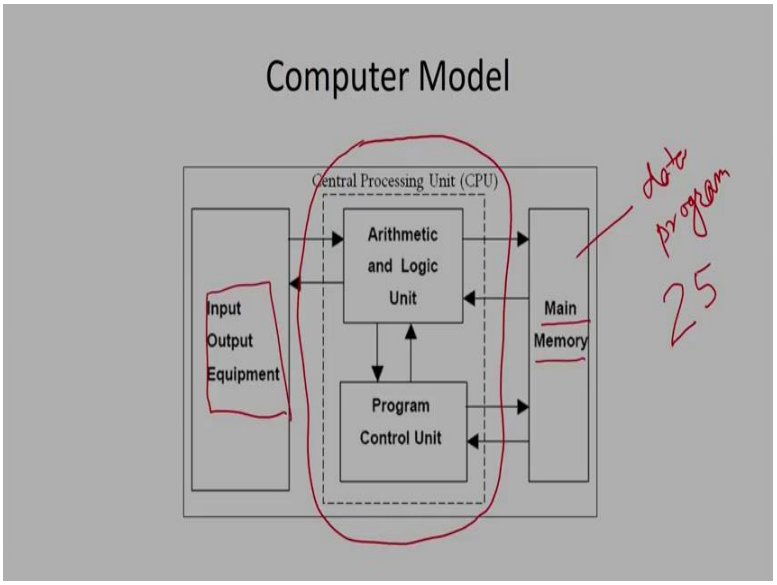
(Refer Slide Time: 24:42)

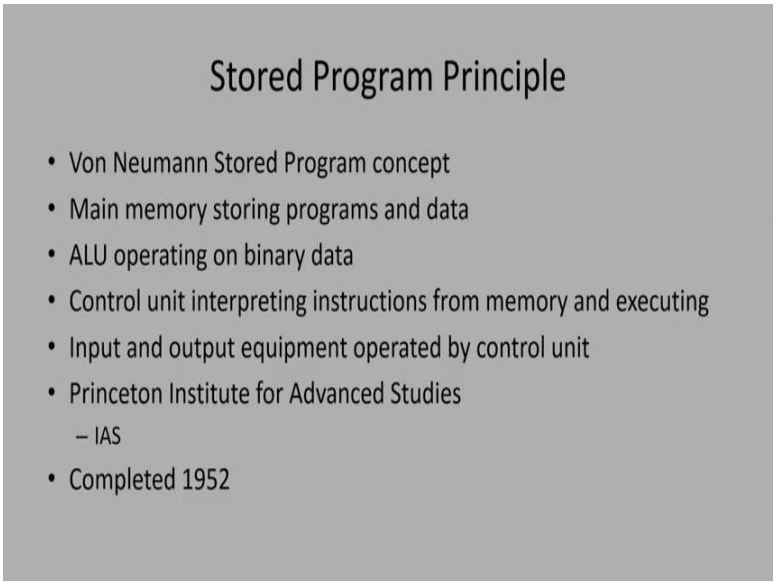


Now, we see what is a model of computer if you see the computer model the main component is your CPU central processor unit. So this is the central processor unit which is the main processing part it is having two parts one is called arithmetic and logic unit and second one is your program control unit. So all the processing is done in the central processing unit. Along with that we are having main memory, so informations are available in the main memory and processor take this particular information from main memory and process the job and store the result in main memory. And to keep the information in the main memory we need input output devices so we have to have some input output devices to give the information. So you can use those devices to work with the computer. As a simple example now I can say that this stylus pen is an input device I can write something over here and once I am writing it then it is going to the processor and the storage unit. Secondly, you know about a keyboard if you press something for in a keyboard it is acting as an input device and whatever you have pressed in a keyboard it is displayed in a monitor, so monitor is an output device. So through input output devices we are going to interact with the computer; that means this is the interface to the external world of a computer.

So this is the basic model of computer and how computer works it basically works on stored program principle and this principle as introduced by scientist Von Neumann and we said that this is a Von Neumann stored program concept. So what is that particular

concept if having a storage unit we call it is a main memory, in that particular main memory we are going to store our program as well as data.

(Refer Slide Time: 26:40)



ALU operates on binary data. So we are having a processing element we call it is an ALU arithmetic and logic unit it can perform some arithmetic operation and some logic operation say arithmetic operation I can say that addition, subtraction, multiplication like that and logic operation we know that AND, OR, XOR. So ALU is having all those particular operation and it can perform operation on binary data, control unit interpreting instruction from memory and executing. So you see that we are having in main memory already I have said that here we are storing our data as well as program everything is in binary. Now that controlling this give the information in such a way that we are going to keep bring this particular information inside a processor and processor is going to process the job or perform the tasks and finally result will be stored in the main memory. So this is the stored program concept and input and output equipments operated by control unit already I said that if I have to give some information then from this particular input devices I am going to give it.

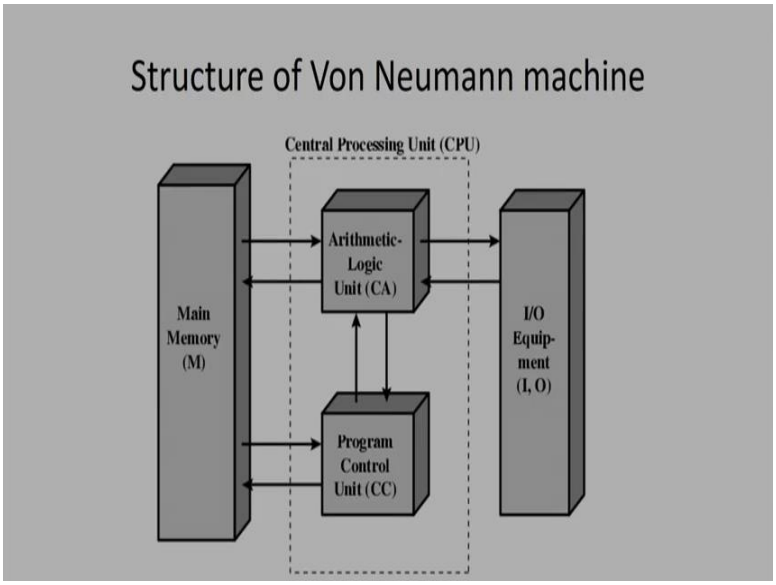
So that processor should have the capabilities to control those particular input devices as well as when we are keeping this information in main memory or say our result then we has to give this result to the users may be through monitors or maybe through printer. So again control uniit is going to perform those particular tasks of control those particular

devices to transfer information from main memory to the output devices. So basically when I talk about the Von Neumann stored program principle we may concentrate on those particular issue and we can say that this is a closed system CPU or the processor and the main memory. Once we have the information in our main memory then processor can work with this particular information and perform the job.

Now, how to get the information to the main memory for that we need this particular input output devices through input devices you can put the information into main memory and once job is done then we can take out this information through output devices. So it was basically designed and developed in Princeton universities and this Princeton institute for advanced studies and machine is known as IAS Institute for Advanced Studies IAS model and this project was completed in 1952.

So this is the basic structure of Von Neumann machine which is developed in Princeton universities in Institute of advanced studies.

(Refer Slide Time: 29:29)

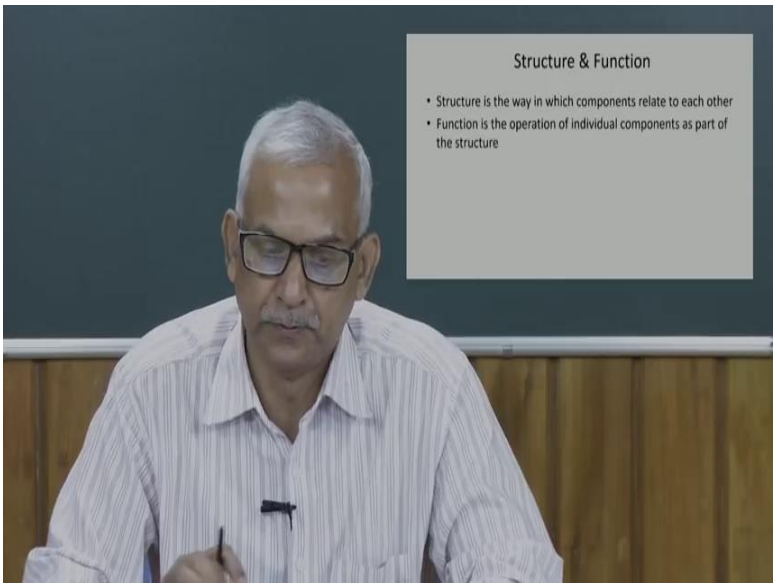


So this is the central processing unit we are having that arithmetic and logic unit and the control unit it is worked with this particular main memory we should have all the information in main memory and processor is going to handle the information that is available in main memory and carry out a job and the interfacing is done with this particular I/O devices I/O equipment through input devices we are going to give the information to the computer; that means, we are putting it in the main memory,

processeor is going to take the information from main memory carry out a job and put the information in the or result in the main memory and through output devices, we are going to give the result to the users. This is the structure of Von Neumann store program principle of Von Neumann's machine.

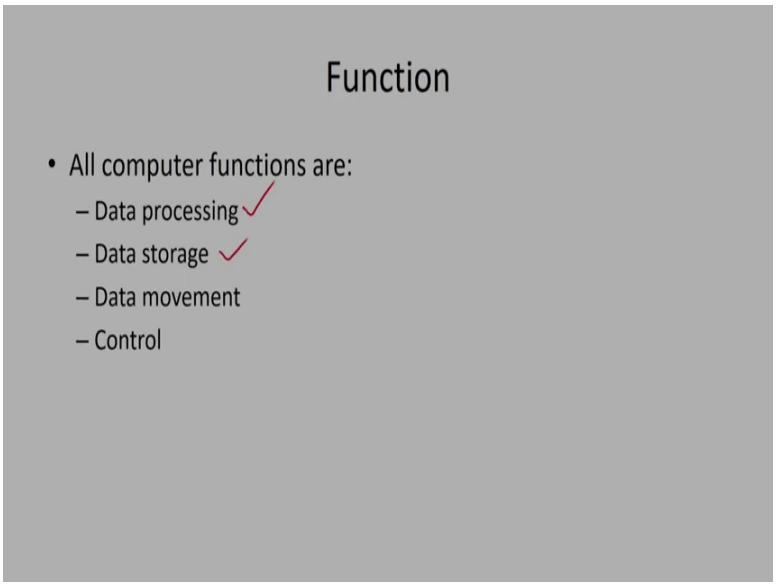
Now, whatever computer you are using now whatever advanced it may be you can talk about parallel processor or you can talk about the core multi core system where you can have 4 core 8 core, but all those machine works on this particular Von Neumann stored program principle.

(Refer Slide Time: 30:40)



Now, when we are going to discuss about the computer basically we are having two issues one is known as what is the structure of the computer and what are the function that we are having for that particular computer. So we have to fix what is the structure and function. So structure is the way in which components related to each other and function is the operation of individual components as part of the structure.

(Refer Slide Time: 31:14)

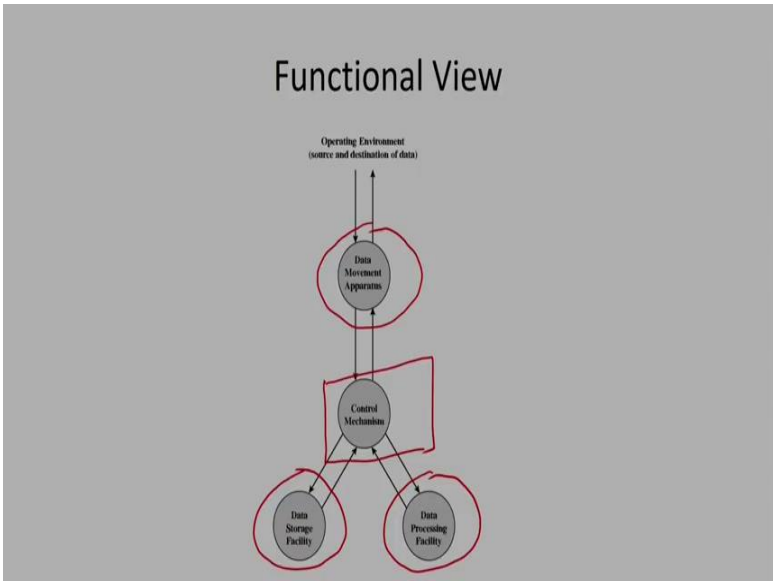


So we are going to see how the component functions in a computer. First we are going to look into the functions what are the functions that we have in a computer. So if you look into the computer functions all the function can be categorized into 4 different categories and these categories are one is your data processing, second one is your data storage, third one is your data movement fourth one is control. So we may have several instructions or several operations in a computer, but all those can be categorized into this particular four categories. So we are going to do some processing job so we are having some instruction to process the information may be addition of 2 numbers is a processing instruction or a processing task, may be multiplying 2 numbers is a processing task, compare 2 numbers is a processing task. So we should have some instruction to do the data processing.

Second one is your data storage now once we have processed our information and we are going to get our result then what will happen we have to store those particular information. So we need some instruction for data storage. So one categories of function is there to store the data another categories are your data movement moving data from 1 point to the other point like that I am saying that computer works on von Neumann stored program principle; that means, we have to store our information in our main memory.

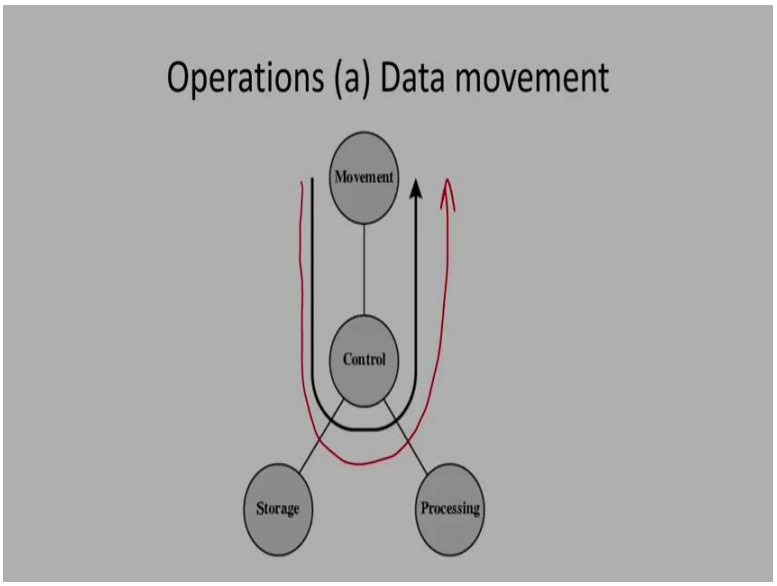
Now, how to move the information to the main memory from all input devices. So for that we need some instruction 1 we process the data we store our result in our main memory as per von Neumann stored program principle, now how to transfer those information to output devices maybe like printer. So for that we need some instruction. So those instructions comes under this particular data movement and some instructions are there to control the entire machine and the computer. How to control the printer, say when we send give the print to send a file to the printer we have to make sure that printer is ready, once printer is ready we have to transfer all the information to the printer. So these are controlling information that we have to provide that controller printer even to start the printing, at the end of the file stop the printing.

(Refer Slide Time: 33:48)



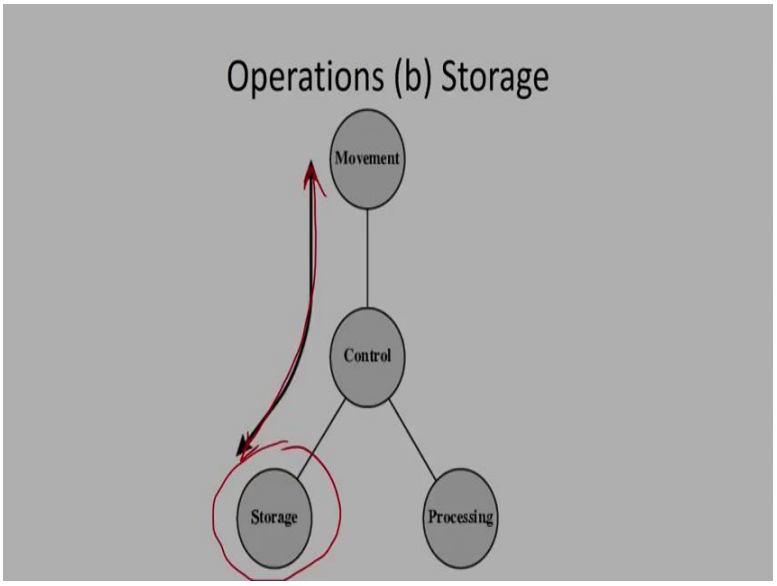
So these are the control instructions, so whatever instruction we are having in the instruction set all those instructions can be categorized into these particular 4 functions. So now we are going to see the functional view. So one is your data movement, data storage, data processing and control. So for that when we are going to look for a functional view we will see that what are the things that we are having, so one we are having data movement apparatus how to move the data. Another component we are having data storage facility how to store the data, another one we are having data processing facility to process our information and all those things will be controlled by our control mechanism.

(Refer Slide Time: 34:38)



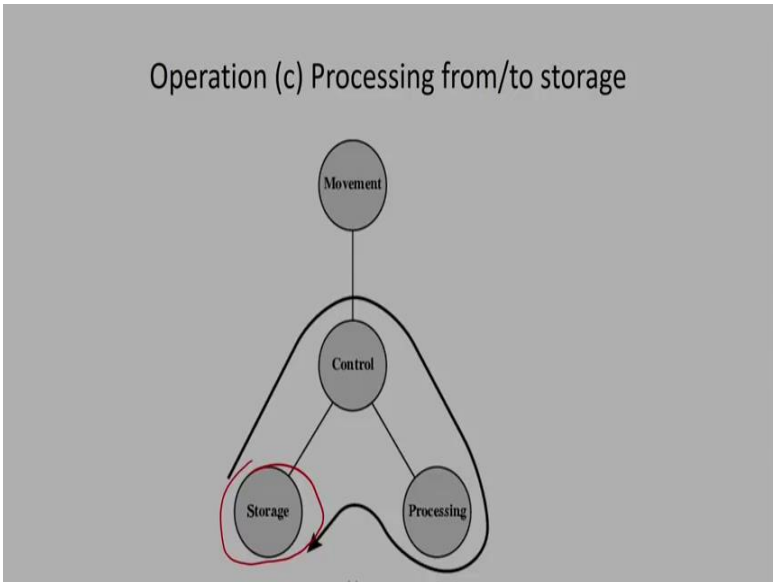
So these are the functions that we are having and this is the way we can look into it. Now what are the functions that we are going to do first one is your data movement so that means data will move from one point to the other point and one device to the other device like a simple example I can say when I press some keys in the keyboard I am entering something to the computer and that thing is displayed in the monitor. So this is a data movement moving moving information from keyboard to monitor.

(Refer Slide Time: 35:10)



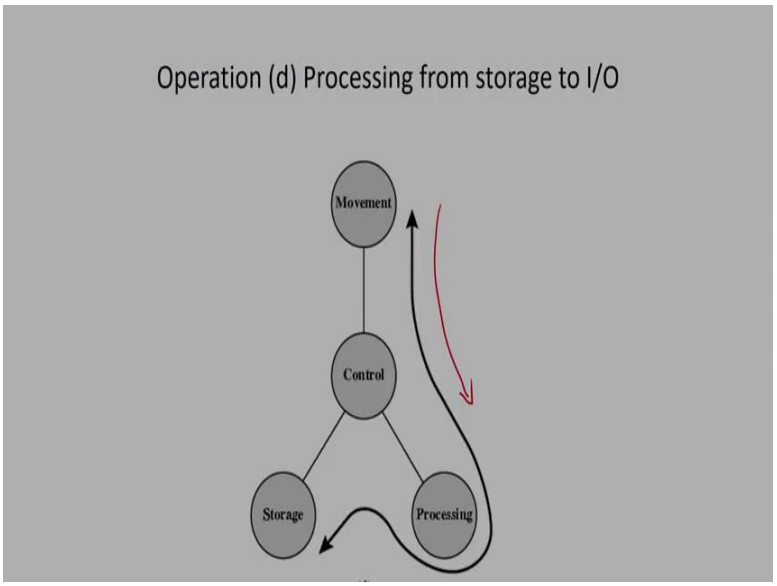
So one class of information is your data movement, second one is your storage. So we are having information in some devices now you have to bring it to the storage unit. So this is the data moment. So basically bringing it from the input devices to the storage and from storage to the output devices because computer works on von Neumann stored program principle. So we have to keep all the information in the storage first then only processor can handle those particular information. So we need one class of information or instruction which is your basically data storage. Third class is your data processing.

(Refer Slide Time: 35:44)



So we are having the information in our storage now processing elements or processing unit have having defined processing element like that adding 2 numbers multiplying 2 numbers. So depending on our instruction it will take the information from storage, it will do the processing tasks, it will add the 2 numbers if my task is you are adding 2 numbers and again it will store the result in the storage. So this is your processing from and to storage and another class is your transferring the information from storage to output devices or through processing.

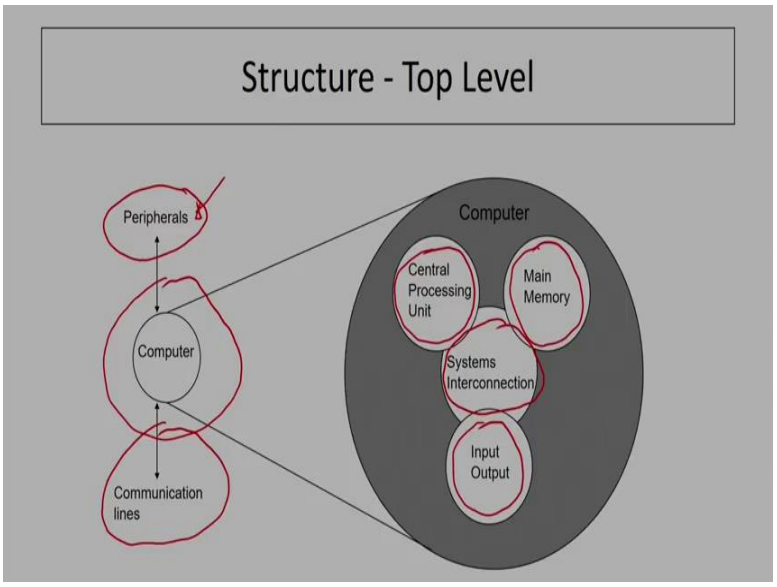
(Refer Slide Time: 36:25)



So we are going to take the information from storage we process it and we can give it to the output so that means, if we want to add 2 numbers and we want to display the result then taking the information from storage and processing it and giving the result to the output devices maybe to the monitor. But secondly, we are taking the input from some input devices we process it then we put it into the storage.

We store it in some memory location. So, this is processing from storage and I/O.

(Refer Slide Time: 37:09)



So these are the different tasks that we can perform. Now we will see what is the structure of a computer is: this is the structural view. So in that particular case you see how we are going to visualize a computer you can see that just we are representing a bubble to represent the computer. So this is a computer now what we can see that it is connected to some peripherals. Peripherals are nothing but the input and output devices, to work with a computer we need some I/O devices input output devices these input output devices will be connected to the computer and nowadays network or computer network is an integral part. So we should have provision to connect to the network so we are having that communication link also. So if you see computer will just simply see that this is the representing with the help of bubble this is a computer along with that we are having some peripheral devices and we are having interconnection network.

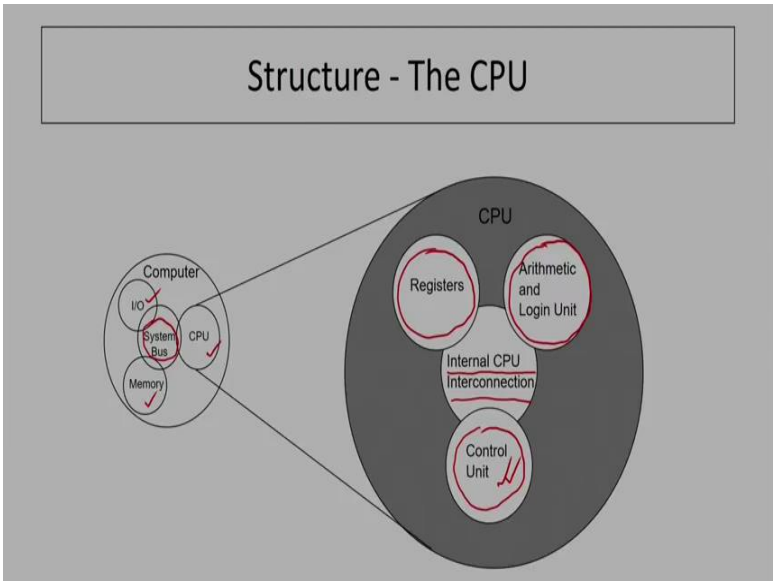
Now, what is there inside the bubble? So we are going to look for top down approach. You just see that now we can bubble up this particular computer and we are going to see, what are the components that we have inside this particular computer. So here we are going to say that we have the central processor unit CPU generally in most of the books in the primary level or school level is say will get a sentence like that CPU is the brain of computer.

So it is going to perform the tasks now how computer works it works on von Neumann stored program principle. So we have to keep the information in some storage unit. So this is the second component called memory unit or main memory. So processor is going to work with the information that are available in the main memory.

Now, how we are going to get information in the main memory? Through input devices. So we are having this particular input output mechanism. So if you see that these are the 3 basic functional units that we have in computer. So you can visualize or you can view the structure of the computer like that now there should have a communication between all those components because you have to take something from input to the memory from memory to the processor again from processor to the memory may be memory to the output. So all are connected together, we are having a system interconnection network we are having define where to implement these things we will see we will discuss these issues. So when we are going to visualize the computer as a bubble what are the things that we have inside a computer we are going to get four basic component central processing unit, main memory and input output and they are connected to the

system interconnection. Now what we have seen that inside computer now we know that we are having CPU, main memory, I/O and system bus.

(Refer Slide Time: 40:09)



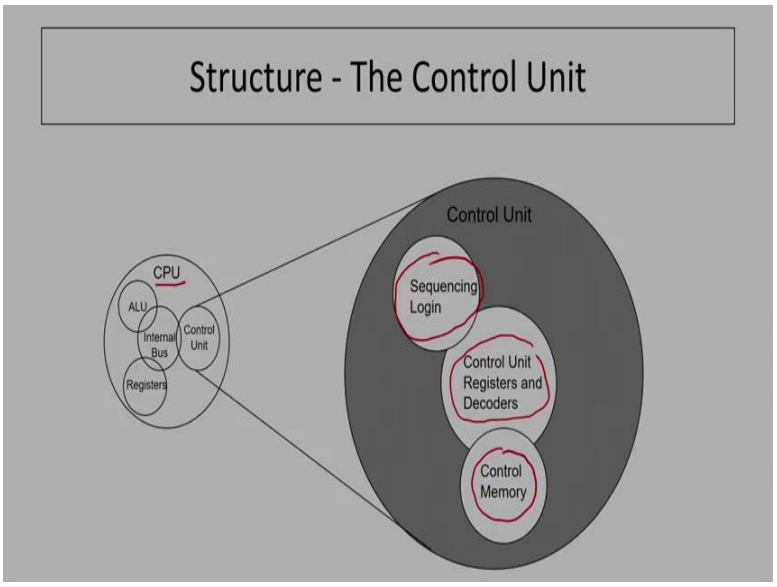
Now, what is inside this particular CPU now again you can bubble it up now we are going to see what the things that we have. So for that already have mentioned that we are having a processing element and generally which is known as your ALU or arithmetic and logic unit we are having some arithmetic operation and we are having some logic operation depending on the instruction set we have to have this particular ALU. Some of the function in this has to be implemented in hardware basic or some of the instruction may be done in the software we will discuss this in similar topic. Secondly, when we are bringing the information from storage main memory we need some temporary storage space inside the processor and these are known as my registers in registers we can store some information.

So we are having some registers in the processor and we said this is the register bank which is nothing but the temporary storage and along with that now we need the control unit which is the main part of the CPU and we are going to give more emphasis on design of this control unit. So the basic task of the control unit is to synchronize the operation, transport information from main memory to the processor then process the job then whatever result you are getting transfer it to the main memory. So everything needs

to be done in a coherent way and approve run in a proper sequence that sequencing signals will be generated through this particular control unit.

Now, we are going to discuss or in this particular course we are going to discuss about all the design issues of this particular control unit again inside this processor inside the CPU all those particular component has to be connected together. So for that we are again having an internal CPU interconnection. Now user see that now when we are going to visualize it view it what is there inside the CPU central processing unit again we are going to get this particular 4 components. Ok like that in top down approach we are going to explore each and every bubble and finally, in subsequent lecture we are going to be discuss everything in details we look for all the design issues of all these particular component.

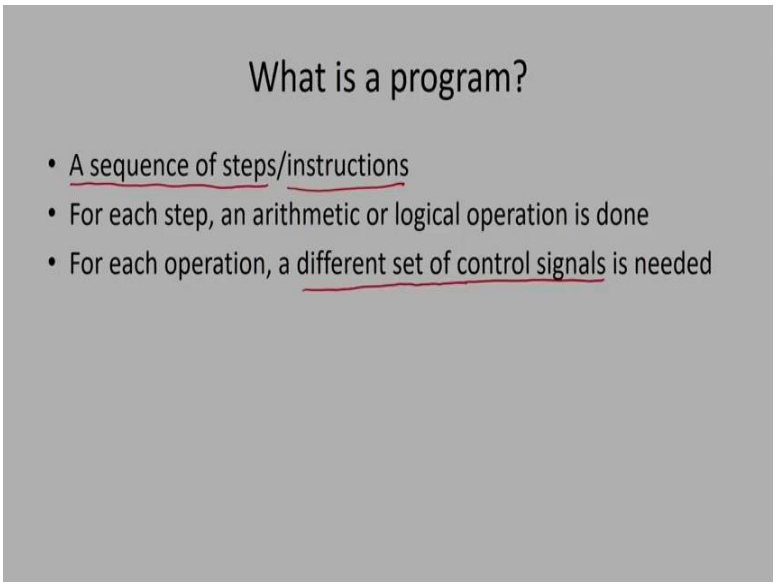
(Refer Slide Time: 42:40)



Now when we talk about the CPU you see that we know that it is having ALU, registers and control unit and they are connected through this particular internal bus. Now what is there in control unit again we can see or you can bubble it up and basically all that I have mentioned that we have to maintain the proper sequence for that we are having this particular sequencing logic. So we have to design and implement this particular sequencing logic so that everything will be done in proper sequence. For this in the proper controlling sometimes we have to keep some information inside the control unit also for that we need a storage or memory and this is known as my control memory.

So some of the information sometimes they are going to store in control memory and to interpret the information in the control unit again we may need some registers, decoders etcetera. So this is basically control unit is going to have some registers and decoders etcetera to have the proper functioning. So these are the components that will be having they will be interconnected they will be interlinked and we are going to discuss all those issues in our subsequent module.

(Refer Slide Time: 43:56)



Now say you are working with a computer how computer works most of you will tell that we are having a computer program and we are going to execute this particular computer program once they execute a computer program then what we are going to get according to our requirement we are going to get our result.

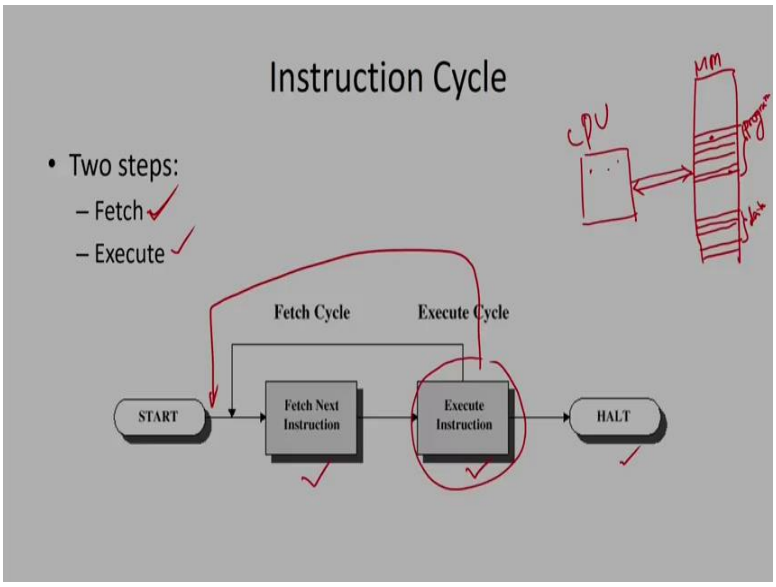
Now, what is a program? So, if you look into a program we will say that it is nothing but a sequence of steps or instructions. So we are having a sequence of steps or we say these are the instructions, now what are those instruction when we talk about this instruction basically this will come from the instruction set of this particular processor we have to execute those particular instruction one by one. For each step an arithmetic or logic operation is done because if I am having an addition operation we are going to perform the addition. So this is the instruction that we are going to get.

And for each operation different set of control signals is needed it what we are saying different set of control signals are needed. So when I am going to perform an instruction

say adding 2 numbers we need different set of control signals to coordinate all the component and they will be done in different step. So when I am going to add 2 numbers it is not like that in one go I can do it, but it involves several steps once you complete all those particular step then only that instruction is over. Ok this is a program and in program basically it is nothing but a set of instruction and we are going to execute that instruction in sequence one by one. That way we have to take it. So we can visualize the computer program in that particular way.

Now how we are going to execute a program and when we are going to execute the program we can say this is the instruction cycle already I have mentioned that one instruction cannot be done in one step we are having several step and complete collection of all those particular steps are known as my instruction cycle.

(Refer Slide Time: 46:02)



In basic way what will happen I can say that instruction cycle consists of 2 steps one we talk about the fetch and second one is execute. Now say computer works on von Neumann stored program principle we are storing our information in main memory. So what will happen I can say that this is my processor or say CPU and we are having this particular main memory. So somewhere in the main memory I am storing my program and what we have done we are a having the interconnection so they are connected together.

Now, when I am going to execute this particular program this program is having several instruction and we are storing the instruction one by one. So first we have to bring this instruction from this main memory to the processor. So bringing the information from main memory to the processor is known as the fetching of the instruction. So this is the fetch, once fetch the instruction then what will happen now my information is inside my processor. Now, we are going to execute that particular instruction or we are going to perform the task we say this is the execution phase. So thats why we are saying that it is having two step and we can say that this is the instruction cycle first we are going to fetch the instruction after fetching it we are going to execute the instruction and program is a collection of instruction after execution of the instruction we go back over here again we will fetch the next instruction will execute it until and unless we are going to get the last instruction which may be end instruction or stop instruction at that particular point we will come out from this cycle and execution of this particular instruction is over. So mainly in instruction cycle we can say that it is having basic 2 step fetch and execute.

But depending on the nature of this instruction that execution phase or in execution of instruction may have again several phases we can have several phases for this excitation phase because it may happen that to execute some instruction we are getting the instruction, but we have to get the data again this data is available in main memory. So we are having the data over here. So what will happen after getting the instruction we know that we have to take the data from my main memory then again you have 2 fetch or take this particular instruct data. Once I get both the data then I can perform the addition operation. So that execution phase can be again sub divided into several phases.