Data types specify how & what type of data we enter into a program.
Languages has some pre defined set of data types to handle various kinds of data that we have in our programs.
Every data type have diff. storage capa

There are two types of data types.

1. Primary data types: These are fundam data types in C namely integer, cha float, void etc

2. Derived data types: Derived data ty are nothing but primary data types but a little twisted or grouped toge like structure, union etc.
eg: student:
name - char
RollNo - int
marks - float

```
struct student {
        int RollNo;
        char name[];
        float marks;
```

4.	Double	8 byte	%f
5			
6	Byte	8 bits	
7	short int	2 byte	
8	long		%ld

64 bit comp.
32 bit comp.
size of registers.
(fastest memory)

Register
Register is the smallest memory in comp. and only memory that can interact with ALU.

```
#include<stdio.h>
{
int main {
    printf("Hello world");
return 0;
}
```

to the compiler.

→ That meaning cannot be changed.

→ There are total of 32 keywords in C language.
eg :→ Integer, float, while, do, if, else etc

Identifiers

Identifiers are the name given to variable, constants, functions name & user defined data.

There are some set of rules for writing identifiers.

Rule 1: An identifier can only have alphanumeric char (a-z, A-Z, 0-9) and underscore (__)

Rule 2: NO special character such as !, $, @, ② whitespaces etc are allowed in an identifier.

eg: abc, ABC123, _ABC

Rule 3: The first char of an identifier must be either alphabet (a-z, A-Z,) or underscore It cannot start with number.

123abc ⊗ , _abc ✓

Rule 4: Identifiers are case sensitive.

eg:→ abc is different from AbC.

Rule 5: Keywords are not allowed to be used as identifier.

```
// #include <stdio.h>
   int main(){
      return 0;
   }
```
/* basic structure */

// command to include file of declaration of those prototypes

gcc _ filename.c → compile

./a.exe → execute

2. Non-volatile memory → The purpose of this type memory is to store data permanently, even after the power is switched off the data is not lost.
eg:→ hard disk.

1) The total memory capacity of a computer can be seen by heirarchy of components means a computer consist of ram, cache or some other devices.

2) Heirarchy consist of all storage devices consist in a system or available in a system, from slow auxillary memory to fast main memory to smaller cache memory.

* Comparision in terms of access time

→ Auxillary memory takes roughly 1000 times of access times than of main memory.
eg: Let the access time of main is 1unit per milli second than time taken by auxillary memory is 1unit per second.

→ Acces time of cache is roughly 7-10 times faster than main memory.

→ when the program is not in main memory but requires for execution than it is brought to main memory for auxillary memory.

→ Program which are not currently needed or not in execution are

Store frequently access data.

Memory Access Methods

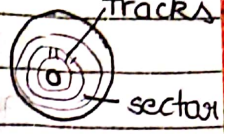
→ Each memory type in a collection of numerous memory locations to access data from any memory first it must be located and then the data is used/read from the memory location.

1. Random Access Memory (RAM)
Main memory are random access memory in which each memory location have unique address using this unique address any memory location can be accessed or reached in the same amount of time in any order.

2. Sequential Access
This method allows memory access in sequence or in a particular order.

3. Direct Access.

combination of tracks → Platter



4. Main memory / Ram / Primary memory
The memory unit that communicates directly within the CPU. Auxiliary memory and cache memory is called main memory. It is the central storage unit of computer system. It is large and fast memory used to store data during computer operation. Various types of RAM are as follows:

1) D- RAM (Dynamic RAM)
→ Dynamic Ram is made up of capacitors and transistors. It must be refreshed every 10 - 100 millisecond It is slower and cheaper than S-RAM.

2) S- RAM (static RAM)
→ In static RAM there are 6 transistors circuit in each cell. It retains data until power is out.

Date

3. N-V RAM
Non-volatile ram retains it data even when power is turned off.

RAM (Read Only Memory)
It is a non-volatile memory i.e it stores data permanently. ROM consist of a special code called Bootstrap loader.

Bootstrap loader is a program responsible for loading an operating system at the time of computer start / turned on.

1) P ROM 2) EP ROM 3) EEP ROM are commonly used ROM

* Auxillary Memory:
Devices that provide back ups storage for permanent purpose are called auxillary memory. Magnetic disk and magnetic tapes are some commonly used auxillary memory.
It is not directly accessable to the CPU.
It is access using the input output channels called System Calls

* Cache Memory
The data or content of the main memory that are used again-again or frequently by CPU are stored in

Date

the cache so that it can be easily accessed in shorter time.

→ whenever the CPU needs to access memory it first checks the cache memory, if the data is not found in cache then CPU moves to main memory.

→ It also transfer blocks of recent data into the cache and keeps on deleting the old data to accomodate the new data.

Depending upon the size of a network the network is divided into three categories:-

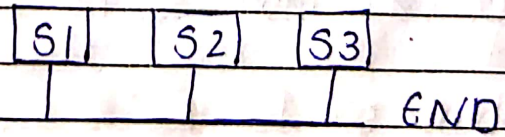
1. LAN
2. MAN } Autonomous Network
3. WAN

Internet is a connection of Autonomous Network.

Network Topology

→ BUS
→ STAR
→ RING
→ MESH
→ TREE

1 BUS



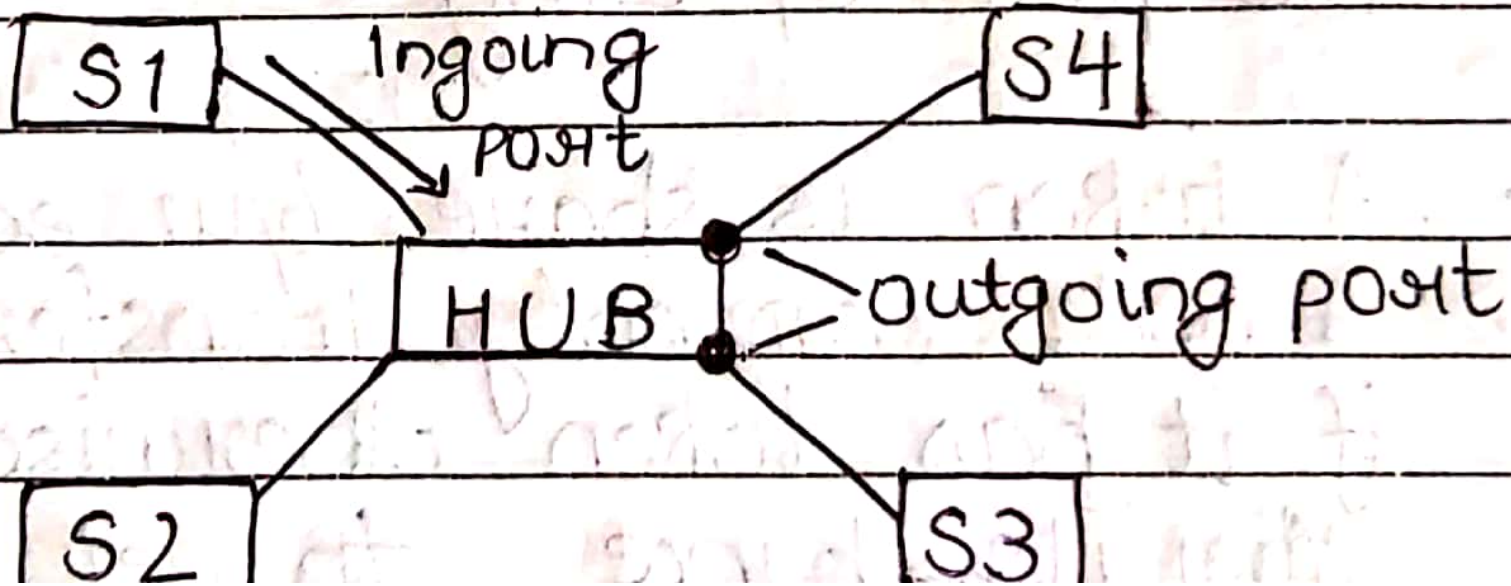
Advantages of topology

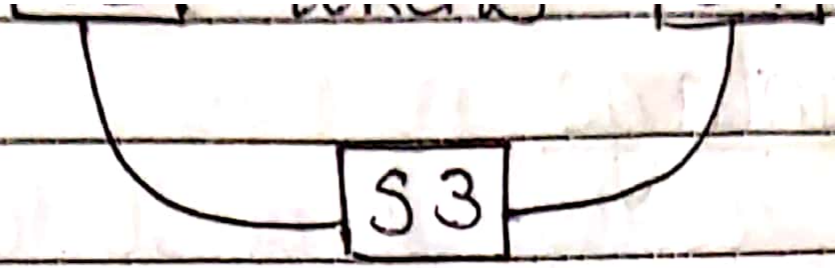
1. This topology is cost efficient.

Disadvantage

If the bus wire became unavailable for just a moment than the whole network shuts down.

Star





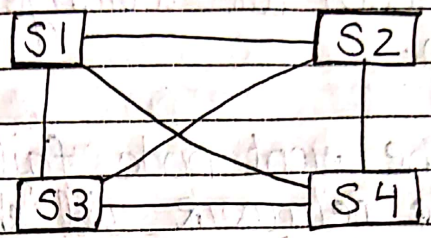
Properties:-

- The nodes connect with eachother in the form of ring.
- A token is share b/w each node.
- A node can only transfer the data if it has token otherwise it will wait for its chance to get token.

be max.

4. MESH TOPOLOGY

→ In MESH Topology every node is directly connected with each other.



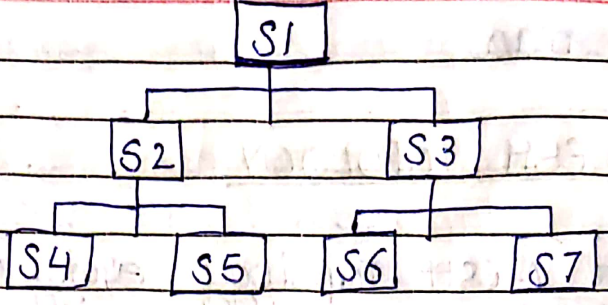
→ It is very costly.

→ Adding a new node in the network will does not affect the working of the network but it is costly to add because adding of a single node can result in addition of multiple wires.

→ The data transmission delay is minimum.

5. TREE TOPOLOGY

The network will be connected in hierarchy.



→ The nodes are arranged in hierarchy form.

→ If the root node fails then the whole network will shut down, but if any leaf node fails then it will not affect the working of the network

→ Addition of a new node is very easy.

→ This is much more efficient.

What is network Topology :-
Network topology is the arrangement of the element of a communication network. Network topology can be used to define or describe the arrangement of various types of telecommunication networks including command and control radio network computer network and industrial field busses.

COMPUTER NETWORK & HARDWARE DEVICES

Hardware devices which are used to connect computer, printer, fax machine and other devices through a network are called network devices.

These devices transfer data in a fast secure and correct manner over a same or different network.

Network devices may be internetwork or intranetwork.

Network Devices

Modem -> It is a device that unables a computer to send & receive data on telephone or cable lines. The data stored on the computer is digital whereas a telephone line can transmit only analog data.

→ Modulator converts digital data into analog data when computer sends the data where as d-modulator converts analog data to digital data when the data is received by the computers.

tion with other devices on the network. Each ethernet card have a physical address called Mac address which never changes. It is of 48 bits.

IP address is used to identify the network. It is of 32 bits. It keeps on changing every time we connect to internet.

Port number: It is used to identify the services running on the operating system within the computer. It is

Date

The typical speed of ethernet card is 10-20 mbps (Mega bits per seconds)

Routers

→ Routers is a network layer hardware device that transmits data from one LAN to another. If both network supports the same set of protocols.

Gateway

→ Gateway is network device used to connect 2 or more disimilar networks

→ A gateway is usually computer with ~~com~~ multiple NIC connected to the different network.

Switch

→ switch is a network device that connects other devices to ethernet networks through twisted pair cables.

Wifi - card

→ Wifi card is used to connect any device to the local network wirelessly. The physical area of network

user and hardware which allows user to access hardware efficiently and effectively.

O.S provides various services which are essential for the working of computer system.

Some of the services are as follows:-

1. Memory management : It is the RAM management.

2. Process management

3. File management / Disc management

4. Device management → To operate IO calls other external devices.

read, write and execute.

* Memory Management

Management memory is the management of RAM. Operating system keeps track of available space in the main memory i.e what part of it is in use and what part is free.
In multiprogramming the O.S decide which process will get how much memory and RAM.

Allocation & deallocation of memory when a process request it or process no longer need it is manage by operating system.

* Process Management
In multiprogramming environment O.S decide which process will get the processor when & for how much time.
The function is called process stabling.

An OS does the following activity for process management.
It keeps tracks of processor and status of process.

how much time and when.

File management

A file management is normally organised into directory for easy usage and navigation. These directory may contain files & other directories also.

* FAT32 → File allocation technique 32 (1-block

* NTFS → (New table file system)

I node → Index node

1. For loop → It starts from one point and come back to the same time.

→ For doing repeative task.

Syntax for FOR loop

for(; ;)

for(initialization ; condition ; exp)
{
Body of the loop
}

2. While loop

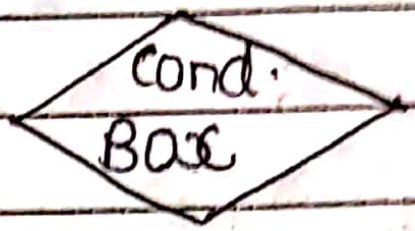
syntax

while (condition) {

}

Do while also work when the condition fails.

Infinity loop while (1) {
break;
}



Algorithms

It is a combination of sequence of finite steps to solve a particular problem.

Write an algo. for printing a factorial of n.

Date

n = n-1 then go to step 6.
8. Print fact.
9. END

Switch

```
if (a==1)
  a=5;
else if (a==2)
  a=12;
else if(a==3)
  a=4;
else if(a==4)
  a=1;
   or
switch(a){
case 1: a=5;
case 2: a=12;
case 3: a=4;
case 4: a=1;
}
```

```
int arr[10];
↓   name[size];
Data type
```

Array takes constant time i.e O(1)

4000 + 2(4)

= 4008

Base add + index * size of (data type)

int arr[10] = {0}; all value 0

In case of excessive or lower size we can initialize like static memory Allocation (Compilation access memory)

```
int n;
scanf("%d", &n);
int array[n];
```

Date 14/10/19

2D Array

```
#include <stdio.h>
int main(){
int arr[6][6];
for(i=0; i<6; i++)
{
for(j=0; j<6; j++)
{
scanf("%d", &arr[i][j]);
}
}
for(i=0; i<6; i++)
{
for(j=0; j<6; j++)
{
scanf("%d", arr[i][j]);
}
printf("\n");
}
return 0;
}
```

Base address

* arr + i * no. of col. + j * size of data

* arr + j * no. of col + i * size of data

Stack → local variable store
heap → dynamic.

arr = (int**) malloc (row * size of(int*));

Comparisions

No. of comparisions
=> $\frac{n(n-1)}{2}$

n is no. of element

Sorting

Arranging the numbers in some order in sorting.

eg :- 64, 63, 7, 2, 48

output 2, 7, 48, 63, 64

Algorithms for sorting

1. Selection sort
2. Bubble sort
3. Insertion sort
4. Merge sort
5. Quick sort
6. Counting sort
7. Radix sort
8. Shell sort
9. Bucket sort
10. Heap sort.

for 10^9 no. → counting sort.

1. Selection Sort

7	3	8	2	5
0	1	2	3	4

1st pass [2, 7, 3, 8, 5]

2nd pass [2, 3, 7, 8, 5]

3rd pass [2, 3, 5, 8, 7]

Output 4th pass [2, 3, 5, 7, 8]

Stable sort :- If implemented carefully.

=> Orig -> 7, 3a, 2, 3b, 5

=> Sorted -> 2, 3a, 3b, 5, 7

count no. of swaps

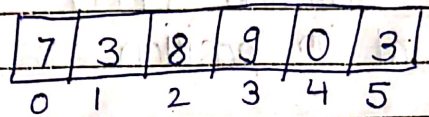
```
s=0
for(i=0; i<n-1; i++){
  for(j=i+1; j<n; j++)
  {
```

count no. of comparision

$$\frac{n(n-1)}{2} + n - 1 \quad (\because j = i)$$

Bubble Sort

Monday 4/11/19



After each iteration largest no. reaches to the end.

Syntax:

```
for(i=0; i<n; i++)
{
for(j=0; j<n-i-1; j++)
{
if(arr[j] > arr[j+1])
{
temp = arr[j];
arr[j] = arr[j+1];
arr[j+1] = temp;
}
}
}
```

Bubble

2. After ith iteration $(i+1)^{th}$ largest element will be at ~~ith~~ $(n-i-1)^{th}$ position

Complexity comparision.

	Selection	Bubble	Insertio
worst	$O(n^2)$	$O(n^2)$	$O(n^2)$
Best	$O(n^2)$	$O(n^2)$	$O(n)$
Avg	$O(n^2)$	$O(n^2)$	$O(n^2)$

In case of comparision bubble sort takes less comp. thus it is preferable over selection.

```
#include <stdio.h>
 int main ()
 {


 scanf("%d", &n);
 int arr[n], i, j, temp, key;

 for(i=0; i<n; i++)
   scanf("%d", &arr[i]);

 for(i=1; i<n; i++) {
        key = arr[i]
        j = j+1;
      while(j >= 0 && arr[j] > key)
        {

          arr[j+1] = arr[j];
          j--;

        }
       arr[j+1] = key;
 }
```

Complexcity list Date

	Selection	Bubble	Insertion
worst	$O(n^2)$	$O(n^2)$	$O(n^2)$
Avg	$O(n^2)$	$O(n^2)$	$O(n^2)$
Best	$O(n^2)$	$O(n^2)$	$O(n)$
Space	constant	$O(n)$	$O(1)$

Inplace algorithm

Segmentation fault
Whenever we (program) try to access illegal memory at run time segmentation fault occur.

Baund Checking
It checks the boundary.

Auto : It automatically assigns the variable to Ram & register.
Syntax : Auto int a;

Extern: Extern variable can be used from one file to another file.

Static: Static variable keep up the calculated value even after the function gets destroyed. Initialization takes place once & compulsory.
Eg: static int i=0; // initialization

Constant: cons. int a=10;
It keeps/sets the value permanently in the program & refuse change to the value.

Return type function name (Arguments)

```
int main()
{
int a, b, sum;
scanf("%d %d", &a, &b);
sum= add(a,b);
printf("%d", sum);
}
int add(int x, int y)
{
return x+y;
}
```

Q. WA Function which will multiply a float & int.

=)
```
float mult (float x, int y)
{
return x*y;
}
```

Q. WA Function which given a, b, c prints the two possible value of x, y real value does not exist the function should print imaginary value.

MON

Date 11/11/19

Functions

Function are the set of code which take inputs, and do some specific task and give output.

Declaration of function

```
Returntype FunctionName(Parameters){
        Body of function
    }
```

* Reusability
* Error detection & correction become easy.

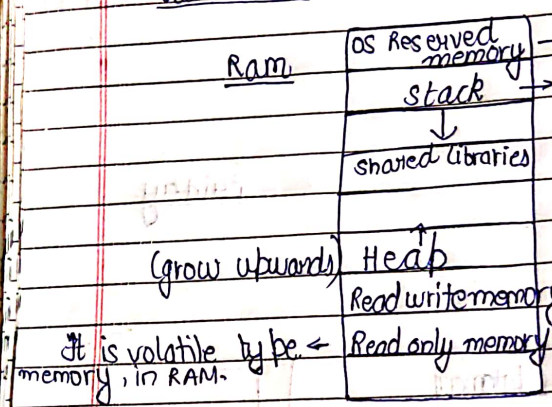
1. Prototype or Signature
2. Definition

Ex:
```
#include <stdio.h>
void sum();
int main(){
    sum();
    return 0;
}
void sum(){
    int a, b;
    scanf("%d %d", &a, &b);
    printf("%d", a+b);
}
```

Date Friday

15/11/19

Memory Representation of C Program Variables



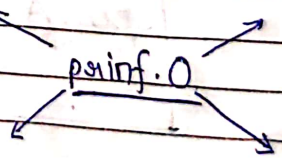
* How compiler differentiate b/w global, local, static variables?

* Illegal memory access by a program causes segmentation fault.

* stack is data structure is used for function call, Queue is used for process stabling.

* ROM (read only memory) is used to store bootstrap loader. It is a type of non volatile memory.

Shared Libraries.



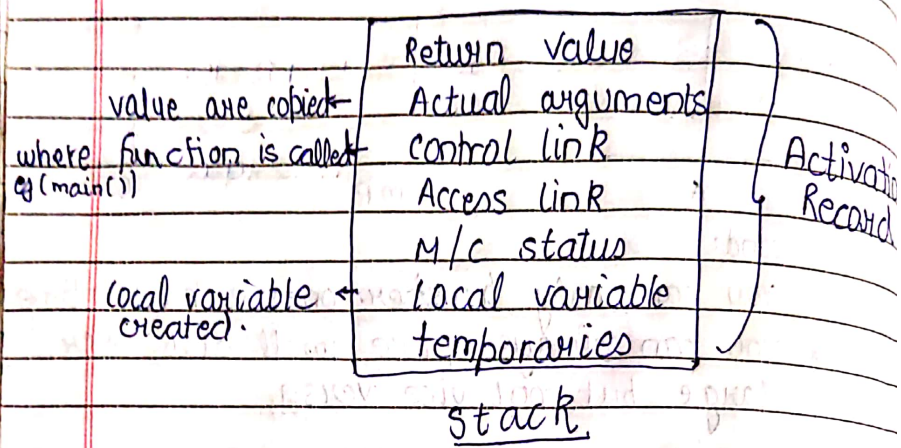
It is shared once so that other programs can use it.
Queue is used by shared library.

```
                                    Not stored
#include <stdio.h>                      ↓
#define PI 3.14
int a=10;          R/W memory
int main(){
        const int b=20; #read only
            int c=10; #stack
            display(c);
            return 0;
        }
void display(int p){ #stack
    int q=10; #stack
}
```

* Static variables are not destroyed after the function ends, it remains the same and keeps the updated value.

21/11/19 Thursday

Activation Record



* A function gets activated only when the function is called!

⇒ M/c status (Machine) → checking of status of machine before calling a function.

→ The temporary variable used for functioning are stored in temporaries.

→ Access link is created between the function & where it is called, so that the function can access the data from it.

* Control stack is a runtime stack which is used to keep track of live process activation.

i.e It is used to find out the procedures whose execution have not been completed.

* When the activation begins then the procedure name will push onto the stack.

* When activation ends then it will be pop.

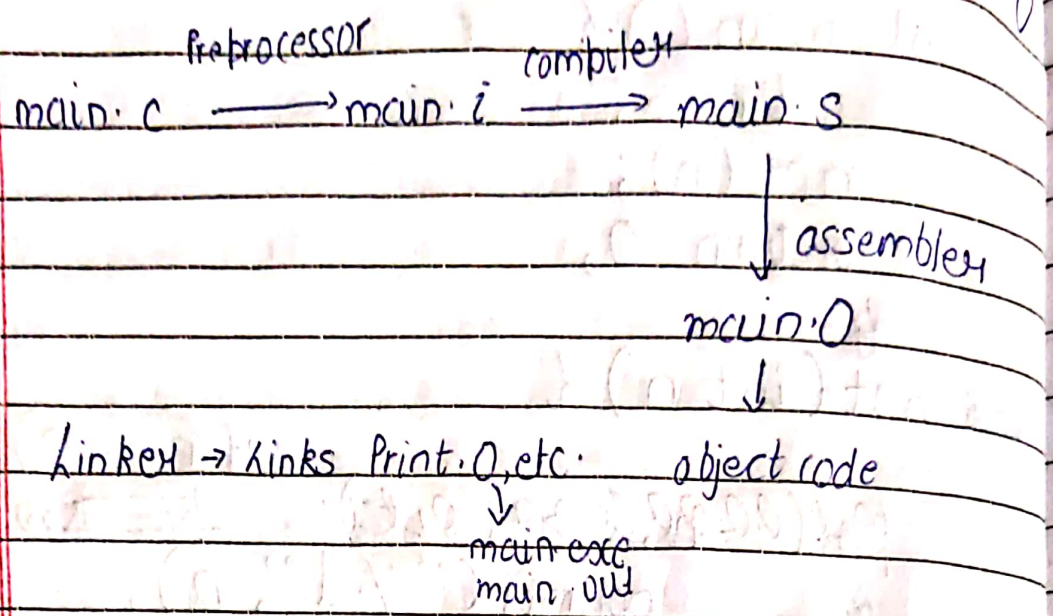
* Activation record is used to manage the information needed by the single execution of a procedure.

= Return — It is used by calling procedure to ~~receive~~ return the message from callee procedure.

⇒ Actual Parameter → It is used by callee procedure to sublike parameters to the called procedures.

⇒ control link = It points to the activation record of caller.

⇒ Access link ⇒ It is used to refer to non local data or global data on other activation records.



Liner does <u>static</u> & Dynamic linking

<u>Static Linking</u>

When the program is compiled the compiler generates object code after generating the object code. The compiler also invokes linker. One of the main task for linker is to make code of library functions available at your program. Linker can accomplish this task in two ways.

1. By copying the code of library functions to your object code. (static linking)

Date

at runtime. (Dynamic linking)

~~Indirect Recur~~

INDIRECT RECURSION

Direct Recursion: void foo(){ base cond;
foo();
}

Indirect Recursion: void foo()
{ base cond:
fun();
}
void fun(){ base cond;
foo();
}

25/11/19 Monday

Dynamic Memory allocation → allocated at run time.

Static Memory allocation → allocated at compile time.

Dynamic memory is extensively used in linked list, trees, graphs.

Pointers int a[10];

Pointer is used to store address.

Declaration: int *a; } holding address