Introduction to
Scientific & Engineering Computing
BIL 102FE (Fortran) Course
for
Week 1

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in

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BIL 102 FE COURSE

Policy:

All BIL 102 Students are strongly advised to attend the class. Each student shall sign a Lecture attendance form at mid time of each lecture. The lower limit of lecture time attendance is %70 of total lecture hours. The lower limit of computer applications is %80 of total application time. The students who are beneath any limit shall not be accepted for the final exam.

Each student or group will do their homework assignment and other computer work in their own departmental computer room.

BIL 102 is an INTRANET based course. All required documents, announcements, assignments etc. shall be found on the related internet address and the web page which is "http://atlas.cc.itu.edu.tr/~F90/"or ftp://160.75.48.1.

Homework assignments shall be obtained and returned back using the FTP facility within the appropriate deadlines. i.e. late delivers shall not be accepted and graded officially

Prerequisite:

Each student should have been successful in BIL 101 course.

A Working knowledge about Windows (Versions 98/NT/2000), Browsers (Internet Explorer/Netscape), Electronic Mail and FTP use.

Compilers:

F_World Editor and its compiler should be installed on PC. It can be downloaded from the bottom part of the web site of "http://atlas.cc.itu.edu.tr/~F90/".

Microsoft Developer studio, which should be already installed on each PC, can be used.

Textbooks:

As the main course book "Programming in F by: T.M.R. ELLIS and I.R. PHILIPS from Addison-Wesley, England, 1998 (ISBN 0-201-17991-1)" shall be used. Sufficient copies can be found at in the Mustafa İnan library.

Essential Fortran 90&95, Common Subset Edition by Loren P. Meissner, Univ. of San Francisco.

Plenty of computer books can be obtained from the Mustafa İnan Library.

Grading:

Homework assignments: 10 Homework assignments shall be submitted and 8 best of them shall be regarded. Homework assignments shall be completed and submitted within one week from the delivery time. Assignments exceeded the one-week deadline shall not be regarded. Therefore the weight of assignments shall be %20 (8*2.5) of total success.

Mid Term Exam): The mid term exam shall be carried out 9th week of the semester and shall be graded with %40 of total success. It might be on paper or on PC or both.

Final Exam: The final exam shall be carried out on paper or on PC or both with %40 weight of total success.

Course Syllabus

Week **Topic** **Details**

1-Introduction

Contents of course, Historical development of programming languages from BASIC, COBOL, Pascal, FORTRAN etc., to F.

2-First steps

Programming steps, basic concepts, running a program, error handling, design and testing of a program

3-Data handling

Data types, variables, expressions, i/o, constants, characters.

4-Building blocks

Programs and modules, procedures, subprograms, arguments

5-Program flow

Choice and Decision-making, logical expressions, case constructs

6-Repetitive execution
do constructs, do loops, exceptional situations

7-Arrays
Concept, declarations, i/o, assignments

8-Improved building blocks
Recursive procedures, arguments

9-Control over I/O
Format and edit descriptors, i/o editing, i/o statements, More powerful formats

10-File use
Files and records, file connections

11-Introduction to Numerical methods
Numerical calculations, precision, rounding, data fitting, iterative solutions

12- Array processing and matrix manipulation
Matrices, multidimensional arrays, i/o, assignments

13-Practice at PC Lab.

.**Programming Languages**

This chapter is devoted to computer programming languages.

What is a programming language?

Computers obey instructions.
They must be issued in a particular form.
The set of instructions and the rules, by which they are to be issued and acted on, forms the basis of the computer language.

A computer program is a series of instructions to the computer, which are executed in an appropriate order to perform a particular task. Since the purpose of each instruction must be obvious. Writing computer programs is a long job for a specialist computer expert, who may take many hours to find any error in it.

Compilers and Interpreters

The instructions must be converted into the executable machine code, which the computer processor can understand.

Compilers take the entire source code program issued by the programmer and convert it into object code. This means that the entire program is translated in one go and resaved in its converted form.

The translated object code is then linked and finally run.

Interpreters take the program one statement at a time, translate and execute the single statement before going to the next.

1.BASIC

The first specific language which it shall be considered is BASIC. BASIC is an old language, which has become particularly commonly used in programming in order to create menu operations and link between other compiled programs in windows 95/98/NT operating system.

The programming language BASIC (Beginners' All-purpose Symbolic Instruction Code) was developed in 1974 at Dartmouth College, Hanover, New Hampshire, USA.

Despite the simplicity, BASIC has rather a bad image among many within the computer industry. It is instructive to consider why this should be, particularly since it is the first language meet by many entrants to the industry:

1-) BASIC is non-standard: Since the implementations of the language vary in their range of facilities by several hundred percent. BASIC is a compiler dependent programming language. A BASIC program may not be work when the compiler was changed.

2-) BASIC is often unstructured: BASIC was designed well before the days when structured programming becomes the normal approved method.

3-) BASIC is small: The major difficulty is the size of the problem, which may be solved satisfactorily using BASIC. For smaller problems BASIC is easy to learn and very satisfactory, but it is difficult to do large-scale development well for earlier versions of BASIC, 'QuickBASIC', for example.

A BASIC Application

As an example, we consider the problem of calculation of area of triangle.

```
REM AREA OF A TRIANGLE
CLS
PRINT "Please type in the length of base of the
triangle"
PRINT
PRINT " "
INPUT Y
PRINT
PRINT "Please type in the length of the height of the
triangle"
PRINT
PRINT " "
INPUT Z
PRINT
PRINT "The area of the triangle is"; Y * Z / 2
END
```

After execution the monitor looks like

```
Please type in the length of base of the triangle

10

Please type in the length of the height of the
triangle

5

The area of the triangle is 25
```

2.Pascal

Pascal is much more recent language than BASIC. Pascal was invented by Professor Niklaus Wirth of Zurich over a period of years up to 70.

Pascal is respected as a good language. What are the features of the languages, which gain favor with compute scientists?

1-) Pascal is a structured language: Good programs are, by definition, well-structured programs.

2-) Pascal is strongly-typed language: This means that every variable used within a program must be declared before it is used.

3-) Pascal is small language: Some computer languages have built into them a very large number of standard instructions, functions and procedures. Pascal is small in comparison, and it is possible to learn all the facilities of the language relatively quickly.

4-)Pascal is widespread: Different Pascal compilers can easily support the programs.

3.**Cobol**

COBOL is one of the longest established computer programming languages still in general use and it is commonly used in business data processing applications. The language COBOL (Common Business Oriented Language) was first introduced in the USA in 1959 as a high level language suitable for use in writing programs which could handle efficiently large amounts of data in file processing applications.

COBOL entered the arena at the point when data processing applications such as writing letters and processing invoices and orders or personnel activities. It has been estimated that over 70% of all programming carried out in 1990 used COBOL.

4.C

The programming language C, which was created by Dennis Ritchie from Bell Labs in 1972, has become popular recently for a wide variety of programming applications. D. Ritchie was working alongside Ken Thompson at the time, designing the UNIX operating system. C itself was derived from Thompson's earlier language 'B'.

C may be distinguished from other languages by its chief design goal: to be a tool for working programmers, and therefore useful. Thus, we may contrast the elegance of Pascal, the simplicity of writing elementary programs using BASIC and the usefulness of C. C is rapidly (with C++) becoming one of the most popular and widely used programming languages for the development of applications. It is flexible, convenient, efficient and also portable.

Who uses C?

There are three principal groups of people who program using C (C++).

1-) The writers of operating systems and system software

2-) The writers of general applications.

3-) The writers of specialized applications for interfacing.

5.Modula-2

Modula-2 is the most recent of all languages discussed here. Modula-2 has its roots in Pascal. Niklaus Wirth.

The design of Modula-2 was motivated from the desire to develop a successor to Pascal.
It reflects the more highly structured approaches being developed to the writing of computer programs. Although, there are already quite number of languages in different parts of the software development business, Modula-2 has the flexibility and functionality to perform any purpose in the arena and it is likely to become the first choice programming language for Computer Science students.

6. Fortran

The FORTRAN (FORmula TRANSlation) programming languages was first developed in the late 50's by IBM workers.

FORTRAN became popular because it did provide a realistic and desirable alternative low-level language programming requiring high-powered number-crunching mathematical and scientific applications. By 1966 a standard version of

FORTRAN, "FORTRAN IV" or "FORTRAN 66" had emerged and this standard version was implemented on computer systems until an improved version "FORTRAN 77" was introduced in 1977. FORTRAN 77 was upward compatible with FORTRAN 66 (which means that FORTRAN 66 programs would run without amendment on FORTRAN 77 systems), but introduced many of facilities necessary in order to utilize the more modern systems.

FORTRAN's facilities

1) Data types: The language provides different classes of data from integer, real to double precision, complex number and string.

2) Input and Output (I/O): The input and output facilities by FORTRAN are very versatile with the use of READ and WRITE statement.

3) Predefined functions: FORTRAN provides a wide range of mathematical functions to evaluate sines, cosines logarithms and so on.

The **maximum facility**: FORTRAN provides a statement (Max(a, b, c,...)) in which selects the biggest value of a group defined.

```
                PROGRAM BIG
C
C     THIS PROGRAM TAKES FOUR INTEGERS FROM THE       USER
AND PRINTS ON
C                     THE SCREEN
C
C     OUT THE BIGGEST
C
C
       INTEGER A, B, C, D, E
       WRITE(6,10)
   10 FORMAT(' TYPE IN FOUR INTEGERS, SEPARATED BY SPACES
                     OR COMMAS')
       READ(5,*) A, B, C, D
       E = MAX(A, B, C, D)
       WRITE(6,20) A, B, C, D, E
   20 FORMAT(' THE BIGGEST NUMBER OUT OF ',I4,I4,I4,' AND ',I4,' IS
',
     C   I4/' C o n g r a t u l a t i o n s')
                STOP
                END
```

After execution the output looks

```
TYPE IN FOUR INTEGERS, SEPARATED BY SPACES OR COMMAS
7 8 9 10
 THE BIGGEST NUMBER OUT OF    7   8   9 AND   10 IS   10
 C o n g r a t u l a t i o n s
```

4) Functions and subroutines: FORTRAN responds to the desire of the programmer to define segments of code with a particular purpose by providing the facility to establish functions and subroutines. Functions and subroutines defined by the programmer are defined either before or after, but never within, the main program.

FORTRAN 90, 95 and F

Fortran 90 and with minor revisions of it –known as FORTRAN 95-were issued in the early 90's for not only for teaching but also for professional use. By the spring of 1996, a new language called F was introduced together with arrangements for compilers on all major personal platforms, namely Windows 95, 98, NT, 2000 based PCs, Power Macintoshes and personal computers running Linux.