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SCHOOL OF COMPUTING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UNIT – IV – PROBLEM SOLVING TECHNIQUES WITH C and C++ SCSA1104

UNIT 4

POINTERS AND FILE PROCESSING

POINTERS AND FILE PROCESSING: Pointers: Introduction, Arrays Using Pointers – Structures Using Pointers – Functions Using Pointer, Dynamic Memory Allocation, Storage Classes, File Handling in 'C' Algorithms: Swap elements using Call by Reference – Sorting Arrays using pointers- Finding sum of array elements using Dynamic Memory Allocation.

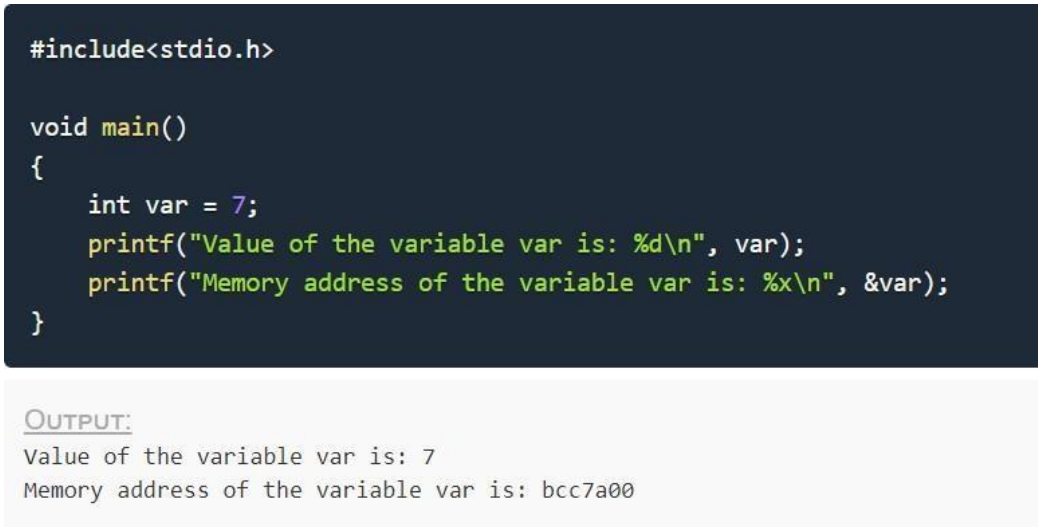
POINTERS

- A Pointer in C language is a variable which holds the address of another variable of same data type.
- Pointers are used to access memory and manipulate the address.
- Pointers are one of the most distinct and exciting features of C language.
- It provides power and flexibility to the language.

ADDRESS IN C

- Whenever a variable is defined in C language, a memory location is assigned for it, in which it's value will be stored using the & symbol.
- If var is the name of the variable, then &var will give it's address.

EXAMPLE

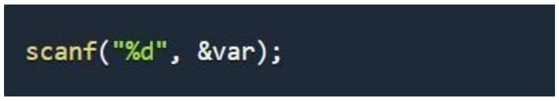


```
#include<stdio.h>

void main()
{
    int var = 7;
    printf("Value of the variable var is: %d\n", var);
    printf("Memory address of the variable var is: %x\n", &var);
}
```

OUTPUT:

```
Value of the variable var is: 7
Memory address of the variable var is: bcc7a00
```

- You must have also seen in the function scanf(), we mention &var to take user input for any variable var.



```
scanf("%d", &var);
```

- This is used to store the user inputted value to the address of the variable var.

CONCEPT OF POINTERS

```
int a = 10;
```

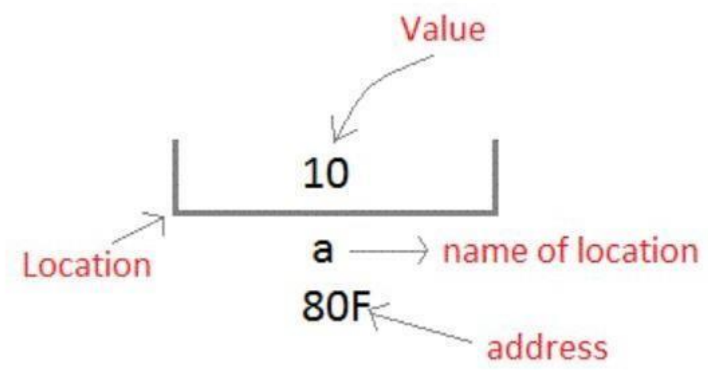


Fig.1.Concept of pointer

- Whenever a variable is declared in a program, system allocates a location i.e an address to that variable in the memory, to hold the assigned value.(Fig.1)
- This location has its own address number
- Let us assume that system has allocated memory location 80F for a variable a. (above mentioned)

POINTER VARIABLES

- The memory addresses are also just numbers, they can also be assigned to some other variable.
- The variables which are used to hold memory addresses are called Pointer variables.
- A pointer variable is therefore nothing but a variable which holds an address of some other variable.

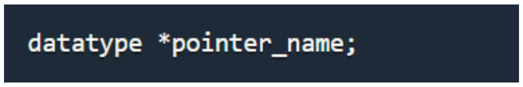
BENEFITS OF USING POINTERS

- Pointers are more efficient in handling Arrays and Structures.
- Pointers allow references to function and thereby help in passing of function as arguments to other functions.
- It reduces length of the program and its execution time as well.
- It allows C language to support Dynamic Memory management.

DECLARING, INITIALIZING AND USING A POINTER VARIABLE IN C

DECLARING OF C POINTER

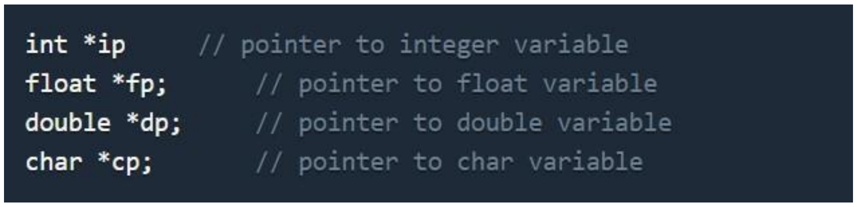
Syntax



```
datatype *pointer_name;
```

- Data type of a pointer must be same as the data type of the variable to which the pointer variable is pointing.
- void type pointer works with all data types, but is not often used.

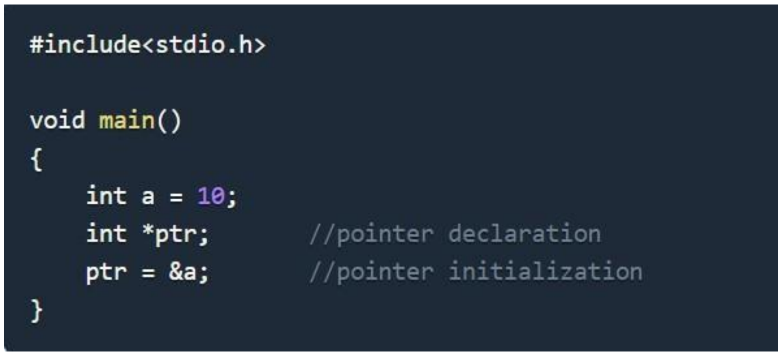
Examples



```
int *ip     // pointer to integer variable
float *fp;      // pointer to float variable
double *dp;     // pointer to double variable
char *cp;       // pointer to char variable
```

INITIALIZATION OF C POINTER VARIABLE

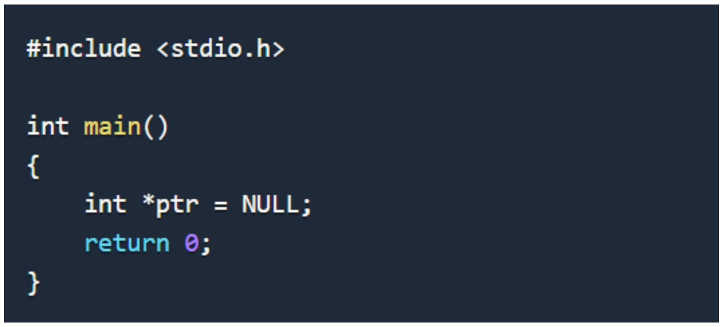
- Pointer initialization is the process of assigning address of a variable to a pointer variable.
- Pointer variable can only contain address of a variable of the same data type.
- In C language address operator & is used to determine the address of a variable.
- The & (immediately preceding a variable name) returns the address of the variable associated with it.



```
#include<stdio.h>

void main()
{
    int a = 10;
    int *ptr;       //pointer declaration
    ptr = &a;       //pointer initialization
}
```

NULL Pointer

- The variable's address to assign to a pointer variable while declaration, it is recommended to assign a NULL value to your pointer variable.
- A pointer which is assigned a NULL value is called a NULL pointer.



```c
#include <stdio.h>

int main()
{
    int *ptr = NULL;
    return 0;
}
```

EXAMPLE FOR POINTERS

```c
#include <stdio.h>

int main()
{
    int i = 10;     // normal integer variable storing value 10
    int *a;     // since '*' is used, hence its a pointer variable
    a = &i;
    /*
        below, address of variable 'i', which is stored
        by a pointer variable 'a' is displayed
    */
   printf("Address of variable i is %u\n", a);
    /*
        below, '*a' is read as 'value at a'
        which is 10
    */
   printf("Value at the address, which is stored by pointer variable a is %d\n",*a);
   return 0;
}
```

Output

Address of variable i is 2686728 (The address may vary)

Value at an address, which is stored by pointer variable a is 10

POINTERS USING ARRAYS

Example 1

```
#include  <stdio.h>

const int MAX = 3;

int main () {

   int var[] = {10, 100, 200};
   int i;

   for (i = 0; i < MAX; i++) {
      printf("Value of var[%d] = %d\n", i, var[i] );
   }

   return 0;
}
```

Output

```
Value of var[0] = 10
Value of var[1] = 100
Value of var[2] = 200
```

Example 2

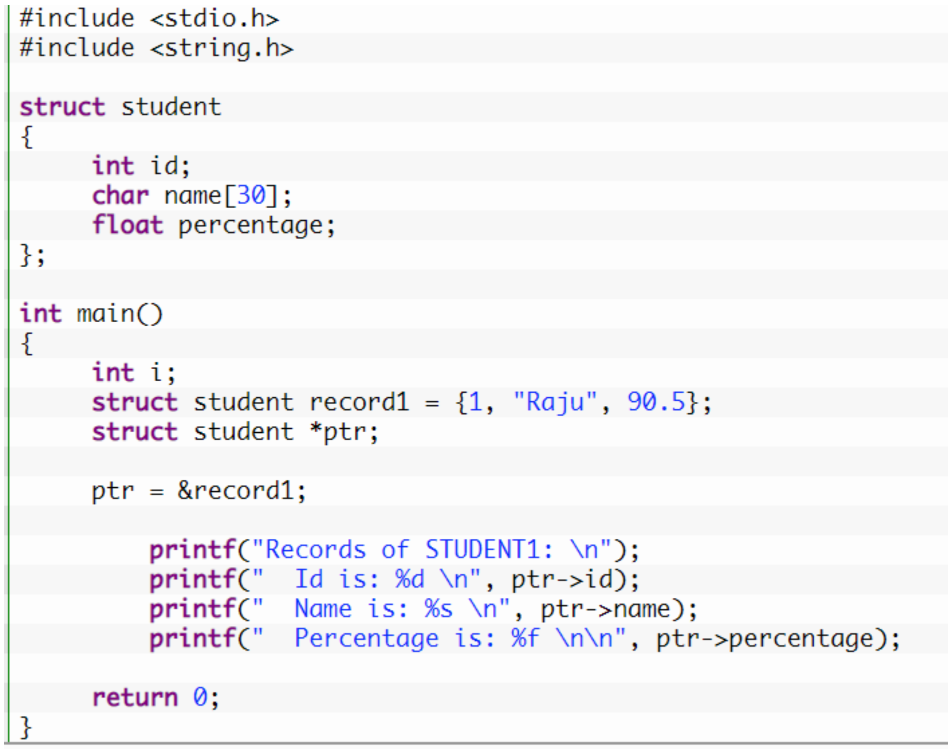
```
#include <stdio.h>

const int MAX = 4;

int main () {

   char *names[] = {
      "ABCD",
      "EFGH",
      "IJKL",
      "MNOP"
   };

   int i = 0;

   for ( i = 0; i < MAX; i++) {
      printf("Value of names[%d] = %s\n", i, names[i] );
   }

   return 0;
}
```

Output

```
Value of names[0] = ABCD  Value
of names[1] = EFGH
Value of names[2] = IJKL
Value of names[3] = MNOP
```

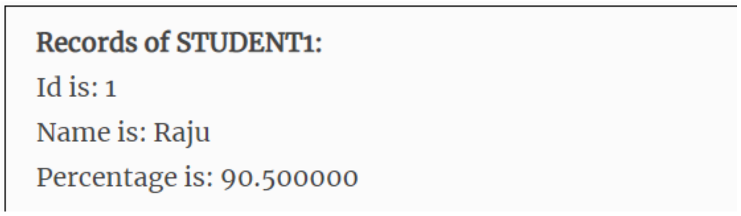
POINTERS USING STRUCTURES

Example



```c
#include <stdio.h>
#include <string.h>

struct student
{
      int id;
      char name[30];
      float percentage;
};

int main()
{
      int i;
      struct student record1 = {1, "Raju", 90.5};
      struct student *ptr;

      ptr = &record1;

          printf("Records of STUDENT1: \n");
          printf("  Id is: %d \n", ptr->id);
          printf("  Name is: %s \n", ptr->name);
          printf("  Percentage is: %f \n\n", ptr->percentage);

      return 0;
}
```

Output



```
Records of STUDENT1:
Id is: 1
Name is: Raju
Percentage is: 90.500000
```

POINTERS USING FUNCTIONS

Example 1

```
#include <stdio.h>
void salaryhike(int  *var, int b)
{
    *var = *var+b;
}
int main()
{
    int salary=0, bonus=0;
    printf("Enter the employee current salary:");

    scanf("%d", &salary);
    printf("Enter bonus:");
    scanf("%d", &bonus);
    salaryhike(&salary, bonus);
    printf("Final salary: %d", salary);
    return 0;
}
```

Output

```
Enter the employee current salary:10000
Enter bonus:2000
Final salary: 12000
```

Example 2

Swapping two numbers using Pointers

- This is one of the most popular example that shows how to swap numbers using call by reference.

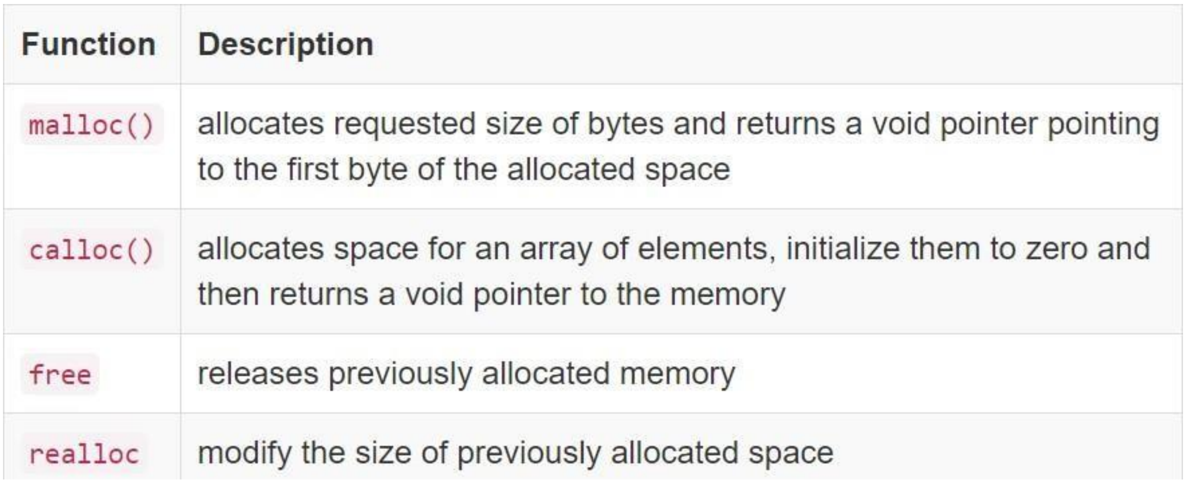
```
#include <stdio.h>
void swapnum(int *num1, int *num2)
{
   int tempnum;

   tempnum = *num1;
   *num1 = *num2;
   *num2 = tempnum;
}
int main( )
{
   int v1 = 11, v2 = 77 ;
   printf("Before swapping:");
   printf("\nValue of v1 is: %d", v1);
   printf("\nValue of v2 is: %d", v2);

   /*calling swap function*/
   swapnum( &v1, &v2 );

   printf("\nAfter swapping:");
   printf("\nValue of v1 is: %d", v1);
   printf("\nValue of v2 is: %d", v2);
}
```

Output

```
Before      swapping:
Value of v1 is: 11
Value of v2 is:     77

After  swapping:
Value of v1 is:     77
Value of v2 is:     11
```

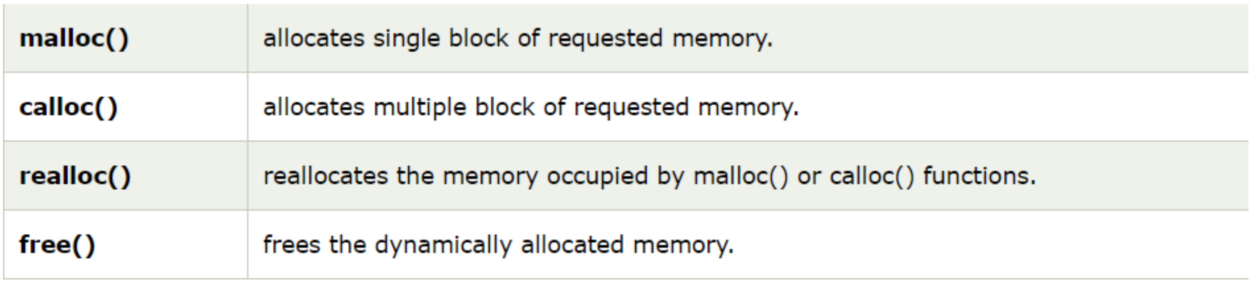
DYNAMIC MEMORY ALLOCATION

- The process of allocating memory at runtime is known as dynamic memory allocation.
- Library routines known as memory management functions are used for allocating and freeing memory during execution of a program.
- These functions are defined in stdlib.h header file.
- Dynamic memory allocation in c language is possible by 4 functions
    - malloc()
    - calloc()
    - realloc()
    - free()



Function	Description
`malloc()`	allocates requested size of bytes and returns a void pointer pointing to the first byte of the allocated space
`calloc()`	allocates space for an array of elements, initialize them to zero and then returns a void pointer to the memory
`free`	releases previously allocated memory
`realloc`	modify the size of previously allocated space

OR



malloc()	allocates single block of requested memory.
calloc()	allocates multiple block of requested memory.
realloc()	reallocates the memory occupied by malloc() or calloc() functions.
free()	frees the dynamically allocated memory.

MEMORY ALLOCATION PROCESS

- Global variables, static variables and program instructions get their memory in permanent storage area whereas local variables are stored in a memory area called Stack.(Fig.2)
- The memory space between these two regions is known as Heap area.
- This region is used for dynamic memory allocation during execution of the program.
- The size of heap keeps changing.

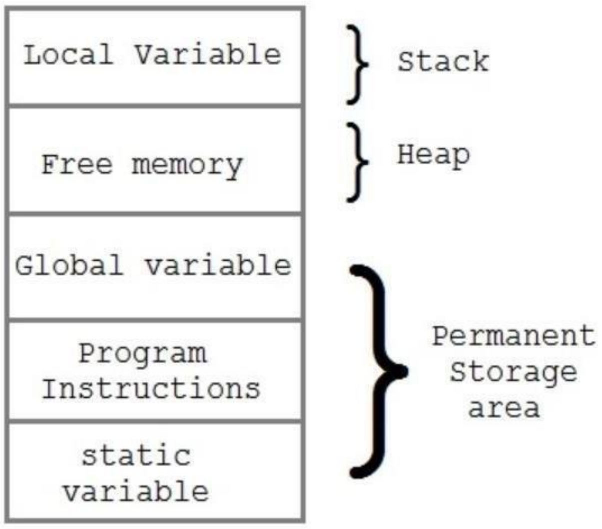
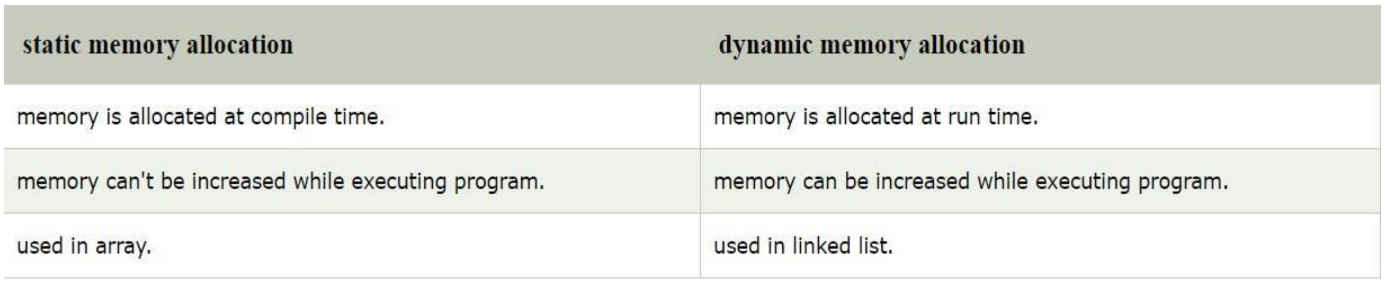
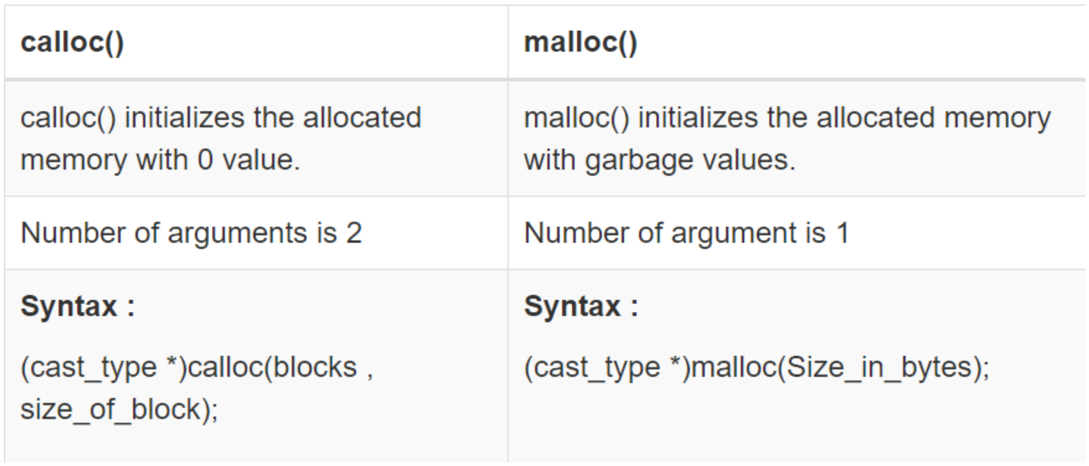


Fig.2.Memory Allocation Process

DIFFERENCE BETWEEN STATIC MEMORY ALLOCATION AND DYNAMIC MEMORY ALLOCATION



static memory allocation	dynamic memory allocation
memory is allocated at compile time.	memory is allocated at run time.
memory can't be increased while executing program.	memory can be increased while executing program.
used in array.	used in linked list.



calloc()	malloc()
calloc() initializes the allocated memory with 0 value.	malloc() initializes the allocated memory with garbage values.
Number of arguments is 2	Number of argument is 1
Syntax : (cast_type *)calloc(blocks , size_of_block);	**Syntax :** (cast_type *)malloc(Size_in_bytes);

DIFFERENCE BETWEEN calloc() and malloc()

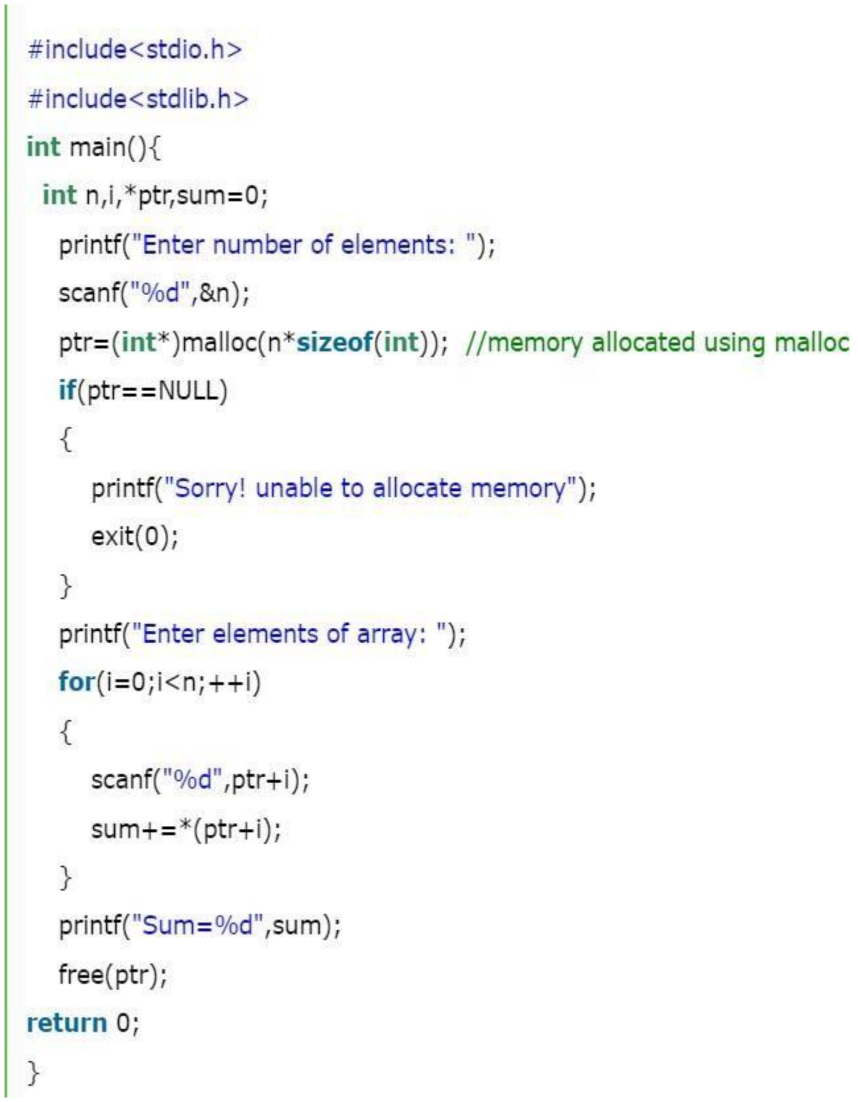
malloc() function in C

- The malloc() function allocates single block of requested memory.
- It doesn't initialize memory at execution time, so it has garbage value initially.
- It returns NULL if memory is not sufficient.

Syntax of malloc()

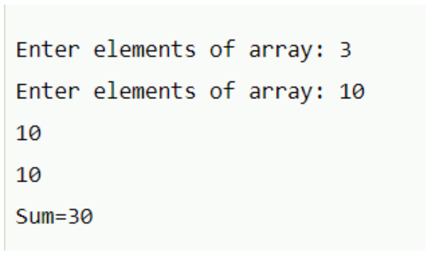
ptr = (cast-type*) malloc (byte-size)

Example



```c
#include<stdio.h>
#include<stdlib.h>
int main(){
 int n,i,*ptr,sum=0;
  printf("Enter number of elements: ");
  scanf("%d",&n);
  ptr=(int*)malloc(n*sizeof(int));  //memory allocated using malloc
  if(ptr==NULL)
  {
     printf("Sorry! unable to allocate memory");
     exit(0);
  }
  printf("Enter elements of array: ");
  for(i=0;i<n;++i)
  {
     scanf("%d",ptr+i);
     sum+=*(ptr+i);
  }
  printf("Sum=%d",sum);
  free(ptr);
return 0;
}
```

Output



```
Enter elements of array: 3
Enter elements of array: 10
10
10
Sum=30
```

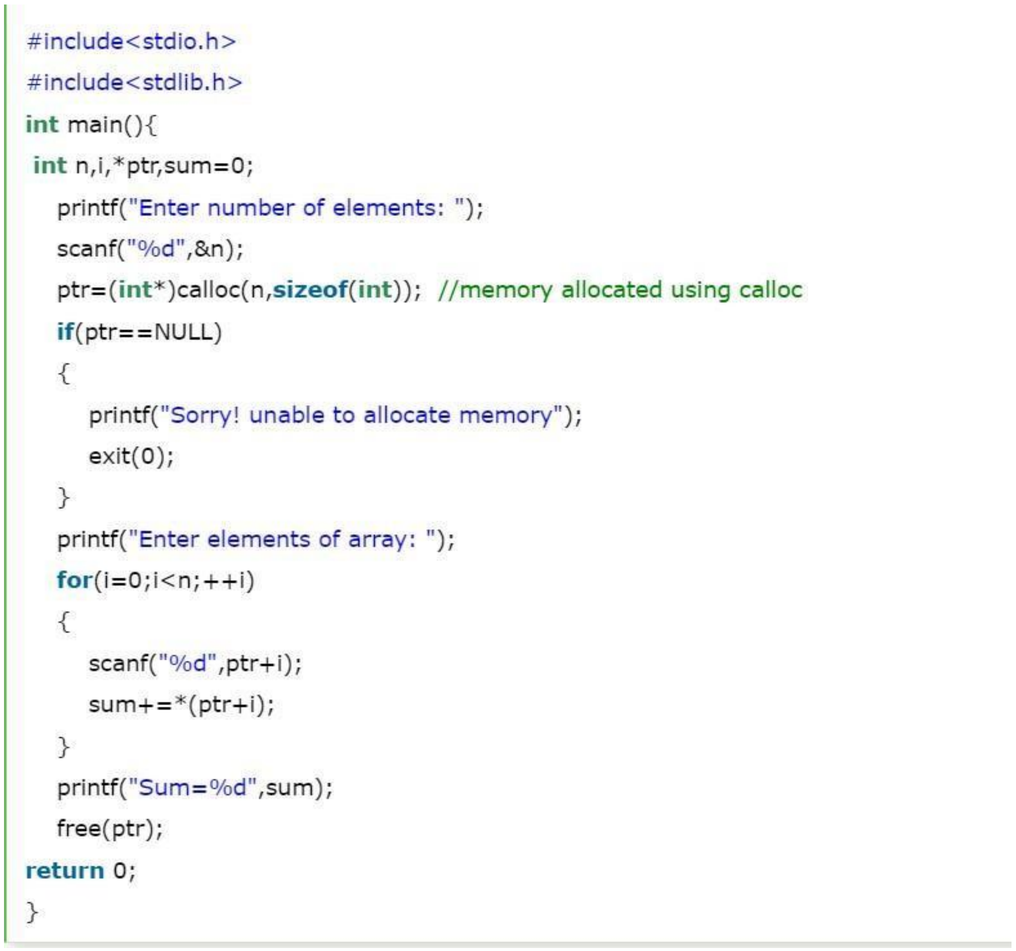
calloc() function in C

- The calloc() function allocates multiple block of requested memory.
- It initially initialize all bytes to zero.
- It returns NULL if memory is not sufficient.

Syntax

ptr = (cast-type*) calloc (number, byte-size)

Example



```
#include<stdio.h>
#include<stdlib.h>
int main(){
 int n,i,*ptr,sum=0;
    printf("Enter number of elements: ");
    scanf("%d",&n);
    ptr=(int*)calloc(n,sizeof(int));  //memory allocated using calloc
    if(ptr==NULL)
    {
        printf("Sorry! unable to allocate memory");
        exit(0);
    }
    printf("Enter elements of array: ");
    for(i=0;i<n;++i)
    {
        scanf("%d",ptr+i);
        sum+=*(ptr+i);
    }
    printf("Sum=%d",sum);
    free(ptr);
return 0;
}
```

Output

```
Enter elements of array: 3
Enter elements of array: 10
10
10
Sum=30
```

realloc() function in C

- If memory is not sufficient for malloc() or calloc(), you can reallocate the memory by realloc() function. In short, it changes the memory size.

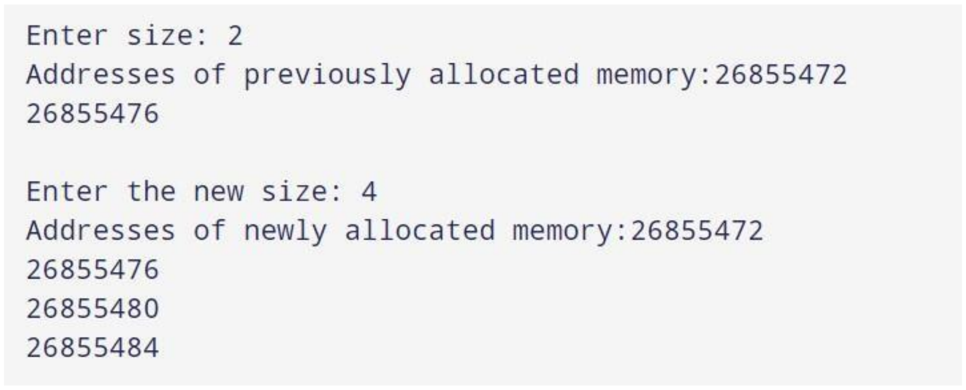
Syntax

ptr = realloc (ptr, new-size)

Example

```
int main()
{
    int *ptr, i , n1, n2;
    printf("Enter size: ");
    scanf("%d", &n1);

    ptr = (int*) malloc(n1 * sizeof(int));

    printf("Addresses of previously allocated memory: ");
    for(i = 0; i < n1; ++i)
         printf("%u\n",ptr + i);

    printf("\nEnter the new size: ");
    scanf("%d", &n2);

    // rellocating the memory
    ptr = realloc(ptr, n2 * sizeof(int));

    printf("Addresses of newly allocated memory: ");
    for(i = 0; i < n2; ++i)
         printf("%u\n", ptr + i);

    free(ptr);

    return 0;
}
```

Output



```
Enter size: 2
Addresses of previously allocated memory:26855472
26855476

Enter the new size: 4
Addresses of newly allocated memory:26855472
26855476
26855480
26855484
```

free() function in C

- The memory occupied by malloc() or calloc() functions must be released by calling free() function.
- Otherwise, it will consume memory until program exit.

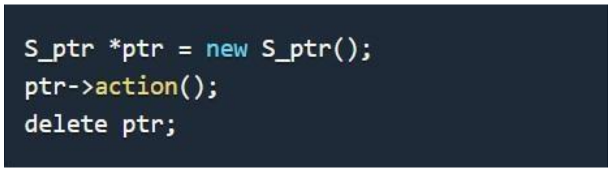
Syntax

free (ptr)

SMART POINTER

- Smart Pointer is used to manage the lifetimes of dynamically allocated objects.
- They ensure proper destruction of dynamically allocated objects.
- Smart pointers are defined in the memory header file.
- Smart pointers are built-in pointers, we don't have to worry about deleting them, they are automatically deleted.
- By using the delete keyword we can delete the memory allocated

Example



```
S_ptr *ptr = new S_ptr();
ptr->action();
delete ptr;
```

STORAGE CLASSES IN C

- In C language, each variable has a storage class which decides the following things:
- Scope- where the value of the variable would be available inside a program.
- Default initial value- if we do not explicitly initialize that variable, what will be its default initial value.
- Lifetime of that variable - for how long wills that variable exist.

Storage classes are most often used in C programming

- Automatic variables
- External variables
- Static variables
- Register variables

AUTOMATIC VARIABLES

Keyword : auto

- SCOPE: Variable defined with auto storage class are local to the function block inside which they are defined.
- Default initial Value: Any random value i.e garbage value.
- Lifetime: Till the end of the function/method block where the variable is defined.

AUTOMATIC VARIABLES

- A variable declared inside a function without any storage class specification, is by default an automatic variable.
- They are created when a function is called and are destroyed automatically when the function's execution is completed.
- Automatic variables can also be called local variables because they are local to a function.
- By default they are assigned garbage value by the compiler

Example

```
#include<stdio.h>
void main()
{
    int detail;
    // or
    auto int details;    //Both are same
}
```

EXTERNAL or GLOBAL VARIABLE

Keyword : extern

- **Scope:** Global i.e everywhere in the program. These variables are not bound by any function, they are available everywhere.
- **Default initial value:** 0(zero).
- **Lifetime:** Till the program doesn't finish its execution, you can access global variables.

GLOBAL VARIABLE

- A variable that is declared outside any function is a Global Variable.
- Global variables remain available throughout the program execution.
- By default, initial value of the Global variable is 0 (zero).

Example

```
#include<stdio.h>
int number;     // global variable
void main()
{
    number = 10;
    printf("I am in main function. My value is %d\n", number);
    fun1();     //function calling, discussed in next topic
    fun2();     //function calling, discussed in next topic
}
/* This is function 1 */
fun1()
{
    number = 20;
    printf("I am in function fun1. My value is %d", number);
}
/* This is function 1 */
fun2()
{
    printf("\nI am in function fun2. My value is %d", number);
}
```

Output

```
I am in function main. My value is 10
I am in function fun1. My value is 20
I am in function fun2. My value is 20
```

extern KEYWORD

- The extern keyword is used with a variable to inform the compiler that this variable is declared somewhere else.
- The extern declaration does not allocate storage for variables.(Fig.3)

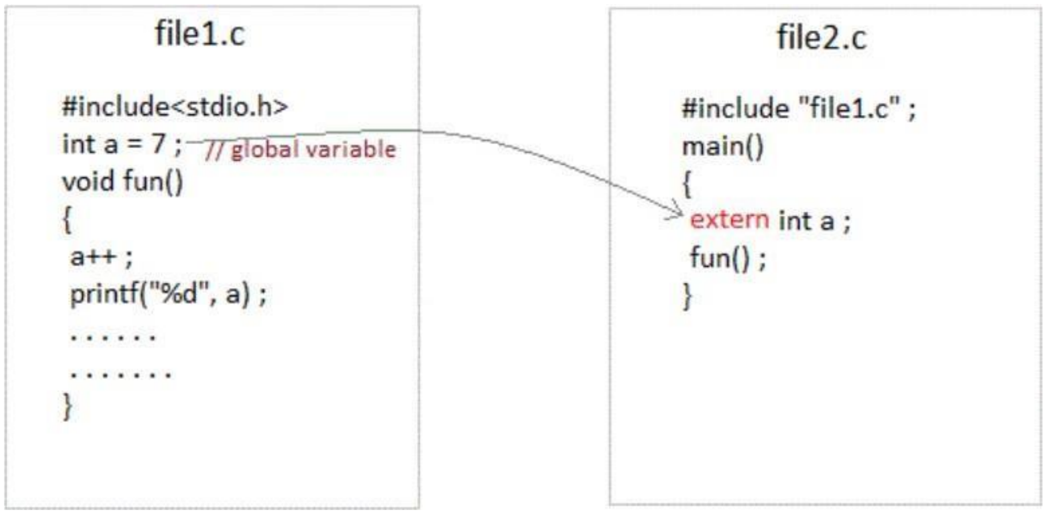


Fig.3.extern Keyword

Problem when extern is not used

```
int main()
{
    a = 10;     //Error: cannot find definition of variable 'a'
    printf("%d", a);
}
```

Example :

using extern in same file

```
int main()
{
    extern int x;   //informs the compiler that it is defined somewhere else
    x = 10;
    printf("%d", x);
}
int x;      //Global variable x
```

STATIC VARIABLES

Keyword : static

- **Scope:** Local to the block in which the variable is defined
- **Default initial value:** 0(Zero).
- **Lifetime:** Till the whole program doesn't finish its execution

STATIC VARIABLES

- A static variable tells the compiler to persist/save the variable until the end of program.
- Instead of creating and destroying a variable every time when it comes into and goes out of scope, static variable is initialized only once and remains into existence till the end of the program.
- A static variable can either be internal or external depending upon the place of declaration.
- Scope of internal static variable remains inside the function in which it is defined.
- External static variables remain restricted to scope of file in which they are declared

Example

```
#include<stdio.h>
void test();    //Function declaration (discussed in next topic)
int main()
{
    test();
    test();
    test();
}
```

```
void test()
{
    static int a = 0;       //a static variable
    a = a + 1;
    printf("%d\t",a);
}
```

Output

1 2 3

REGISTER VARIABLE

- **Scope:** Local to the function in which it is declared.
- **Default initial value:** Any random value i.e garbage value
- **Lifetime:** Till the end of function/method block, in which the variable is defined.

Keyword : register

Syntax

register int number;

REGISTER VARIABLE

- Register variables inform the compiler to store the variable in CPU register instead of memory.
- Register variables have faster accessibility than a normal variable.

FILE HANDLING IN C

- In any programming language it is vital to learn file handling techniques.
- Many applications will at some point involve accessing folders and files on the hard drive.
- In C, a stream is associated with a file.
- Special functions have been designed for handling file operations.
- The header file stdio.h is required for using these functions

Different operations that can be performed on a file are:

1. Creation of a new file (**fopen with attributes as "a" or "a+" or "w" or "w++"**)
2. Opening an existing file (**fopen**)
3. Reading from file (**fscanf or fgets**)
4. Writing to a file (**fprintf or fputs**)
5. Moving to a specific location in a file (**fseek, rewind**)
6. Closing a file (**fclose**)

The text in the brackets denotes the functions used for performing those operations.

File opening modes in C:

- **"r" –** Searches file. If the file is opened successfully fopen( ) loads it into memory and sets up a pointer which points to the first character in it. If the file cannot be opened fopen( ) returns NULL.
- **"w" –** Searches file. If the file exists, its contents are overwritten. If the file doesn't exist, a new file is created. Returns NULL, if unable to open file.
- **"a" –** Searches file. If the file is opened successfully fopen( ) loads it into memory and sets up a pointer that points to the last character in it. If the file doesn't exist, a new file is created. Returns NULL, if unable to open file.
- **"r+" –** Searches file. If is opened successfully fopen( ) loads it into memory and sets up a pointer which points to the first character in it. Returns NULL, if unable to open the file.
- **"w+" –** Searches file. If the file exists, its contents are overwritten. If the file doesn't exist a new file is created. Returns NULL, if unable to open file.
- **"a+" –** Searches file. If the file is opened successfully fopen( ) loads it into memory and sets up a pointer which points to the last character in it. If the file doesn't exist, a new file is created. Returns NULL, if unable to open file.

Opening file

- The function fopen() for opening a file.
- Once this is done one can read or write to the file using the fread() or fwrite() functions
- The fclose() function is used to explicitly close any opened file.

SYNTAX

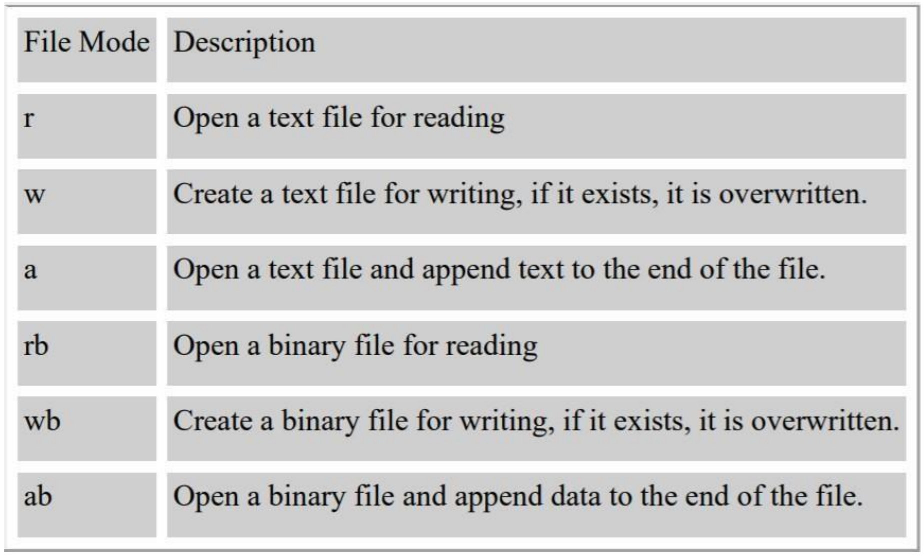
FILE*fopen("filename" , "mode");

EXAMPLE

```
#include        <stdio.h>
 main ()
 {
 FILE *fp;
 fp = fopen("data.txt", "r");
if    (fp    ==    NULL)    {
printf("File does not exist,
please check!\n");
 }
 fclose(fp);
 }
```

fopen()

- This function accepts two arguments as strings.
- The first argument denotes the name of the file to be opened and the second signifies the mode in which the file is to be opened.
- The second argument can be any of the following:



File Mode	Description
r	Open a text file for reading
w	Create a text file for writing, if it exists, it is overwritten.
a	Open a text file and append text to the end of the file.
rb	Open a binary file for reading
wb	Create a binary file for writing, if it exists, it is overwritten.
ab	Open a binary file and append data to the end of the file.

fclose()

- The fclose() function is used for closing opened files.
- The only argument it accepts is the file pointer.
- If a program terminates, it automatically closes all opened files.
- fclose(p1);

fscanf() and fprint()

- The functions fprintf() and fscanf() are similar to printf() and scanf() except that these functions operate on files and require one additional and first argument to be a file pointer

fprintf()

Example

```
#include <stdio.h>
main(){
  FILE *fp;
  fp = fopen("file.txt", "w");//opening file
  fprintf(fp, "Hello file by fprintf...\n");//writing data into file
  fclose(fp);//closing file
}
```

fscanf()

Syntax:

```
int fscanf(FILE *stream, const char *format [, argument, ...])
```

Example:

```
#include <stdio.h>
main(){
  FILE *fp;
  char buff[255];//creating char array to store data of file
  fp = fopen("file.txt", "r");
  while(fscanf(fp, "%s", buff)!=EOF){
  printf("%s ", buff );
  }
  fclose(fp);
}
```

Output:

```
Hello file by fprintf...
```

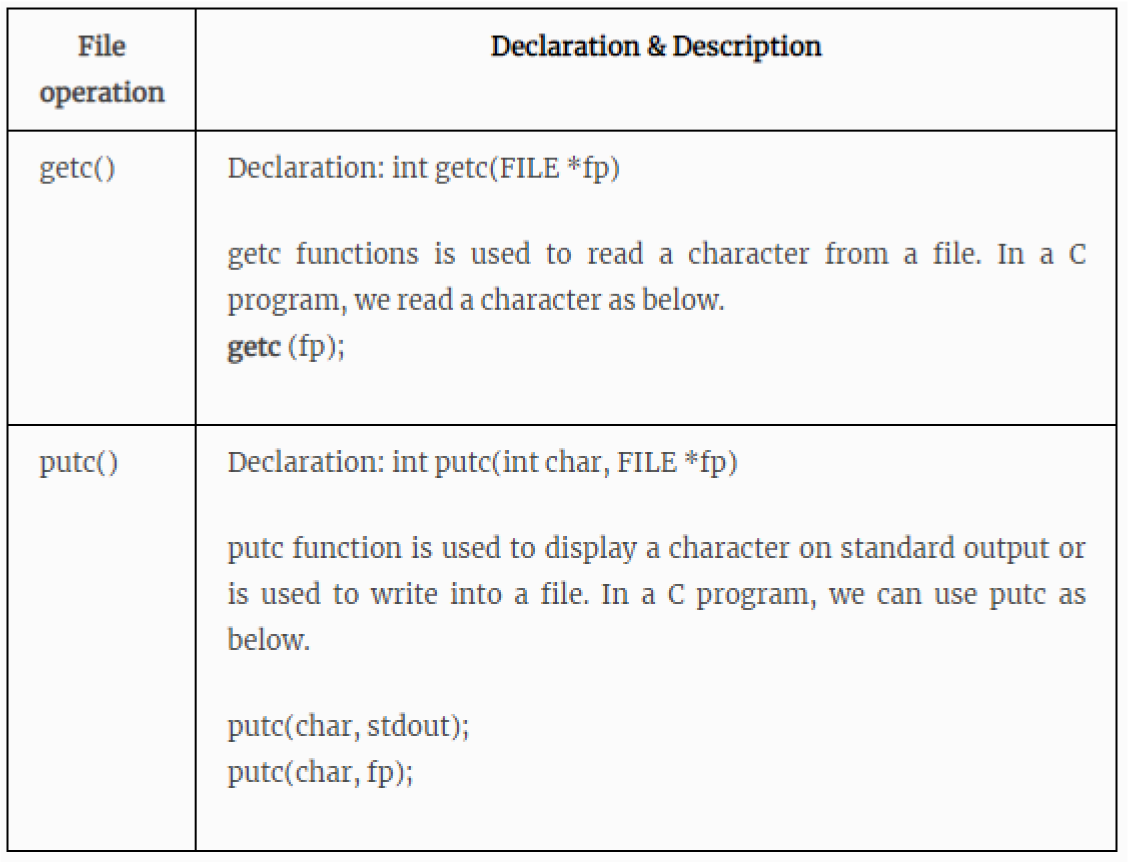
EXAMPLE

```
#include<stdio.h>
main ()
{
 FILE   *fp;
 float total;
 fp = fopen("data.txt", "w+");
 if (fp == NULL) {
 printf("data.txt does not exist, please check!\n");
 exit (1);
 }
 fprintf(fp,              100);
 fscanf(fp, "%f", &total);
 fclose(fp);
 printf("Value of total is %f\n", total);
}
```

getc() and putc()

- The functions getc() and putc() are equivalent to getchar() and putchar() functions
- Input and Output, except that these functions require an argument which is the file pointer.
- Function getc() reads a single character from the file which has previously been opened using a function like fopen().
- Function putc() does the opposite, it writes a character to the file identified by its second argument.
- The format of both functions is as follows

  ```
  getc(in_file); putc(c,
  out_file);
  ```



File operation	Declaration & Description
getc()	Declaration: int getc(FILE *fp) getc functions is used to read a character from a file. In a C program, we read a character as below. **getc** (fp);

putc()	Declaration: int putc(int char, FILE *fp)
	
	putc function is used to display a character on standard output or is used to write into a file. In a C program, we can use putc as below.
	
	putc(char, stdout);
	putc(char, fp);

Example:
Getc()

```
#include <stdio.h>
int main()
{
   char ch;
   FILE *fp;
   if (fp = fopen("test.c", "r"))
   {
     ch = getc(fp);
     while (ch != EOF)
     {
        putc(ch, stdout);
        ch = getc(fp);
     }
     fclose(fp);
     return 0;
   }
   return 1;
}
```

Example

Using getc() and putc()

```
#include        <stdio.h>
main ()
{
 char in_file[30], out_file[30];
 FILE *fpin, *fpout;
 int c;
 printf("This program copies the source file to the destination file \n\n"); printf("Enter
 name of the source file :");
 scanf("%30s", in_file);
 printf("Enter name of the destination file :");
 scanf("%30s",                     out_file);
 if((fpin=fopen(in_file, "r")) == NULL)
 printf("Error could not open source file for  reading\n"); else
 if  ((fpout=fopen(out_file,  "w"))  ==  NULL)  printf("Error
 could not open destination file for reading\n"); else
 {
 while((c    =getc(fpin))    !=    EOF)
 putc(c, fpout);
 printf("Destination file has been copied\n");
 }
}
```

BINARY STREAMINPUT AND OUTPUT

- The functions fread() and fwrite() are a somwhat complex file handling functions used for reading or writing chunks of data containing NULL characters ('\0') terminating strings
- The function prototype of fread() and fwrite() is as below

  ```
  size_t fread (void *ptr, size_t sz, size_t n, FILE *fp)

  size_t fwrite (const void *ptr, size_t sz, size_t n, FILE *fp);
  ```

- The return type of fread() is size_t which is the number of items read.
- Function fread() reads it as a stream of bytes and advances the file pointer by the number of bytes read.
- Function fwrite() works similarly, it writes n objects of sz bytes long from a location pointed to by ptr, to a file pointed to by fp, and returns the number of items written to fp

Description for fread() and fwrite() declaration (above mentioned)
fread()

Declaration:

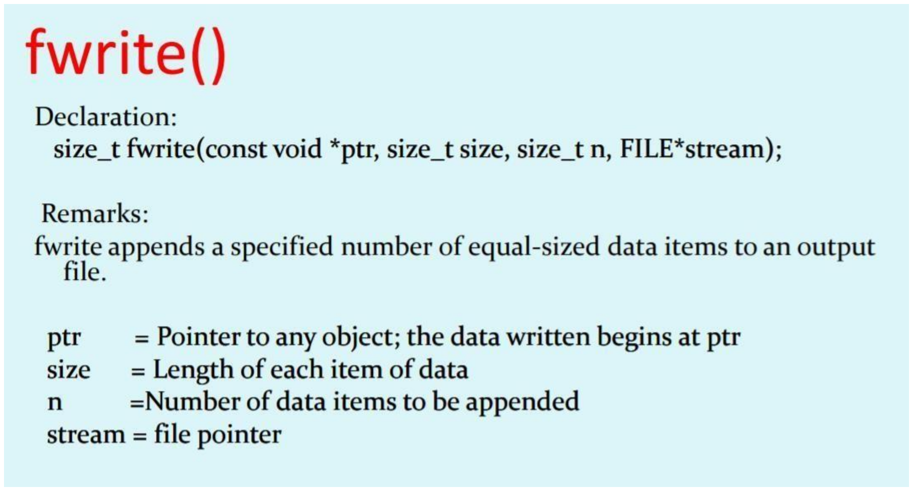
Size_t fread(void *ptr,size_t size,size_t n,FILE *stream);
Remarks:
fread reads a specified number of equal-sized data items from an input stream into a block.

Ptr = points to a block into which data is read
Size=length of each item read,in bytes
n =number of items read
stream = file pointer

Example for fread()

```
#include<stdio.h>
int main()
{
FILE *f;
char buffer [n];
if(f=fopen("fred.txt","r"))
{
fread(buffer,1,10,f);
buffer[10]=0
fclose(f);
printf("first 10 characters of the file:/n%s\n",buffer);
}
return 0;
}
```

fwrite()



fwrite()

Declaration:

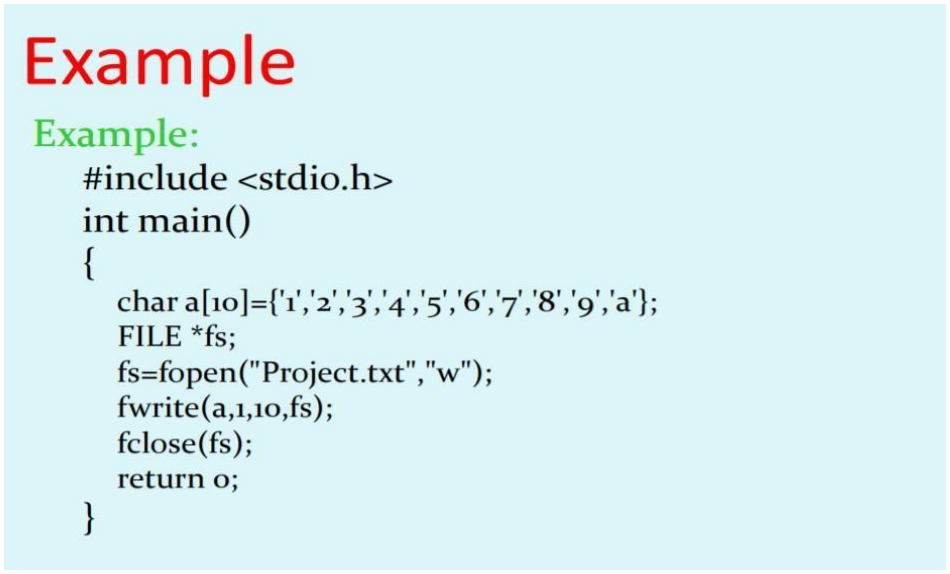
size_t fwrite(const void *ptr, size_t size, size_t n, FILE*stream);

Remarks:

fwrite appends a specified number of equal-sized data items to an output file.

ptr	= Pointer to any object; the data written begins at ptr
size	= Length of each item of data
n	=Number of data items to be appended
stream	= file pointer

Example for fwrite()


Example

Example:

```
#include <stdio.h>
int main()
{
    char a[10]={'1','2','3','4','5','6','7','8','9','a'};
    FILE *fs;
    fs=fopen("Project.txt","w");
    fwrite(a,1,10,fs);
    fclose(fs);
    return 0;
}
```

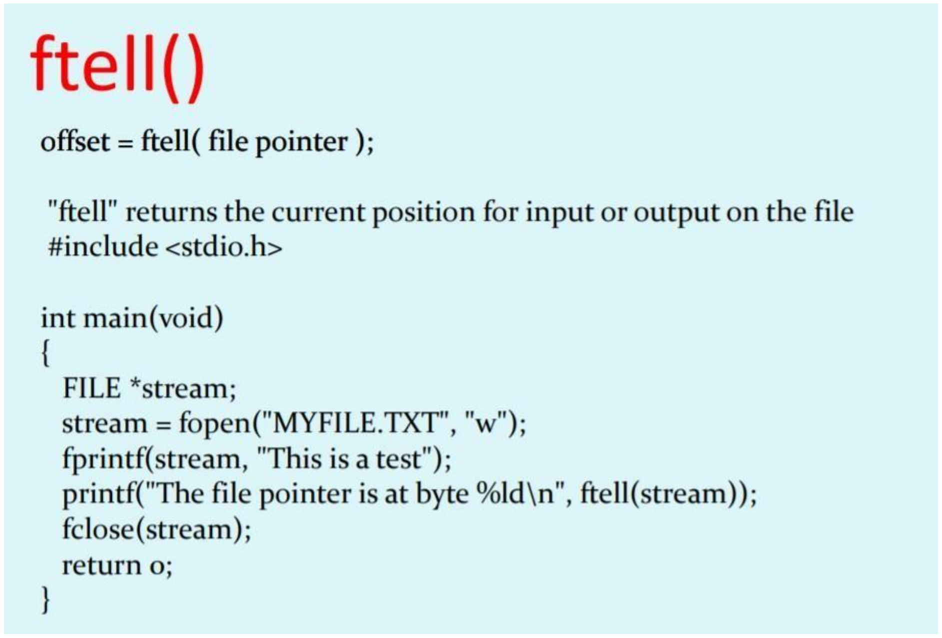
Example:
Using fread() and fwrite() function:

```
#include        <stdio.h>
#define MAX_SIZE 1024
main ()
{
 FILE *fp, *gp;
 char   buf[MAX_SIZE];
 int i, total = 0;
 if  ((fp  =  fopen("data1.txt",  "r")  )  ==  NULL)
 printf("Error in data1.txt file \n");
 else  if  ((gp=fopen("data2.txt",  "w"))  ==  NULL)
 printf("Error in data2.txt file \n");
 else
 {
 while(i=fread(buf, 1, MAX_SIZE, fp))
 {
 fwrite(buf,   1,   MAX_SIZE,   gp);
 total +=i;
 }
 printf("Total is %d\n", total);
 }
 fclose(fp);
 fclose(gp);
}
```

ftell()

- Functions ftell() and fseek() are important in a program performing file manipulations.
- Function ftell() returns the current position of the file pointer in a stream.
- The return value is 0 or a positive integer indicating the byte offset from the beginning of an open file
- A return value of -1 indicates an error.
- Prototype of this function is as shown below :

    long int ftell(FILE *fp);



ftell()

offset = ftell(file pointer);

"ftell" returns the current position for input or output on the file

```
#include <stdio.h>

int main(void)
{
  FILE *stream;
  stream = fopen("MYFILE.TXT", "w");
  fprintf(stream, "This is a test");
  printf("The file pointer is at byte %ld\n", ftell(stream));
  fclose(stream);
  return o;
}
```

fseek()

- This function positions the next I/O operation on an open stream to a new position relative to the current position.

    int fseek(FILE *fp, long int offset, int origin);

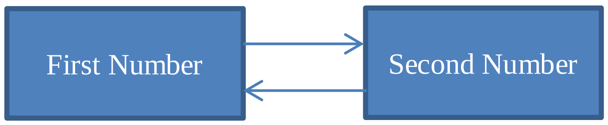
- Here fp is the file pointer of the stream on which I/O operations are carried on, offset is the number of bytes to skip over
- The offset can be either positive or negative, denting forward or backward movement in the file.

EXAMPLE

```
#include  <stdio.h>
#include <stdlib.h>
char buffer[11];
int        position;
main ()
{
 FILE     *file_ptr;
 int num;
 if ((file_ptr = fopen("test_file", "w+f 10"))== NULL)
 {
 printf("Error opening test_file \n");
 exit(1);
 }
 fputs("1111111111",file_ptr);
 fputs("2222222222", file_ptr);
 if ( (position = fseek(file_ptr, 10, SEEK_SET)) != 0)
 {
 printf("Error in seek operation: errno \n"); exit(1);
 }
 num = 11;
 fgets(buffer,       num,       file_ptr);
 printf("The record is %s\n", buffer);
 fclose(file_ptr);
}
OUTPUT: The record is 2222222222.
```

Algorithms:

Swap elements using Call by Reference



Since we want the local variables of main to modified by swap function, we must them using pointers in C.

The idea is simple

1. Assign x to a temp variable : temp = *x
2. Assign y to x : *x =* y
3. Assign temp to y : *y = temp

Program:

```
#include <stdio.h>

void swap(int*, int*);

int main()
{
  int x, y;

  printf("Enter the value of x and y\n");
  scanf("%d%d",&x,&y);

  printf("Before Swapping\nx = %d\ny = %d\n", x, y);

  swap(&x, &y);

  printf("After Swapping\nx = %d\ny = %d\n", x, y);

  return 0;
}

void swap(int *a, int *b)
{
  int temp;

  temp = *b;
  *b = *a;
  *a = temp;
}
```

Sorting Arrays using pointers

Given an array of size n, the task is to sort this array using pointers in C.

Examples:

Input: n = 5, arr[] = {0, 23, 14, 12, 9}
Output: {0, 9, 12, 14, 23}

Input: n = 3, arr[] = {7, 0, 2}
Output: {0, 2, 7}

Approach:

The array can be fetched with the help of pointers with the pointer variable pointing to the base address of the array. Hence in order to sort the array using pointers, we need to access the elements of the array using **(pointer + index)** format.(Fig.4)

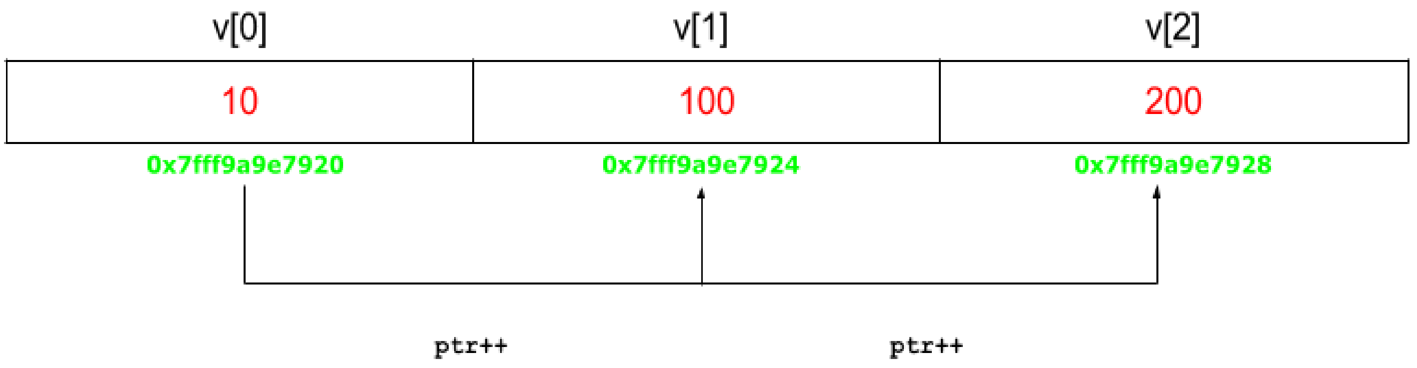


Fig.4.Sorting Arrays using Pointers

Program:

```
#include <stdio.h>

// Function to sort the numbers using pointers
void sort(int n, int* ptr)
{
    int i, j, t;

    // Sort the numbers using pointers
    for (i = 0; i < n; i++) {

        for (j = i + 1; j < n; j++) {

            if (*(ptr + j) < *(ptr + i)) {

                t = *(ptr + i);
                *(ptr + i) = *(ptr + j);
                *(ptr + j) = t;
            }
        }
    }

    // print the numbers
    for (i = 0; i < n; i++)
        printf("%d ", *(ptr + i));
}

// Driver code
int main()
{
    int n = 5;
    int arr[] = { 0, 23, 14, 12, 9 };

    sort(n, arr);

    return 0;
}
```

Finding sum of array elements using Dynamic Memory Allocation:
Dynamic Memory Allocation Example: In this C program, we will declare memory for array elements (limit will be at run time) using malloc(), read element and print the sum of all elements along with the entered elements.
This program is an example of Dynamic Memory Allocation, here we are declaring memory for N array elements at run time using malloc() - which is used to declare memory for N blocks at run time, we will read N elements, will print them and also print the sum of all elements.

Example: C program to find sum of array elements using Dynamic Memory Allocation

```
#include<stdio.h>
#include<stdlib.h>

int main()
{
    int *ptr;       //declaration of integer pointer
    int limit;      //to store array limit
    int i;          //loop counter
    int sum;        //to store sum of all elements

    printf("Enter limit of the array: ");
    scanf("%d",&limit);

    //declare memory dynamically
    ptr=(int*)malloc(limit*sizeof(int));

    //read array elements
    for(i=0;i<limit;i++)
    {
        printf("Enter element %02d: ",i+1);
        scanf("%d",(ptr+i));
    }

    //print array elements
    printf("\nEntered array elements are:\n");
    for(i=0;i<limit;i++)
    {
        printf("%d\n",*(ptr+i));
    }

    //calculate sum of all elements
    sum=0;          //assign 0 to replace garbage value
    for(i=0;i<limit;i++)
    {
        sum+=*(ptr+i);
    }
    printf("Sum of array elements is: %d\n",sum);

    //free memory
    free(ptr);        //hey, don't forget to free dynamically allocated memory.

    return 0;
}
```

Algorithms

Swap two numbers using call by reference

Algorithm:

```
Step 1: Start the program.
Step 2: Set a ← 10 and b ← 20
Step 3: Call the function swap(&a,&b)
Step 3a: Start fuction
Step 3b: Assign t ← *x
Step 3c: Assign *x ← *y
Step 3d: Assign *y ← t
Step 3e: End function
Step 4: Print x and y.
Step 5: Stop the program.
```

```
#include<stdio.h>
#include<conio.h>
void swap(int *,int *);    // Declaration of function
void main( )
{
   int a = 10, b = 20 ;
   clrscr();
   printf("n  Before swapping");
   printf( "n  a = %d b = %d", a, b );
   swap(&a,&b);    // call by reference
   printf("n  After swapping");
   printf( "n  a = %d b = %d", a, b );
   getch();
}
void swap( int *x, int *y )
```

```
{
    int t;
    t = *x;
    *x = *y;
    *y = t;
}
```

Sorting Arrays using pointers

Input size and elements in array. Store them in some variable say size and arr.

Declare two function with prototype int sortAscending(int * num1, int * num2) and int sortDescending(int * num1, int * num2).

Both the functions are used to compare two elements and arrange it in either ascending or descending order. sortAscending() returns negative value if num1 is less than num2, positive value if num1 is greater than num2 and zero if both are equal.

Similarly, sortDescending() returns negative value if num1 is greater than num2, positive value if num2 is greater than num1 and zero if both are equal.

Declare another function to sort array with prototype void sort(int * arr, int size, int (* compare)(int *, int *)). It takes three parameter, where first parameter is the array to sort, second is size of array and third is a function pointer.

```
#include <stdio.h>
#define MAX_SIZE 100
void inputArray(int * arr, int size);
void printArray(int * arr, int size);
int sortAscending(int * num1, int * num2);
int sortDescending(int * num1, int * num2);
void sort(int * arr, int size, int (* compare)(int *, int *));
int main()
{
    int arr[MAX_SIZE];
    int size;
   printf("Enter array size: ");
    scanf("%d", &size);
    printf("Enter elements in array: ");
    inputArray(arr, size);
    printf("\n\nElements before sorting: ");

    printArray(arr, size);

    printf("\n\nArray in ascending order: ");

    sort(arr, size, sortAscending);

    printArray(arr, size);

    printf("\nArray in descending order: ");

    sort(arr, size, sortDescending);

    printArray(arr, size);

    return 0;

}

void inputArray(int * arr, int size)
{
    // Pointer to last element of array
    int * arrEnd = (arr + size - 1);

    while(arr <= arrEnd)
        scanf("%d", arr++);
}
void printArray(int * arr, int size)
{
    // Pointer to last element of array
    int * arrEnd = (arr + size - 1);
    while(arr <= arrEnd)
        printf("%d, ", *(arr++));
}
int sortAscending(int * num1, int * num2)
{
    return (*num1) - (*num2);
}
int sortDescending(int * num1, int * num2)
{
    return (*num2) - (*num1);
}
void sort(int * arr, int size, int (* compare)(int *, int *))
{
    // Pointer to last array element
    int * arrEnd  = (arr + size - 1);
    // Pointer to current array element
    int * curElem = arr;
    int * elemToSort;
    // Iterate over each array element
    while(curElem <= arrEnd)
    {
        elemToSort = curElem;
        while(elemToSort <= arrEnd)
        {
           if(compare(curElem, elemToSort) > 0)
           {
              *curElem    ^= *elemToSort;
              *elemToSort ^= *curElem;
              *curElem    ^= *elemToSort;
           }
           elemToSort++;
        }
        // Move current element to next element in array.
        curElem++;
    }
}
```

Finding sum of array elements using Dynamic Memory Allocation

1. Create a pointer variable, which points to an integer data.
2. Take a number i.e size of array as input.
3. Create a block of space fo size **(size-of-array*sizeof(int))** using **malloc()** assigning the starting address of this whole space to the pointer variable.
4. Iterate via **for** loop for reading array elements as input.
5. Iterate again via **for** loop to access the address stored in pointer variable, adding the iterator value to it, so as to access every element of array, and calculating the overall sum.

```
#include <stdio.h>
#include <malloc.h>

void main()
{
       int i, n, sum = 0;
       int *a;

       printf("Enter the size of array A \n");
       scanf("%d", &n);

        a = (int *) malloc(n * sizeof(int));

        printf("Enter Elements of the List \n");
       for (i = 0; i < n; i++)
        {
                scanf("%d", a + i);
       }

/*  Compute the sum of all elements in the given array */

        for (i = 0; i < n; i++)
        {
                sum = sum + *(a + i);
            /* this *(a+i) is used to access the value stored at the address*/
        }

        printf("Sum of all elements in array = %d\n", sum);
        return 0;
}
```