Dynamic memory allocation and releasing dynamically allocated memory

C **Dynamic Memory Allocation** can be defined as a procedure in which the size of a data structure (like Array) is changed during the runtime.There are 4 library functions provided by C defined under **<stdlib.h>** header file to facilitate dynamic memory allocation in C programming. They are:

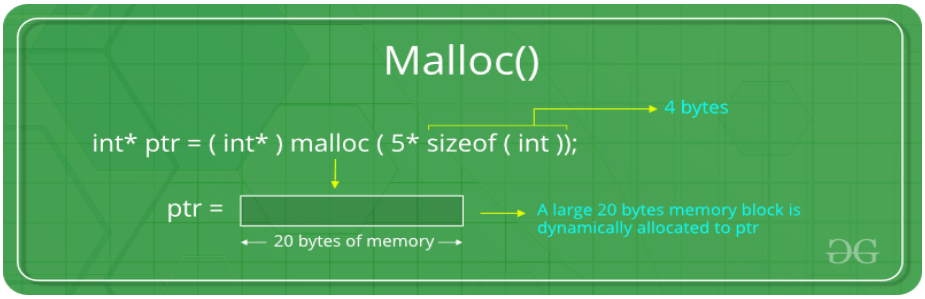
1. malloc()
2. calloc()
3. free()
4. realloc()

- **C malloc()**

The **"malloc"** or **"memory allocation"** method in C is used to dynamically allocate a single large block of memory with the specified size. It returns a pointer of type void which can be cast into a pointer of any form. **It doesn't initialize memory at execution time** so that it has initialized each block with the **default garbage value initially.**

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

ptr = (int*) malloc(100 * sizeof(int));
Since the size of int is 4 bytes, this statement will allocate 400 bytes of memory. And, the pointer ptr holds the address of the first byte in the allocated memory.




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

```
int main()
{
	int* ptr;
	int n, i;

	// Get the number of elements for the array
	printf("Enter number of elements:");
	scanf("%d",&n);
	printf("Entered number of elements: %d\n", n);

	// Dynamically allocate memory using malloc()
	ptr = (int*)malloc(n * sizeof(int));

	// Check if the memory has been successfully
	// allocated by malloc or not
	if (ptr == NULL) {
		printf("Memory not allocated.\n");
		exit(0);
	}
	else {

		// Memory has been successfully allocated
		printf("Memory successfully allocated using malloc.\n");

		// Get the elements of the array
		for (i = 0; i < n; ++i) {
			ptr[i] = i + 1;
		}

		// Print the elements of the array
		printf("The elements of the array are: ");
		for (i = 0; i < n; ++i) {
			printf("%d, ", ptr[i]);
		}
	}

	return 0;
}
```

- **C calloc() method**

1. **“calloc”** or **“contiguous allocation”** method in C is used to dynamically allocate the specified number of blocks of memory of the specified type. it is very much similar to malloc() but has two different points and these are:
2. It initializes each block with a default value ‘0’.
3. It has two parameters or arguments as compare to malloc().

Syntax:-

```
ptr = (cast-type*)calloc(n, element-size);
here, n is the no. of elements and element-size is the size of each
element.
```

ptr = (float*) calloc(25, sizeof(float));
This statement allocates contiguous space in memory for 25 elements each with the size of the float.

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

int main()
{

        int* ptr;
        int n, i;

        // Get the number of elements for the array
        n = 5;
        printf("Enter number of elements: %d\n", n);

        // Dynamically allocate memory using calloc()
        ptr = (int*)calloc(n, sizeof(int));

        // Check if the memory has been successfully
        // allocated by calloc or not
        if (ptr == NULL) {
                printf("Memory not allocated.\n");
                exit(0);
        }
        else {

                // Memory has been successfully allocated
                printf("Memory successfully allocated using calloc.\n");

                // Get the elements of the array
                for (i = 0; i < n; ++i) {
                        ptr[i] = i + 1;
                }

                // Print the elements of the array
                printf("The elements of the array are: ");
                for (i = 0; i < n; ++i) {
```

```
                printf("%d, ", ptr[i]);
            }
        }

        return 0;
}
```

- ## C free() method

“free” method in C is used to dynamically **de-allocate** the memory. The memory allocated using functions malloc() and calloc() is not de-allocated on their own. Hence the free() method is used, whenever the dynamic memory allocation takes place. It helps to reduce wastage of memory by freeing it.

Syntax:

```
free(ptr);
```

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

int main()
{

        // This pointer will hold the
        // base address of the block created
        int *ptr, *ptr1;
        int n, i;

        // Get the number of elements for the array
        n = 5;
        printf("Enter number of elements: %d\n", n);

        // Dynamically allocate memory using malloc()
        ptr = (int*)malloc(n * sizeof(int));

        // Dynamically allocate memory using calloc()
        ptr1 = (int*)calloc(n, sizeof(int));

        // Check if the memory has been successfully
        // allocated by malloc or not
        if (ptr == NULL || ptr1 == NULL) {
                printf("Memory not allocated.\n");
                exit(0);
        }
        else {

                // Memory has been successfully allocated
```

```
            printf("Memory successfully allocated using malloc.\n");

            // Free the memory
            free(ptr);
            printf("Malloc Memory successfully freed.\n");

            // Memory has been successfully allocated
            printf("\nMemory successfully allocated using calloc.\n");

            // Free the memory
            free(ptr1);
            printf("Calloc Memory successfully freed.\n");
        }

        return 0;
}
```

- ## C realloc() method

“realloc” or **“re-allocation”** method in C is used to dynamically change the memory allocation of a previously allocated memory. In other words, if the memory previously allocated with the help of malloc or calloc is insufficient, realloc can be used to **dynamically re-allocate memory**.

Syntax:

ptr = realloc(ptr, newSize);

where ptr is reallocated with new size 'newSize'.

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

int main()
{
        int* ptr;
        int n, i;

        // Get the number of elements for the array
        n = 5;

        printf("Enter number of elements: %d\n", n);

        // Dynamically allocate memory using calloc()
        ptr = (int*)calloc(n, sizeof(int));


        // Check if the memory has been successfully
        // allocated by malloc or not
```

```
	if (ptr == NULL) {
		printf("Memory not allocated.\n");
		exit(0);
	}
	else {

		// Memory has been successfully allocated
		printf("Memory successfully allocated using calloc.\n");

		// Get the elements of the array
		for (i = 0; i < n; ++i) {
			ptr[i] = i + 1;
		}

		// Print the elements of the array
		printf("The elements of the array are: ");
		for (i = 0; i < n; ++i) {
			printf("%d, ", ptr[i]);
		}

		// Get the new size for the array
		n = 10;
		printf("\n\nEnter the new size of the array: %d\n", n);

		// Dynamically re-allocate memory using realloc()
		ptr = realloc(ptr, n * sizeof(int));

		// Memory has been successfully allocated
		printf("Memory successfully re-allocated using realloc.\n");

		// Get the new elements of the array
		for (i = 5; i < n; ++i) {
			ptr[i] = i + 1;
		}

		// Print the elements of the array
		printf("The elements of the array are: ");
		for (i = 0; i < n; ++i) {
			printf("%d, ", ptr[i]);
		}

		free(ptr);
	}

	return 0;
}
```