Unit 2
Elements of C

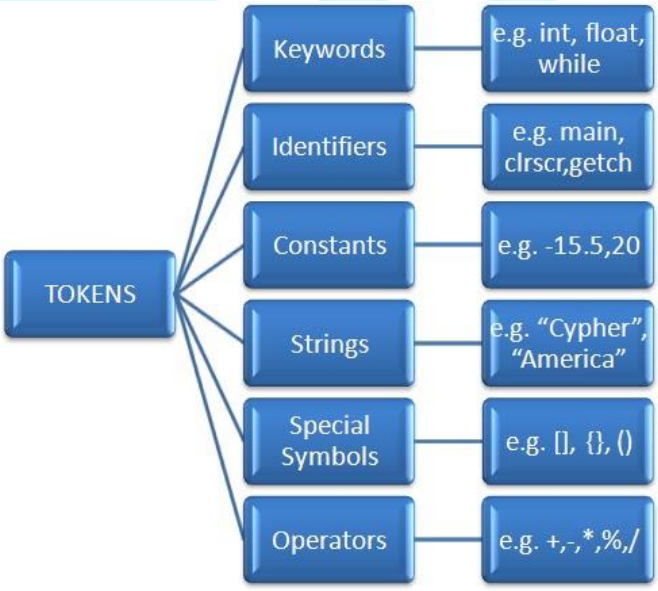
Character Set

- Set of characters that are used to form words, numbers and expression in C is called C character set.
- Characters in C are grouped into the following four categories:

1. ***Letters or Alphabets:***
   - Uppercase alphabets → A…….Z
   - Lowercase alphabets → a…….z
2. ***Digits:***
   All decimal digits → 0, 1, 2,……..,9
3. ***Special characters:***
   , → comma ; → semicolon “→ quotation mark & → ampersand etc.
4. ***White spaces:***
   Blank spaces, horizontal tab, vertical tab etc.

C Tokens

- C tokens are the basic buildings blocks in C language which are constructed together to write a C program.
- Each and every smallest individual unit in a C program is known as C tokens.
- C tokens are of six types.



Keywords

- Keywords are predefined words for a C programming language.
- All keywords have fixed meaning and these meanings cannot be changed.
- The keywords cannot be used as variable names.

E.g.

auto	double	int	struct
break	else	long	switch
case	enum	register	typedef
char	extern	union	continue
return	sizeof	for	signed
void	do	if	static
while	default	goto	volatile
const	float	short	unsigned

Identifiers

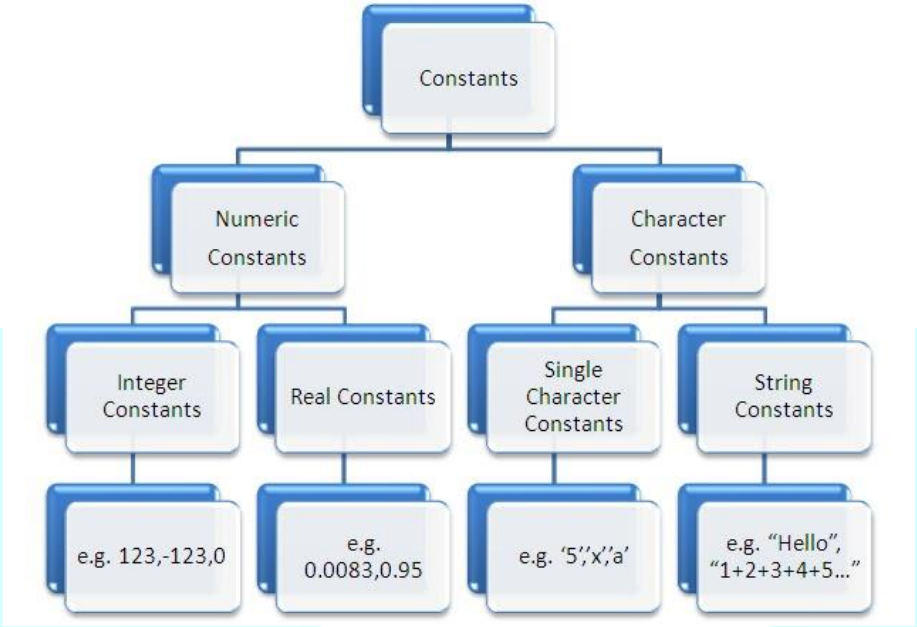
- Every word used in C program to identify the name of variables, functions, arrays, pointers and symbolic constants are known as identifiers.
- These are user defined names consisting of arbitrarily long sequence of letters and digits with either a letter or the underscore (_) as a first character.
- There are certain rules that should be followed while naming C identifiers:
  1. They must begin with a letter or underscore (_).
  2. They must consist of only letters, digits, or underscore. No other special character is allowed.
  3. It should not be a keyword.
  4. It must not contain white space.
  5. It should be up to 31 characters long as only first 31 characters are significant.
  6. Uppercase and lowercase letters are not interchagable.

E.g. Valid and Invalid identifiers

Valid	Invalid
sum	7of9
c4_5	x-name
A_NUMBER	name with spaces
longnamewithmanychars	1234a
TRUE	int
_split_name	AXYZ&

Constants

- A C constant refers to the data items that do not change their value during the program execution.
- These fixed values are also called **literals**.
- Several types of C constants that are allowed in C are:



Integer constants:

- Integer constants are whole numbers without any fractional part. It must have at least one digit and may contain either + or – sign. A number with no sign is assumed to be positive.
- There are three types of integer constants: ***Decimal integer constant***, ***Octal integer constant*** and ***Hexadecimal integer constant***.
- A prefix specifies the base or radix: 0x or 0X for hexadecimal, 0 for octal, and nothing for decimal.

E.g. Decimal integer constant: 1, 3, 65, 5436664, -785
Octal integer constant: 037, 0, 0320, 0432
Hexadecimal integer constant: 0x4, 0X563, 0x1A

Real constants:

- The numbers having fractional parts are called real or floating point constants. These may be represented in one of the two forms called ***fractional form*** or the ***exponent form*** and may also have either + or – sign preceding it.
- Example of valid real constants in fractional form or decimal notation: 0.05, -0.905, 562.05, 0.015

Representing a real constant in exponent form:

- The general format in which a real number may be represented in exponential or scientific form is: ***mantissa e exponent***
- The mantissa must be either an integer or a real number expressed in decimal notation.
- The letter e separating the mantissa and the exponent can also be written in uppercase i.e. E and, the exponent must be an integer.
- Examples of valid real constants in exponent form are: 252E85, 0.15E-10, -3e+8, 4.1e8

Character constants:

- A character constant contains one single character enclosed within single quotes.
  E.g. 'a', 'Z', '5'
- It should be noted that character constants have numerical values known as ASCII values, for example, the value of 'A' is 65 which is its ASCII value.

String constant:

- String constants are sequence of characters enclosed within double quotes.
- May contain letters, numbers, special characters or blank spaces.
- For e.g., "hello", "abc", "hello91", "2077"

➢ **symbolic constants**

A symbolic constant is a name given to some numeric value, or a character constant or string constant.

Defining symbolic constants:

1) Using pre-processor directive **#define**
   Syntax: #define CONSTANT_NAME literal
   e.g. #define PI 3.14159

2) Using keyword literal
   Syntax: Const datatype CONSTANT_NAME = literal
   e.g. Const float PI= 3.14159

Special Symbols

The following special symbols are used in C having some special meaning and thus, cannot be used for some other purpose.

[] () {} , ; : * . = #

Braces { }: These opening and ending curly braces marks the start and end of a block of code containing more than one executable statement.

Parentheses ( ): These special symbols are used to indicate function calls and function parameters.

Brackets [ ]: Opening and closing brackets are used as array element reference. These indicate single and multidimensional subscripts.

Escape Sequence

- An escape sequence is a non-printing characters used in C.
- These non-printing characters can be represented by using escape sequences represented by a backslash(\) followed by one or more characters.
- Each sequence are typically used to specify actions such as carriage return, backspace, line feed or move cursors to next line.

E.g.

Esc. Seq.	Purpose	Esc. Seq.	Purpose
\n	New line	\t	Tab
\b	Backspace	\r	Carriage return
\f	Form feed	\a	Alert
\'	Single quote	\"	Double quote
\\	Backslash		

```
#include <stdio.h>
#include <conio.h>
main()
{
   printf("Hello\tworld!!\n");
   printf("Hello!\n How are you?");
   getch();
   return 0;
}
```

Output:
Hello world!!
Hello!
How are you?

Delimiters

- A delimiter is a unique character or series of characters that indicates the beginning or end of a specific statement, string or function body set.
- Delimiter examples include:
  - Parentheses: ( )
  - Curly brackets: { }
  - Escape sequence or comments: /*
  - Double quotes for defining string literals: " "

Data Types

- A data type is a **type of data**.
- Data type is a data storage format that can contain a specific type or range of values.
- Data type in C refers to an extensive system used for declaring variable for function of different types. The type of a variable determines how much space it occupies in storage and how the bit pattern stored is interpreted.

ANSI C supports three classes of data types:

- Primary/fundamentals data types
- User-defined data types
- Derived data types

Primary Data Types

Primary data types are categorized into five types:

1. ***Integer type (int):***
   - Integers are whole numbers.
   - It requires 16 bit of storage i.e. 2 bytes.
   - Three classes of integer: **Integer(int)**, **Short integer (short int)** and **Long integer (long int)**

	Type	Size (bytes)	Range
Integer (int)	Signed int	2	-2^{15} to $2^{15}-1$
	Unsigned int	2	0 to $2^{16}-1$
Short integer (short int)	Signed short int	2	-2^{15} to $2^{15}-1$
	Unsigned short int	2	0 to $2^{16}-1$
Long integer (long int)	Signed long int	4	-2^{31} to $2^{31}-1$
	Unsigned long int	4	0 to $2^{32}-1$

- Defined as:

```
int a;
int x=5;
```

Signed integer vs Unsigned integer:

Signed Integer	Unsigned Integer
It represents both positive and negative integers	It represents only positive integers
The data type qualifier is **signed int or int.** Variables are defined as: signed int a; Int b;	The data type qualifier is **unsigned int or unsigned** Variables are defined as: unsigned int a; unsigned b;
By default all int are signed	Unsigned int have to be declared explicitly
It reserves 16-bit (2 bytes) in memory	It reserves 16-bit (2 bytes) in memory
Range -2^{15} to $+2^{15}$ i.e. -32,768 to 32,767	Range from 0 to $+2^{16}$ i.e. 0 to 65,535
Its conversion character is **d**	Its conversion character is **u**

2. *Floating point type (float):*

- Floating point type are fractional numbers.
- A variable of float type requires 4 bytes and the range of values that can be stored in it, is 3.4e-38 to 3.4e+38.
- Variable is defined as:

```
float a;
float x=23.7;
```

3. *Character type (char):*

- All single character used in programs belong to character type.
- The character data type holds exactly 8 bits (1 byte).
- The unsigned char has values between 0 and 255.
- The signed char has values from -128 to 127.
- Variable is declared as:

```
char var1= 'h';
```

Here, var1 is a variable of type char which is storing a character 'h'.

4. *Double precision floating point type (double):*

i. Double precision:
- It reserves 8 bytes in memory.
- It represents fractional number of the range 1.7e-308 to 3.4e+308

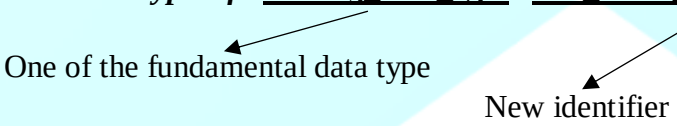
ii. Long double precision:
- It reserves 10 bytes in memory.
- It represents fractional numbers of the range 3.4e-4932 to 1.1e+4932

5. Void type:

- The void type has no value.
- This is usually used to specify a type of function when it does not return any value to the calling function.
- E.g. void main()

User Defined Data Types

- C supports a feature called type definition which allows users to define an identifier that would represent an existing data type.
- **typedef** statement is used to give new name to an existing data type.
- It allows users to define new data types that are equivalent to an existing data types.
- General form: ***typedef existing_data_type new_name_for_existing_data_type;***



- E.g. **typedef int** salary;
  Here salary symbolizes int data types. They can be later used to declare variables as:
  salary dept1, dept2;
  Therefore dept1 and dept2 are indirectly declared as integer datatype.

Derived Data Types

- Array, functions, pointers are derived data types they are discussed in unit 6, 7 and 9.

Conversion specifier

%d → integer
%f → floating point
%c → character
%s → string

Input/Output
scanf()/printf()

printf("%d",100);

scanf("conversion specifier", &variable_name);

if x is an integer variable.
scanf("%d",&x)

```
#include <stdio.h>
int main()
{
   char ch = 'A';
   printf("%c\n", ch);
   return 0;
}
```

```
#include <stdio.h>
int main()
{
   float a = 12.67;
   printf("%f\n", a);
   return 0;
}
```

Variables

- A symbolic name which is used to store data item i.e. a numerical quantity or a character constant.
- Each variable in C has a specific type, which determines the size and layout of the variable's memory; the range of values that can be stored within that memory; and the set of operations that can be applied to the variable.
- The same variable can store different value at different portion of a program.
- Variable name may consists of letters, digits or underscore characters.
- The rules for naming variables are similar to those of identifiers.

Variable Declaration:

- Any variable should be defined before using it in a program.
- The variable are declared using following syntax:

```
data_type  variable_name1, variable_name2, ……..;
```

E.g.
```
int n1;
int v1, v2, v3;
char c;
float radius;
```

Preprocessor Directives

- Collection of special statements that are executed at the beginning of a compilation process.
- Placed in the source program before the main function.

```
#include<stdio.h>      //used for file inclusion
#define PI 3.1416      //defining symbolic constant PI
```

- These statements are called preprocessor directives as they are processed before compilation of any other source code in the program.

Statement

- Statement is the complete direction to computer to perform specific task.
- In C, a statement is terminated by semicolon(;)

Types of statement:

1) Null statement: Does nothing.

```
;
```

2) Compound statement: Block of statement

```
{
    ……;
    ……;
}
```

Compound statement

Expression

- Combination of variable, constant, operators etc. on the basis of language grammar.
- Every expression consists of at least on operand and can have one or more operators.
- Operands are values and operators are symbols that represent particular actions.
- E.g. a+b, a+b*c, a*b/3

Some Q & A (C Program)

Q. Write a program to input the marks of a student in different 5 subjects in a class test and compute total marks and percentage score. Assume each subject has full marks 20.

```
#include<stdio.h>
#include<conio.h>
#define FM 20
void main()
{
   float sub1, sub2, sub3, sub4, sub5, total, percentage;
   printf("Enter the marks of 5 subjects:");
   printf("\nSub1:");
   scanf("%f", &sub1);
   printf("\nSub2:");
   scanf("%f", &sub2);
   printf("\nSub3:");
   scanf("%f", &sub3);
   printf("\nSub4:");
   scanf("%f", &sub4);
   printf("\nSub5:");
   scanf("%f", &sub5);
   total= sub1+sub2+sub3+sub4+sub5;
   percentage=total/(5*FM)*100;
   printf("he total marks obtained=%f",total);
   printf("\nThe percentage score=%f", percentage);
   getch();
}
```

Q. An employee has some basic salary. He gets 10% performance allowance and 20% expense allowances. The provident fund is deducted as 10% of his basic salary and 1% tax is ducted after provident fund. Find his net payment of a month.

```
#include<stdio.h>
#include<conio.h>
void main()
{
   float BS, PA, EA, PF, tax, TS, NS;
   printf("Enter the basic salary:");
   scanf("%f",&BS);
   PA=(10.0/100)*BS;
```

BS→Basic salary
PA→Performance allowance
EA→Expense
PF→Provident fund
TS→Total salary
NS→Net salary

```
    printf("The PA is %f\n", PA);
    EA=(20.0/100)*BS;
    printf("The EA is %f\n", EA);
    PF=(10.0/100)*BS;
    printf("The PF is %f\n", PF);
    TS=BS+PA+EA-PF;
    printf("The TS is %f\n", TS);
    tax=(1.0/100)*TS;
    printf("The tax is %f\n", tax);
    NS=TS-tax;
    printf("The NS is %f", NS);
    getch();
}
```

Q. Write a program to compute the area of circle.

```
#include<stdio.h>
#include<conio.h>
#define PI 3.1416
int main()
{
   float radius, area;
   printf("\nEnter the radius of Circle : ");
   scanf("%f", &radius);
   area = PI * radius * radius;
   printf("\nArea of Circle : %f", area);
   getch();
   return 0;
}
```

Q. Write a program to compute the roots of quadratic equation $ax^2 + bx + c = 0$ where the coefficient a, b, c are inputs to the program.

```
#include<stdio.h>
#include<conio.h>
#include<math.h>
void main()
{
    float a, b, c, d, root1, root2;
    printf("Enter the coefficient of x^2:");
    scanf("%f",&a);
    printf("\nEnter the coefficient of x:");
    scanf("%f",&b);
    printf("\nEnter the constant:");
    scanf("%f",&c);
    d=b*b-4*a*c;
    root1=(-b+sqrt(d))/(2*a);
```

```
    root2=(-b-sqrt(d))/(2*a);
    printf("\nroot1=%f",root1);
    printf("\nroot2=%f",root2);
    getch();
}
```