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Technical Note

NCEP Standards for Operational Codes and Implementations[1]

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1. Introduction

This technical note gives an overview and description of the standards expected of Environmental Modeling Center (EMC) programmers when preparing programs to run in the NCEP production suite. Many of the standards and procedures for implementing new codes have been documented by NCEP Central Operations (NCO), however some of these documents are now outdated or, in some cases, exist only by "word of mouth". Thus, there is a need for a survey of the current operational standards and procedures, written for an audience consisting primarily of EMC programmers who may not be aware of the demands and protocols of the production suite.

This technical note is divided into several sections: 1) an overview of the NCEP production suite and the general design principles desirable in a new program, 2) some specifics of how to prepare run scripts and code for implementation, 3) a description of the procedures to follow once scripts and code are ready, and 4) an appendix containing some further documentation of NCO policies and standards.

2. Overview and general design principles

a. The Production Suite

The NCEP production suite consists of those jobs that run under the class "prod" on one of the three NCEP central computers (currently one Cray C90, two Cray J916 machines). This class of jobs is assigned a higher priority than general "batch" jobs, and a certain percentage of machine resources (*i.e.* global memory, job queues) are reserved strictly for production jobs. The amount of the machine reserved for production is not fixed, as it has to be periodically adjusted to meet the needs of production. Currently, the total global memory of 890 Mwords on the Cray C90 is partitioned so that 410 Mwords, or about 46 %, is reserved for production jobs at all times. The rest is available for general "checkout" (batch jobs). Whereas batch jobs often have to spend long amounts of time waiting "in queue" before running, production jobs generally have to run at fixed times during the day and within a narrow time window. The Supervisor Monitor Scheduler (SMS) controls the timing and release of each production job. Once a job has been released by SMS, it should spend no more than a few seconds waiting in queue before running. Longer delays occasionally occur when the system, for whatever reason, becomes too busy and production jobs begin to back up. In general, however, production jobs must run at predictable times of the day and within a much stricter time limit than checkout jobs. Also, since SMS controls the release of operational jobs, there is no need for production jobs to resubmit themselves using "qsub", as is commonly done in batch mode for automation. These are important considerations for programmers when designing and testing their codes for implementation.

A second consideration is that all NCEP production jobs are operationally supported, 24 hours a day, 7 days a week. The Senior Production Analysts (SPAs) who work for NCEP Central Operations (NCO) maintain the production suite and respond to job failures when they occur. This includes hours outside of the normal work day, such as overnight and weekends. New programs being tested for implementation must therefore be reliable and "bullet-proof", otherwise unnecessary work and grief will occur. The SPAs are trained to handle system related failures, such as a machine being down or a disk system being temporarily unavailable; however, they are not paid to be "debuggers" or beta testers for EMC programmers. EMC staff will be contacted, including during non-working hours if necessary, when a SPA is unable to resolve a programmer-related failure and the failure is hindering the remainder of the production suite. Therefore, it is in the best interest of both EMC and NCO to make sure that all new programs being considered for implementation are fully tested and as robust as possible. Programs should be extensively tested and optimized to ensure that they run as efficiently as possible.

b. Language standards

Source code *must* be provided for all operational programs. Providing only an executable for any job step, no matter how trivial, is unacceptable. Currently, FORTRAN 90 and "C" are the only acceptable programming languages for operational programs. The vast majority of codes currently running in production are written in FORTRAN 77. At the level of run scripts, UNIX korn shell (ksh) is the standard. The distributed-brokered Networking system (dbnet), which allows for efficient and reliable data transfers between computers, is written in Perl. For the purposes of this document, comments on language standards will be restricted to FORTRAN.

In general, code that meets the ANSI standards for FORTRAN 77 will be sufficient for the FORTRAN 90 standard. Many features permissible in a particular vendors' FORTRAN 77, however, are non-standard. In other words, the mere fact that compilation is successful doesn't prove that the code is FORTRAN 77 compliant. On the Crays, compilation with the "-en" option in either F77 or F90 will flag for non-standard usage. Users should attempt this and remove or replace all non-standard features. More fundamentally, a basic design principle of any operational program is that it should be as "machine independent" as possible. With computer systems evolving and changing rapidly, codes that can be easily ported to new systems will become an increasingly more common requirement. See Appendix C for more specific examples.

c. Input/Output

The writing/reading of data to/from output/input files is one of the *least* efficient operations on the Cray computers (and on computational machines in general), particularly when performing input/output (IO) in small increments. In terms of operating on small portions of a file, a personal computer is actually many times more efficient than the Cray C90. Therefore, programmers should try to limit the amount of repetitive I/O in their programs to as little as possible. Large output files used during debugging stages should also be eliminated, as well as any scratch files, which are a programming device used to get around core memory limitations of older mainframes. These scratch files are largely a legacy of a bygone programming era and should be eliminated. The amount of speed up that can be achieved by switching to dynamically allocating memory for large arrays (instead of using scratch files) can be substantial.

d. Job control

On the SMS workstations, there are task scripts which control the submission of production jobs to the Crays. These task scripts are triggered by either the clock or by the successful completion of other jobs. The task scripts submit jobs on the Crays, called "J-jobs". The J-job is a short UNIX script which initializes the more important shell script variables such as the cycle, the location of source, scripts, and executables. The J-job then executes another UNIX shell script, often referred to as a run script. The run script does the real work, and is usually much larger and more complex than either the J-job or the SMS task script. The run script is the level at which any compiled codes are executed. The J-job sets UNIX shell variables and then exports them for use by the run script and any "child" script. This is an important principle which should be followed at all levels of shell script programming, namely that variables should be defined only once and at the highest level possible. For example, if your run script (parent) has to call other scripts (child scripts), then the child scripts should not be setting global variables (i.e. the date, cycle, etc.) Control variables should always be set in the J-Job, or at least in the main run script, and should be set only once. From a programmer's standpoint, the run script is the only component of job control which they need to know how to modify. Task scripts and J-jobs are maintained by NCO personnel. However, before making changes to the run script, programmers should familiarize themselves with the J-job associated with the run script, and make changes accordingly.

3. Specifics

a. Getting the Date

One of the most basic things any program that runs daily needs to do is to figure out what the date is. In UNIX, there are several different ways to do this. Using the "date" command, which echoes back the current date, is the most common. This fails in operations because the models or jobs may be run for a previous day or cycle. However, there is a standard method of calculating today's date which all production jobs follow. There are Year 2000 compliant dates in the directory "/com/date" on all three Crays. In this directory, there are files named "T00Z", "T01Z", "T02Z", ... , "T23Z" which contain the current date for that particular Greenwich Mean Time (GMT). By doing a "cat" on the particular file which has the same name as the cycle of your job, and cutting out the seventh through fourteenth characters using the UNIX "cut" command, you can create an eight digit date, *i.e.* 19980526 for May 26, 1998. As for calculating the cycle, all NCEP production jobs have the current cycle (usually T12Z or T00Z) pre-defined in the J-Job. Programmers should use the "CYCLE" variable, which is set and exported in the J-job, to control any cycle related variables. Programmers should also be aware that when modifying an existing run script, the six digit date already exists in the variable named "PDY". Also, yesterday's six digit date is stored in the variable "PDYm1"; the previous day's date in "PDYm2", etc. The utility script "setpdy.sh" located in /nwprod/util/scripts sets the PDY variables within the J-Job, and makes most date calculations within run scripts unnecessary.

b. Working Directories

One big difference between a production job and a checkout job is the location of the so-called "working directory". The working directory is where executables are run, temporary files are copied to and created, and where general output files end up. In checkout mode, the directory "/tmp" is generally used. Production jobs have their own area, a directory called "/tmpnwprd". Most production jobs create a temporary working directory in this area, which gets cleaned out as soon as the production job finishes. This has the advantage of keeping disk space usage down, since files exist only as long as it takes for the job to run. The "/tmp" directory occasionally fills up and locks out new jobs from running, which is unacceptable for production. For the EMC programmer, setting up a working directory is rather simple. In the J-job, a variable named "DATA" which represents the working directory is created and exported . Therefore, changing directory to "$DATA" is all that is necessary for the programmer to do, somewhere near the beginning of the run script.

c. Output Directories

Production jobs copy final job output (after a successful run) to the directories /com, /pcom, /scom, or /dcom. Other directories, such as "/ptmp1" or "/wd2" are not acceptable output directories for production jobs (nor are they acceptable locations for working directories). If the program execution is successful and the environmental variable SENDCOM is set to YES in the J-job, then any output files that are to be saved should be copied to the desired operational directory. Directly assigning a file in an operational directory can lead to problems, such as creating a zero byte count file if the job step fails. Any direct assignments of output file names in /com, /pcom or /com will not be accepted by NCO. Likewise, any direct assignment of input files in the /com, /dcom, or /pcom directories is also unacceptable. Input files should be first copied to the working directory, then assigned a unit number.

d. Location of fixed files, parameter files, source, executables

For any production job, there is a hierarchy of directories where certain types of permanent files necessary for execution are kept. Generally, EMC programmers will not be responsible for creating these directories, however it is a good idea to have some notion of what and where they are. For purpose of demonstration, we will assume that the job network hierarchy has the name "network". A network is a name for a group of jobs which have something in common, for example "eta" for the eta model or "wave" for wave model jobs.

/nwprod/network/exec:	location on the Cray of any executables
/nwprod/network/fix:	location of any fixed input files
/nwprod/network/parm:	location of any parameter files

/nwprod/network/scripts:	location of any shell scripts which may be invoked by the run script for any job running in that particular network
/nwprod/network/sorc:	location of all source code, as well as makefiles
/nwprod/network/ucl:	location of other fixed files, which may be copied to the working directory and modified, such as templates

e. Error Handling

Production jobs must be much more robust than general checkout jobs in terms of error handling. Error handling is the way that a program exits after a condition preventing normal completion occurs. For example, a program which processes satellite winds may fail if there is an interruption in the flow of data. However, since this type of condition may occur intermittently, it is best to have the program exit "gracefully" at the point where it is evident there is no data, rather than die in a later step of the program. If a run script ends with a non-zero exit code, the J-job will flag it as failing and SMS will note an error. To prevent this, the run script should "trap" on predictable errors, send some information on the error to standard output or to the jlog file, and exit with a condition code of zero. In general, program output sent to standard output should be minimal and should be oriented towards identifying run-time errors. If run-time errors are frequent and your program won't run to normal completion close to 100% of the time, it shouldn't be implemented at all.

Production jobs should also not have so-called "normal errors". These are errors occurring during run-time which are non-fatal, but still generate error messages. For example, if in your run script you remove a file which is not normally present, such as a core file, an error message will be generated. This only leads to confusion when a SPA has to do trouble-shooting work. Normal errors can also lead to non-zero exit codes from shell scripts called from the main run script. If the normal error occurs at the end of the shell script, the exit value of the last executed command in the main run script will be non-zero and quite possibly the job will fail, despite the fact that the error was non-fatal. This can best be avoided by eliminating all normal errors.

f. Program Documentation

Proper documentation of source code is a critical, though often overlooked, step in preparing a program for implementation. Though seemingly tedious and unimportant, leaving some sort of written instructions on how a program operates allows future programmers to make use of existing code without having to start over from scratch. The standard item for internal documentation of source code at NCEP is the documentation block, or DOCBLOCK. This is a short block of comments near the beginning of all main programs and subroutines, with a fixed format. The precise details of how a docblock should be written appear in the on-line version of the NCEP handbook, but I will attempt to provide a summary and additional comments here.

The DOCBLOCK should be a concise, informative set of comments containing sufficient information to allow another NCEP colleague to run the program. The "acid test" is this: can someone read the DOCBLOCK and then get the program to run without having to come back to you with questions? If not, you have more work to do. DOCBLOCKs are mandatory for main programs, and will also be mandatory for subprograms. Here is a list of some (but not all) of the components of a good DOCBLOCK:

PRGMMR:	Programmers' name, in case of failure
TITLE:	A short, one line descriptive title
ABSTRACT:	A more lengthy description of what the program does. Don't get too detailed with any description of how to run it, or how it works internally.
PROGRAM HISTORY LOG:	A log of all code changes, to be updated whenever any change is made to the code.
USAGE:	A short description of how the program is called or interacts with other programs

INPUT FILES:	List of all input files used, including UNIT numbers
OUTPUT FILES:	List of all output files used, including UNIT numbers
SUBPROGRAMS CALLED:	A list of all non-library routines called by the main program
EXIT STATES:	A list of all programmed condition codes for STOP's in the main program and what they mean. A critical item if other programmers and/or SPAs are to be able to understand what the various exit states of your program mean
REMARKS:	An optional section for further comments which don't fit in any other section, but may still be useful
ATTRIBUTES:	List the specific compiler and options, and the language version used, *i.e.* FORTRAN 90. Also can include hardware information, *i.e.* CRAY J916.

4. Final Preparations

Once you think you have the code in an implementation-ready form, it's time to begin filling out Job Implementation Forms (JIFs). The details of the JIF are present in the updated version of the NCEP handbook, available on-line on the NCEP home page. Before you begin writing JIFs, you should first run two utility tools as a check on your programs. The first utility is called JIFCHECK; it verifies that the format of your main DOCBLOCK is correct and calls to W3TAGB and W3TAGE are present. It is invoked by doing a "cd" to your source directory and executing the following:

/nwprod/util/jifcheck/jifcheck.x arg1 arg2 arg3 arg4, where

arg1 is the local filename of the main program
arg2 is the operational name of this executable
arg3 is your last name
arg4 is your NCEP routing code, *i.e.* NP21

The file ft50.dat, created by jifcheck, contains the updated main program.

The second utility is called scanscript. It checks for illegal assignments to /com, /pcom, /dcom, or /scom and for use of non-Y2K compliant dates, as well as use of /tmp or

$TMPDIR for the working directory in your run script(s). To invoke scanscript, do a "cd" to your script directory, and type:

/nwprod/util/scripts/scanscript.sh arg1	where arg1 is the local filename of the script.

Any problems will be flagged by scanscript and reported back to you.

Running both jifcheck and scanscript on all source codes and run scripts, respectively, is highly recommended. Once you have done so, you are ready to begin filling out the JIFs.

The JIF is a form containing explicit instructions to the Production Management Branch (PMB) on how to implement your code. It is the only set of written instructions describing exactly what steps PMB must take in order to implement your code. As such, it must be clearly written and highly accurate. A separate JIF for each job step needs to be submitted. For example, if your run script invokes three new executables, three JIF's must be filled out, one for each program executable. The JIF should be filled out and submitted by the programmer responsible for the implementation. The JIF form contains spaces to enter your name, routing code, phone number and e-mail address, as well as location of scripts, source code, fixed files and data cards. The form requires you to list the production job name, usually a number corresponding to the J-Job, and the production program name, which usually corresponds to the name of the executable for that particular step. Executable names should not exceed 8 characters, and should not have an "_" (underscore) character in the name. The form also contains a space for a "quotable quote" describing the rationale for the JIF and a short description of what the program does, if it is a new program. Note that makefiles must be placed into the same directory as source code. Makefiles, which are used to build the executables, are mandatory items for each job step. Each job step should have its own directory for placing the source code and makefile corresponding to the job step, *i.e.*, .../sorc/executablename.fd.

One of the most common errors made during implementation is failing to set permissions correctly to allow NCO staff to copy your source and makefiles from the programmers area into their own areas. Remember to make all your files world-readable and parent directories world- readable and executable before submitting JIFs. If your implementation requires more extensive instructions than allowed in the "description of change" section, place additional comments in the "special instructions" section. The submission of JIFs to NCO is now done electronically, via the JIF editor software available on certain EMC personal computers. In the Ocean Modeling Branch (OMB), Larry Burroughs has the JIF software running on his computer. Larry should see all OMB JIFs before they get submitted, and hard copies should be made for book-keeping purposes.

Now that you have gotten to this stage, congratulations!! All this work will hopefully pay off when your new or modified programs are tested and smoothly implemented, with no further questions from the SPAs. However, since no one is more familiar with a code than the person who wrote it, it isn't unusual to get a call from NCO asking a few questions. Keep in mind that the SPAs have no knowledge of how your program works, and only a vague idea of what it does. All the work done to keep things "standardized" should keep questions to a minimum, though. Once your program is scheduled for implementation, you will be notified directly via e-mail. Your program will also be advertised in the JIFMEMO, a weekly memo from NCO containing a list of all scheduled modifications to the NCEP production suite. The JIFMEMO is available either by request from PMB or by visiting the PMB home page.

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7) DOCBLOCKs must be present in all main programs and will eventually be required in all subprograms. In addition, calls to the W3TAGB and W3TAGE routines must be present in your code. See Attachment III for details.

   The presence of the main source code DOCBLOCK and calls to W3TAGB and W3TAGE will be verified by our JIFCHECK program. Calls to W3LOG are no longer required and will be removed by the JIFCHECK program if supplied. You should run the JIFCHECK verification process yourself, prior to submitting your JIF, possibly eliminating any delays in your implementation. See Attachment IV for details.

8) When preparing operational scripts, the following standards must be followed:

   a. Obtain the NCEP production dates, using the Year 2000 compliant dates in /com/date.

   b. No direct assignments to /com, /pcom or /dcom will be accepted. The standard is to copy input files or write output files to the working directory. If the program execution is successful and the environment variable SENDCOM=YES (production run, not a test run) then copy the working directory files to the desired operational directory. Directly assigning a file in an operational directory can lead to problems, such as creating a zero byte count file if the job step fails.

   You can verify that your script meets these standards prior to submitting your JIF by running the SCANSCRIPT utility. See Attachment V for details.

APPENDIX B, ATTACHMENT I

Makefiles provide the rules to the make utility. Makefiles come in many different flavors subject to individual customization. Please refer to the man page or use docview for further information. A generic makefile can be generated by using the fmgen utility.

Makefile example, where progname=the name of your code:

```
SHELL=          /bin/sh
LIBS=           -l/nwprod/w3libs/w3lib
progname.xc:    progname.o progname.heap
    segldr -l progname.heap -o progname.xc progname.o $(LIBS)
progname.heap:  progname.lmap progname.high
    cp progname.lmap load.MAPP
    cp progname.high HIMEMBLK
    /ntprod/setheap
    mv MAXHEAP progname.heap
    rm load.MAPP HIMEMBLK
progname.high:
    echo 10050 >progname.high
progname.lmap:  progname.o
    segldr -M progname.lmap,s -o progname.xcmap progname.o
$(LIBS)
progname.o:         progname.f
    cf77 -c -Zv progname.f
```

Note: This example is for demonstration only, please feel free to create (and test) your own.

APPENDIX B, ATTACHMENT II

1) Use units 5, 11-49 for all INPUT files; i.e., all files containing data created prior to the execution of the program.

2) Use units 6, 51-79 for all OUTPUT files; i.e., all files containing data for subsequent programs to use.

3) Use units 80-94 for all WORK files; i.e., all files that are written and read in the same program but have no further use.

Except for work files, the same unit number should NEVER be used for both input and output by the same program.

Units 1-10 are for system or future use (units 5 and 6 are the standard FORTRAN READ and PRINT files, respectively).

Unit 50 is reserved for future use.

Units 95-99 are for production use - log files, etc.

APPENDIX B, ATTACHMENT III

Required Contents for Operational Codes

1. THE MAIN DOCBLOCK.

   The MAIN DOCBLOCK is mandatory -- the DOCBLOCKs for any subprograms are highly desirable. The MAIN program and its associated DOCBLOCK must be the first program in any data set submitted for operations containing both main and subprograms.

   Templates for main and subprogram DOCBLOCKs can be copied from /nwprod/docs/main and /nwprod/docs/subp. Refer to NCEP Handbook Section 3.1.1 for further details on filling out DOCBLOCKS.

2. Calls to W3TAGB and W3TAGE

   The first executable statement in your MAIN code must be a call to W3TAGB with five parameters exactly as indicated below, including the apostrophes and spacing. When your code is submitted for operational implementation, the JIFCHECK program will insert the operational program name in the first parameter, the date and time of compilation in parameters two through four, and your organization code in the fifth parameter.

   ```
   CALL W3TAGB('WMOGRIB ',1998,0007,0050,'NP11    ')
   ```

   The last executable statement before the normal exit from your MAIN program must be a call to W3TAGE with one parameter exactly as indicated below, including the apostrophes and spaces. A call to W3TAGE should also be placed before all abnormal exit statements in your MAIN program and subroutines.

   ```
   CALL W3TAGE('WMOGRIB ')
   ```

   Sample constructs of these calls can be copied from /nwprod/docs/w3tag.

APPENDIX B, ATTACHMENT IV

To execute the JIFCHECK program and verify that the format of your MAIN DOCBLOCK is correct and the mandatory calls to W3TAGB and W3TAGE are present:

cd to your source directory and execute the following statement:

```
/nwprod/util/jifcheck/jifcheck.x arg1 arg2 arg3 arg4
```

Where:

arg1 is the local filename of the main program
arg2 is the operational name of this executable
arg3 is your last name
arg4 is your routing code

Examples of qualified JIFCHECK executions:

```
/nwprod/util/jifcheck/jifcheck.x MAIN.f etafcst rogers NP22
```

```
/nwprod/util/jifcheck/jifcheck.x ebu.f ETAFCST RoGerS NP22
```

Note: Argument 1 is case sensitive, and arguments 2, 3 and 4 are not.

The following local file is created by the jifcheck executable:

ft50.dat: Contains the updated main program.

APPENDIX B, ATTACHMENT V

To execute the SCANSCRIPT utility to verify that your script meets operational standards:

cd to your script directory and execute the following statement:

/nwprod/util/scripts/scanscript.sh arg1

Where:

arg1 is the local filename of the script.

Appendix C: FORTRAN 77 Standards

Things which were not Fortran 77 standard (and therefore not F-90 standard either), but are known to be present in some NCEP code:

- Equivalence between character and non-character data
  - This is known to cause run time errors
  - cray and origin compilers attempt to compile
  - Where necessary, it typically occurs in places where I suggest using a different programming language entirely. C, C++, for instance.

- Boolean constants (X'00ff')
  - Use hexadecimal (Z'7ff') if this is necessary

- Hollerith constants
  - Use variables of type 'CHARACTER' and format descriptor A

- Use of a character literal as a Hollerith constant
  - Use character literals solely. Hollerith itself is also an extension.

- Initializing a common block other than in a block data subprogram
  - Parameter statements (F-77 standard) and inline initialization (F-90) should meet most needs for initialization.

- Length specifiers for non-character data (i.e., REAL*4 declaration)
  - May or may not cause run-time problems (if it compiles at all).
  - Usage superseded (where necessary, and it typically is _not_ in common NCEP circumstances) by the 'KIND' type parameter in F-90

- Initialization of non-integers with hexadecimal values (i.e., DATA INDEF /Z'7FFFFFFFFFFFFFFF'/ where INDEF is not an integer)

- Various intrinsic functions are nonstandard. This includes: DFLOAT.
  - F-90 adds _many_ intrinsic functions to the list that were standard in F-77. Use one of these instead.

- Nonstandard to equivalence numeric types where one of the numerics is a non-default type.
  - This is a consequence of using the nonstandard length specifier.
    1) Use standard lengths
    2) Editorial: Don't equivalence numerics.

- More than 19 continuation lines is an extension to the F90 standard in fixed source form.
  - Either break up the continuation, or use F90 free form.

- Use of "#" as a continuation character is an extension to the F90 standard -- Use standard symbols
  - editorial: Use numbers, cycling from 1-9,0,1-9 as you continue.

- Transfer of control into a do loop is nonstandard
  - Don't do it. Reexamine your program's logic and make appropriate use of IF - THEN - ELSE.

Things which are Fortran 77 standard (and therefore permitted in Fortran 90), but which are noted as obsolescent. Obsolescent features can be expected to be removed from a future standard. Further, they have counterparts in the new (or Fortran 77) standard which renders them unnecessary. (Features and responses taken from Luc Chamberland, Fortran 90: A Reference Guide, Prentice Hall, NJ, 1995.)

- Arithmetic IF
  - Use the Logical IF statement, IF construct, or CASE construct

- DO control variables and expressions of type REAL
  - Use variables and expressions of type INTEGER

- PAUSE statement
  - Use a dummy READ statement

- Alternate return specifiers:
  - instead of:

    ```
    CALL SUB(A, B, C, *10, *20, *30)  (Fortran 77)
    ```

  - use:

    ```
    CALL SUB(A, B, C, RET_CODE)
    SELECT CASE (RET_CODE)
    CASE(1)
    ...
    CASE(2)
    ...
    CASE(3)
    ...
    END SELECT
    ```

- ASSIGN and assigned GO TO statements
  - Use internal procedures

- Branching to an END IF statement from outside the IF block
  - Don't. Branch to the statement that follows the END IF

- Shared loop termination and termination on a statement other than END DO or CONTINUE
  - Use an END DO or CONTINUE statement to terminate each loop.

- Hollerith edit descriptor
  - Use character constant edit descriptor (A)

Fortran 90 includes a number of new features, and standardizes a number of formerly common extensions. The above is merely a warning against nonstandard or obsolete practice. Introducing all the goodies would take more time.

- Testing your codes:
  - On Crays: f90 -c -en -m1 file.f
    -en is a language compliance flag
    -m1 means give relatively verbose commentary (-m0 for most verbose)

  - On origin machines (emc1, etc.): f90 -c file.f

  The two compilers complain with differing severity about some items. The boolean X'00ff' type descriptor is accepted (but noted as nonstandard) by the cray, but generates an error on emc1. Best to try the code on both machines.

OPC CONTRIBUTIONS

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