have been a 10, ERROR 10 will be generated.

There is no error message 11.

ERRSET : **** ERROR 12 **** Number of issued errors exceeds "k1".

Trouble. If one really wants to see all the errors at the same time, go ahead and recompile *EDITOR* with a higher value of `k1`. However, there is probably something really wrong with the input files, and this will have to be corrected. Once the errors are fixed, this error message should go away as well.

INOREX : **** ERROR 13 **** Unrecognised *EDITOR* command.

EDITOR didn't recognise what followed the `*` sentinel as a valid *EDITOR* command. Check syntax.

INOREX : **** ERROR 14 **** More than ten nested `*if` statements.

EDITOR only allows as many as 10 nested `*if` statements, whether they be `*if define` or `*if alias`. One needs to simplify the nested structure.

INOREX : **** ERROR 15 **** Expecting a character expression.

See ERROR 3.

INOREX : **** ERROR 16 **** Expecting a Boolean `.and.` or `.or..`

If an *EDITOR* `*if define` statement lists more than one macro, these macros must be separated by an `.and.` or an `.or..`

INOREX : **** ERROR 17 **** Expecting a Boolean `.eq.` or `.ne..`

An `*if alias` statement must have either an `.eq.` or a `.ne.` in the fourth field.

INOREX : **** ERROR 18 **** Dangling `*endif` statement.

More `*endif` statements than the number of pending `*if` statements have been discovered. All `*endifs` must have a corresponding `*if` statement appearing before it in the deck.

INOREX : **** ERROR 19 **** Too few `*endif` statements in previous deck.

At least one `*if` statement was not closed by an `*endif` statement by the time the previous deck was closed. All `*if` statements must be closed by an `*endif` statement before the next deck begins. This message is placed immediately after the `*deck` statement of the deck immediately following the deck with the unbalanced `*if` statement(s).

LIST : **** ERROR 20 **** Unbalanced parentheses.

A *FORTRAN* statement with an argument list (*if*, *computed goto*, *etc.*) has unbalanced parentheses. This *FORTRAN* syntax error is only reported when it interferes with the desired preprocessing (*e.g.*, looking for targets at the end of an *if* statement).

MERGE : **** ERROR 21 **** Expecting a character expression.

See ERROR 3

MERGE : **** ERROR 22 **** Reference made to an undefined deck.

A MERGE edit (**insert*, **delete*, or **replace*) has been issued which refers to a deck not found in the master source code. The most likely reason is that the deckname has been misspelled.

MERGE : **** ERROR 23 **** Expecting a line number to follow deck name.

MERGE edits require at least one reference to a line number. If no line numbers were given, this error message is issued.

MERGE : **** ERROR 24 **** Last line number must be greater than first.

For the MERGE edit: **delete filename.n,m*, *m* must be greater than *n*.

MERGE : **** ERROR 25 **** Specified range not found in deck.

The specified lines in the **delete* statement were not found in the specified deck. Check the fifth column of the source code formatted by *NUMBER* and make sure the lines do indeed exist.

MERGE : **** ERROR 26 **** Cannot find specified line. Was it deleted?

Probable cause of this error message is a previous **delete* statement removed the line(s) that the current MERGE edit is trying to affect.

NMLST : **** ERROR 27 **** Missing opening delimiter /.

The NMLST errors should not be confused with the namelist error messages that may appear during run time of the user's program should syntax errors be found in the namelist input data file. The NMLST errors are those generated by improper syntax of the namelist statement in the user's source code itself. This error message indicates that the opening slash is absent from the namelist designation. See §2.2 for an example of proper namelist syntax.

NMLST : **** ERROR 28 **** Missing closing delimiter /.

This error message indicates that the closing slash is absent from the namelist designation. See §2.2 for an example of proper namelist syntax.

NMLST : **** ERROR 29 **** Too many variables in namelist. Increase "k9".

This error message indicates that the user has defined more variables in the namelist statement than may be accommodated by the current setting of the internal parameter `k9`. One may break up the namelist into smaller namelists, or recompile *EDITOR* with a larger value of `k9` (§9.3).

NMLST : **** ERROR 30 **** Too many vars. in namelist. Increase "inmlst".

This error message indicates that the user has defined more variables in the namelist statement than the user-selected value of `inmlst` (§2.5) would allow. One may break up the namelist into smaller namelists, or reset `inmlst` to a higher value.

NMLST : **** ERROR 31 **** No variables found in namelist.

There must be at least one valid variable listed in each namelist defined.

NMLST : **** ERROR 32 **** Unrecognised syntax in dimension statement.

In replacing the namelist statement with calls to subroutines in `namelist.a`, *EDITOR* must make decisions as to which subroutines to call. In so doing, *EDITOR* scans the declarations at the head of the program module to learn about the attributes (real, integer, *etc.*) and dimensions, if any, of each variable in the namelist. Should it find any *FORTRAN* syntax error in the declaration list that impedes its scan, *EDITOR* generates this message.

NMLST : **** ERROR 33 **** Blank "nlsdac" suffix! Check declarations.

This error stems (usually) from some syntax error (such as a missing comma) in the declaration list that wasn't detected while the declaration list was being scanned and left the variable attribute undetermined. In this event, *EDITOR* is unable to determine which of the `namelist.lib` subroutines (named `nlsdacnn`, where `nn` ranges from 01 to 24) to call. Check which variable is involved with the statement to which this error message refers and examine how that variable is declared in that program module.

PRECOM : **** ERROR 34 **** Call made to an unknown common deck.

See ERROR 2.

TARGET : **** ERROR 35 **** Unrecognised character in first five columns.

TARGET errors refer always to incorrect *FORTRAN* syntax which impedes the tidy-up process. This particular error is generated if there is anything other than a digit (0 to 9) in the first 5 columns of any statement that is not a comment, blank, or *EDITOR* statement.

TARGET : **** ERROR 36 **** Too many targets - Going on to next deck.

Too many targeted statements in the program module. The tidy-up process cannot continue with current module, so execution continues with the next module. Either break the module up into smaller modules, or recompile *EDITOR* with a larger value of `k5` (§9.3).

TARGET : **** ERROR 37 **** Unrecognised syntax.

The statement does not conform to ANSI-standard *FORTRAN 77*.

TARGET : **** ERROR 38 **** Expecting a numerical target.

A *FORTRAN* statement which is supposed to include a numerical target (*e.g.*, *goto*) did not have a numerical target where one was expected.

TARGET : **** ERROR 39 **** Too many origins - Going on to next deck.

Too many origins in the program module. The tidy-up process cannot continue with current module, so execution continues with the next module. Either break the module up into smaller modules, or recompile *EDITOR* with a larger value of *k3* (§9.3).

TARGET : **** ERROR 40 **** Target defined more than once.

Two or more target statements use the same target number.

TARGET : **** ERROR 41 **** Origin has no target.

The origin refers to a non-existent targeted statement.

TARGET : **** ERROR 42 **** Ambiguous targets.

This error message is a fossil of an earlier version of *EDITOR* stemming from an incomplete algorithm for replacing *do-enddo* structures with targeted *do*-loops. That incompleteness has been corrected (as of June, 2014), and this error message should not arise.

TARGET : **** ERROR 43 **** Too many "do"s and/or "goto"s in this deck.

The sum of the number of *do*-loops and the number of *goto* statements (including *gotos* implied by the *err* and *end* parameters in *open* and *read* statements) exceed *ienddo-ibegdo+1*, where *ibegdo* and *ienddo* are namelist input parameters (see §5.1). One must either decrease the number of targets in this module, or increase the difference between *ibegdo* and *ienddo*.

TARGET : **** ERROR 44 **** Too many "read"s in this deck.

The number of formatted *read* statements exceeds *iendre-ibegre+1*, where *ibegre* and *iendre* are namelist input parameters (see §5.1). One must either decrease the number of *read* targets in this module, or increase the difference between *ibegre* and *iendre*.

TARGET : **** ERROR 45 **** Too many "write"s in this deck.

The number of formatted *write* statements exceeds *iendwr-ibegwr+1*, where *ibegwr* and *iendwr* are namelist input parameters (see §5.1). One must either decrease the number of *write* targets in this module, or increase the difference between *ibegwr* and *iendwr*.

TARGET : **** ERROR 46 **** More than *i* decks defined. Part of file lost.

Program has more modules (subroutines or decks) than can be accommodated by *EDITOR* as compiled. Either reduce the number of modules in the program, or recompile *EDITOR* with a larger value for *k4*.

PARALLEL: **** ERROR 47 **** Too many variables in do-loop. Increase "k9".

The number of variables to be scoped in the nested do-loop structure being micro-tasked is more than can be accommodated by *EDITOR* as compiled. Either reduce the number of variables being used in the offending do-loop, or recompile *EDITOR* with a larger value for *k9*.

MERGE : **** ERROR 48 **** Too many nested *reads.

Like the *call statement, as many as 10 *read statements may be nested. Since it is unlikely that more than 10 nested *reads would ever be deliberate, this is probably caused by a closed loop. That is, change deck 1 reads change deck 2 which reads change deck 3 which reads change deck 1, or something to that effect.

TARGET : **** ERROR 49 **** Unmatched "enddo" statement.

In dealing with do-enddo structures, *EDITOR* encountered an extra enddo statement that cannot be matched to an opening do statement.

TARGET : **** ERROR 50 **** "do" statement unmatched by an "enddo".

In dealing with do-enddo structures, *EDITOR* encountered an extra do statement that cannot be matched to a closing enddo statement.

ERRMSG : **** ERROR 999 **** Unspecified error.

No guidance, other than to say this message should *never* come up.

A.3 Warnings

In this release, there is only one warning message, per se, and this is completely harmless. It is echoed to the user's CRT and is not placed into any of the output files.

TARGET : **** WARNING **** Increment for deck: *deckname* reduced from *i1* to *i2*.

If the number of targets found in the current module exceeds $(i_{\text{enddo}} - i_{\text{begdo}}) / \text{inc}$, where *ienddo*, *ibegdo*, and *inc* are namelist input parameters chosen by the user (see §5.1), then the user-supplied value for *inc* is reduced until the number of targets is less than $(i_{\text{enddo}} - i_{\text{begdo}}) / \text{inc}$. If choosing *inc*=1 still doesn't do it, then error message 43 (or 44, or 45) will result. Note that the reduction of the value of *inc* applies to the current module only. Where ever possible, *EDITOR* will abide by the user's choice for *inc*.

A.4 NAMELIST errors

Namelist error messages (as opposed to the NMLST error messages described in §A.2) arise only at run time of software that was precompiled with the namelist replacement option turned on. These messages appear if any syntax errors are found in the namelist input disc files. An example of an *EDITOR* namelist error message follows.

```
*****
      , q1=1.0e-10, infile='indata' inam=1,1,2,2,3
      ^
NAMELIST ERROR 4 ---> unexpected character - check syntax
*****
```

The error message echos the offending line in the namelist input data file, places a carat (^) immediately under the offending character in that line, then explains what is wrong. In this case, there is a missing comma. The only problem with *EDITOR* namelist error messages is that only one message can be generated at a time. Each error message aborts execution and thus it may take several tries before all the syntax errors are found and corrected.

Below is a list of the possible namelist errors along with brief descriptions.

```
NAMELIST ERROR 1 ---> column 1 reserved for comment sentinel: c
```

The rules of namelist input decks must be adhered to exactly. If a character other than a blank, c, or C appears in the first column anywhere in the input data file, this message will be issued.

```
NAMELIST ERROR 2 ---> column 2 reserved for $ delimiter
```

If a character other than a blank or \$ appears in the first column anywhere in the input data file, this message will be issued.

```
NAMELIST ERROR 3 ---> variable not found in namelist
```

A variable is being set which was not part of the namelist declaration in the source code. The usual reason for this error is a misspelled variable.

```
NAMELIST ERROR 4 ---> unexpected character - check syntax
```

The usual reason for this message, as in the example above, is a missing comma. Check the syntax of the offending line carefully.

```
NAMELIST ERROR 5 ---> invalid logical expression
```

A logical variable has been assigned a value other than `.true.`, `.t.`, `.false.`, or `.f.` (including the periods).

```
NAMELIST ERROR 6 ---> namelist does not exist, or is out of sequence
```

The source code attempts to read a namelist not found in the namelist input data file. This is usually caused by a misspelled namelist name or a namelist that appears out of order in the data file. Note that the order of the namelists in the data file must be the same as the order in which the source code reads them.

NAMelist ERROR 7 ---> error reading input deck

Does the namelist input data file exist on disc in the directory in which the executable was executed?

NAMelist ERROR 8 ---> variable not declared as a vector

A scalar is assigned values as though it were a vector.

NAMelist ERROR 9 ---> next namelist begun before closing quote found

Character assignments may run over several lines. Thus, if a namelist opening sentinel \$ is found in the second column of a line before the closing quote of the current character assignment is found, this message results. A common cause of this message is if the closing quote has been inadvertently shoved beyond the 72nd column, or if the closing quote is a single (double) quote while the opening quote is a double (single) quote.

NAMelist ERROR 10 ---> missing opening quote

If the first non-blank character after the = in a character assignment is not a single or a double quote, this message is issued.

NAMelist ERROR 11 ---> blank data

A variable is assigned a null field.

NAMelist ERROR 12 ---> premature end of file

File appears to have ended before the closing sentinel \$ of the current namelist was found. Common cause is if the closing sentinel of the last namelist was inadvertently shoved beyond the 72nd column.

NAMelist ERROR 13 ---> missing \$ sentinel to close namelist

Next namelist has begun (a \$ sentinel was found in column 2) before the closing sentinel of the current namelist was found. Common cause is if the closing sentinel is inadvertently shoved beyond the 72nd column.

NAMelist ERROR 14 ---> exponent must not exceed 999

The *EDITOR* namelist will not permit exponents in real variable assignments to exceed 999 (or be lower than -999). Obviously, a 32-bit word machine will have even more stringent limits.

NAMelist ERROR 15 ---> no more than 15 digits in single precision

The tone of this message is a fossil of the days when *EDITOR* ran only under UNICOS, and where single precision was 15 significant digits (double precision on most other platforms). The *EDITOR* namelist will only allow as many as 15 significant figures to be specified in a real variable assignment.