MCA : MANAGEMENT : SEMESTER-I

NEW SYLLABUS

C Programming with Data Structure

Dr. Mrs. Smita Chavan
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NIRALI PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

A Text Book of

C PROGRAMMING WITH DATA STRUCTURE

FOR
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Dr. Mrs. SMITA CHAVAN
M.Sc. (Electronics), MCM, MCA, Ph.d. (Comp. Mgt.)
Associate Director
NBN – Sinhgad School of Computer Studies
Pune

GAUTAM BAPAT
M.C.A.
Asst. Professor, Computer Science & Applications
MITSOM College,
Pune

SHILPA PAWALE
M.C.S., M.C.A.
Lecturer, P.V.G.'s College of Science
Pune

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NIRALI PRAKASHAN
Abhyudaya Pragati, 1312, Shivaji Nagar
Off J.M. Road, PUNE – 411005
Tel - (020) 25512336/37/39, Fax - (020) 25511379
Email : niralipune@pragationline.com

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PREFACE

There has been significant development in recent years in the field of Computer Science. The book is a perfect blend of technology which has been a field of dramatic revolution; this subject focuses on different technologies of it.

It gives us great pleasure in presenting this book **"C Programming with Data Structure"** designed to serve as a textbook for students of the First Semester of Master of Computer Application (M.C.A.), the book is organized in such a way that it mirrors the revised syllabus. The book will be found useful by a wide section of readers, teachers and students of Business, Technology and Computer Management courses in Indian Universities.

The book has its own unique features. It brings out the subject in a very simple and lucid manner for easy and comprehensive understanding of the basic concepts, its intricacies, procedures and practices. This book will help the readers to have a broader view on C Programming with Data Structure. The language used in this book is easy and will help students to improve their vocabulary of Technical terms and understand the matter in a better and happier way.

Particular attention has been paid to making this book stimulating and highly readable. The result is a text which is clear, focused and designed to capture student interest. This text is equally suitable for courses directed at undergraduates and postgraduates.

We have given our best inputs for this book. Any suggestions towards the improvement of this book and sincere comments are most welcome on niralipune@pragationline.com.

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AN OVERVIEW OF C

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1.1 Introduction to 'C' Language

- C language is a general purpose and structured programming language developed by 'Dennis Ritchie' at AT &T's Bell Laboratories in the 1972s in USA.
- A structured programming language offers a variety of programming possibilities and capabilities. It support different control loops, different statements etc.
- C language combines the best elements of high-level language with control and flexibility of assembly language so it is a middle level language.
- C language is also called as 'Procedure oriented programming language.'
- C has now become a widely used professional language for following reasons :
  1. C language is easy to learn.
  2. C language is structured language.
  3. C language produces efficient programs.
  4. C language can handle low-level activities.
  5. C language can be compiled on a variety of computers.

- As a programming language, C is rather like **Pascal** or **Fortran** i.e. values are stored in variables programs are structured by defining and calling functions, program flow is controlled using loops, if statements and function calls. Input and output can be directed to the terminal or to files and related data can be stored together in arrays or structures. C allows the most precise control of input and output.

1.2 A Brief History of C

- The development of C was a cause of evolution of programming languages like Algol 60, CPL (Combined Programming Language), BCPL (Basic Combined Programming Language) and B.
- Table 1.1 shows brief history of C language.
- C was developed by Dennis Ritchie at Bell Laboratories in 1972. Most of its principles and ideas were taken from the earlier language B, BCPL and CPL.
- CPL was developed jointly between the Mathematical Laboratory at the University of Cambridge and the University of London Computer Unit in 1960s.
- CPL (Combined Programming Language) was developed with the purpose of creating a language that was capable of both machine independent programming and would allow the programmer to control the behavior of individual bits of information. But the CPL was too large for use in many applications.
- In 1967, BCPL (Basic Combined Programming Language) was created as a scaled down version of CPL while still retaining its basic features. This process was continued by Ken Thompson. He made B Language during working at Bell Labs.
- B Language was a scaled down version of BCPL. B Language was written for the systems programming.
- In 1972, a co-worker of Ken Thompson, Dennis Ritchie developed C Language by taking some of the generality found in BCPL to the B language.
- The original PDP-11 version of the Unix system was developed in assembly language.
- In 1973, C language had become powerful enough that most of the Unix kernel was rewritten in C. This was one of the first operating system kernels implemented in a language other than assembly.
- The 1989 standard for C is commonly referred as C89.
- During 1990s the development of C++ language consumed most programmers attention but work on C continued quietly along with a new standard for C being developed and the result was the 1999 standard for C, usually referred as C99. It retained all features of C89.

Table 1.1

Year of establishment	Language name	Description
1960	ALGOL-60	ALGOL is an acronym for Algorithmic Language developed by Cambridge University. It was the first structured procedural programming language, developed in the late 1950s and once widely used in Europe. But it was too abstract and too general structured language.
1963	CPL (Combined Programming Language)	CPL is an acronym for Combined Programming Language. It was developed at Cambridge University.
1967	BCPL (Basic Combined Programming Language)	BCPL is an acronym for Basic Combined Programming Language. It was developed by Martin Richards at Cambridge University in 1967. BCPL was not so powerful. So, it was failed.
1970	B	B language was developed by Ken Thompson at AT & T Bell Laboratories in 1970. It was machine dependent. So, it leads to specific problems.
1972	C	'C' Programming Language was developed by Dennis Ritchie at AT & T Bell Laboratories in 1972. This is general purpose, compiled, structured programming language. Dennis Ritchie studied the BCPL, then improved and named it as 'C' which is the second letter of BCPL.
1989	C89	The ANSI C developed C89 language and add some new library functions.
1999	C99	It retained nearly all of the features of C89, thus C is still C.

1.3 Features and Characteristics of C

1.3.1 Features of C

- C language consist of following features :
  1. **Middle Level Language :** C is a middle level language as it combines elements of high-level language with the functional of assembly language. C allows direct manipulation of bits, bytes, words, and pointers.

2. **Block Structured Language :** C is referred as a structured language because it is similar in many ways to other structured languages like ALGOL, Pascal and the likes. C allows compartmentalization of code and data. This is a distinguishing feature of any structured language.
3. **Code Portability :** The code written in C is machine independent which means, there is no change in 'C' instructions, when you change the Operating System or Hardware. There is hardly any change required to compile when you move the program from one environment to another.
4. **Recursion :** A function may call itself again and again this feature is called as recursion, is supported by C.
5. **Efficiency :** C provides fast program execution.
6. **High level language feature :** This feature allows the programmer to concentrate on the logic flow of the code.
7. **Low level features :** C has a close relationship with assembly languages. So it is easy to make assembly program in C.
8. **Powerful :** C is very powerful language since low level commands have been access like assembly language.
9. **Flexibility :** In C language programmer has many ways to accomplish the same task.
10. **Small size :** C language provides no input output facilities. This helps to keep program small.

1.3.2 Characteristics of C

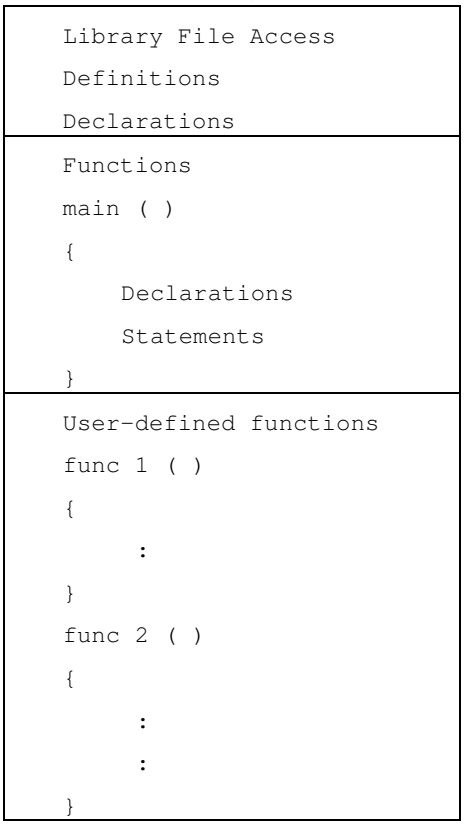
- The C language also exhibits the following specific characteristics :

1. There are a small, fixed number of keywords, including a full set of flow of control primitives : for, if, while, switch, and do..while. There is basically one namespace, and user-defined names are not distinguished from keywords by any kind of sigil.
2. There are a large number of arithmetical and logical operators, such as +, +=, ++, &, ~, etc.
3. More than one assignment may be performed in a single statement.
4. Function return values can be ignored when not needed.
5. Typing is static, but weakly enforced : all data has a type, but implicit conversions can be performed; for instance, characters can be used as integers.
6. Declaration syntax mimics usage context. C has no "define" keyword; instead, a statement beginning with the name of a type is taken as a declaration. There is no "function" keyword; instead, a function is indicated by the parentheses of an argument list.

7. Low-level access to computer memory is possible by converting machine addresses to typed pointers.
8. Procedures (subroutines not returning values) are a special case of function, with a dummy return type void.
9. Functions may not be defined within the lexical scope of other functions.
10. Function and data pointers permit ad hoc run-time polymorphism.
11. A preprocessor performs macro definition, source code file inclusion, and conditional compilation.
12. There is a basic form of modularity : files can be compiled separately and linked together, with control over which functions and data objects are visible to other files via static and extern attributes.
13. Complex functionality such as I/O, string manipulation, and mathematical functions are consistently delegated to library routines.

1.4 Structure of a C Program

- Following blocks shows structure of a C program.



- The C program begin executing at main( ). In the above declaration library file are used to give instructions to compiler for linking purpose.
- All constants and global variables declarations is done here. In second box consists of main( ). Local variable declarations and statements define in main( ).
- The last and third port consists of all user defined functions. These functions are called in main( ) function.

1.5 Program Development Life Cycle

- The program development life cycle of 'C' language has four steps as shown in Fig. 1.1.
  1. **Writing the source code :** The program is to be written using a text editor or word processor. Most language compilers have their built-in editors. The program or source code should be written in the syntax provided by that language. In C source code have extension .c.
  2. **Compiling the source code :** The source code is compiled using compiler of that language. The compiler converts the source code into the object code (in binary format). The compiler checks the syntax errors in the source code.
  3. **Linking the object code :** If the object code requires some precompiled library routines then the linking of the program with the library routines is done with the help of a linker. The linker creates a executable code file with extension **.exe**.
  4. **Executing the program :** Executable file is ready-to-run file. In DOS operating system we can run this file by just writing its name at prompt. In UNIX it is run using ./a.out (where **a.out** is executable file).

Fig. 1.1 : Program development life-cycle

1.5.1 A Simple C Program ("Hello World")

- Every C program must contain main( ) function. Execution of each and every C program starts with main function only.
- Every C program can contain more than one function but each program has to be a main( ) function in order to execute the program.
- C program is also called as **procedure oriented programming language** where importance is given to the procedure i.e. the task to be done which is expressed in the form of functions. So functions works as a building block for the programs.

- The program prints out "hello world" to the standard output, which is usually a terminal or screen display.

```
1. #include<stdio.h>
2. int main(void)
3. {
4. printf("hello world\n");
5. return 0;
6. }
```

1. `#include<stdio.h>`

This first line of the program is a preprocessing directive, **#include**. This causes the preprocessor — the first tool to examine source code as it is compiled — to substitute the line with the entire text of the **stdio.h** file. The header file **stdio.h** contains declarations for standard input and output functions such as **printf**.

2. `int main(void)`

This line indicates that a function named main is being defined. The main function serves a special purpose in C programs. The run-time environment calls the main function to begin program execution. The type specifier int indicates that the return value, the value of evaluating the main function that is returned to its invoker (in this case the run-time environment), is an integer. The keyword void as a parameter list indicates that the main function takes no arguments.

3. `{`

This opening curly brace indicates the beginning of the definition of the main function.

4. `printf("hello world\n");`

This line calls (executes the code for) a function named **printf**, which is declared in the included header stdio.h and supplied from a system library. In this call, the printf function is passed (provided with) a single argument, the address of the first character in the string literal "hello world\n". The semicolon (;) terminates the statement.

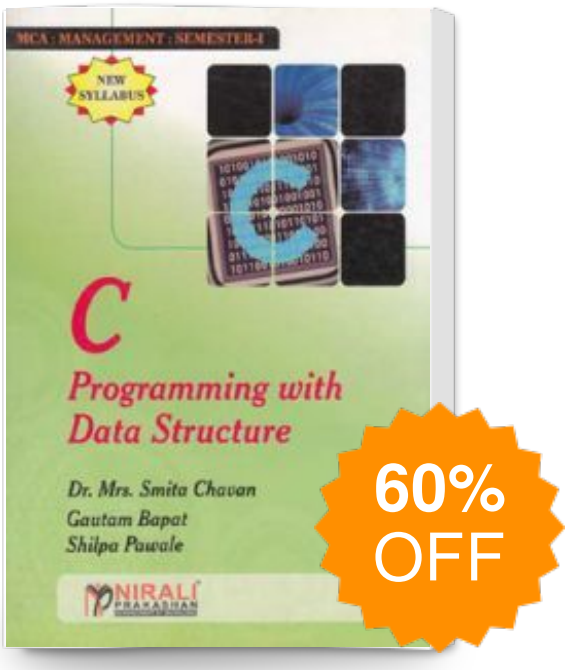
5. `return 0;`

This line terminates the execution of the main function and causes it to return the integer value 0, which is interpreted by the run-time system as an exit code, (indicating successful execution).

6. `}`

This closing curly brace indicates the end of the code for the main function.

C Programming With Data Structure



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