

## FORTRAN 77 to Fortran 90 Converter

### INTRODUCTION

Fortran is the dominant scientific language and most of the Fortran code in existence today is written in FORTRAN 77. However, this language does not have many of the features which programmers find in other newer languages. Fortran 90 rectifies these shortcomings by adding a considerable number of very powerful new features while retaining all of FORTRAN 77.

The Fortran 90 codes are more concise, efficient, readable, and less error prone. In addition, its features for expression of data parallelism make it easily adaptable to modern high performance computer architectures. Efficient Fortran 90 compilers are now available from several vendors. Fortran 90 has also been adopted as an ISO/IEC 1539:1991 (E) standard and consequently the support for FORTRAN 77 compilers will slowly cease. Most of the optimization effort in future will be focussed on the newer features of Fortran 90. In this changed scenario it is essential that programmers begin migrating old codes to Fortran 90 and start writing new codes in it.

Manual conversion of FORTRAN 77 programs to Fortran 90 is highly time intensive and hence an extremely expensive process. This is because the syntax of good Fortran 90 programs are entirely different and usage of the new features to extract good performance from modern architectures requires significant code restructuring. Only tools can facilitate this migration process and C-DAC's C-F77to90\* is an extremely powerful tool for migrating FORTRAN 77 programs to Fortran 90 providing much more than a simple translation of syntax.

### Fortran 90 FEATURES

- Full array language with index triplet notation.
- User defined data types.
- Modular programming via modules / internal procedures
- Support for dynamic data structures via pointers and allocatable objects.
- New Control Constructs.
- Support for procedure interface, keyword and optional arguments.
- Operator overloading and generic procedures.
- Free and Fixed Source formats.

### C-F77to90 HIGHLIGHTS

- Generation of new source form.
- Removal of obsolete features.
- Elimination or reduction of GOTOs and labels.
- Generation of array syntax in place of loops.
- Creation of MODULES from COMMONs.
- Automatic generation of interface blocks.

## DESCRIPTION

The C-F77to90 converter has many features, which assist in maintaining the Fortran programs. The old programs are transformed to clear, efficient Fortran 90 programs automatically. It contains many output formatting features which improve the appearance of the output code. Static error detection and generation of warning messages are the other added advantages. The important features of the converter are detailed below:

### Format Conversion

Format conversion involves the conversion of the source text into a form required by the user. It supports free or fixed format output. For better readability of the code, it has user configurable indentation levels.

The converter provides the user the option to either retain or remove comments from the source program. Comments are also added by the converter to describe the transformations.

### Error Detection

- Full syntax and semantic check of input language is done and elaborate error messages are generated in case of faulty programs.
- Warning Messages for ambiguous conversion are generated by the converter.

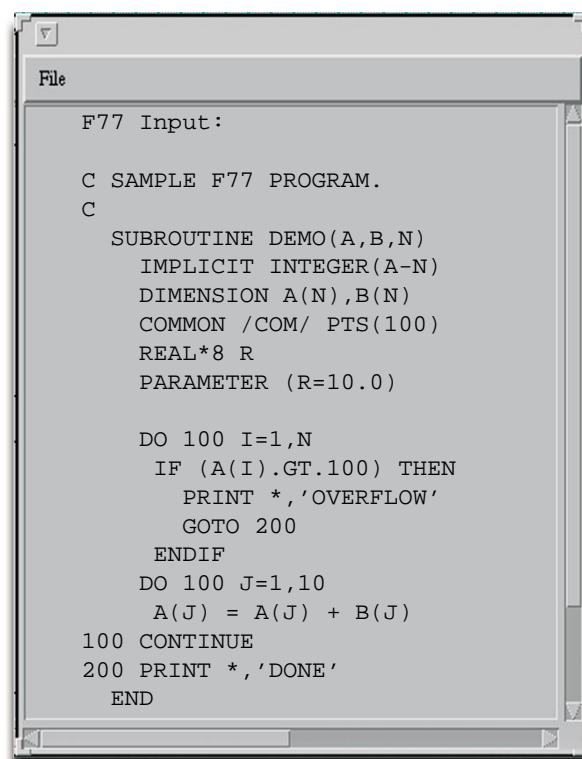
### Elimination of Obsolete Features

The C-F77to90 converter eliminates the following obsolete features of FORTRAN 77.

- Arithmetic IF statements are replaced with block IF statements.
- Alternate Return Subroutines are eliminated with more readable CASE constructs.
- ASSIGN and ASSIGN GOTO statements are replaced with more readable SELECT CASE statement.
- Computed GOTO statement is converted to SELECT CASE.
- PAUSE statement is replaced by a WRITE statement followed by READ statement.

### Elimination of GOTOs and Labels in DO Loops

- GOTO statement inside the DO loop is converted to CYCLE or EXIT statement. C-F77to90 translates branches to the end of the loop into CYCLES, and branches to the statement immediately following the end of the loop into EXITS.



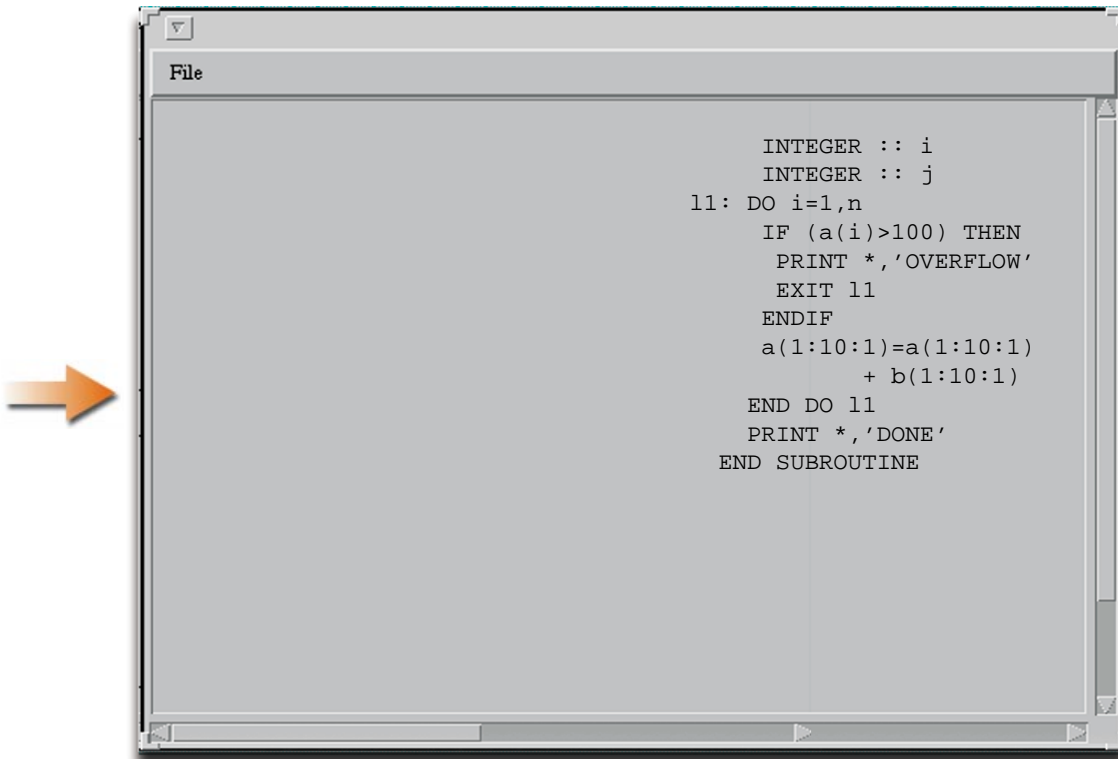
```
File
F77 Input :
C SAMPLE F77 PROGRAM.
C
SUBROUTINE DEMO(A,B,N)
  IMPLICIT INTEGER(A-N)
  DIMENSION A(N),B(N)
  COMMON /COM/ PTS(100)
  REAL*8 R
  PARAMETER (R=10.0)

  DO 100 I=1,N
    IF (A(I).GT.100) THEN
      PRINT *, 'OVERFLOW'
      GOTO 200
    ENDIF
  DO 100 J=1,10
    A(J) = A(J) + B(J)
  100 CONTINUE
  200 PRINT *, 'DONE'
  END
```

### Advanced Features

Fortran 90 has powerful array operations and instructions which work on array sections. Many of the DO loops can be reduced to these concise array notations. This not only improves the readability but also specifies parallelism in the program which can be utilised by the compiler. C-F77to90 converts the DO loops to vector assignment statement. The goal of automatic vectorization is to convert the code written for a serial computer to a code, which uses the vector instructions of the target machine.

FORTTRAN 77 programmers use COMMON blocks to communicate across procedures. This explicit storage association through COMMON blocks is against the principles of data hiding,



```
File
INTEGER :: i
INTEGER :: j
11: DO i=1,n
  IF (a(i)>100) THEN
    PRINT *, 'OVERFLOW'
    EXIT 11
  ENDIF
  a(1:10:1)=a(1:10:1)
    + b(1:10:1)
END DO 11
PRINT *, 'DONE'
END SUBROUTINE
```

### C-F77to90 example

Created Fortran 90 Module  
file "COM\_C.f90":

```
MODULE com_c
PUBLIC
REAL :: pts(100)
END MODULE
```

Created Fortran 90 Code:

```
! SAMPLE F77 PROGRAM.
!
SUBROUTINE demo(a,b,n)
USE com_c
INTEGER :: n
INTEGER :: a(n)
INTEGER :: b(n)
DOUBLEPRECISION,
PARAMETER :: r=10.0D0
```

data protection and data encapsulation. Fortran 90, through MODULE provides an elegant solution to the sharing of data and information across procedures. C-F77to90 converts COMMON block to MODULE wherever possible. It also warns about the improper use of COMMON blocks.

### Automatic Generation of Interface Blocks

C-F77to90 creates an interface file for each routine it processes. The creation of the interface files allows the Fortran compiler to check for argument mismatches in type, number and kind.

### C-F77to90 Usage

The tool is provided with the list of names of FORTRAN 77 files to be converted to Fortran 90. A set of default options are used for converting the code, but any of these defaults can be changed in addition to modifying the output format parameters to fit the specific requirements.

The process of translating the FORTRAN 77 to Fortran 90 with C-F77to90 is extremely fast. It translates a Perfect club benchmark code of about 14561 lines with 117 individual subroutines using default options in merely 17 seconds on Sun Ultra 450 systems.

### RELATED TOOLS

C-DAC has developed an integrated Fortran program development environment which includes the Fortran 90 compiler, debugger, source browser, profiler, and project manager. CAF90\* is a highly optimising Fortran 90 and FORTRAN 77 compiler developed jointly by C-DAC and Apogee Inc., USA. It is fully ANSI X3.9:1978 and ISO/IEC 1539:1991 compliant.

## AVAILABILITY

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Supported Hardware	:	UNIX workstations
Supported Operating System	:	Solaris 2.x
User Interfaces	:	GUI
Prerequisite Software	:	Java



A Scientific Society of the  
Department of Electronics  
Government of India

### **Additional Information**

For more information on CDAC HPCC software, contact your CDAC marketing representative, access the CDAC Home Page on the internet World-Wide Web ( [www.cdac.org.in](http://www.cdac.org.in) ), or send an e-mail over the internet to : [ssg@cdacb.ernet.in](mailto:ssg@cdacb.ernet.in)

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#### **Headquarters**

University of Poona Campus,  
Ganesh Khind, Pune - 411 007, INDIA  
Tel : 352461 Fax : 91-212-357551  
Tlx : 0145-7615 CDAC IN  
email : [business@cdac.ernet.in](mailto:business@cdac.ernet.in)

#### **Business Division**

Ramanashree Plaza, 2/1 Brunton Road,  
Bangalore - 560 025, INDIA  
Tel : 5584271 Fax : 91-80-5584893  
Tlx : 0845-8413 CDAC IN,  
email : [bdm@cdacb.ernet.in](mailto:bdm@cdacb.ernet.in)

#### **Delhi Centre**

E-13, 2nd Floor, Hauz Khas,  
New Delhi - 110 016, INDIA  
Tel : 6863428 Fax : 91-11-6863428