Creating array of pointers in C++

An array of pointers is an array of pointer variables. It is also known as pointer arrays. We will discuss how to create a 1D and 2D array of pointers dynamically. The word **dynamic** signifies that the memory is allocated during the runtime, and it allocates memory in Heap Section. In a Stack, memory is limited but is depending upon which language/OS is used, the average size is **1MB**.

Dynamic 1D Array in C++: An array of pointers is a type of array that consists of variables of the pointer type. It means that those variables can point to some other array elements.

Example:

```
int *p[3];

// Now P[0], P[1], P[2] can point to int memory blocks.
```

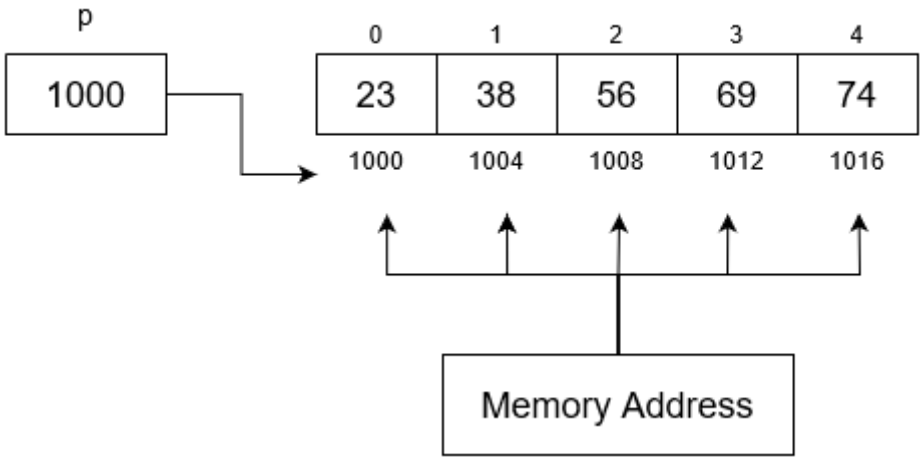
In a dynamically allocated array of size **N**, the block is created in the heap and returns the address of the first memory block. By using that address every element can be accessed. The dynamic array in C++ one should be familiar with the new keywords or malloc(), calloc() can be used.

Syntax:

```
<dataType> * <pointer name> = new <dataType> [<size>];
```

Example:

```
int *p = new int [5];
```



Accessing Elements of a Dynamic Array:

- 1. 1D array of size **N**(= 5) is created and the base address is assigned to the variable **P**. If the below statement is written then the output is **1000**.

  cout << p;

- If the value in the 1000^{th} address is wanted then dereferenced it using the * (asterisk) symbol as illustrated below:

  cout << *P;

  // It is the same as P[0]. The output is 23.

Basic Pointer Arithmetic: Below is some points regarding Pointer Arithmetic:

- ***(P + 1):**

  P = 1000 and 1 = sizeof(int) = 4 bytes.
  Hence, *(1004) and dereferencing by * (asterisk) symbol. Now, the final result is 38.

- ***(P) + 1:**

  P = 1000 and 1 = sizeof(int) = 4 bytes.
  Hence, *(1004) and dereferencing by * (asterisk) symbol and then by adding 1 modifies the result to 23 + 1 = 24.

Below is the C++ program to illustrate the above concepts:

```
// C++ program to illustrate the concepts
// of creating 1D array of pointers
#include <iostream>
using namespace std;

// Driver Code
int main()
{
        // Dynamically creating the array
        // of size = 5
        int* p = new int[5];

        // Initialize the array p[] as
        // {10, 20, 30, 40, 50}
        for (int i = 0; i < 5; i++) {
                p[i] = 10 * (i + 1);
        }
```

```
    // Print the values using pointers
    cout << *p << endl;
    cout << *p + 1 << endl;
    cout << *(p + 1) << endl;
    cout << 2 [p] << endl;
    cout << p[2] << endl;
    *p++;

    // Pointing to next location
    cout << *p;

    return 0;
}
```

Output

```
10
11
20
30
30
20
```

Dynamic 2D Array of Pointers in C++: A dynamic array of pointers is basically an array of pointers where every array index points to a memory block. This represents a 2D view in our mind. But logically it is a continuous memory block.

Syntax:

```
<dataType> **<Pointer name> = new <dataType> *[<size>];
```

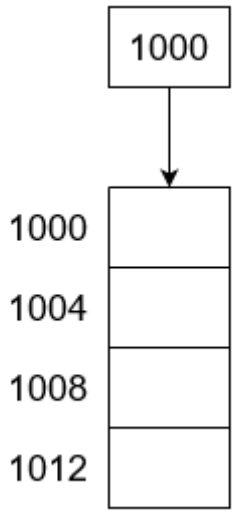
Example:

```
int **P = new int *[4];
```

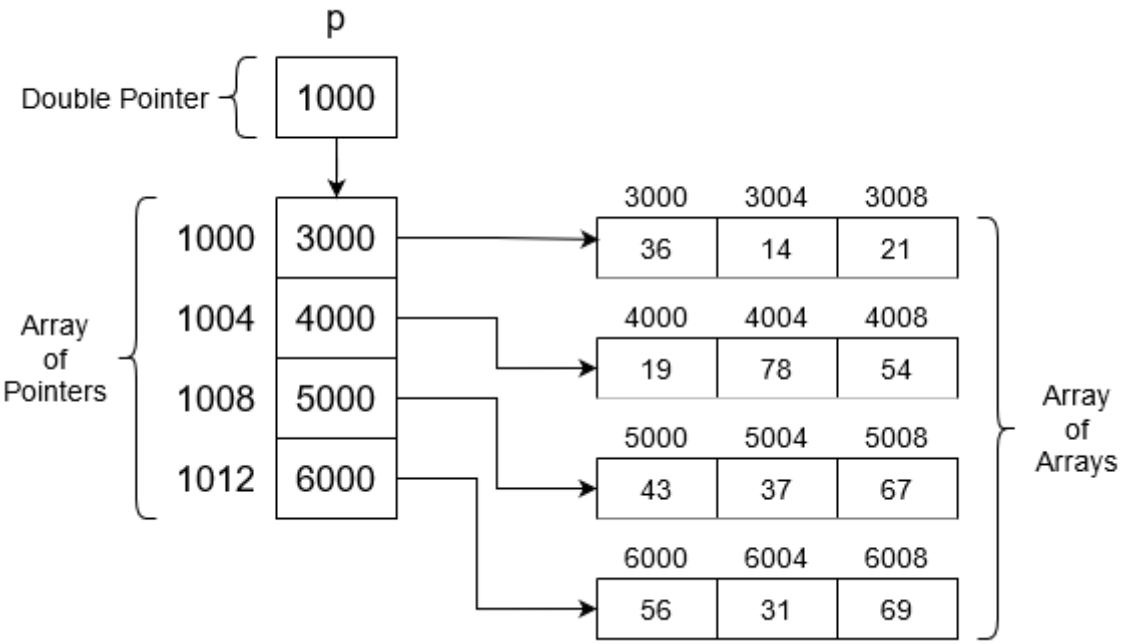
Note: The ***(asterisk)** symbol defines the level of the pointer, one * means one level of pointers, where ** implies two levels of pointers, and so on. Also, the level of the pointer must be the same as the dimensional array you want to create dynamically.

Approach:

- Create a **1D** array of pointers.



- Now, create the column as array of pointers for each row as:
  - P[0] = new int [3];
  - P[1] = new int [3];
  - P[2] = new int [3];
  - P[3] = new int [3];



- The 1D array of pointers are pointing to a memory block(size is mentioned). Basically, **P[0], …, P[3]** are pointing to a 1D array of integers.

Accessing the array elements:

- ***P** is equal to **P[0]** which is the address of the 1st row, 1st column is **&P[0][0]** = **3000**.
- ***(P + 1)** is equal to '**P**' is **1000 + 1(sizeof int)** = **1004** and * means dereferencing. So the value stored at the address is printed i.e., ***1004** = **4000.**

- ***(P + 1) + 2** is same as above case but **+2** means **(&P[1] + 2)** is equal to **&P[1] [2]** = **4008**.
- ***(*(P + 1) + 2)** is same as above case but that first asterisk **‘*(....)’** means dereferencing that address. Therefore, the result is equal to the value in **&P[1][2]** = ***(4008)** = **54**.

Below is the C++ program to illustrate the above concepts:

```
// C++ program to illustrate the concepts
// of creating 2-D array of pointers
#include <iostream>
using namespace std;

// Driver Code
int main()
{
	int N = 3;

	// Creating the array of pointers
	// of size N
	int** p = new int*[N];
	int x = 1;

	// For multiplying
	for (int i = 0; i < N; i++) {

		p[i] = new int[N];

		// Creating N sized int memory
		// block
		for (int j = 0; j < N; j++, x++) {

			p[i][j] = 10 * x;

			// The above statement can
			// also be written as:
			// *(*(p+i)+j) = 10 * x
		}
```

```
    }

    // Print the values using pointers
    cout << *p << endl;
    cout << **p << endl;
    cout << *p + 1 << endl;
    cout << **p + 1 << endl;
    cout << *(*(p + 1) + 0) << endl;
    cout << p[2][2] << endl;

    return 0;
}
```

Output

```
0x158de90
10
0x158de94
11
40
90
```