DATA STRUCTURES AND ITS APPLICATIONS

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Memory Allocation

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Memory Allocation

- Static Memory Allocation
- Dynamic Memory Allocation

Static Memory Allocation

- allocated by the compiler.
- Exact size and type of memory must be known at compile time
- Memory is allocated in stack area

```
int b;

int c[10] ;
```

Disadvantages of Static Memory Allocation

- Memory allocated can not be altered during run time as it is allocated during compile time
- This may lead to under utilization or over utilization of memory
- Memory can not be deleted explicitly only contents can be overwritten
- Useful only when data size is fixed and known before processing

Dynamic Memory Allocation

- Dynamic memory allocation is used to obtain and release memory during program execution.
- It operates at a low-level
- Memory Management functions are used for allocating and deallocating memory during execution of program
- These functions are defined in “stdlib.h”

Dynamic Memory Allocation Functions:

- Allocate memory - malloc(), calloc(), and realloc()
- Free memory - free()

Dynamic Memory Allocation Functions: malloc()

To allocate memory use

```
void *malloc(size_t size);
```

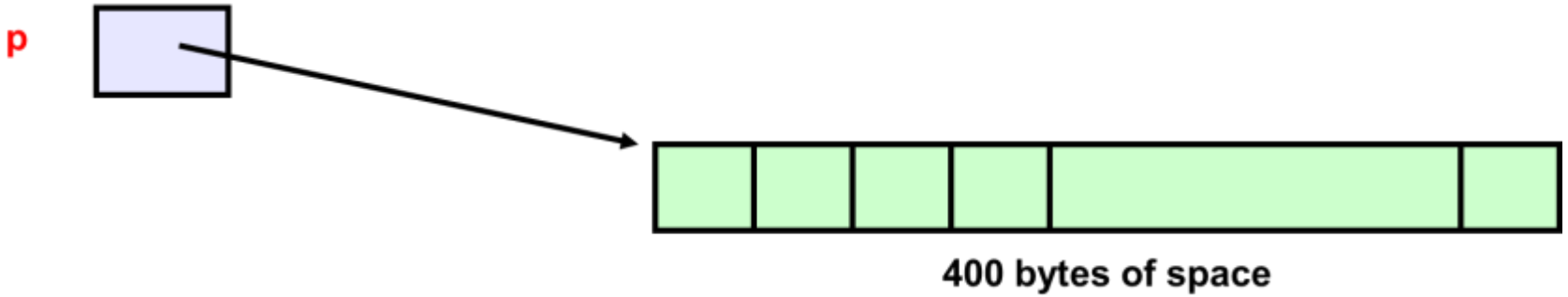
- Takes number of bytes to allocate as argument.
- Use sizeof to determine the size of a type.
- Returns pointer of type void *. A void pointer may be assigned to any pointer.
- If no memory available, returns NULL.

Dynamic Memory Allocation Functions: malloc()

To allocate space for 100 integers:

```
int *p;
if ((p = (int*)malloc(100 * sizeof(int))) == NULL){
   printf("out of memory\n");
   exit();
   }
```

- Note we cast the return value to int*.
- Note we also check if the function returns NULL.



Dynamic Memory Allocation Functions: malloc()

- cptr = (char *) malloc (20);

  Allocates 20 bytes of space for the pointer cptr of type char

- sptr = (struct stud *) malloc(10*sizeof(struct stud));

  Allocates space for a structure array of 10 elements. sptr points to a structure element of type struct stud

Always use sizeof operator to find number of bytes for a data type, as it can vary from machine to machine

Dynamic Memory Allocation Functions: malloc()

- malloc always allocates a block of contiguous bytes
  - The allocation can fail if sufficient contiguous memory space is not available
  - If it fails, malloc returns NULL

```
if  ((p = (int *) malloc(100 * sizeof(int))) == NULL)
 {
      printf ("\n Memory cannot be allocated");
      exit();
 }
```

The n integers allocated can be accessed as *p, *(p+1), *(p+2),…, *(p+n-1) or just as p[0], p[1], p[2], …,p[n-1]

Dynamic Memory Allocation Functions: free()

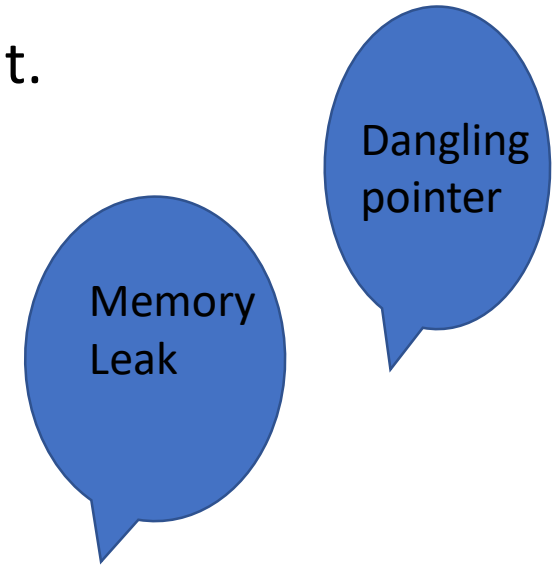
To release allocated memory use

```
free(ptrvariable)
```

- Deallocates memory allocated by malloc().
- Takes a pointer as an argument.

e.g.

```
free(newPtr);
```



Dynamic Memory Allocation Functions: calloc()

Similar to malloc(),

But allocated memory space are zero by default..

calloc() requires two arguments –

```
void *calloc(size_t nitem, size_t size);
```

Example

```
int *p;
p=(int*)calloc(100,sizeof(int));
```

returns a void pointer if the memory allocation is successful,
else it'll return a NULL pointer.

Dynamic Memory Allocation Functions: realloc()

Reallocate a block

Two arguments

- Pointer to the already allocated block
- Size of new block

```
int *ip;
ip = (int*)malloc(100 * sizeof(int));
. . .
/*  need twice as much space */
ip = (int*)realloc(ip, 200 * sizeof(int));
```

DATA STRUCTURES AND ITS APPLICATIONS

Lecture Summary

Memory Allocation

- Static Memory allocation
- Dynamic memory allocation

Apply the concepts to implement C program for the following problem statement

- Multiply two matrices . Allocate the memory for the matrices dynamically

THANK YOU

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