Computer Organization and Architecture: A Pedagogical Aspect

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Lecture – 01
Model of Computer and Working Principle

Welcome back to the course on computer organization and architecture this is the first module of this particular course before going to the course matters a slightly want to explain about the method of pedagogy and the outcome based learning because in this course we will follow the process of outcome based learning.

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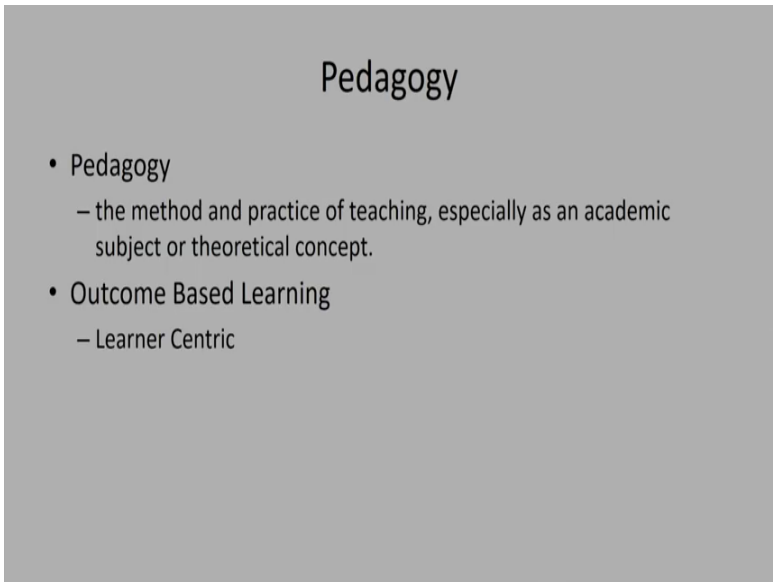

Now, first question arises what is pedagogy the dictionary meaning it says that the method and practice of teaching especially as an academic subject or theoretical concept. So, this is the default definition of pedagogy.

This is a method of practice for teaching something in universities for theoretical subject and will follow the outcome based learning and outcome based learning basically learner centric.

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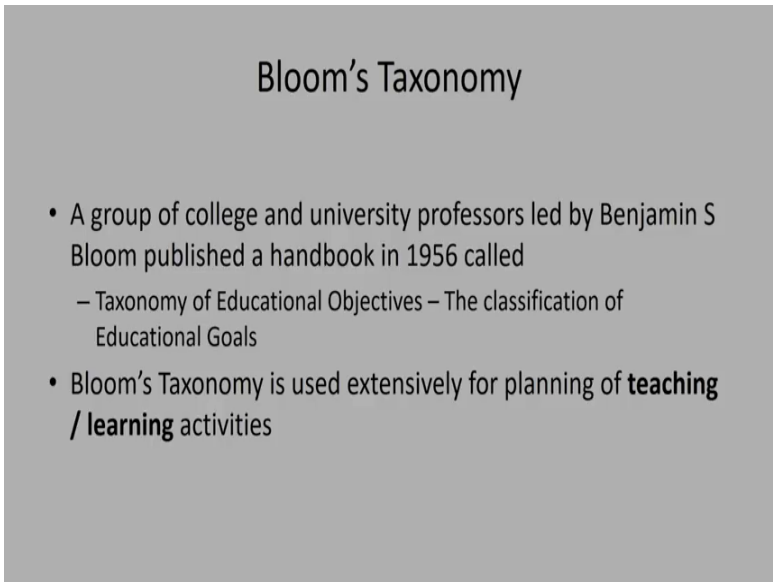

The party vision for a learner is most essential when we follow this particular outcome base learning now we talk about the teaching methodologies now we are teaching decided is (Refer Time: 01:28) single decision from long back, but people tell that there should be a proper mechanism or materials to teach the student for a subject.

For that reason a group of college and university professor led by Benjamin s bloom published a handbook in 1956 called taxonomy of educational objectives the classification of educational goal, bloom taxonomy use extensively for planning of teaching and learning objectives. Basically bloom technology says about the planning of teaching and learning activities. It is having 2 components one is teaching and another is learning. We have to plan what instructor has to plan how to teach a subject and. Secondly, learner or the students have a plan how to learn the subject.

In blooms taxonomy we define all those things and accordingly we try to deliver our lecture. When we are going for the learning when we are going to teach a subject basically all categories of learning can be categorized into 3 different domain as per blooms taxonomy these domains are cognitive domain psychomotor domain and affective domain.

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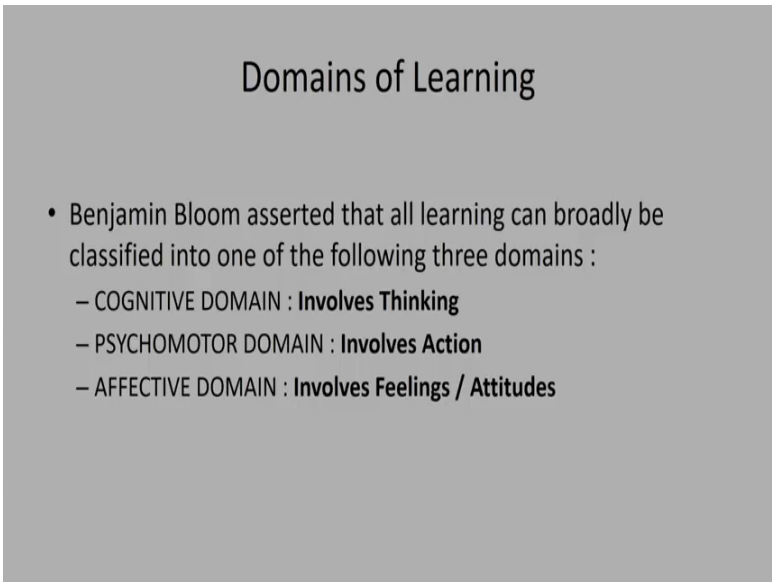

In case of cognitive domain it inputs thinking; basically we are going to teach the student the subject matter. That we can generate the thinking process on the student there is a thing why it is happening and how it is going to solve in most of the higher learning activities we use that cognitive domain.

Another domain is your psychomotor domains which involve action basically these courses are mostly dominated by practical you have to know how to handle equipment how to take readings and how efficiently you can handle equipment. Those issues are defined or addressed in psychomotor domain and another domain is your affective domain which involved feelings and a tissue. We have to give some training to the students also how to handle a situation how to work with a team how to control his own sentiment all those things should be a part of this particular learning activities in this course or in the higher education mainly we concentrate on cognitive domain and cognitive domain is based on thinking skill.

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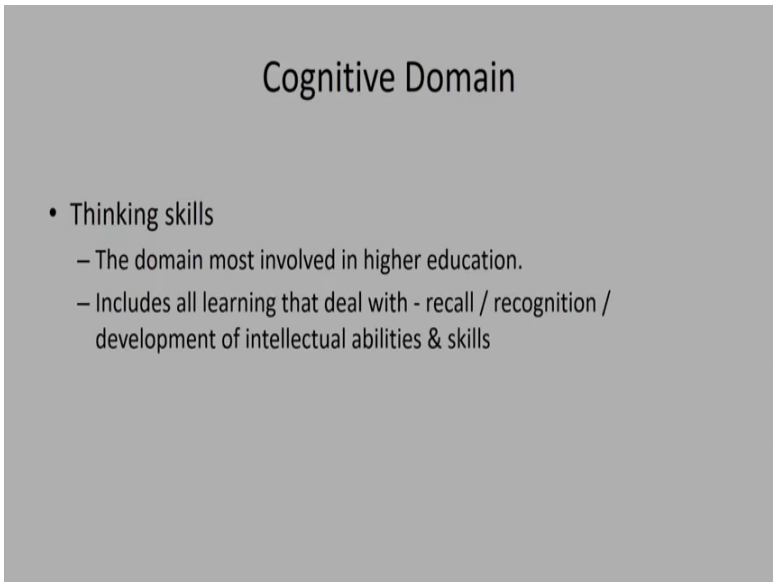

The domain most involved in higher education and it includes all the learning that deals with recall recognition and development of intellectual abilities and skill.

Basically that learning method basically talk about some recall of your earlier knowledge then recognize some situation and finally, develop the intellectual abilities and skill to solve the real life situation, in cognitive domains we address those issues.

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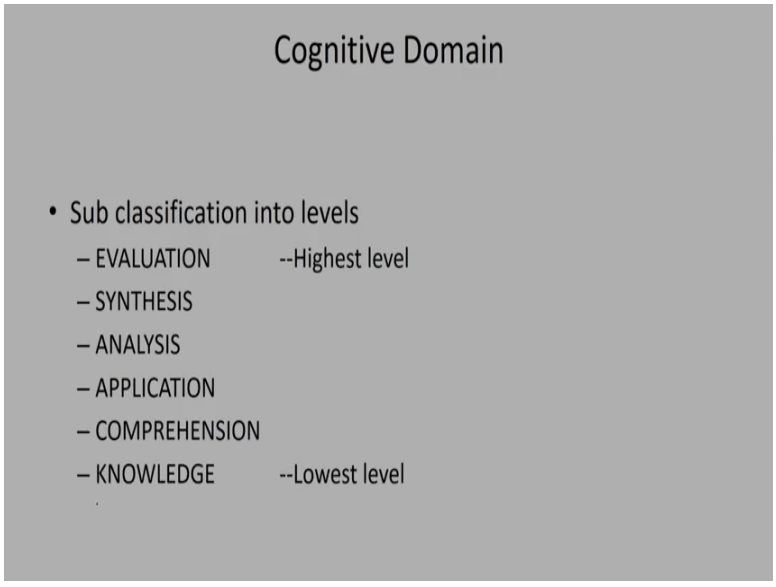

And in this course basically are going to address mainly in the cognitive domain again there are some sub classification or levels in a domain. In cognitive domain basically sub classifications are in the lowest level it is knowledge.

We will give some ideas in knowledge level which is required and after looking into the scenario you will be able to comprehend the situation and you can apply your knowledge this will go into the application level when you get a new scenario or new situation you will be able to analyze it depending on your knowledge and finally, what will happen it will be the design process basically you are able to design a new system which is the synthesis system and finally, you can evaluate the system.

This is the from lowest level to highest level when a student or learner I see the highest level it is assumed that he has already mastered the lower level classes. In this way while delivering our lectures will indicate which portion has address in which level whether it is an application level or it is in design level? Now, in outcome based learning always you have to think about what is the outcome of the course.

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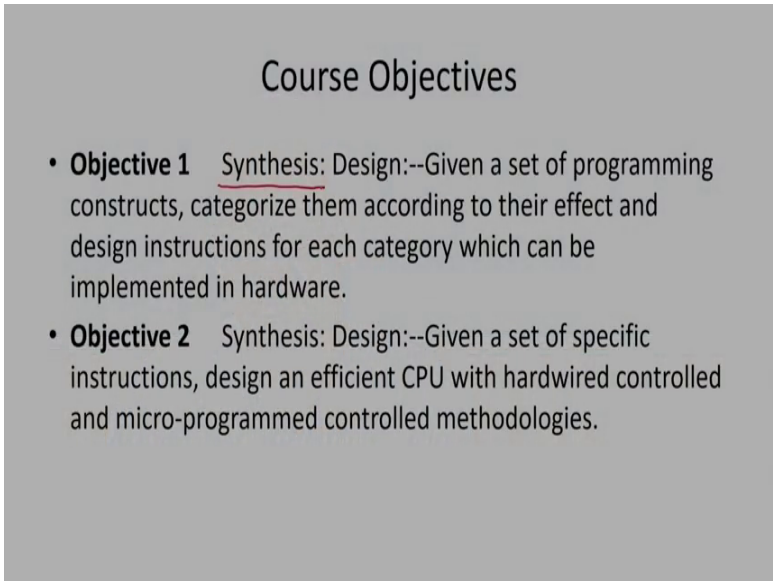

What the learners is going to accept after going through this particular course. In that particular case initially we are going to define the objective of the course and once we go through the course and once you complete the course we will make sure that all the objective will be accept or all of the table met by the student. First objective we are just looking into this where it is in the design phase or it is in the synthesis level what we said

that given a set of programming constructs categorize them according to their effect and design instruction for each category which can be implemented in hardware

It is a design objective of final objective is to design the computer system. Why you are going to design a computer system we are having some requirement first of all you have to identify those requirement and accordingly we have to come with a algorithm or you can say this is the programming construct, now whatever touch we want to perform have to be categorized into the different category and for each and every category we are going to define the operation or tax finally, those operation will be implemented in hardware.

We are going to meet this objective while go through this particular course objective 2 again it is in the design level. What we are going to set given a set of specific instruction design an efficient CPU with hardware control and micro work and control methodologies. Basic objective 2 is design of an efficient CPU central processing unit and while we are going to design the processor we are going to look for 2 methodologies 1 methodology is called hardwired controlled and second method is called micro program control methodologies. We are going to address the design issues with the help of these 2 methodologies. Once we have made this objective then learner will design a processor either by hardwired control logic or micro program control methodologies objectivity.

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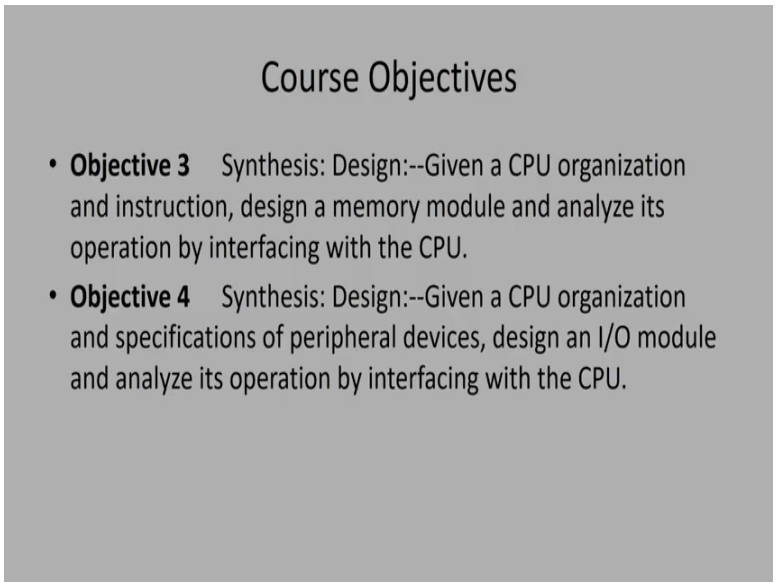

We are talking about again synthesis level or design issues given a CPU organization and instructions design a memory module and analyze it operation by interfacing with the CPU. Memory is also important component in the processor we are going to with the objective how to design a memory unit and how to interface that particular memory unit with the processor objective 4 again it is in the synthesis level and design issues given a CPU organization and specification of peripheral devices design an I O module and analyze it operation by interfacing with CPU.

Computer will come up with some peripheral devices input output devices how to integrate those particular input output devices what are design issues we are going to discuss.

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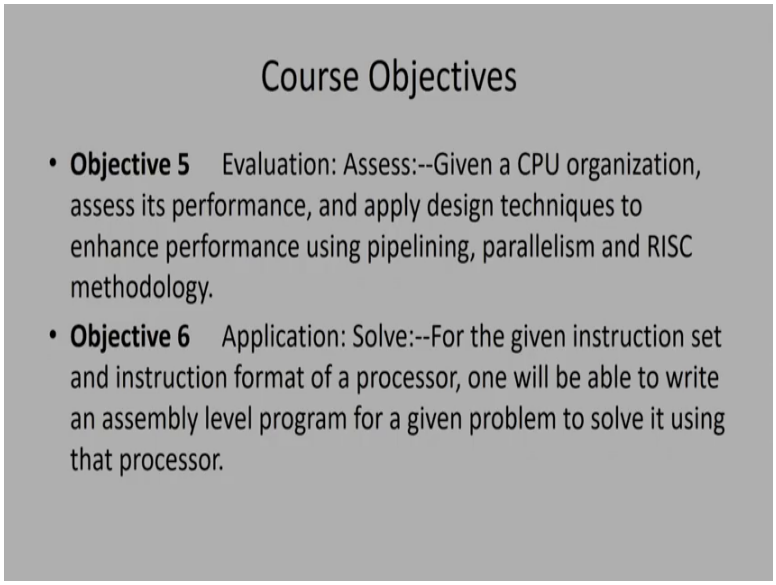

And we are going to make this objective also while complete this particular course objective type this is evaluation or performance evaluation you can say this is your assessment of our desire it says that given a CPU organization versus it is performance and apply design technique to enhance performance using pipelining parallelism and mix methodologies.

While designing our processor there will be some issues are there is scope to improve the performance. We are going to just evaluate it and we will address those issues only we are not going into the design process the design process will be address in some high level course objective 6 we are talking about it is in the level of application or you can

solve something what we are saying for a given instruction set an instruction format of a processor 1 will be able to write an assembly level program for a given problem to solve it using a processor. If you look for any processor that is available and if you know the instruction set and instruction format then efficiently you will be able to write a program in assembly level to solve any problem, this is in the application level.

We are defining 6 objective, we are defining 6 objective for this particular course and throughout this particular of course, we are going to deliver a laxer in such a way that finally, we are going to meet all those particular objective know already we have mentioned that the course will be divided into several modules and the first module is fundamentals of digital computers.

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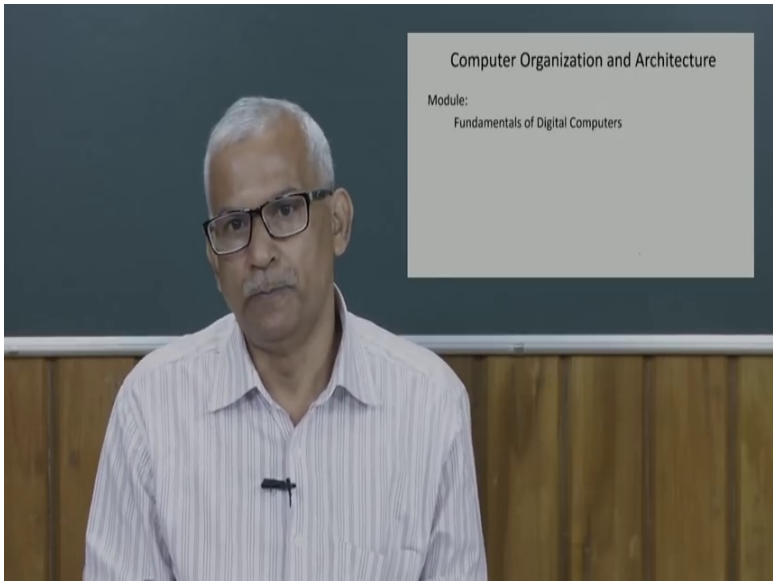

Now, what we are going to address in this particular module we are going to see basically we are going to know define the objective of this particular module.

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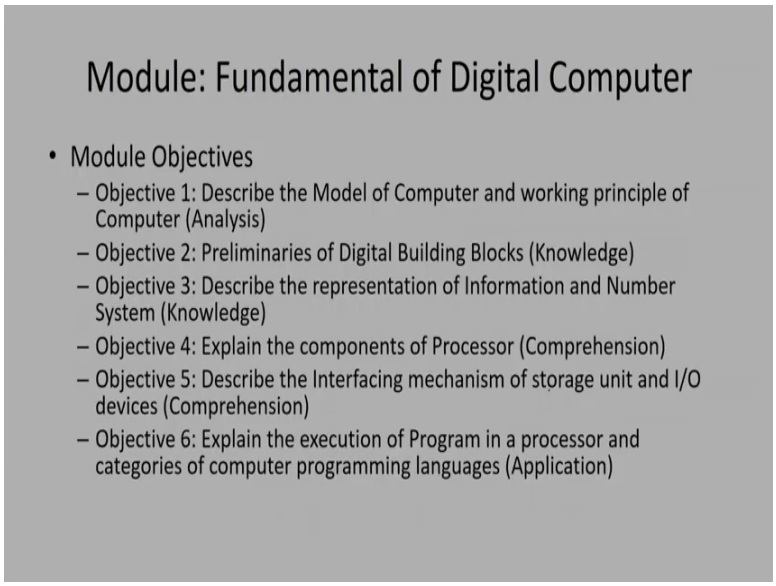

What is the objective we are defining the objective like that objective 1 described a model of computer and working principle of computer. This is basically in the analysis level, how a computer works and what is the model we are going to accept once you meet this particular objective 2 preliminaries of digital building blocks.

This is in a knowledge level; we need several digital blocks, will simply give the introduction of those particular building blocks only. It is in knowledge level once we have the knowledge that particular component then, we can use those things while designing our computer objective tree described a representation of information and number system this is also in knowledge level, just we will mention how information is represented in computer and how number system is used to represent all information.

Here we are depending these 2 things in your knowledge level, but if we are going to address tab for example, I am saying if we are going to address the said digital building blocks in details then we are going to address these things in another subject in the particular subject, we are going to address those particular issues in higher level maybe in the design level. That is why we are saying that the prerequisite for this particular courses the digital system. Once you have gone through this particular course then you will know the details of this particular digital system.

Will simply given knowledge level view and we are going to use those things objective 4 explained the components of processor which is in a comprehension level. Here what we

are going to see what are the components are there and how they are interconnected and once you see this thing that you will able complain how computer works. This is in this module we are having these things in the comprehension level, but in subsequent module those issues will go into the design level because ultimately you have to know everything in details objective 5 describe the interfacing mechanism of storage unit and I o devices. This is also in comprehension level memory is an integral part of our computer.

Here we are simply going to give the interaction and how you are going to connect it and how we are going to use it, but in another module we are going to address all those issues in details in details and it will be in the design level objective 6 explained the execution of program in a processor and categories of computer programming language it is an application level. We are going to give and sample saw or illustrated with an example how a processor exactly executes a program.

Here we are going to give the module learning strategy what is the strategy of learning this particular module. Here basically we are going to give all the resources that will be used for these particular courses. For unit 1 we are going to use the book computer organization and architecture designing for performance.

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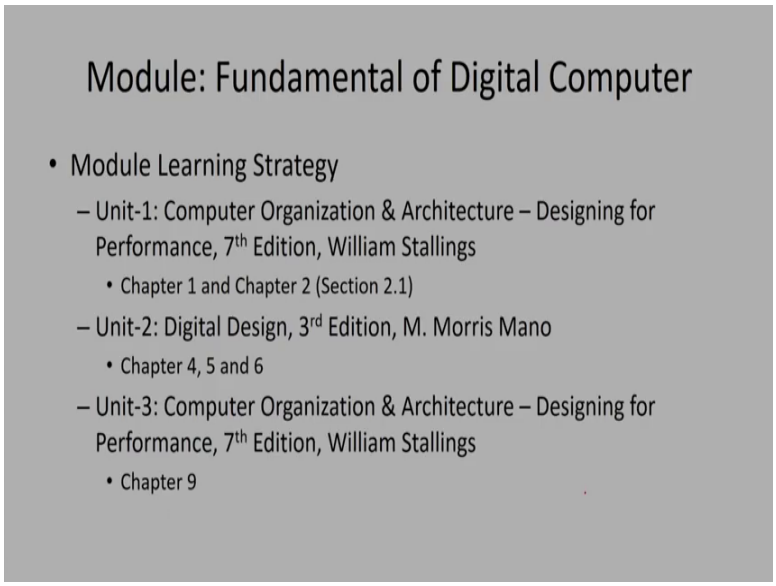

Just I am looking for the 7 edition of that particular book and it is written by William Stallings for this unit 1 you have to go through sceptre 1 it is a very small sceptre and a section 2.1dot sceptre 2. If you go to simply read these particular materials then you will

be able to understand what we are going to discuss about this thing and in my presentation I am going to use the metals from this particular book and some of the slides I have borrowed from the (Refer Time: 14:08) homepage also and some of the slide I have modified according to my convenience for unit 2 the reference book is a digital design third edition an author is an modest manner. Here I am mentioning 4 sceptres that is 3 sceptres the sceptre 4 5 and 6.

In those particular sceptres detailed design issues mention, but here we are going to address these things in knowledge level. If you want to brush up then you can go through those particular sceptres or if you have confident a conversion about those issues then you can skip this particular sceptres for unit 3 again I am going to use the book by Stallings computer organization architecture designing for performance and these are basically taken from the sceptre 9 of that particular book. For unit 4 5 and 6 again I am using the same books the book written by William Stallings.

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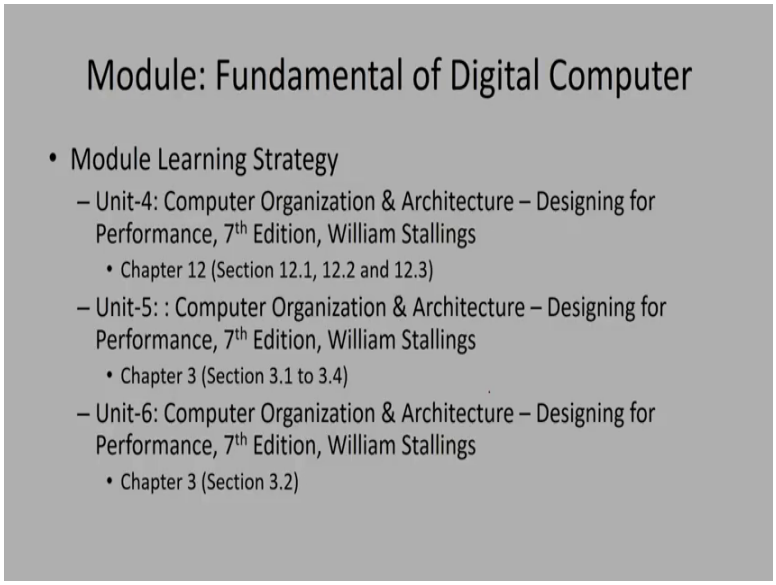

For module unit for you have to look for the sceptre 12 this is a section 12.1 1 12 .2 and 12.3 for unit 5 I am taking some material from sceptre 3 mainly section from 3.1 to 3.4 and for unit 6 again I am using the same book again in the sceptre 3 and this material is taken from sceptre 3.2. If you go through that particular section then it will be easier to follow my lectures know we have defined objective of our course the course is divided

into several modules and the first module is a fundamental of digital computer again this module is divided into several unit.

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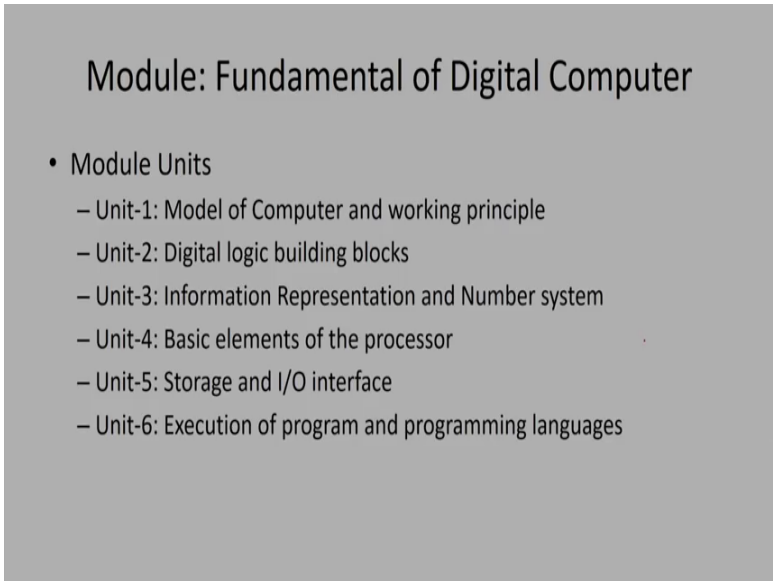

What are the units we are dividing it with 6 unit first unit is model of computer and working principle unit 2 is digital logic building blocks unit 3 is information representation and number system unit 4 basic elements of the processor unit 5 storage and I O interfaces and unit 6 execution of program and programming languages already I have mention about learning studies.

You know what are the resources that we are going to use for those particular events now unit 1 this is model of computers and working principle, what are the objective of this particular module objective one explain the working principle of computer again it is in a knowledge level describe the components of a computer it is in the comprehension level an objective tree illustrate.

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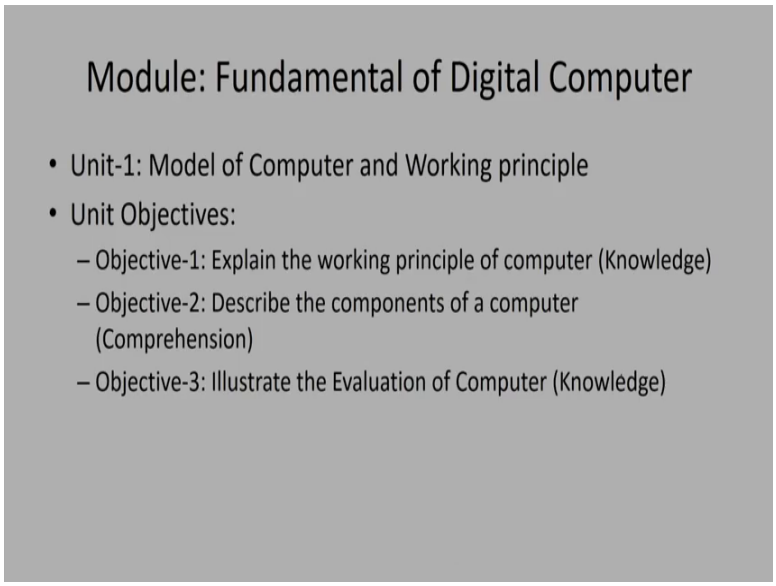

The evolution of computer it is in knowledge level currently your most of you are working with a computer you have at least use the computer to browse the net send mails to your friend you are using some software to draft your letters and some of you might have used some compilers also to write program in high level languages compile it and then execute it.

Here reason the computer, but it is better to know how we have accepted this particular level today. For that we are just simply going to brief idea about the evolution of computers also in this particular course now the name of the subject is computer organization and architecture. In this course name itself we are having 2 terms one is your architecture and second one is all organization. We are going to see what things are that, we are going to address in architecture and what are things that we are going to address in organization.

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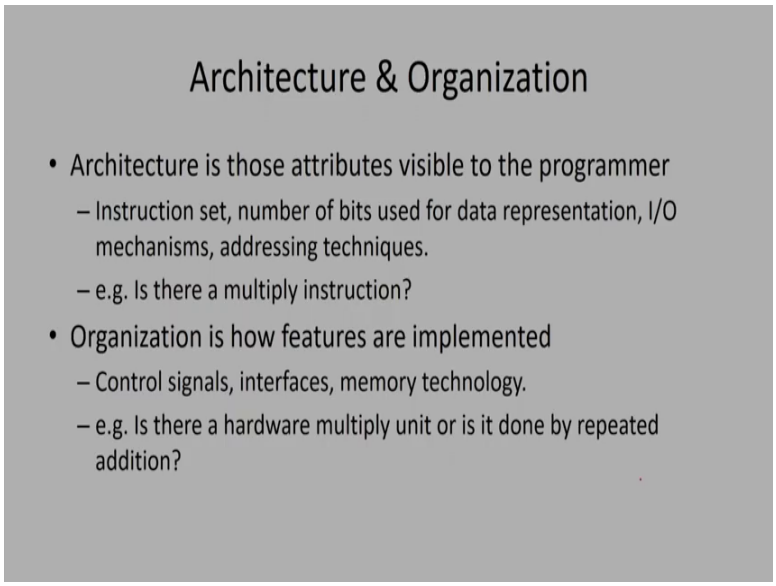

In architecture we are going to said it architecture is those attributes visible to the programmer. When you are going to use a computer you are going to solve your problem and you know that to solve this problem you have to have some operation or instruction. So, this instruction is visible to the user. These are the issues which are visible to the users are basically address in the architecture. Basically what we are going to address in architecture what is the instruction set; that means, what are instruction that we have in the particular computer.

What is the format of instruction each and every instruction should have a format and we have to (Refer Time: 18: 35) here to this particular format and we are going to design all those things in the architecture level and we have to handle our I O devices which way or what are the instruction that we have to handle those particular I O devices will also be addressed in the architecture level.

Once you place the architectures then what will happen now will go for the implementation which is the organizational view for example, here I am saying that is there a multiply instruction. When we are going to design an instruction set we will see that whether multiplication is required or not and whether we are going to put and multiplication instruction or not, if you feel that we have to put a multiplication instruction then in the architecture level it said we are going to freeze it we will say this is an instruction our instruction set and the format of the instruction also we are going to

specify now when we go to the organization it says that how we are going to implement those particular features that already we have defined in our architecture.

We need to generate several control signals,, how to generate those particular control signal how we are going to place the component all those things will be discussed in the organizational issues here one example I am giving say is there a hardware multiply unit or is it done by repeated addition.

Now, you just see that when we said in my processor we are going to put an multiplier or we are going to put an multiplication instruction now how we are going to implement it we are having several algorithms and most of you might be knowing that we are having an algorithm called boots algorithm by which we can multiply 2 numbers that boot algorithms can be implemented in hardware and we can put that particular multiplier unit this is 1 way of implementing our multiplication.

But another word, you can look into that we are having an additional instruction we can use that additional instruction to get the effect of multiplication which is known as your repeated addition. As for example, if I want to multiply 5 by 7 5 in the 7 then what we can do I can add 5 7 times. This is called done by repeated addition now this is a organizationally. We have to please it what way we are going to do it. If I am going to implement it hardware one issues like that we are going to get a faster response, but if in that cost if we are going to use the repeated addition then system will be slow, but we may safe cost. These are races we are going to address a freeze in our organizational issues know again we are going to look into the organization and architecture maintain architecture.

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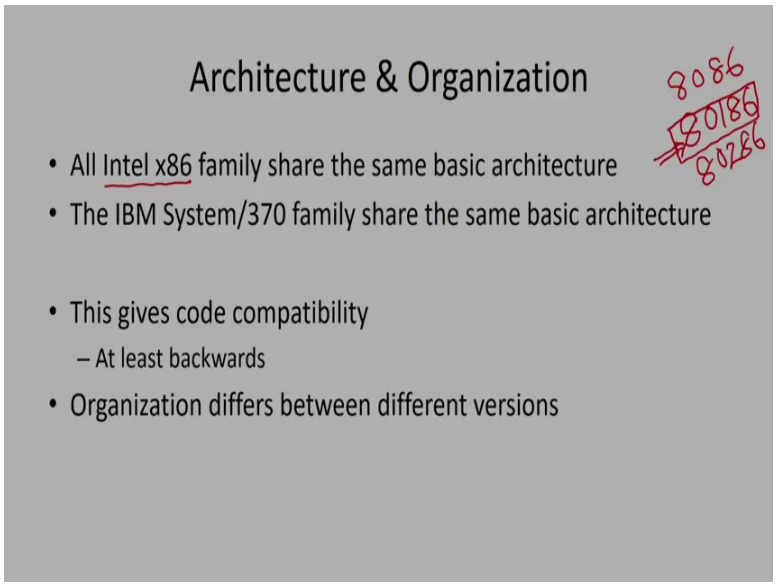

We are going to get a families of architecture like that one family is known as your Intel x86.

In the particular case Intel 86 what will have we are having a common architecture. First we have the processor called 8086. We are having some instruction set and we know the instruction format then what Intel has done they have enhanced the instruction and going to 80186 like that they have gone for 80286 like that they are enhancing the instruction set. This is called a family conscious similarly I b m is also having family system called 370 family. What is the advantage of distance it gives a quote compatibility and it says at least backward.

Now, what does it mean say if you are having a software or we have writ10 a program in (Refer Time: 22:03) 80186 it is executed or it can execute this particular program in 80186, now intelligence this processor 280286 what does it means; that means, they have written the earlier instruction and along with that they gave us some more instruction to solve our problem.

What our instruction is there in you know 186 all are available in 286, but along with that we are having some more additional instruction. Whatever software we have developed in 186 they can run in 286 or, because all those instructions are available. We said this is at least backward compatibility, but if you are writing a new program in 286 it may not run in 186 because some of the instruction may not be available in 186.

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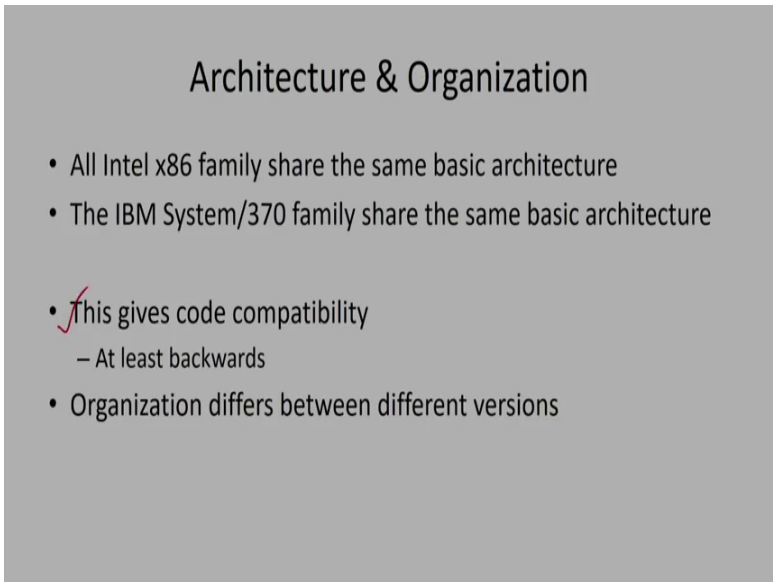

in the family structure or family organization 1 is your code compatibility there is another issues we are having that organization differs between different version.

Basically if you look into the Intel product you know that there is a processor called Pentium again Pentium has 2 versions one called Pentium pro and second one is of Celeron. If you go for particular Pentium processor you will find that the architecture of the Pentium and architecture of Celeron are same, but they define organization. Now, where you are putting a component it is different in Pentium pro or it is different in Celeron. That is why it says that (Refer Time: 24:20) difference between different person. Company religious different person the define organization, but architecture same. All software running what the processor, but since organization is different, there may be some issues on performance one may have better performance than the other.

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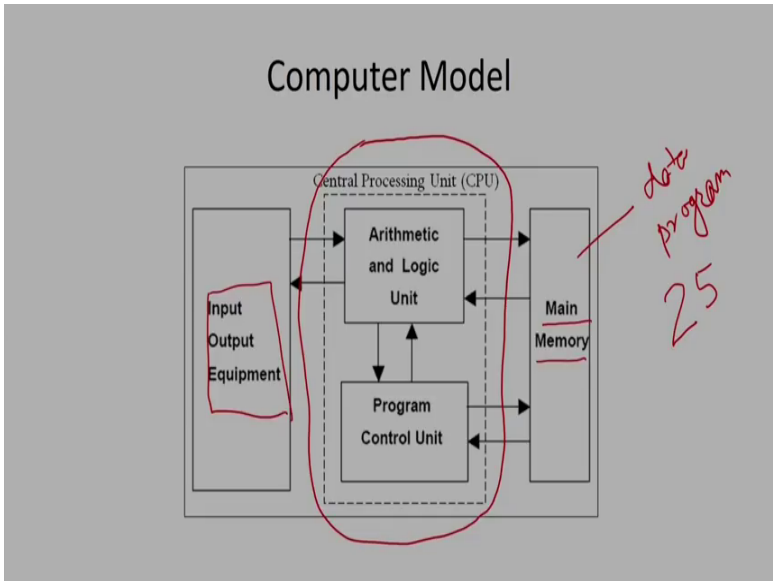

Now, see what a model of computer is if you see the computer model the main component is your CPU central processor unit. This is the central processor unit which is the main processing point it is having 2 parts one is called arithmetic and logic unit and second one is your program control unit. All the processing is done in the central processing unit along with that we are having main memory. Information 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. You have to have some input output devices to give the information. 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 story. Secondly, you know about a keyboard we 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. Monitor is an output device. True input output devices we are going to interact with the computer; that means, this is the interface to the external world of a computer.

This is the basic model of computer and how computer works it basically works on stored program principle and this principle as introduced by scientists von Neumann and

we said that this is a fun human stored program concept. What is that particular concept if having storage in it recalls it is a main memory in that particular main memory.

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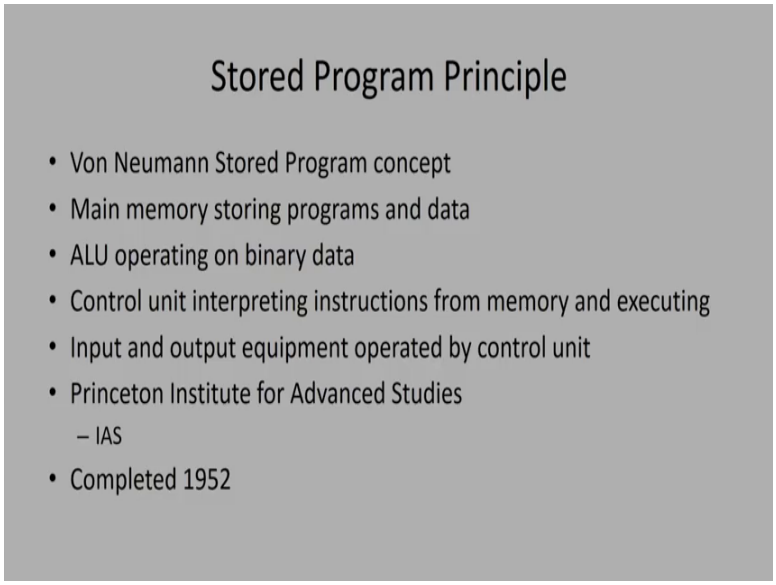

We are going to store our program as well as data ALU operates on binary data. We are having a processing element we call it is an ALU arithmetic and logic unit it can perform some arithmetic operation and some logic operation say arithmetic operation I can say that addition subtraction multiplication like that and logic operation we know that and or excess. ALU is having all those particular operation and it can perform operation on binary data control unit interpreting instruction from memory and executing. 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 keep the information in such a 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, vision will be stored in the main memory. This is the stored program concept and input and output equipments avoid by control unit already I said that if I have to give some information then formed is particular input devices I am going to give it.

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 our result then we has to give this result to the users may be through monitors or maybe through printer. Again

controlling it is going to perform those particular types of control those particular devices to transfer information from main memory to the output devices. Basically when I talk about the upon human 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 dissolve.

Now, how to get the information to the main memory for that we need this particular input output devices to 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. It was basically design and develop in Princeton universities and this Princeton institute for advanced studies and machine is known as IAS institute for advanced studies at IAS modern and this project was completed in 1952.

This is the basic structure of von Neumann machine which is developed in Princeton universities in instead of advanced studies.

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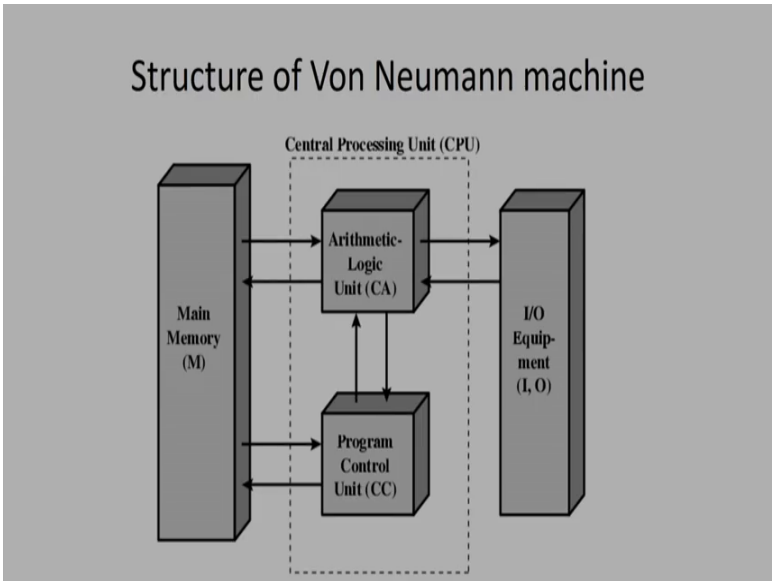

This is the central processing unit we are having that arithmetic and logic unit and the control unit it is worked with this particular main memory we should have all the information in main memory and processor is going to handle information that is available in main memory and carry out a job and the interfacing is done with this particular I O devices I O equipment 2 input devices we are going to give the

information to the computer; that means, we are putting it in the main memory processes is going to take the information from main memory carry out a job and put the information in (Refer Time: 29:40) or result in a 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 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 core 8 core, but all those machine works on this particular von Neumann stored program principle.

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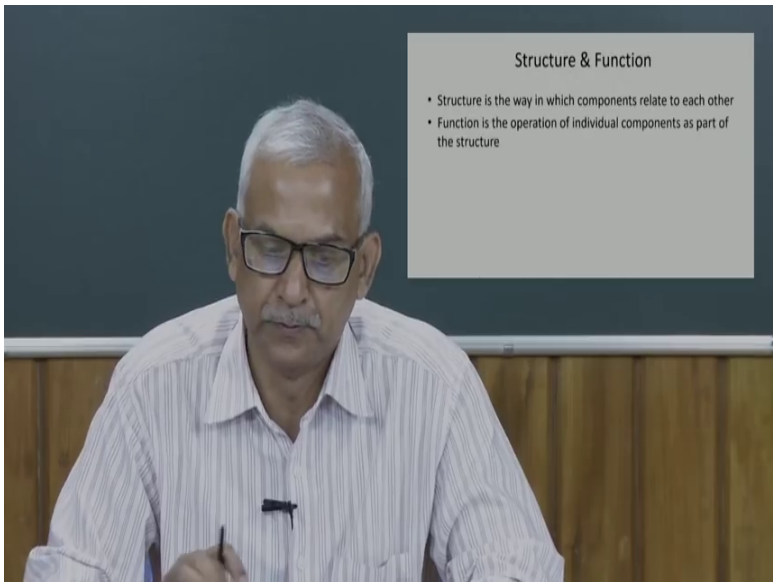

Now, when we are going to discuss about the computer basically we are having 2 issues 1 is known as what the structure of the computer is and what are the function that we are having for that particular computer. We have 2 (Refer Time: 30:43) for the structure and function. Cell structure is the way in which components related to each other and function is the operation of individual components as part of the structure.

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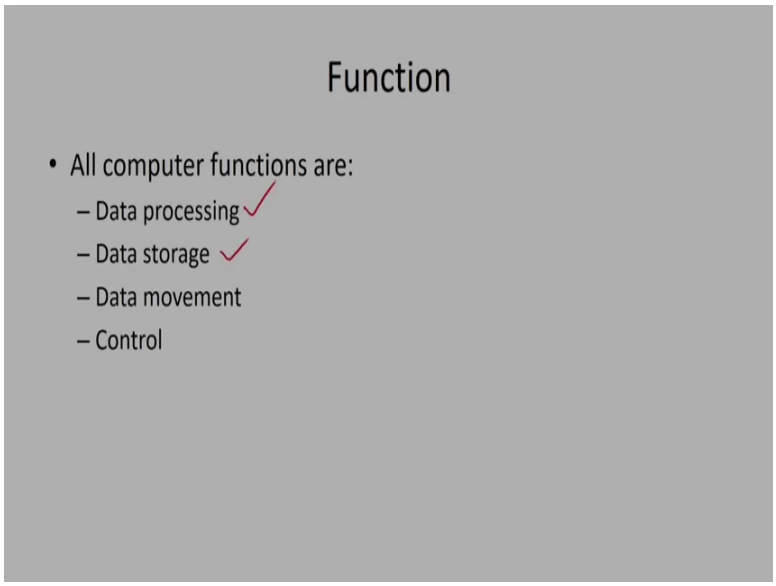

We are going to see how the component functions in a computer first we are going to look into the functions what are the functions that we have in a computer. If you look into the computer functions all the function can be categorized into 4 different categories and this categories are one is your data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

We should have some instruction to do data processing second one is your data storage now once we have process our information and we are going to get our result then what will happen we have to store those particular information. We need some instruction for data storage. one categories of in 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 form all input devices. For that we need some instruction 1 we process the data we store our result in our main memory

as far von Newman stored program in support, now how to transfer those information to output devices maybe like printer. For that we need some instruction. That instruction comes under this particular data movement and some instruction is there to controller enter machine and the computer how to control the printer. When we some give the (Refer Time: 33:46) to send a file to the printer we have to make sure that printer is ready 1 printer is ready we have to transfer all the information to the printer. These are controlling information that we have to provide that controller printer even to start the printing at the end of the file start the printing.

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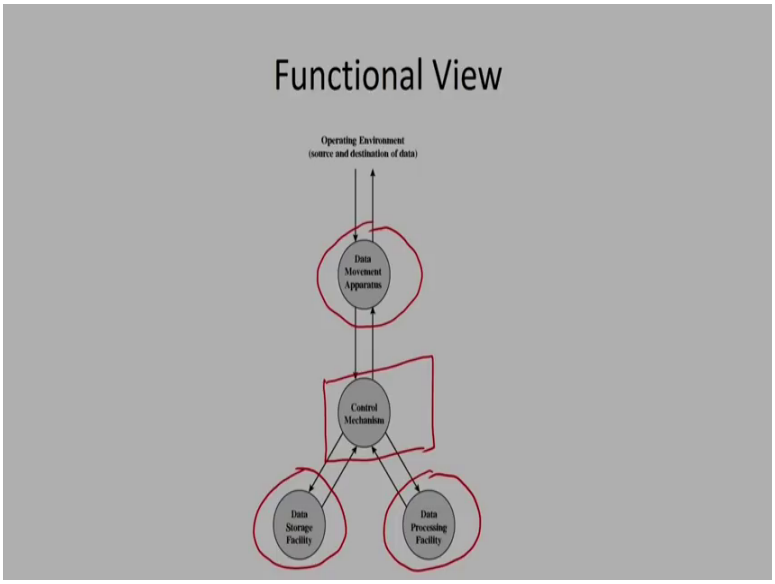

These are the control instruction, whatever instruction we are having in the instruction said all those instruction can be categorized into this particular 4 functions. Now, we are going to set up functional view. One is your data movement data stories data processing and control. For that one we are going to look for a con functional view we will see that what are the things that we are having, 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.

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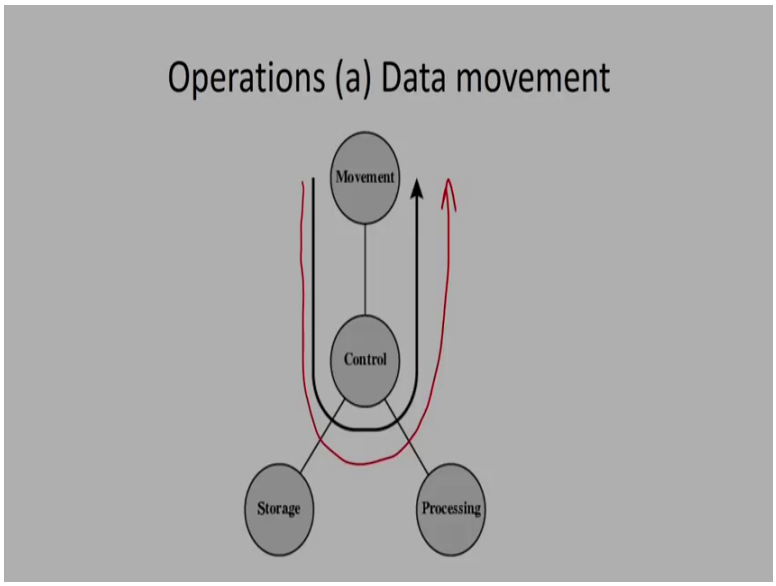

These are function that we are having and this is the way we can look into it know what are the function that we are going to do first one is your data movement so; that means, datai will move from one point to data point on 1 device to the other device like a simple example I can say when I press some keys in the keyboard I am entering something with a computer and that thing is displayed in the monitor. This is a data movement moving information from keyboard to monitor.

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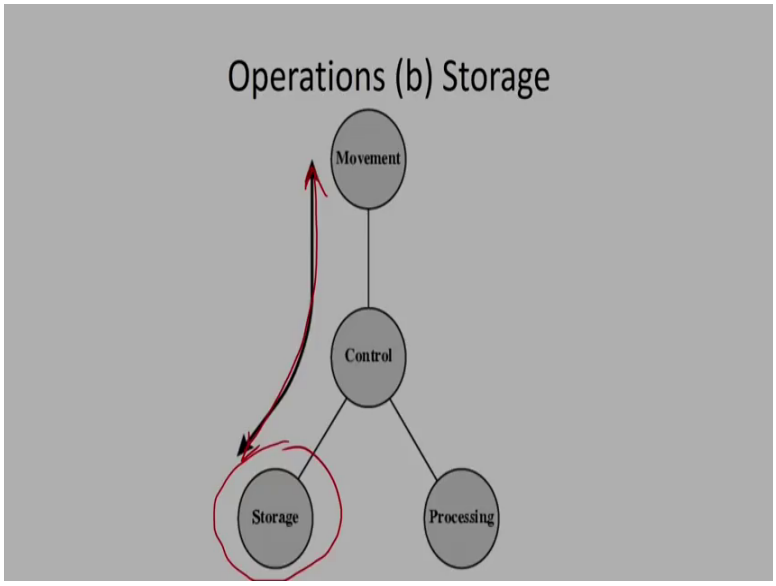

One class of information is your data movement second one is your storage. We are having information in some devices now you have to bring it to the storage unit. This is the data moment. Basically bringing it from the input devices to the storage and from stories to the output devices because computer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

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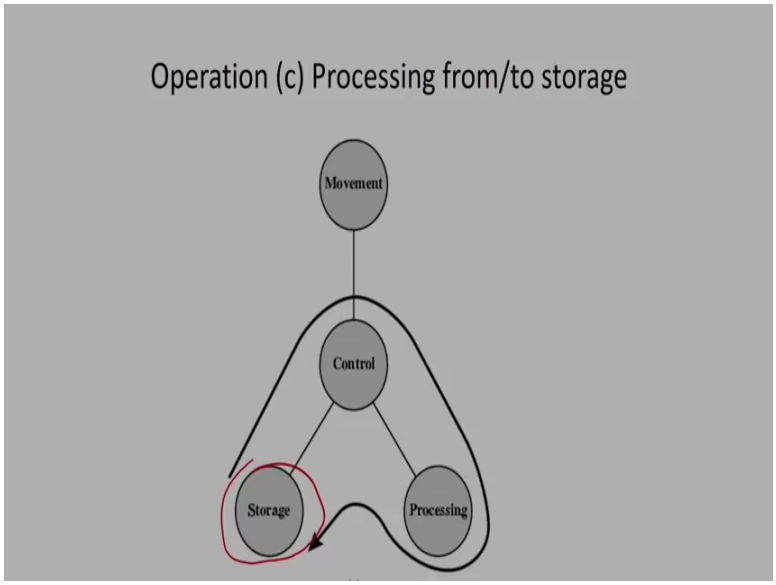

We are having the information in our storage now processing elements of processing unit have having defined processing element like that adding 2 numbers multiplying 2 numbers. Depending on our instruction it will take the information from storage it will do the processing tasks it will add the 2 numbers if my taxes you are adding 2 numbers and again it will store the result in the stories. This is your processing form and 2 stories and another class is your transferring the information from storage to output devices or through processing.

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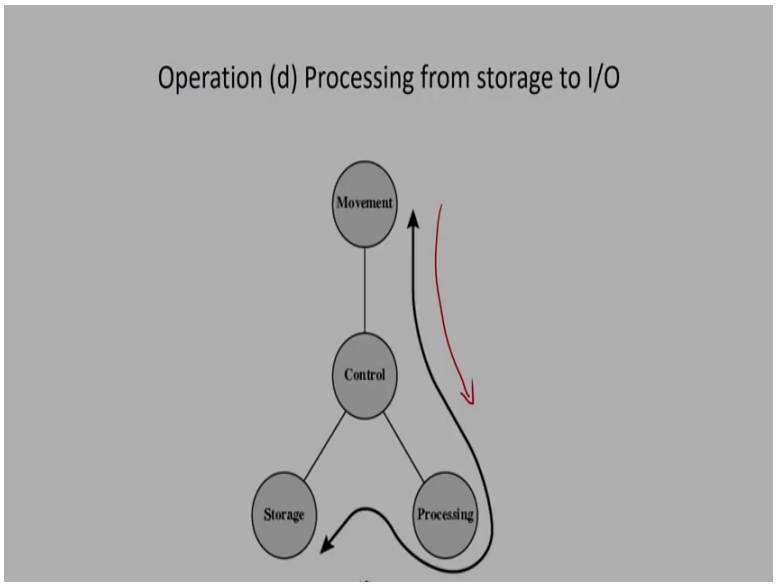

We are going to take the information from storage we process it and we can give it to the output so; that means, if we want to add 2 numbers and we want to display the result then taking the information from storage and processing it and giving the result to the output devices maybe to the monitor, but. 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 an i.

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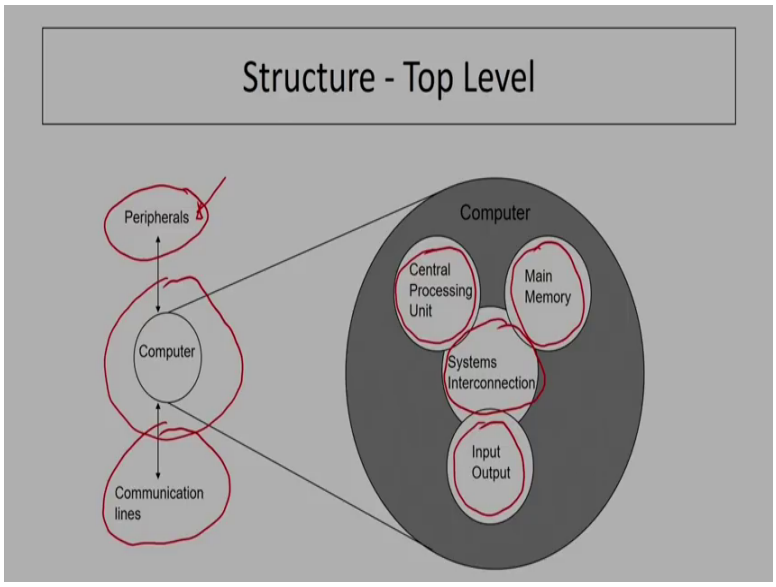

These are the different touch that we can perform now we will see what the structure of a computer is; this is the structure l p. In that particular case you see how we are going to visualize a computer user see that just we are representing a bubble to represent a computer. This is a computer now what we can see that it is connected to some peripherals is nothing.

But the input and output devices to work with a computer we need some I O devices input output devices these are input output devices will be connected to the computer and nowadays network or computer network is an integral part. We should have provision to connect to the network. We are having that communication link also. 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? We are going to look for top down approach user 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. Here we are going to say that we have the central processor any c p u 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.

It is going to perform the tasks now how computer works it works on von Neumann stored program principle. We have to keep the information in some storage unit. This is the second component called memory unit or main memory. Processor is going to work with the information data are available in the main memory.

Now, how we are going to get information in the main memory to input devices. We are having this particular input output mechanism. If you see that these are the 3 basic functional units that we have in computer. You can visualize or you can view the structure of the computer like that not we all should have a communication between all those components because you have to take something from input to the memory from memory data processor again from processor to the memory may be memory to the output.

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. 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 home basic component central processing unit main memory and input output and they are connected to the system interconnection now 1 we have seen that inside computer now we know that we are having CPU main memory I O and system plus.

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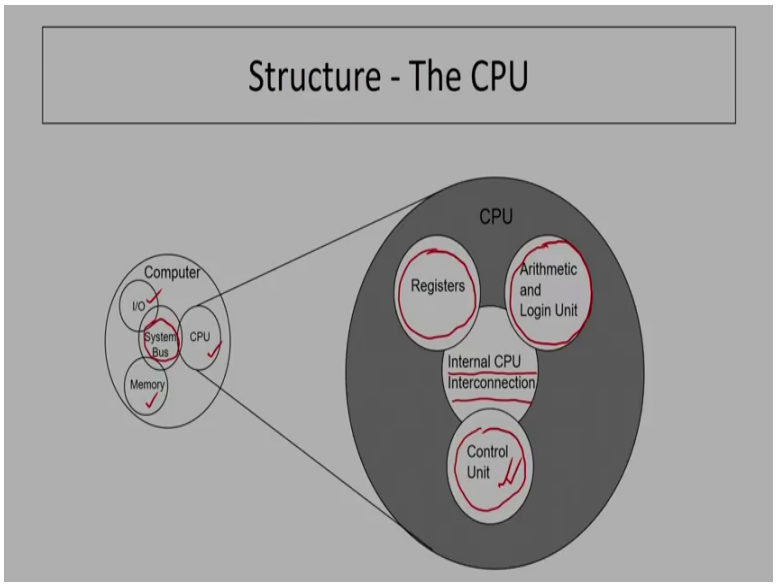

Now, what is inside this particular CPU now again you can bubble it up now we are going to see what the things that we have are. Far that already have mentioned that we are having a processing element and generally which is known as your ALU or arithmetic and logic unit we are having some arithmetic operation and we having some logic operation depending on the instruction set we have to have this particular a l u sum of the function this has to be implemented in hardware basic or some of the instruction may be done in the software we will discuss distance in (Refer Time: 40:15). 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.

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 mean part of the CPU and we are going to give more emphasis on design of this control unit. The basic parts of the control unit is to synchronize the operation transport information from main memory to the processor can process the job then what

about the (Refer Time: 40:30) you are getting transferred to the main memory. (Refer Time: 40:31) unit 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. For that we are again having an internal CPU interconnection now use a sedum 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 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 the particular component.

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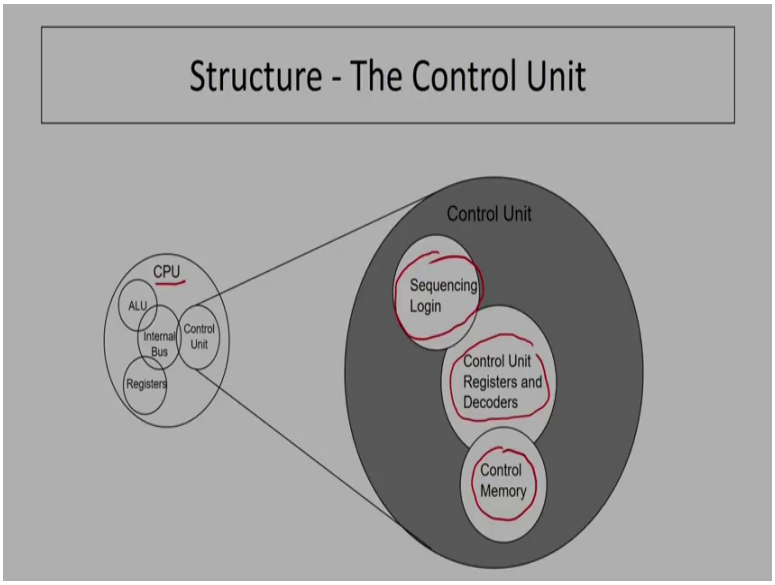

Know when we talk about the CPU uses see that we know that it is having ALU registers and control unit and they are connected to this particular internal was know what is there in control unit again we can see or you can bubble it up and basically all that I have mentioned that we have to maintain the proper sequence for that we are having this particular sequence logic. We have to design and implement this particular sequencing logic. That everything will be done in proper sequence for this wind up report controlling sometimes we have to keep some information inside the button control in it also for that we needed storage or memory and this is known as my control memory.

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. This is basically control unit is going to have some registers and decoders etcetera to have the proper functioning. 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 know said.

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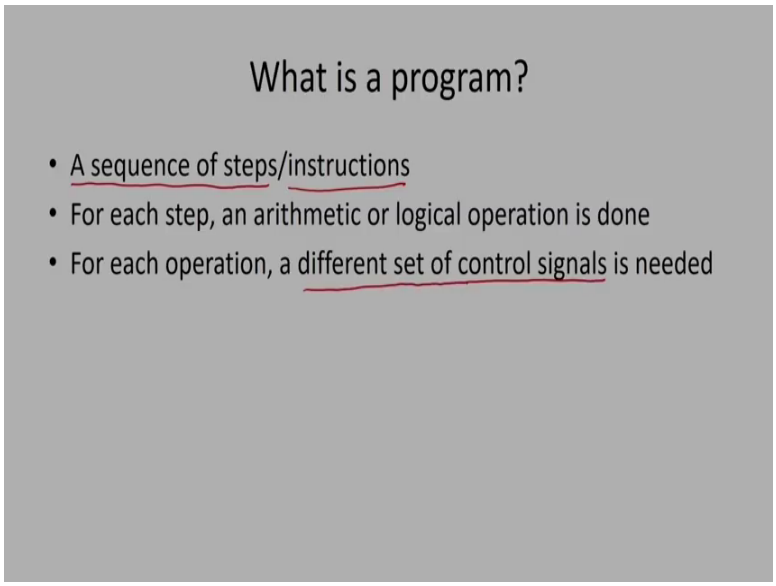

You are working with a computer how computer works most of you will tell that we are having a computer program and we are going to execute this particular computer program once they execute a computer program then what we are going to get according to our requirement we are going to get our result.

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 instruction. We are having a sequence of steps or we said these are instruction now what are those instruction when we talk about this instruction facilities will come from the instruction set up this particular processor we have to execute those pre the particular instruction one by one for each step and arithmetic of logic operation is done because if I am having an addition operation we have to going (Refer Time: 44:01) This is the instruction that we have to going take.

And for each operation different set of control signal seasoning it what we are saying different set of control signals are needed. When I am going to perform an instruction

said in 2 numbers we need different set of in control signals to coordinate all the component and they will be done in different step. 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 down on that instruction is. This is a program and in program by cell it is nothing, but a set of instruction and we are going to execute that instruction in sequence 1 by 1.

There way we have to take it. We can visualize the computer program in the 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 all the day I have mentioned that 1 instruction cannot be done in 1 step we are having several step and complete collection of all those particular steps are known as my instruction cycle.

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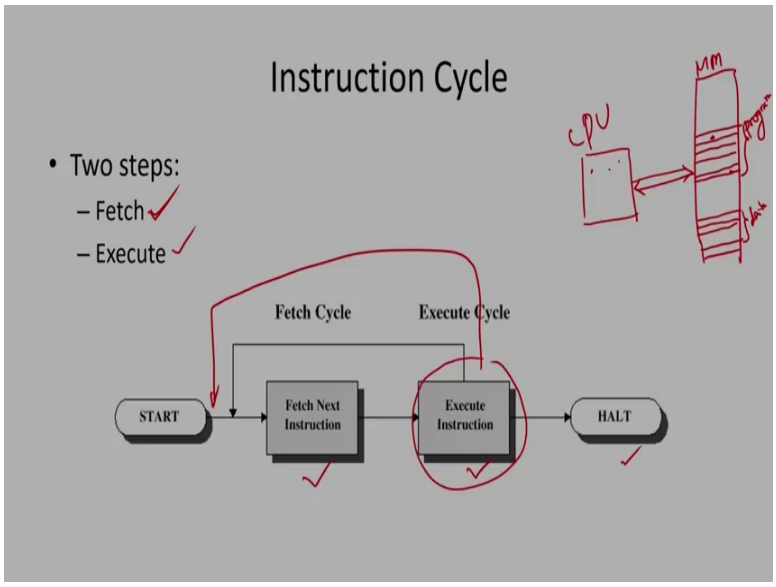

In basic where what will happen I can say that instruction cycle consists of 2 steps 1 we talk about the fetches and second one is executed now say computer works on von Neumann stored program principle we are storing our information in main memory. What will happen I can say that this is my processor or say CPU and we are having this particular main memory? Somewhere in the main memory I am storing my program (Refer Time: 46: 05) we are a having the in the connection. They are connected together.

Now, when I am going to execute this particular program this program is have been several instruction and restoring the instruction 1 by 1. First we have to bring this

instruction from this main memory to the processor. Bringing the information from main memory to the processor is known as the fetching of the instruction. This is the fetch 1 fetch the instruction then what will happen now my information is inside my processor.

Now, we are going to execute that particular instruction all we are going to pop under tax we said this is the execution phase. That is why you are saying that it is having to 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 an instruction or stop instruction at that particular point will come out from this cycle and execution of this particular instruction is over. 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. We are having the data over here. 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 instruction data once I get more data then I can perform the addition operation. That execution phase can be able sub divided into several phases.

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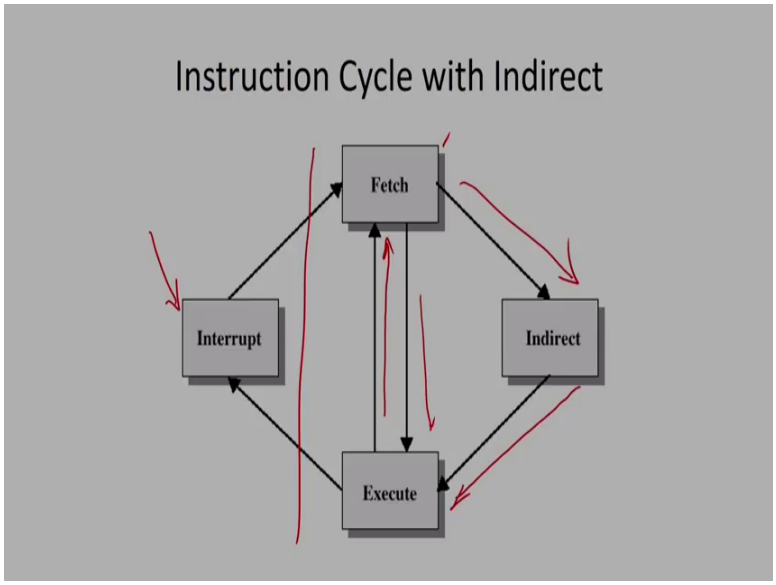

1 simple example I can say that now in general I can say that we are fetching the instruction then we are executing it after completion of the executing we are going to fetch the next instruction. This is the way we are going to set up fetch and execute, but after fetching some instruction if we know that that instruction needs some data then we have to fetch this particular data from the memory. For that we are having this particular indirect cycle we are going to fetch the data from the memory and that data will be supplied to the execution unit and it is going to execute it completely.

Here we have shown another one which is written as our interrupt these things basically related to handling input output devices when we are going to discuss about the IO module at the time we are going to discuss about this particular interval, but currently you consider it is fetch and execute, but to fetch to execute some instruction if we need some data then we will go to the indirect cycle to fetch those particular data. We have seen now the model of computer and how we are going to execute the program and now it as you all of you are using computers to do some different work mainly most of you are doing the net browsing you are sending mail you are writing computer program now in this particular course.

We are going to see how our program is exactly going to executed in the processor and to do that how we are going to design this particular processor, now since we are using computers nowadays, but it is better to know how we are coming to this particular level

we are using very advanced computer nowadays and we are solving many more complicated problem with the help of computer, but in one day we have not accept it. Just now we are going to give some idea about the history of computers.

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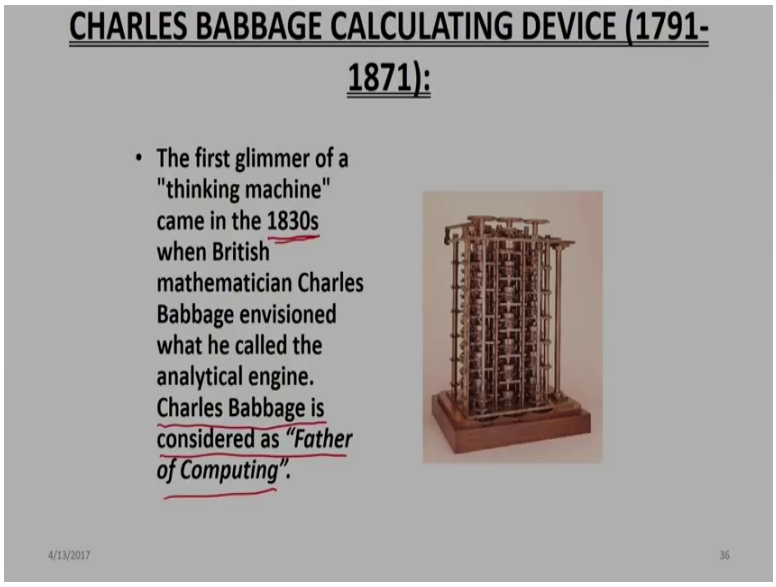

If you look it the most of the cases we know that Charles Babbage consider as a father of computing in most of the book you are going to have these things. Charles Babbage define and calculating devices in 1830 he is a British mathematicians we are doing calculating we know we are doing many more job with pen and paper you say that why you cannot do it automatically. For that is coming up written calculating device and this is called as your analytical engine and the era of this particular automatic computing started somewhere in 1830.

This is the start and nowadays also instead of Charles Babbage consider as a father of computing then when we are having this calculating device.

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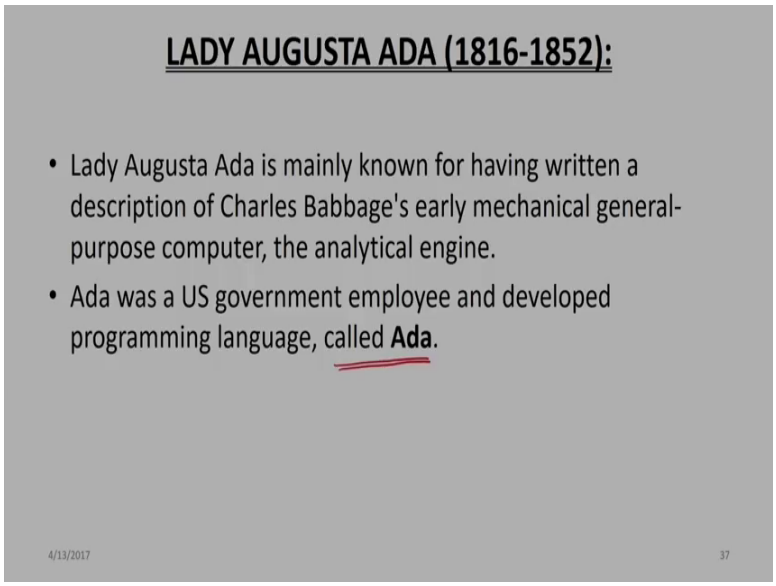

Then we are having the concept of all programming how to program these things how to control this particular calculating devices. For that that lady Augusta Ada has come up with this particular programming concept. We are having an initial programming language called Ada that is also somewhere in Britain 18 16 rate in 52.

She develop upon computer programming language called Ada and we have started with Ada, but nowadays Ada.

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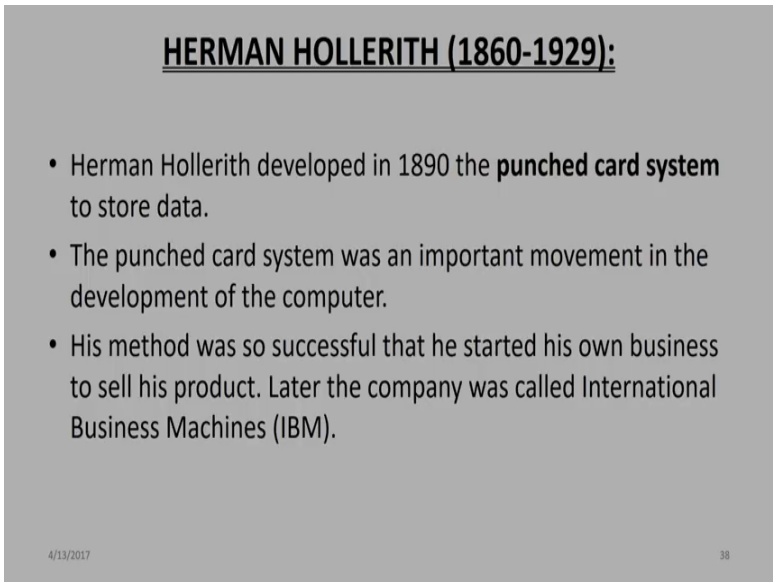

Now, we are not used it. She developed a programming language called Ada. We are having the issues how to give input to the computer how to put all the information in a computer. So, the computer can operative. Hollerith we need some mechanism.

Herman Hollerith developed this particular punched card system to store our data. What it basically does depending on my information we put those things in a pepa true holes. We punched card and once we punched the entered information in the card then this take of the card will be given to the computer and computer reach from that particular card.

This is the punched card system and finally, IBM has developed a particular point scan system and I think till 1980 punched card system was used after their only.

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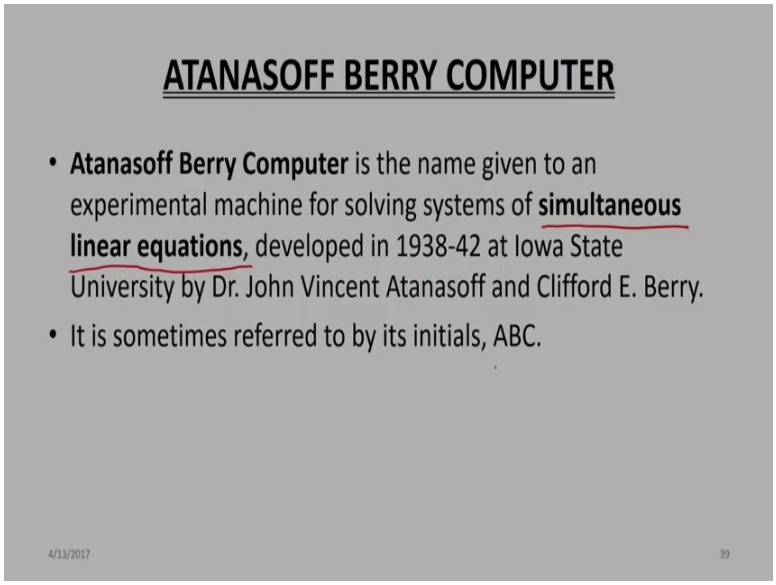

We are going to have that other devices another machine has been developed by atanasoff berry computer known as. Atanasoff berry computer is the name given to the experimental machine for solving simultaneous linear equations. To solve simultaneous linear equation the Dr. John Vincent atanasoff and Clifford E. Berry developed a particular machine.

This is also known as the initials of this particular name ABC. This is another computing machine that.

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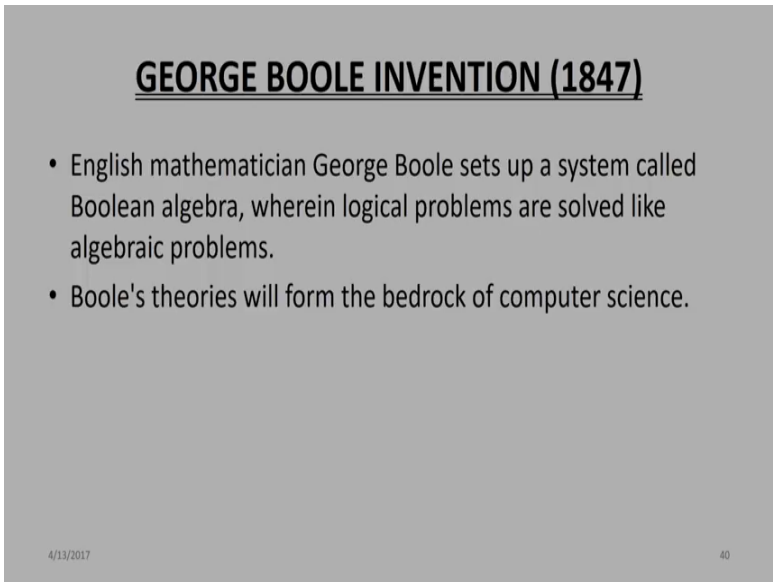

We have in our history which is known as your ABC atanasoff berry computer and it can solve simultaneous linear equation then we are coming to the George bull invention. These English gentlemen are mathematicians come up with the Boolean algebra and that booles theory is basically used to solve our algebraic problem. This is the interfacing between our logic.

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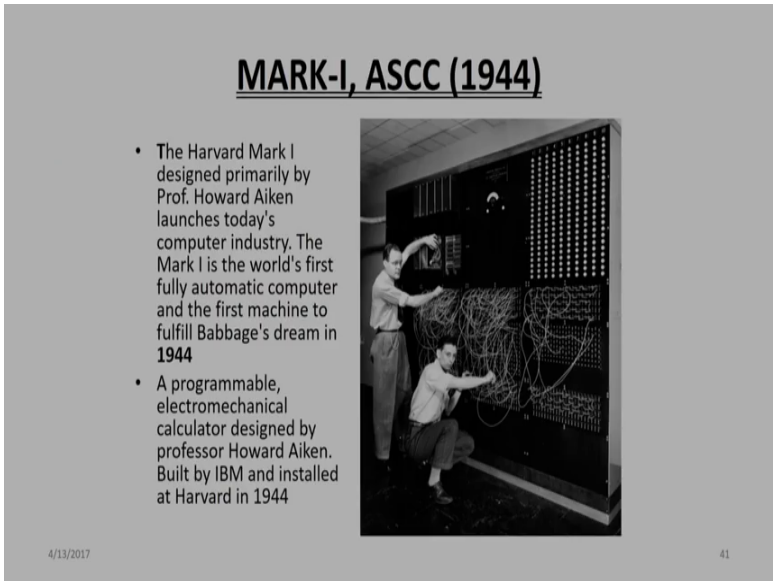

And computing then finally, the first computers comes in 1944 which is your mark one

It was developed in 1944 the Harvard mark one designed primarily by professor Harvard aiken this launched today. This is the view of the computer it is a very big machine. It is a programmable electromechanical calculator designed by Professor Harvard Aiken built by IBM and installed in Harvard university in 1944 just I am just (Refer Time: 55:39) thus giving the diagram. This is the first computing machine for phases company machine that we have been now 1944, but again it is some sort of analytical engine.

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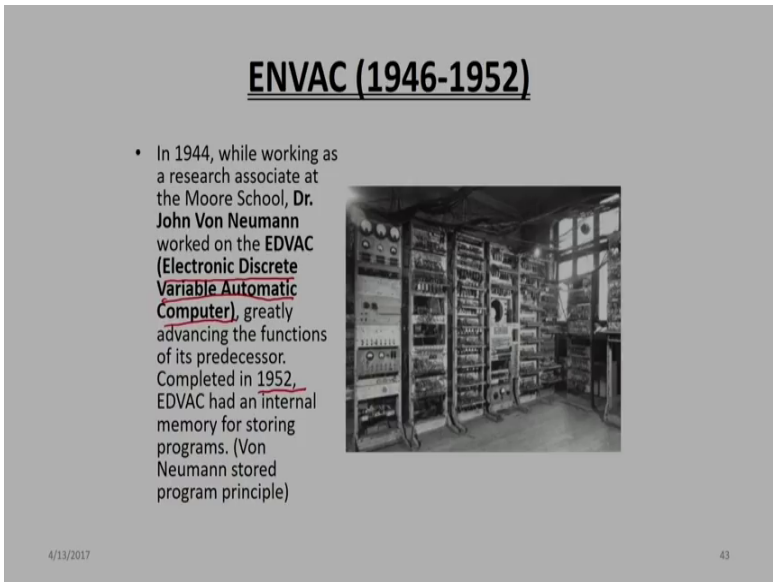

Then next come the enact electronics numerical integrator and computer this is the in here. This is the first or personal electronic digital computer developed for the U S army by jay presper Eckert and john mauchaly at university of Pennsylvania in 1942 to 43

This is the machine that UNIVAC that we have next we are having EDVAC and that is electronic discrete variable automatic competing and this is the computer first computer where we are having the principal of von Neumann store program principal. It was completed somewhere in 1952. ENVAC is the first computer which is resembled they are present the computer which auction von Neumann stored program principle.

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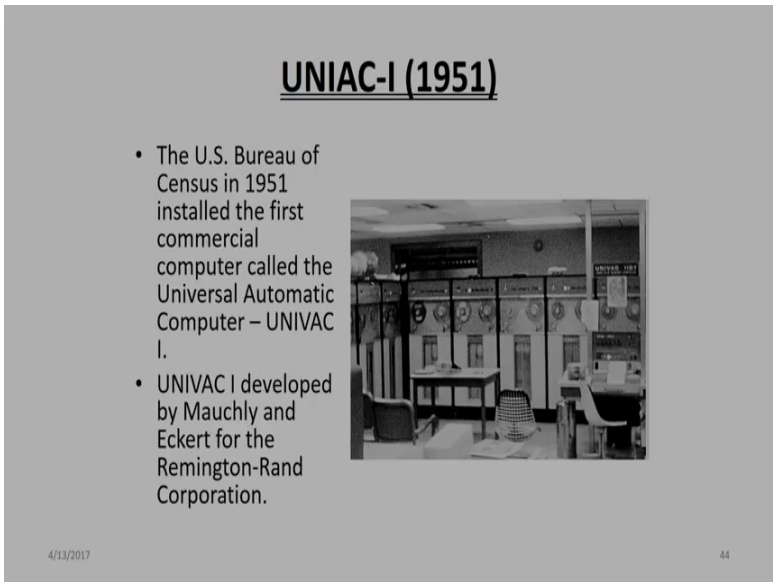

Then next on UNIVAC 1, UNIVAC one developed by mauchuly and Eckert for the Remington rand corporation again it was a project of u s government for the bureau of census they want to make the census in 1951 and they gave this particular project and finally, that UNIVAC one is developed.

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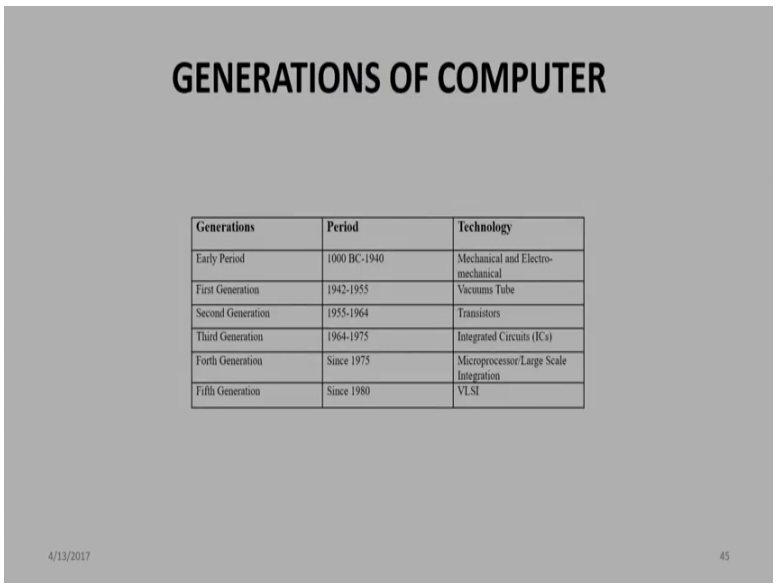

Now, if I look into it then you can categorize the computer into different categories

Till now have seen the earliest is only now we will see how you are coming to the present level. In early period till 1940 the technology used is your electrical and

mechanical and electromechanical. Having mechanical component those component will be controlled by electromechanical devices. Past generation basically started somewhere in 40s to fifties 1940s to 1955 and in the particular time the technology used is your vacuum tube we use the vacuum tube. For that whatever diagram we have seen over here these are very weak machines because vacuum tubes takes spaces, but main metabolism comes when the transistor is developed and all of you about the transistor and you might have started transistor also, main revelation comes in the transistor.

This is we are going to talk about the second generation. Vacuum tubes are replaced by the transistor over here. Sizes reduce drastically then third generation basically started a hummer in 1960s and here we are going to use that integrated circuit. We said these are the third generation basically in India circuit what will happen we are going to put the components in an IC and you might have seen I Cs also then we are coming to the era of microprocessor we said these are the fourth generation. All the required components will be placed inside a ship ICs which is known as your microprocessor and I think you have worked with a microprocessors now all the computers we have that particular processors and after that fifth generation we are talking about VSLI technology very large scale integration.

In that particular case instead of putting only the microprocessor we are going to integrate many more things in a way for and this is the technology currently we are working with this part of fifth generation computer in technology wise now we have started with mechanical and electronic angle system then we are coming to the vacuum tube then when eventually transistors arrives then life become easiers and we are using transistor action extensively to build our electronic computer.

Now, at the time itself that scientists versus predicted something by looking into the trend of users of transistors which is known as your Moores law.

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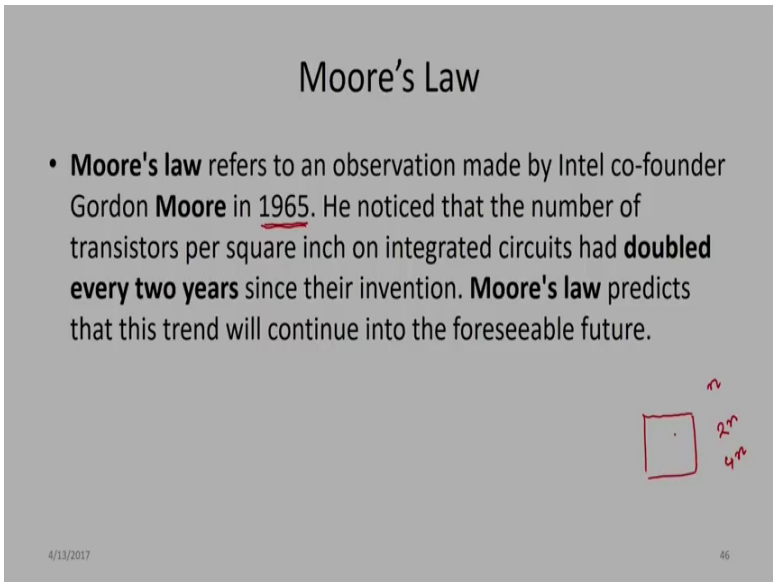

Now, Moores law reads us like that Moores law refers to an absorption made by intel corp. Under Gordon Moore in 1965, way back in 1965 Moores observed something he noticed that the number of transistors per square inch on integrated circuits has doubled every 2 years. If we taken (Refer Time: 59:53) area of 1 square inch than the transistor that we can incorporate over here today will be doubled in every 2 years. If we can put a n number of transistor today then after 2 years it becomes 2 value after 4 years it will become 4 value.

This is the trend that he have observed and he has predicted and now also that Moores law values. More and more transistor can be incorporated in some area because technology developed in such a way that now we need very small space to implement a transistor well we say it is a sub micron level in sub micron level you can walk. That is why the packing densities became very high.

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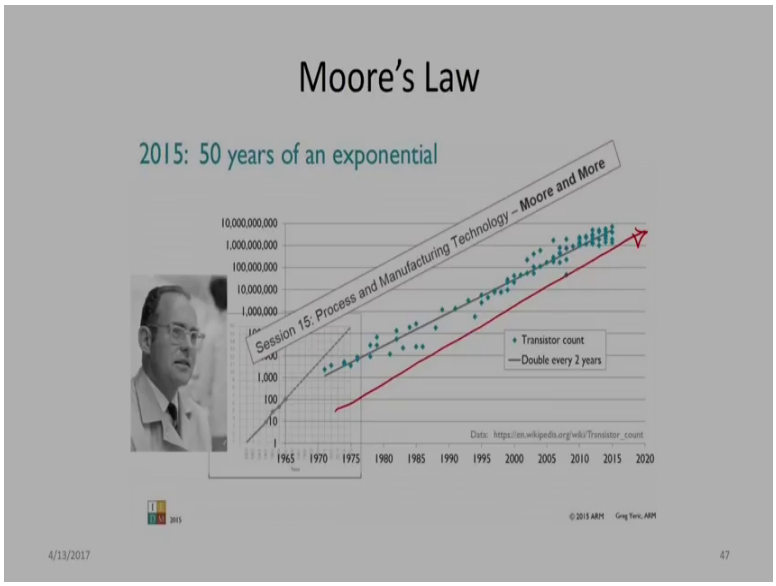

In that particular case if you look in the Moores law now it is 50 hertz as predicted in 1965.

Now, in 2052 1115 in 50 are still valid. It is always increasing by following this particular small slow in one particular area it doubles in every 2 years still it is valid. Whatever now we can put in 2015 now in 2020 it will accordingly increase.

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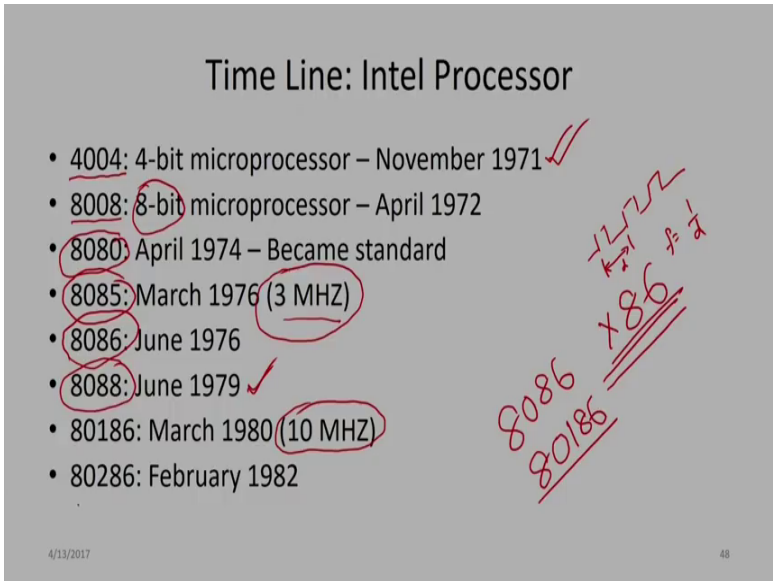

Now, for a particular processor now we are going to see the timeline of the Intel processor because most of you are using Intel processors say I learned as you are using that Intel Pentium processor now a days you are using either I 3 I 5 o I 7.

But in one day we are not getting it what is the time line just I am going to give you a brief idea. Intel has coming to this particular micro processor domain in 1971 in 1971 they have released the processor 4 0 4 which is a 4 bit processor. They have come up with a 4 bit microprocessor in 1971 in the month of November just after 6 month they have come up with the enhanced version of the processor and the next processor is known as your 8 0 8 which is an 8 bit processor. In the timeline of 6 month they have an enhanced the 4 bit processor to 8 bit processor next they have come up with 8 0 8 0 in April 74 after 2 years and now which became a standard for an Intel group and many people are using these things.

They have standardized the processor now in 1976 they come up with microprocessor 8 0 8 5 which works on 3 megahertz. See that in 76 we are working with 3 megahertz clock and 8 0 8 5 is a fully fledged processor which can control some devices and as well as do some processing job.

It is a fully fledged processor that we have am in many place we are using the 8 0 8 5, but 8 0 8 5 is not a fully fledged processor to make a computer then again in the same year they have slightly modified (Refer Time: 63:30) come up with your 8 0 8 6 and which is a processor which is used to build computers along with that they are coming up with another processor called 8 0 8.

These are of processors 8 0 8 6 and 8 0 8 which are used to build computers in that either this maybes in eighties. This is the lines in 71 they have started their micro processor business and in around 10 years 79 they have come up with a processor which can be used to build a computer that whatever computer you have now already I think we have (Refer Time: 63:32) somewhere about that x66 family.

This is the family of Intel x66 family. First processor they are having 8 0 8 6 and some (Refer Time: 63:33) similarly they have having another series 8 0 8, but eventually intelligence return this particular interest they are not going in that particular time then, but they are continuing their 8 0 8 6 and coming up with this x66 family. In the particular case now in 8 0 8 6 we are having the basic functionalities and it can be used to build a

computer then after one year they have enhance it and put some more provision some more facilities and they have released it as a 8 0 1 8 6.

This is your 86 now you see that in 76 that processor works at 3 megahertz, but now in after 10 years this processor is working 10 megahertz. I think you know that is particular frequency; that means, this is the clock frequency. If I talk about this particular clock frequency I consider it is having some duration what about duration I am having the than frequency is nothing, but one upon the I 2 you know that many hearts. In the fraction of time we can perform one operation here one operation means one step that we can perform.

Now due to the improvement of technology now in 10 years they have gone from 3 mega hertz to 10 mega hertz now in this particular x66 family not there Intel has incorporate m more and more features and making it more and more advanced and in 1982.

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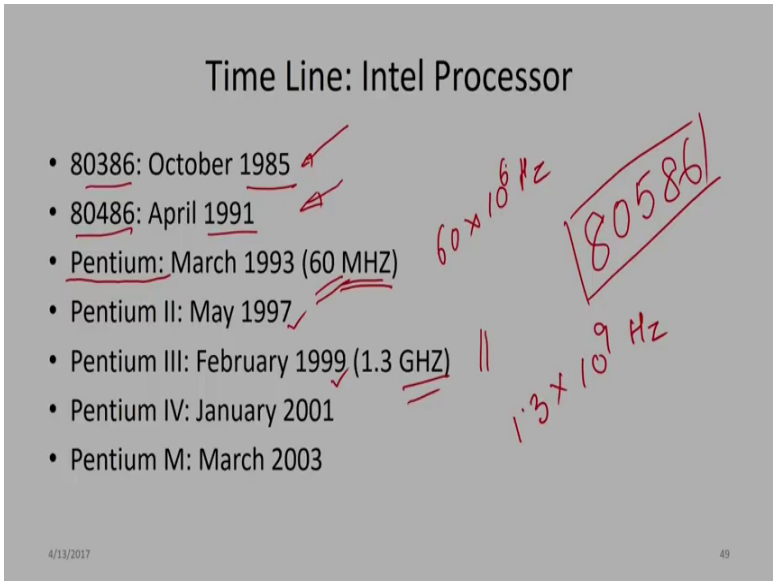

They have released 2 8 6 then in 1985 they have released 386 and April ninety one Intel has release 486. This is the architecture, but they have enhance it for more and more instruction and. That is how he said that code compatibility at least in a backward direction why you say because whatever software we have written in 386 that same software can be run are executed in 486 because we are enhancing the instruction Whatever instruction we have been 386 same instruction we have in 486. That software running 486 also, but if you have developed a software in 486 where you are using those

particular new instruction then that program will not run in 386 because some of the instruction is not available in 386 after that computer Intel is developing their processor and making more and more advanced and they are about to release 8 0 5 eighty six, but some issues arises over here and due to that they have sense the roman now from instead of numbers they are coming to name instead, of releasing 5 8 6 in desert release that Pentium series, this is the some family.

In 1993 they have released this particular Pentium now this Pentium works on sixty megahertz; that means, they have increased the frequency of the clock event now after that a Pentium 2 is coming into 1997 then Pentium 3 is coming into 1999 and at that particular point users see that that operating frequency is now going from megahertz to gigahertz trends. 1.3 gigahertz you know 1.3 into 10 to the power 9 hertz and when you talk about a megahertz it is sixty into 10 to the power 6 arts and 1 hertz is basically the latter 2 1 second. In that way you considered how fast we can carry out one particular step then Pentium 4 is coming into 2001 and Pentium m is coming into 2003 after that we are going to the multiple businesses.

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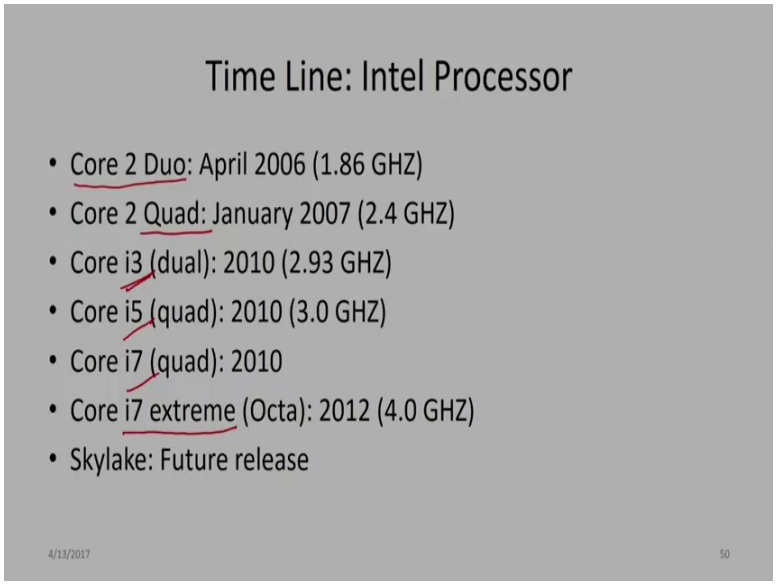

In (Refer Time: 68:45) 2003 (Refer Time: 68:45) Pentium mm we have only one processor and all the job will be carried out by this particular processor then they have come up with the multi processor. Inside a particular microprocessor chip we may have 2 processors. Core 2 duo, in that particular case we are having 2 processor they are

indicating together so; that means, we can perform some fair tax one processor will do one work and second code will do another work similarly they are coming up with quad core in quad core we are having quad core together and quad core is going to operate simultaneously and they work in parallel. It can be run in a first hour after that know they are coming with this particular I series in 2010 itself their Intel come up with 3 system core I 3 core I 5 and core I 7 and in after that in 2012 they release core I 7 extreme which is Octa.

I 3 is a dual core I 5 is a quad core I 7 is also a quad core, but I 7 extremism octa core in case of Octa core we are having 8 processing core inside the ship and it works on 4 gigahertz now it has gone through these things and now Intel is working in the same timeline and they are talking about the new release sky lake which will be release in future. This is the timeline users see that microprocessor era started in somewhere in 71 and in 2011 we are going to core I 7 with core gigahertz clock cycle.

Due to that now we can now perform we can do many more work with the help of computer because now computer becomes more powerful.

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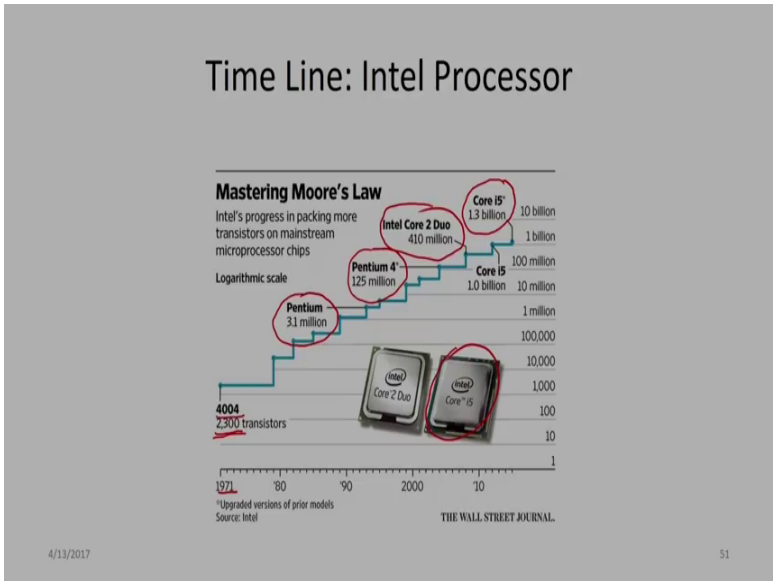

This is the Intel time length they have started in 1971 with the release of 4 0 4 and that processor microprocessor had 2003 100 transistor this is basically the showing about the time line with this Moores law then after that when from 4 0 4 2 they come up to 8 0 8 then 8 0 x 8 x 8 0 8 6 one 8 6 2 8 6 and like that and when they come to the Pentium you

can see that the number of transistor come gones up to 3.1 million when they released this Pentium home that transistor count becomes 125 million Intel core 2 duo it become 4 hundred 10 million transistors now I 5 is having 1.3 billion now this is the transistor count that we have in this particular ship along with that you can look into the area now if you see that density packing density what is the number of transistor in your part square unit of area you will find that still it is going to follow this particular Moores law. This is that timeline that we are having. With this particular timeline now at least we are having some idea how the current engine level computer has been developed from the very basic 4 bit processor.

This is basically about an introductory part of our computer where we are talking about the mod module of the computer of program execute and what is the brief history of development of computer. With this I think we have achieved our objective of this particular unit we have defined the objective and I think we have received those particular 3 objective with the help of this particular unit now after going through this particular lecture just look for some test items or some question the first question I am talking about something like that compared a model of computer with human beings.

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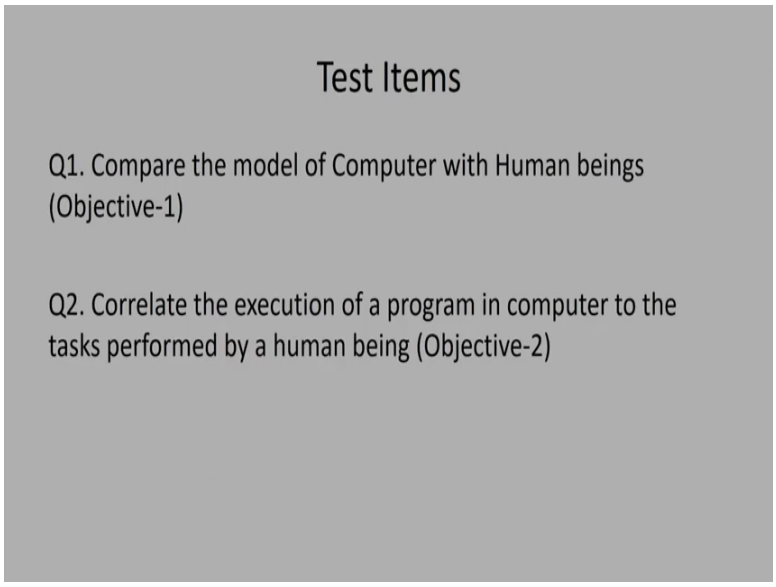

Now, why we have coming to the computers because whatever we are solving whether it can be done automatically or not. This is the way that we can look into it. So, first objective we are talking about a model of computers and how computer execute a

program. It related to these things as I am giving a test item or one question like that compared a model of computers with human beings now you just say I am just anna giving analogy in computer we are in processing unit we have memory and we having input devices and the we having output devices.

Now, in case of human being also how you work. We have brain and when we talk about the brain we talk about the memory also we said that someone memory is very high somebody memory is very low. Basically what will happen we observe the situation we are having some organ like that who I you can see something who knows I can smell something who hear I lis10 something by hand I can pick something to leg I can go from one place to other place.

These are the devices or the organs that I am having with these things we are collecting some information and we are storing in our memory and our brain process those particular information from the memory and take appropriate action and to take the appropriate action it activated it activate the appropriate organ sometimes it activates my hand to pick up something sometimes it activates my legs to run away from the place. So, my process takes information from memory it process it and it activates my some organs. That I can act, this is the way we can look in the computer also we are having input output devices.

To input devices we are collecting the information we are storing it memory through processor we are processing it and we are giving the output to the through the output devices. We can make some analogy of computer model with human now question I am talking about correlate the execution of program in computer to the tasks performed by human being now correlate the execution of program in computer to the tasks performed by the human being this is similar to the first one second one we have seen how computer execute a program.

So, this is basically we have defining objective and first one is we are talking about the objective one; that means, this test item is related to objective one we have achieved this particular objective this question is related to object if we have said how computer works we are going to explain it.

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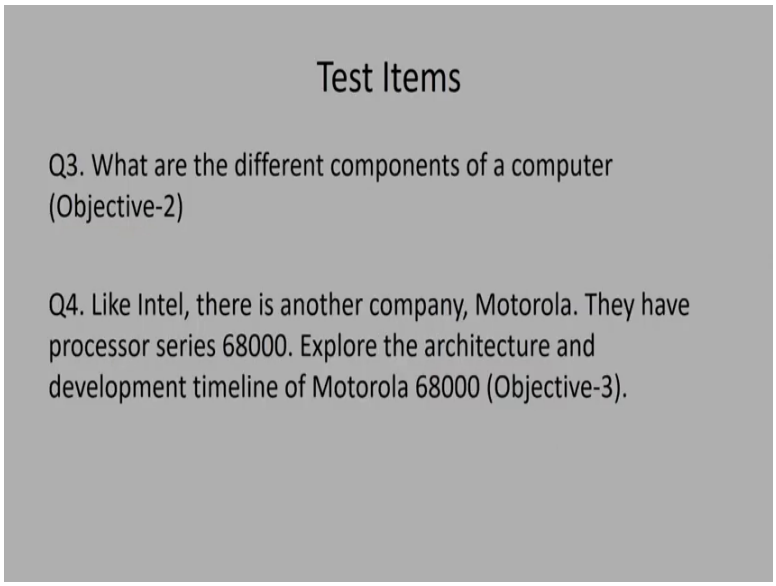

This is basically you can correlate now execution of the computer program and how execute and how human being carry out their work test item 3 we are talking what are the different components of a computer again in objective to we have said that we are going to look into the different components and how they are interconnected like we are talking about the functional view we are talking about the structural view of a computer.

This is a small test I am giving what a different component of computers. This core test item is related to your objective to another test item m giving is like Intel there is another company called Motorola they have processor series called 68000 explore architecture and development timeline of Motorola 68000. We have just giving some idea again I am talking about that whatever you have discussed about the evolution of computer or brief history of computer we have done in knowledge level on (Refer Time: 79:05) just imparting the knowledge only not going to analyze anything not going to look into the design issues of those particular processor, in knowledge level we have address it.

So, we have address about thus Intel family x86 series and we have seen how that from x 86 to 8 0 8 6 to 8 0 1 8 6 and like that we are coming to Pentium then we are coming to core then coming to I 3 I 5 and I 7 . Similarly Motorola is another company who is also working with a processor they are having a series called 680000 this is the basic one now with 68000, now what is happened they are also enhancing the performance of the processor and in this particular family line timeline they have come up with different

processor now you try to explore this particular information and see how you are going to how they have developed this particular processor and an answer power of the processor, with that I am going to wind up this lecture of unit one of this particular module.

Thank you.