Chapter 11 - Dynamic Memory Allocation

C is a language with some fixed rules of programming. For example: changing the size of an array is not allowed.

Dynamic Memory Allocation

Dynamic memory allocation is a way to allocate memory to a data structure during the runtime. We can use DMA functions available in C to allocate and free memory during runtime.

Functions for DMA in C

Following functions are available in C to perform Dynamic memory Allocation:

1> malloc()
2> calloc()
3> free()
4> realloc()

malloc() function

malloc stands for memory allocation. It takes number of bytes to be allocated as an input and returns a pointer of type void

Syntax:

$$\text{ptr} = \underbrace{(\text{int}^*)}_{\text{casting void pointer to int}} \text{malloc}(\underbrace{30}_{\text{space for 30 ints}} * \underbrace{\text{sizeof(int)}}_{\text{returns size of 1 int}})$$

The expression returns a null pointer if the memory cannot be allocated.

Quick Quiz: Write a program to create a dynamic array of 5 floats using malloc().

Calloc() function
Calloc stands for continuous allocation.
It initializes each memory block with a default value of 0.

Syntax:

```
ptr = (float*) calloc (30, sizeof(float));
```

Allocates contiguous space in memory for 30 blocks (floats)

If the space is not sufficient, memory allocation fails and a NULL pointer is returned.

Quick Quiz: Write a program to create an array of size n using calloc where n is an integer entered by the user.

free () function
We can use free() function to de allocate the memory.
The memory allocated using calloc/malloc is not deallocated automatically.

Syntax :

free(ptr); ⟹ Memory of ptr is released.

Quick Quiz : Write a program to demonstrate the usage of free() with malloc().

realloc() function
Sometimes the dynamically allocated memory is insufficient or more than required.

realloc is used to allocate memory of new size using the previous pointer and size.

Syntax :

```
ptr = realloc(ptr, newSize);
ptr = realloc(ptr, 3* sizeof(int));
```

⇓

ptr now points to this new block of memory capable of storing 3 integers.

Chapter 11 - Practice Set

1. Write a program to dynamically create an array of size 6 capable of storing 6 integers.

2. Use the array in problem 1 to store 6 integers entered by the user

3. Solve problem 1 using calloc()

4. Create an array dynamically capable of storing 5 integers. Now use realloc so that it can now store 10 integers.

5. Create an array of multiplication table of 7 upto 10 (7×10 = 70). Use realloc to make it store 15 numbers (from 7×1 to 7×15).

6. Attempt problem 4 using calloc().