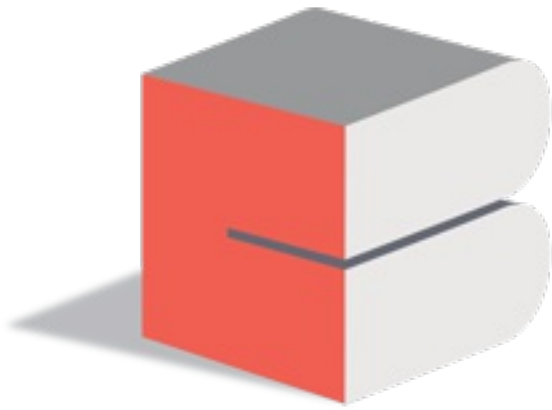


# Dynamic Memory Allocation



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There are two ways that memory gets allocated for data storage:

- Compile Time (or static) Allocation
  - Memory for named variables is allocated by the compiler
  - Exact size and type of storage must be known at compile time
  - For standard array declarations, this is why the size has to be constant
- Dynamic Memory Allocation
  - Memory allocated “on the fly” during run time
  - dynamically allocated space usually placed in a program segment known as the heap or the free store
  - Exact amount of space or number of items does not have to be known by the compiler in advance.
  - For dynamic memory allocation, pointers are crucial

## Dynamic Memory Allocation

- We can dynamically allocate space while the program is running

but we cannot create new variable names “on the fly”

- For this reason, dynamic allocation requires two steps
  - Creating the dynamic space
  - Storing its address in a pointer
- To dynamically allocate memory in C++, we use new operator

## De-allocation

- De-allocation is the “clean up” of space being used by variables or other data storage
- Compile time variable are automatically deallocated based on their know scope
- It is the programmer’s job to de-allocate dynamically created memory
- To de-allocate dynamic memory we use delete operator

## new Operator

- To allocate space dynamically, use the unary operator new, followed by the type being allocated.
  - `new int; // dynamically allocates an int`
  - `new double; // dynamically allocates a double`
- If creating an array dynamically, use the same form, but put brackets with a size after the type:
  - `new int[40]; /allocates an array of 40 ints`
  - `new double[size]; // allocates an array of size double //`  
doubles

- These statements above are not very useful by themselves, because allocation space have no names.

## new operator contd...

```
int * p; // declare a pointer p
p = new int; // dynamically allocate an int and load address
into p
double * d; // declare a pointer d
d = new double; // dynamically allocate a double and load add
ress into d
// we can also do these in single line statements int x = 40;
int * list = new int[x];
float * numbers = new float[x+10];
```

## delete operator

- To de-allocate memory that was created with new, we use the unary operator delete. The one operand should be a pointer that stores the address of the space to be deallocated:

```
int * ptr = new int; // dynamically created int
// ...
delete ptr; // deletes the space that ptr points to
```

**Note that the pointer ptr still exists in this example. That's a named variable subject to scope and extent determined at compile time. It**

## can be reused:

- To deallocate a dynamic array, use this form:

```
int * list = new int[40]; // dynamic array
delete [] list;           // deallocates the array
list = 0;                 // reset list to null pointer
```