Pointer

Accessing address of a variable

Computer’s memory is organized as a linear collection of bytes. Every byte in the computer’s memory has an address. Each variable in program is stored at a unique address. We can use address operator & to get address of a variable:

```
        int num = 23;
        cout << &num;     // prints address in hexadecimal
```

POINTER

A pointer is a variable that holds a memory address, usually the location of another variable in memory.

Defining a Pointer Variable

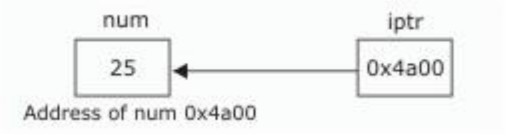
```
        int *iptr;
```

iptr can hold the address of an int

Pointer Variables Assignment:

```
 int num = 25;
 int *iptr;
 iptr = &num;
```

Memory layout



To access num using iptr and indirection operator *

```
    cout << iptr;       // prints 0x4a00
    cout << *itptr;     // prints 25
```

Similary, following declaration shows:
char *cptr;
float *fptr;
cptr is a pointer to character and fptr is a pointer to float value.

Pointer Arithmetic

Some arithmetic operators can be used with pointers:

- Increment and decrement operators ++, --
- Integers can be added to or subtracted from pointers using the operators +, -, +=, and -=

Each time a pointer is incremented by 1, it points to the memory location of the next element of its base type.
If “p” is a character pointer then “p++” will increment “p” by 1 byte.
If “p” were an integer pointer its value on “p++” would be incremented by 4 bytes.

Pointers and Arrays

Array name is base address of array

```
int vals[] = {4, 7, 11};
cout << vals;       // displays 0x4a00
cout << vals[0]; // displays 4
```

Lets takes an example:

```
int arr[]={4,7,11};
int *ptr = arr;
What is ptr + 1?
It means (address in ptr) + (1 * size of an int)
cout << *(ptr+1); // displays 7
cout << *(ptr+2); // displays 11
```

Array Access
Array notation arr[i] is equivalent to the pointer notation *(arr + i)

Assume the variable definitions

```
  int arr[]={4,7,11};
  int *ptr = arr;
```

Examples of use of ++ and --

```
  ptr++; // points at 7
  ptr--; // now points at 4
```

Character Pointers and Strings

Initialize to a character string.
char* a = “Hello”;
a is pointer to the memory location where ‘H’ is stored. Here “a” can be viewed as a character array of size 6, the only difference being that a can be reassigned another memory location.
char* a = “Hello”;

a	gives address of ‘H’
*a	gives ‘H’
a[0]	gives ‘H’
a++	gives address of ‘e’
*a++	gives ‘e’

Pointers as Function Parameters

A pointer can be a parameter. It works like a reference parameter to allow change to argument from within function

```
#include<iostream>
using namespace std;

void swap(int *, int *);

int main()
{
   int a=10,b=20;
   swap(&a, &b);
   cout<<a<<" "<<b;
   return 0;
}
void swap(int *x, int *y)
{
   int t;
   t=*x;
   *x=*y;
   *y=t;
}
```

output:
```
20 10
```

Pointers to Constants and Constant Pointers

Pointer to a constant: cannot change the value that is pointed at
Constant pointer: address in pointer cannot change once pointer is initialized

Pointers to Structures

We can create pointers to structure variables

```
          struct Student {int rollno; float fees;};
          Student stu1;
          Student *stuPtr = &stu1;
          (*stuPtr).rollno= 104;
```

-or-
Use the form ptr->member:

```
          stuPtr->rollno = 104;
```

Static allocation of memory

In the static memory allocation, the amount of memory to be allocated is predicted and preknown. This memory is allocated during the compilation itself. All the declared variables declared normally, are allocated memory statically.

Dynamic allocation of memory

In the dynamic memory allocation, the amount of memory to be allocated is not known. This memory is allocated during run-time as and when required. The memory is dynamically allocated using new operator.

Free store

Free store is a pool of unallocated heap memory given to a program that is used by the program for dynamic allocation during execution.

Dynamic Memory Allocation

We can allocate storage for a variable while program is running by using new operator

To allocate memory of type integer
int *iptr=new int;

To allocate array
double *dptr = new double[25];

To allocate dynamic structure variables or objects
Student sptr = new Student;   //Student is tag name of structure

Releasing Dynamic Memory

Use delete to free dynamic memory
delete iptr;
To free dynamic array memory
delete [] dptr;
To free dynamic structure
delete Student;

Memory Leak

If the objects, that are allocated memory dynamically, are not deleted using delete, the memory block remains occupied even at the end of the program. Such memory blocks are known as orphaned memory blocks. These orphaned memory blocks when increase in number, bring adverse effect on the system. This situation is called memory leak

Self Referential Structure

The self referential structures are structures that include an element that is a pointer to another structure of the same type.

```
struct node
{
  int data;
  node* next;
}
```