



University of Central Punjab

(Incorporated by Ordinance No. XXIV of 2002 promulgated by Government of the Punjab)

FACULTY OF INFORMATION TECHNOLOGY

Programming Fundamentals

Lab 08	
Topic	Dynamic Memory
Objective	<ul style="list-style-type: none">• DYNAMIC MEMEORY ALLOCATION<ul style="list-style-type: none">○ Explaining what is Dynamic Memory Allocation.○ Explaining the problem that is solved by Dynamic Memory Allocation (referred to at the start of Pointer Topic).○ Explaining new and delete (both the forms).○ Discuss stack memory and heap memory.○ Explain the difference between creating/deleting a memory location and multiple memory location (array).

Lab Description:

This lab is basically designed for the dynamic memory. We will see the use of dynamic memory and difference between stack and heap. We will see how to allocate a dynamic memory and deallocate it.

What is Memory Allocation?

As we discussed earlier when we need a memory for any purpose we need to allocate it before using it. There are two ways via which memories can be allocated. The two ways are:

Compile time allocation or static allocation of memory:

Where the memory for named variables is allocated by the compiler. Exact size and storage must be known at compile time and for array declaration, the size has to be constant.

Runtime allocation or dynamic allocation of memory:

Where the memory is allocated at runtime and the allocation of memory space is done dynamically within the program run, the exact space or number of the item does not have to be known by the compiler in advance. Pointers play a major role in this case.

The key word **new** is used to allocate dynamic or run time memory.

Example:

```
int * p=nullptr, size=5;    //declares a pointer p
p = new int;                //dynamically allocate an int and loading the base address in pointer p.
p = new int[size];          //dynamically allocate an int array of size 5 and loading the base address in pointer p.
```



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Delete Operator:

Memory de-allocation is also a part of this concept where the “clean-up” of space is done for variables or other data storage. It is the job of the programmer to de-allocate dynamically created space. For de-allocating dynamic memory, we use the delete operator. In other words, dynamic memory Allocation refers to performing memory management for dynamic memory allocation manually.

Example:

```
int * p=nullptr, size=5;      //declares a pointer p
p = new int;                  //dynamically allocate an int and loading the base address in pointer p.
delete p; // de allocate or free the memory.
p = new int[size]; //dynamically allocate an int array of size 5 and loading the base address in pointer p.
delete [] p; // de allocate or free the memory.
```

Stack and Heap Memory:

Memory is divided into different parts and each part is designed to perform specific tasks.

Heap Memory:

It is reserved for dynamic memory allocation

- In C++, when we use “new” keyword, system reserves memory in heap
- It is necessary for a programmer to free this memory when he doesn’t need it.
- To free this memory, “delete” keyword is used.

Stack Memory:

- Compiler calculates the size of memory needed for local variables.
- Local variables declared in a program are stored in stack.
- Memory reserved in Stack, cannot be increased or decreased during execution of a program.
- Every function has its own stack frame
- Stack frames build on one another. Like a pile of files.
- To access the file at the bottom, files from the top needs to be removed.
- Functions are like files.



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Lab Tasks

Section Allocation Problem:

There is a limit of 45 students in each section. But it's not compulsory that each section must have 45 students. Count of students may vary. But there is a limit if we have count of 5 students than we must close that section. We have record of each section of every course in a separate file. Each file contain total number of records, registration number and marks of that course.

Perform the following on given record:

- Sort the record on the basis of registration number.
- Identify those section who we need to close.
- Identify those section in which we adjust the students of those section which we need to close.

Amazon problem:

Amazon is a world renowned online store. They have different categories for their store. They want to perform some analysis on their categories data. Each category have some product and its related info. There is a separate file for each category which also contains total product count, product ID available stock and total sell.

Amazon wants to perform the following on given record.

- Bestselling item from each category.
- Most selling category.
- Identify which category have maximum product.
- Identify which product need to focus for improving its sell.