Programming with C and C++

CSC-101 (Lecture 23)

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Dynamic Array

- Dynamic arrays are a powerful data structure in programming that allows for creating and manipulating arrays of varying sizes during runtime.
- In C, the most commonly used memory allocation functions are **`malloc()`**, **`calloc()`**, and **`realloc()`**.

Dynamic Array

```c
#include <stdio.h>
#include <stdlib.h>
int main() {
    int size = 5;
    int *arr = (int*) malloc(size * sizeof(int));
    int i;

        for(i = 0; i< size; i++) {
        arr[i] = i;
        }
    // Add a new element to the array
        size++;
        arr = (int*) realloc(arr, size * sizeof(int));
        arr[size-1] = i;

```

https://ideone.com/0bf596

Dynamic Array

```
16      for(i = 0; i< size; i++) {
17          printf("%d ", arr[i]);
18      }
19
20      free(arr);
21
22      return 0;
23  }
24
```

stdout

```
0 1 2 3 4 5
```

Dynamic Array

```c
#include <stdio.h>
#include <stdlib.h>
int main() {
    int size = 5;
    int *arr = (int*) malloc(size * sizeof(int));
    int i;

        for(i = 0; i< size; i++) {
        arr[i] = i;
        }
    // Add a new element to the array
        size++;
        arr = (int*) realloc(arr, size * sizeof(int));
        arr[size-1] = i;

```

https://ideone.com/4U59Q7

Dynamic Array

```
16      for(i = 0; i< size; i++) {
17          printf("%d ", arr[i]);
18      }
19
20      free(arr);
21
22      printf("\n");
23
24      for(i = 0; i< size; i++) {
25          printf("%d ", arr[i]);
26      }
27
28      return 0;
29  }
30
```

stdout

```
0 1 2 3 4 5
0 0 -1289768944 21846 4 5
```

malloc (Memory Allocation)

- malloc stands for "memory allocation."
- It allocates uninitialized memory block.
- The content of the allocated memory is undefined and can contain garbage values.
- It takes one argument, which is the number of bytes to allocate.

calloc (Contiguous Allocation)

- calloc stands for "contiguous allocation."
- It allocates a block of memory for an array of elements, initializing all bits to zero.
- It ensures that the allocated memory is zero-initialized.
- It takes two arguments: the number of elements to allocate memory for and the size of each element in bytes.

calloc

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

int main() {
    int n = 10;  // Number of integers to allocate
    int *arr;

    // Allocate memory for n integers
    arr = (int *)calloc(n, sizeof(int));

    // Check if memory allocation was successful
    if (arr == NULL) {
        printf("Memory allocation failed.\n");
        return 1;
    }
```

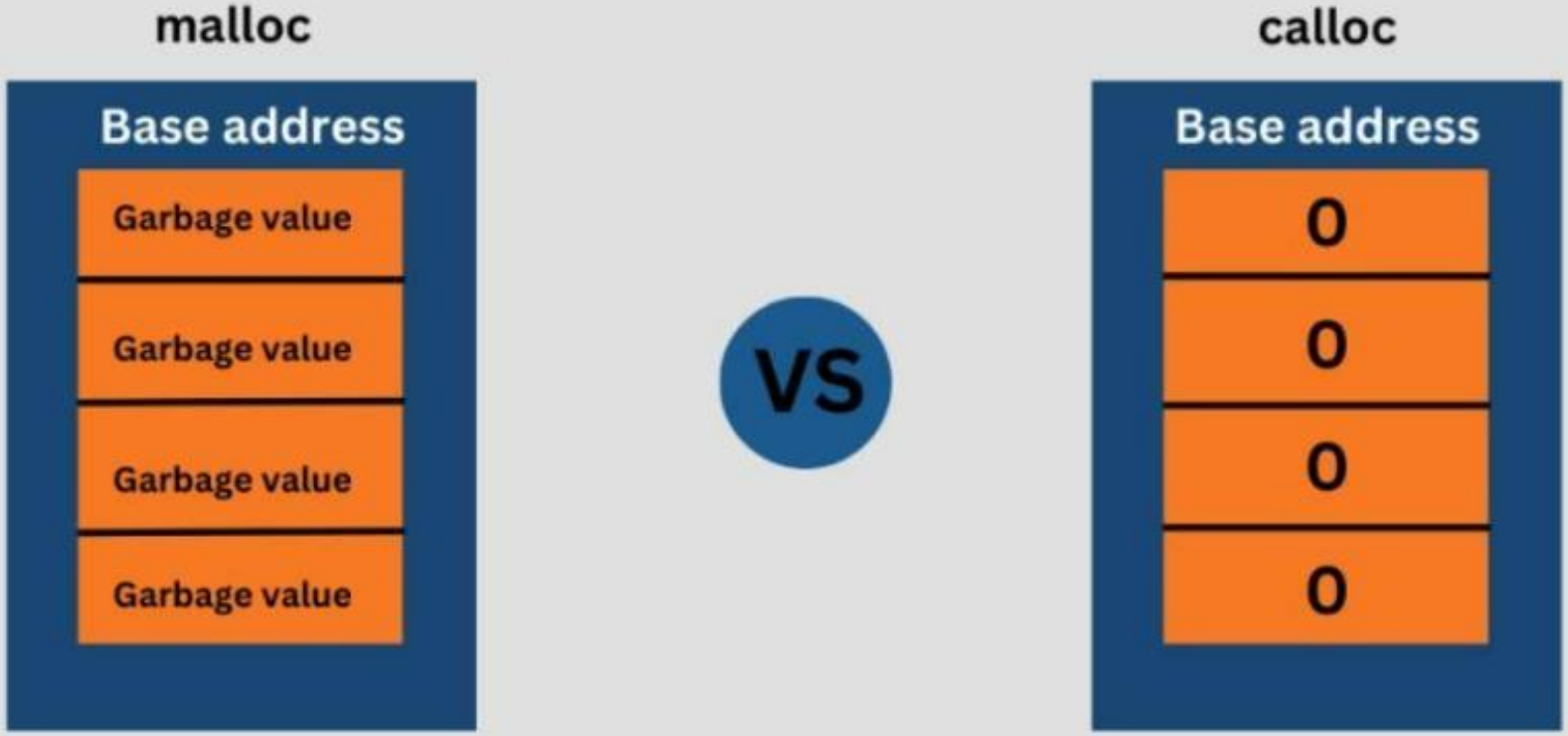
https://ideone.com/ATUIvD

```
16
17      // Use the allocated memory (for example, initialize the array)
18      for (int i = 0; i < n; i++) {
19          arr[i] = i * 10;
20          printf("%d ", arr[i]);
21      }
22
23      // Free the allocated memory (optional)
24      free(arr);
25
26      return 0;
27  }
28
```

stdout

```
0 10 20 30 40 50 60 70 80 90
```

Difference Between malloc() and calloc() with Examples



S.No.	malloc()	calloc()
1.	malloc() is a function that creates one block of memory of a fixed size.	calloc() is a function that assigns a specified number of blocks of memory to a single variable.
2.	malloc() only takes one argument	calloc() takes two arguments.
3.	malloc() is faster than calloc.	calloc() is slower than malloc()

S.No.	malloc()	calloc()
4.	Syntax : void* malloc(size_t size);	Syntax : Syntax : void* calloc(size_t num, size_t size);
5.	malloc() does not initialize the memory to zero	calloc() initializes the memory to zero

Pointer and reference variables

```
pv=0x7fffc9af9b88;
```

```
pv=0;
```

```
pv=NULL;
```

```
int v1=2*(*pv+v);
```

```
&w=2*(&u+&v);
```

```
int v2=2*(&u+&v);
```

Pointer and reference variables

```
pu+pv
```


```
*pu+*pv
```


```
pu=pu+1;
```


```
pv=*pu+pv;
```


```
pu=*pu+pv;
```


```
*pu=*pu+pu
```


void pointer in C

- int i=100; // integer variable initialization.
- int *ip; // integer pointer declaration.
- float *fp; // floating pointer declaration.
- void *ptr; // void pointer declaration.
- ip=fp; // incorrect.
- fp=&i; // incorrect

void pointer in C

- ptr=ip; // correct
- ptr=fp; // correct
- ptr=&i; // correct

Size of the pointers in C

https://ideone.com/L8OUlU

```c
#include <stdio.h>
int main()
{
    void *ptr = NULL; //void pointer
    int *p  = NULL;// integer pointer
    char *cp = NULL;//character pointer
    float *fp = NULL;//float pointer
    //size of void pointer
    printf("size of void pointer = %d\n\n",sizeof(ptr));
    //size of integer pointer
    printf("size of integer pointer = %d\n\n",sizeof(p));
    //size of character pointer
    printf("size of character pointer = %d\n\n",sizeof(cp));
    //size of float pointer
    printf("size of float pointer = %d\n\n",sizeof(fp));
    return 0;
}

```

stdout

```
size of void pointer = 8

size of integer pointer = 8

size of character pointer = 8

size of float pointer = 8
```

```c
#include <stdio.h>
#include<malloc.h>
int main()
{
    int m=1000;
    int *ptr = (int*)malloc(sizeof(int)) ;
    ptr=&m;
    printf("Value which is pointed by x pointer : %d",*ptr);

     return 0;
}

```

stdout

```
Value which is pointed by x pointer : 1000
```

Void pointer

```c
#include <stdio.h>

int main()
{
    int m=1000;
    void *ptr;
    ptr=&m;
    printf("Value which is pointed by x pointer : %d",*ptr);

     return 0;
}

```

compilation info

```
prog.c: In function ‘main’:
prog.c:8:54: warning: dereferencing ‘void *’ pointer
    printf("Value which is pointed by x pointer : %d",*ptr);
                                                     ^~~~
prog.c:8:54: error: invalid use of void expression
```

stdout

```
Standard output is empty
```

Type casting in pointer

https://ideone.com/y2dfJt

```c
#include <stdio.h>

int main()
{
    int m=1000;
    void *ptr;
    ptr=&m;
    printf("Value which is pointed by x pointer : %d",*(int*)ptr);

     return 0;
}

```

stdout

```
Value which is pointed by x pointer : 1000
```

```c
#include<stdio.h>
int main()
{
    float a[4]={6.1,2.3,7.8,9.0};
    void *ptr;
    ptr=a;
    ptr=ptr+12;
    printf("%f\n",*(float*)ptr);
}
```

stdout

```
9.000000
```

https://ideone.com/Kn90k4

Thank You!