Management Information System
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Week – 10
Module - 04
Lecture - 49
Expert Systems

Hi, welcome to the 4th module of 10th week on our course "Management Information Systems"! The subject topic of today's discussion is 'Expert Systems'. In this lecture, we are going to give you abroad introduction to expert systems.

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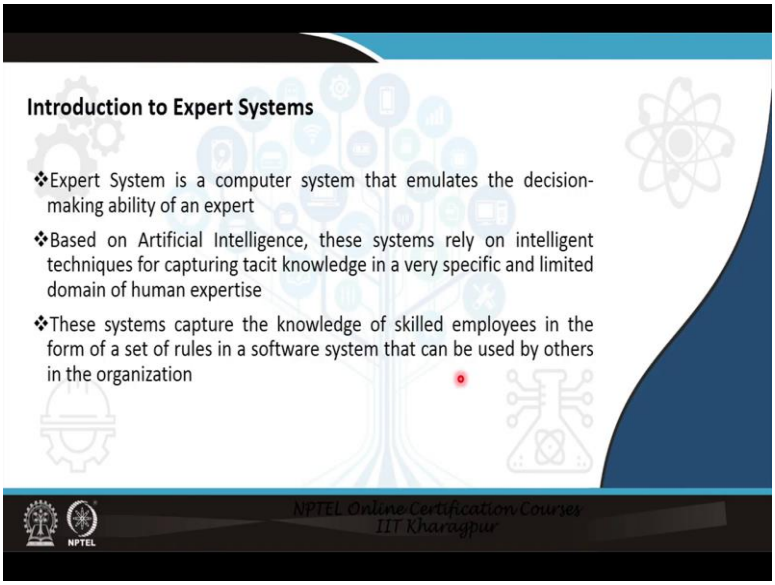

Now, expert system is basically a computer system that emulates the decision making ability of an expert. Based on artificial intelligence, these systems rely on intelligent techniques for capturing mainly tacit knowledge that is undocumented knowledge in a very specific and limited domain of human expertise.

These systems basically capture the knowledge of skilled employees in the form of a set of rules in a software system that can be used by others in the organization; mainly this is used for diagnostic type of problems.

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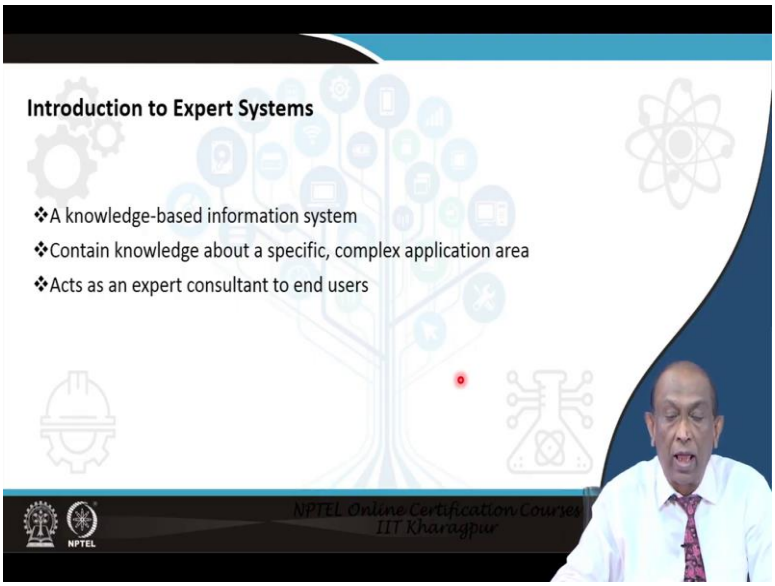

So, expert system is basically knowledge based information systems, contains certain knowledge about a specific complex application area. And, sometimes these systems act as an expert consultant to end users. You must have heard about the famous expert system MYCIN; ok.

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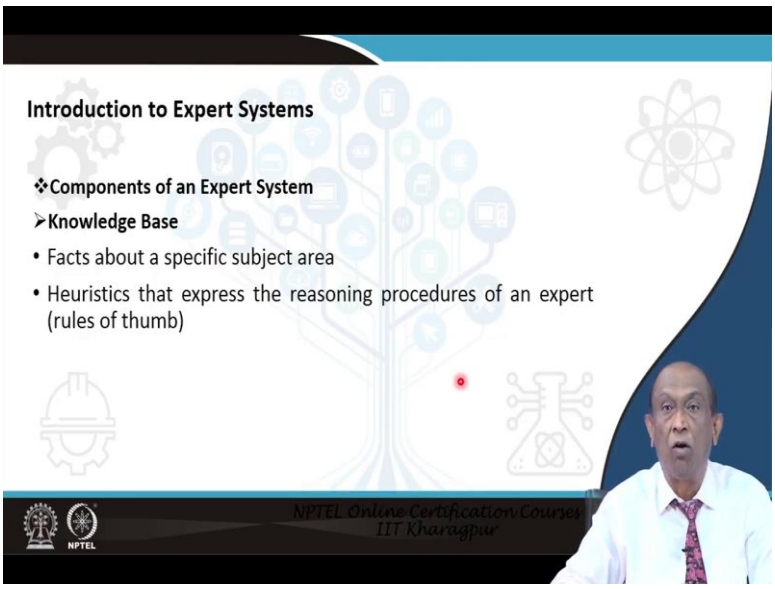

This expert system is basically used in the area of healthcare, particularly in diagnosing what kind of illness a particular patient has got. And, then recommends the various types of medicines before the patient is being taken to a doctor's room. So, MYCIN is very popular.

Similarly, there are expert systems which are widely used in say maintenance type of activities.

For example, you know these different elevator systems that are there, if something goes wrong it is very difficult for a new maintenance person to diagnose the fault and rectify the system within a short period of time. So, these expert systems carry or this maintenance people they carrying their laptop expert systems which basically help them based on the symptoms that they observe to diagnose the actual fault and rectify it within a short of time.

Now, let us first look at the different components of an expert system. Expert systems basically contains a knowledge base that is the core component of an expert system. What is this knowledge base? Knowledge base basically contains facts about a specific subject area and also it contains certain rules of thumb which are known as heuristics that express the reasoning procedures of an expert.

So, there in the knowledge base there are facts about a particular subject area and rules of thumb or heuristics which are used by expert in solving problems. So, knowledge base is at the heart of any expert system.

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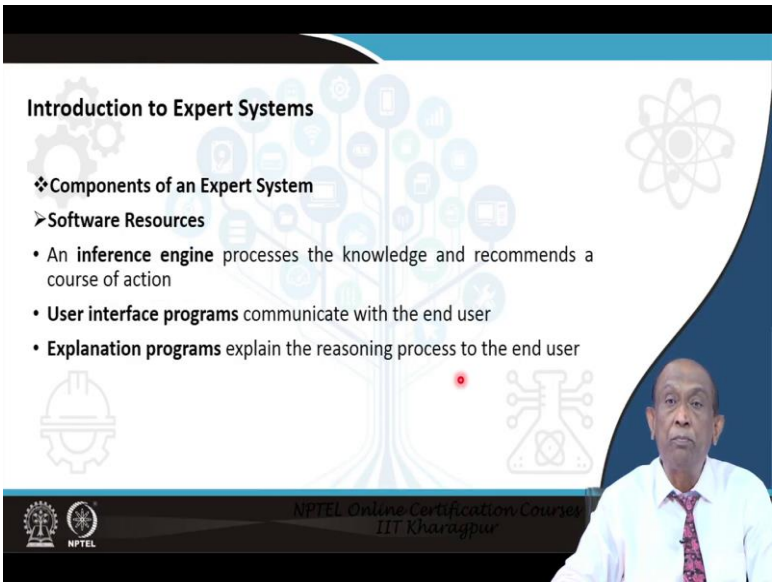

The next important component is the software resource. Now, when I talk about software resources; it comprises of an inference engine. This inference engine processes the

knowledge and recommends a course of action. Besides, this inference engine what are the other software resources? Mainly there is an user interface program.

This user interface program helps the end user to communicate with the system because, it requires some kind of interaction. And then they require explanation programs, basically to explain the reasoning processes to the end user. So, software resources comprises of the inference engine, the user interface programs and the explanation programs.

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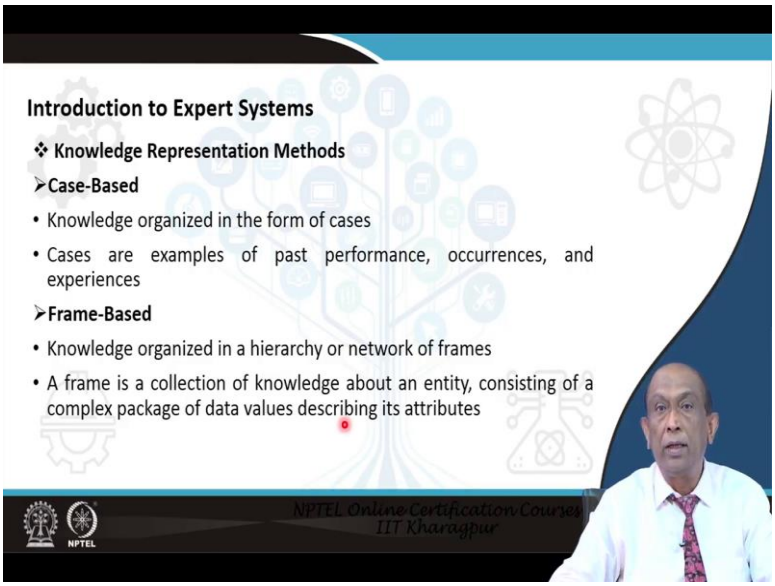

Then we have to know that the knowledge base which contains facts about a specific subject area ok, this in the knowledge base how the knowledge is represented. So, we need to know the various knowledge representation methods. Among the popularly used knowledge representation methods, the widely used is the case based knowledge representation.

What is case based knowledge representation? In here knowledge is organized in the form of cases. What is this case? Cases are examples of past performance, occurrences and experiences. The experiences gathered by people in their real life are documented through cases and these cases are used in representing knowledge.

Next the representation method for knowledge which is very popular is the frame based knowledge representation method. What is this frame based knowledge representation method? In here knowledge is organized in a hierarchy or network of frames. Now what is this frame?

A frame is basically a collection of knowledge about specific or a particular entity consisting of a complex package of data values describing the characteristic, properties or the attributes of that entity. Once again I repeat, a frame is a collection of knowledge about an entity and this frame consists of a complex package of data which describes the characteristic properties of the entity.

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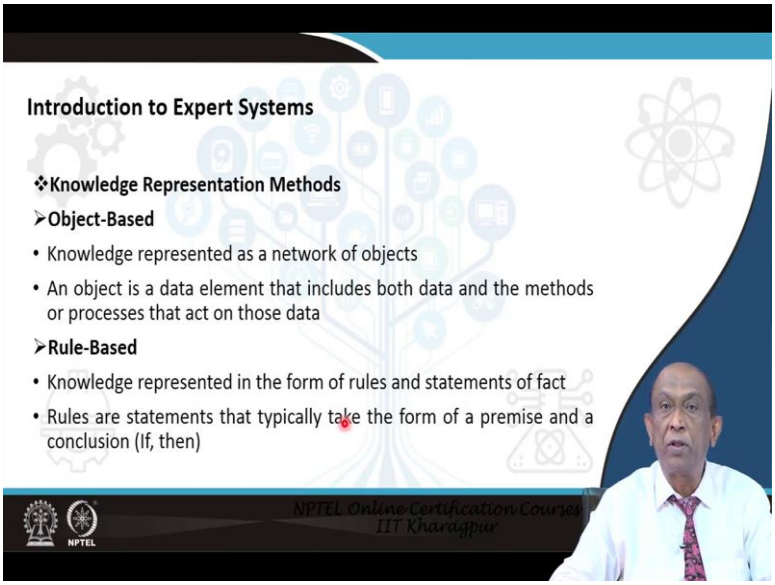

The next knowledge representation method is object based ok. Here knowledge is represented as a network of objects. Now in object oriented programming context, an object is a data element that includes both the data and the methods or the procedures that act on this data. An object is a data element that includes both the data and the procedures or the methods which act on this data to solve or to process it.

And, knowledge is represented through a network of such objects and then the next representation method for knowledge is rule based. What is rule based knowledge representation? Here knowledge is represented in the form of rules and statements of fact; particularly this if something happens then this is the course of action.

So, if then structure, rules are basically statements that typically take the form of a premise and a conclusion based on that premise if it is true. Basically, a set of if something happens then this is the inference or this is the set of action that we should take. So, if then rule is very commonly used in any kind of programming language.

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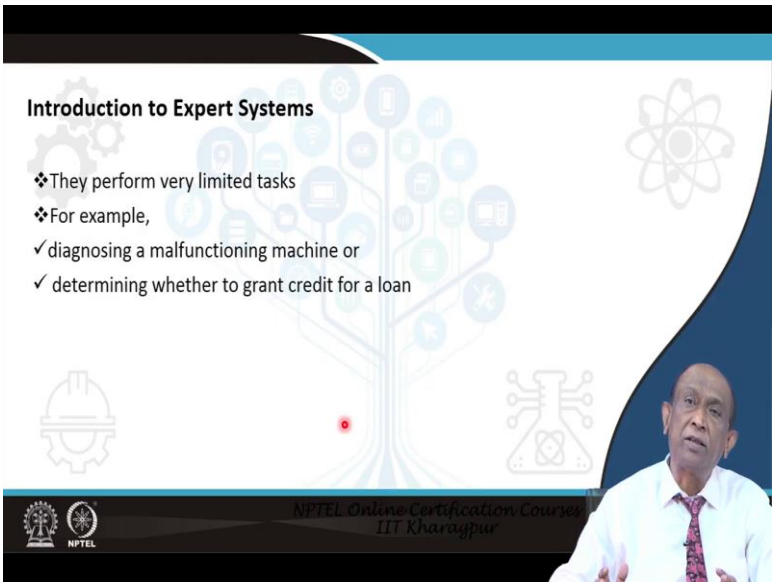

Expert systems mainly perform very limited tasks. For example, I have already mentioned in maintenance type of activities for diagnosing fault of machines when a breakdown occurs or to find faults in particular machines when they are malfunctioning. Also expert systems are widely used in insurance companies or even in banks to determine whether a loan application, application for a loan is to be granted or not; determining whether to grant credit for a loan.

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However, by capturing human expertise in limited areas expert systems do provide lot of benefits thereby, helping organizations to take high quality decisions with less manpower.

Today, such kind of expert systems are widely used in business in highly structured decision making situations. Highly structured decision making situations means, decision making situations, where the objectives are very well defined and they are well established procedures for solving such problems.

Expert systems have got certain limitations; it cannot be used for unstructured or semi-structured type of problems. In case of unstructured problems, the manager has to decide what is to be done based on his experience, intuition, judgement, wisdom. And, you have already noted that for semi-structured problems managers they take the help of decision support systems about which we have already discussed.

But, in the context of expert systems the widely used problems area is basically structured decision problem.

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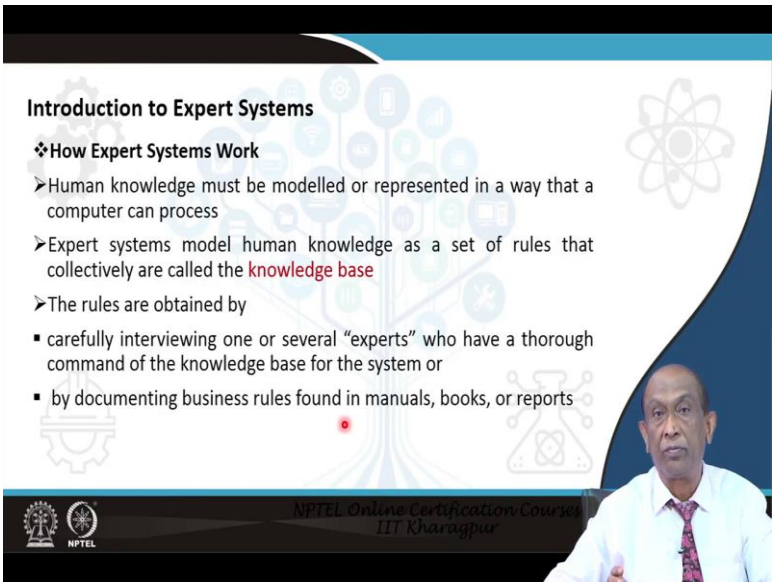

Now, let us see how these expert systems work. Now, if the expert systems have to work then we have already said that we capture the knowledge about its particular area in the knowledge base and this knowledge is captured from experts or human beings. So, this human knowledge must be modeled or this human knowledge has to be represented in a way that a computer system can process.

So, expert systems model human knowledge mainly as a set of rules, that are collectively the essence of a knowledge base. These rules which are captured and maintained in the knowledge base are gathered by carefully interviewing one or several experts who have a thorough command of the knowledge base for the system.

Or, sometimes these rules are captured through documentation of business rules which are found in books, various reports, manuals that come with the machines. All these rules which are documented over there, they are translated and captured in the knowledge base.

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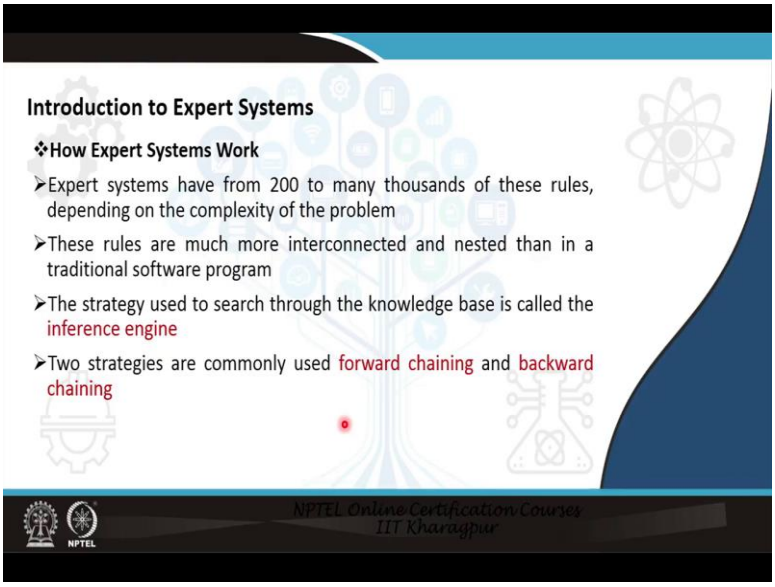

Expert system have thousands of rules at one extreme, on the other it can have say even 20 or 100 rules, depending on the complexity of the problem. These rules are interconnected and may be represented in the form of nested representation. The strategy that is used to search through the knowledge base is basically what is known as the inference engine.

This inference engine basically searches the knowledge base to arrive at a conclusion. There are mainly two strategies that are commonly used for arriving at a conclusion. These two strategies are the forward chaining method and the backward chaining method.

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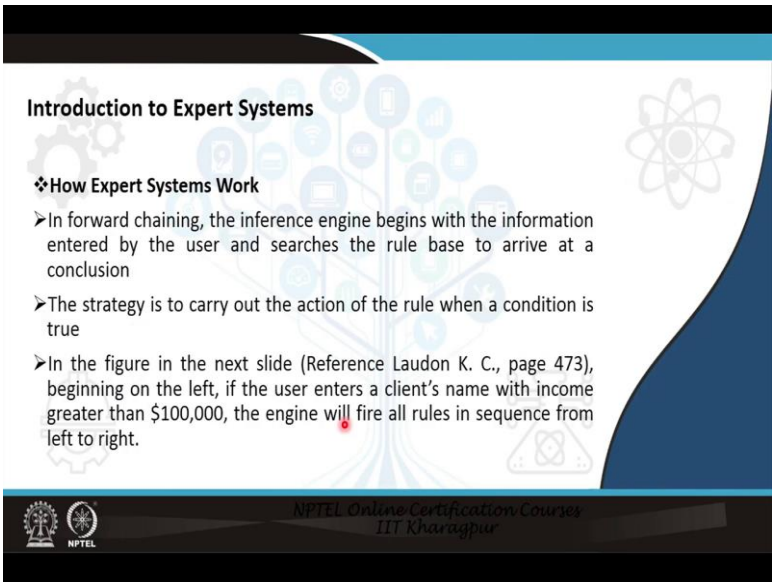

In the forward chaining method, the inference engine begins with the information that is being entered by the user. After the user has entered the some information as an input, the inference engine of the system searches the knowledge base or the rule base to arrive at a conclusion. The strategy is basically to carry out certain actions when the based on the input that the user has put in a particular condition becomes true.

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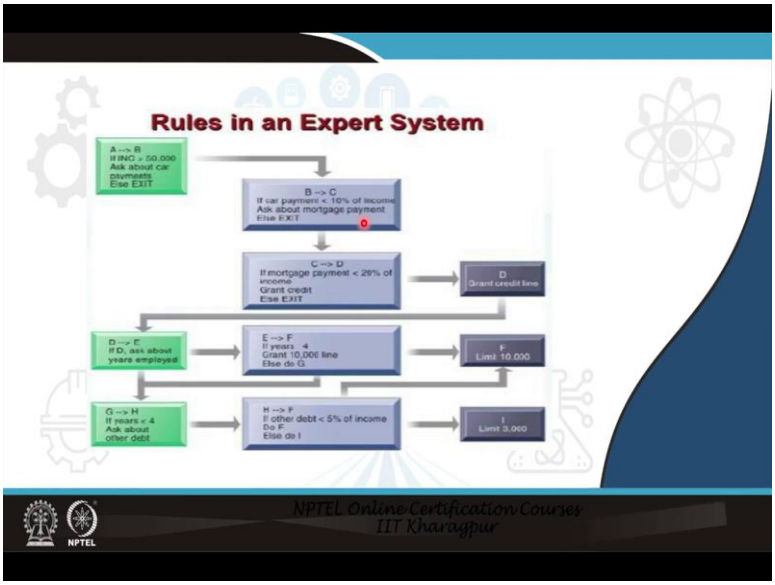

Let us look at the figure in the next slide. See here the user gives an input. And if the income of the user is greater than say hundred thousand, then a series of rules get activated based on

what is true or not. For example: in this figure ok, if the income of the user is greater than 50,000 then the system will ask the user about some payments related to his car.

A chain of rules are activated, you see if this condition is true A then it leads to condition B; where it says that if the payment related to car is less than 10 percent of his income then the system will ask questions about his mortgage payment; otherwise it will go out, exit. Then this rule gets changed, get changed with the rule C, B is changed to C, C is changed to D.

What is rule C? Rule C is asking that whether the mortgage payment is less than 20 percent of his income? If that is the situation then the credit is being granted, like this the chain of events take place based on some condition becoming true or not.

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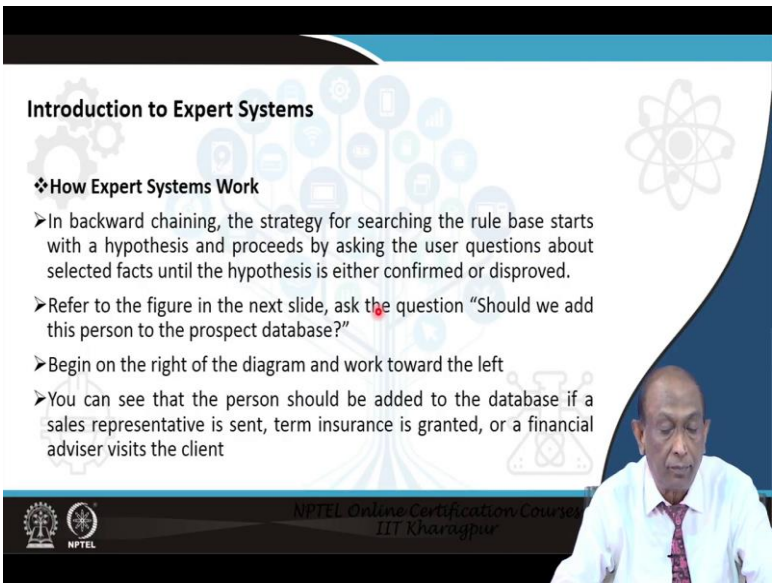

In the backward chaining system, the strategy for searching the rule starts with an assumption and then proceeds by asking the user questions about selected facts; until that assumption is either confirmed or disproved, again, if you refer to the, you know, the diagram which is there in this next slide; ok.

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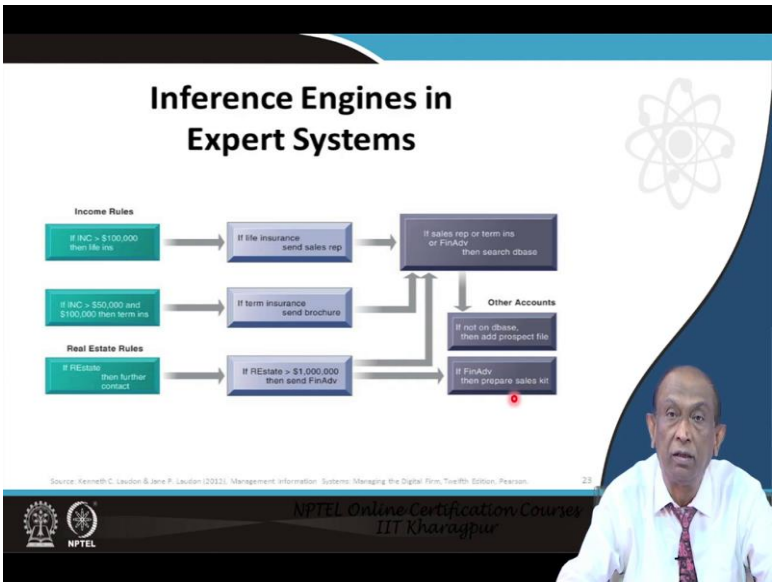

You will see here the processing starts from the right, here they are asking question that whether the person's name should be added in their database or not?

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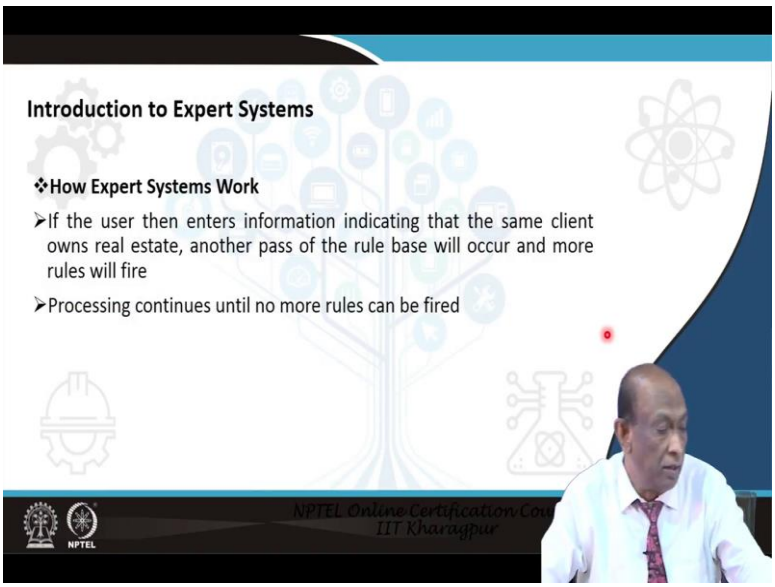

So, it asks questions and it proceeds from the right. If the user say in this case what is happening that certain if the income is greater than something, then if life insurance send sales representative or if sales representative or term insurance or financial advice is given, then search the databases. Like this the rule base is processed.

If the user then enters information indicating that the same client owns real state, then another parts of the rule base takes place. If real state then basically the company will send financial advisor and if financial advice is given then prepare sales kit for that client. So, if you look at the slide in details you will get to know what is happening in the backward chaining method.

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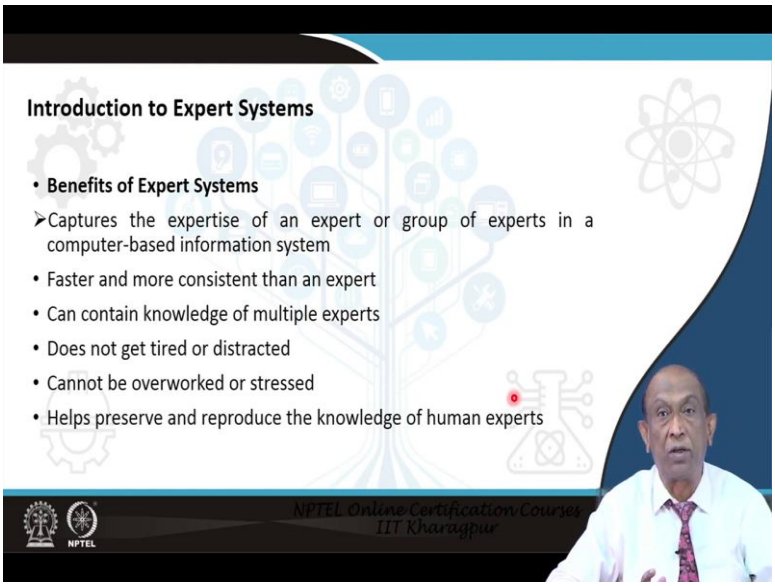

So, what are the benefits of expert system? Expert systems capture the expertise of an expert or group of experts in a computer based information system. The advantage here is that the processing is fast in comparison to an expert. And the most important thing it is not only faster, but more consistent. It contains knowledge of multiple experts so that there is no bias; ok.

Another important thing is that the system does not get tired or distressed or distracted even and there lies the consistency. Anytime and every time, the same course of action will be recommended and the system helps to preserve and reproduce the knowledge of multiple human experts.

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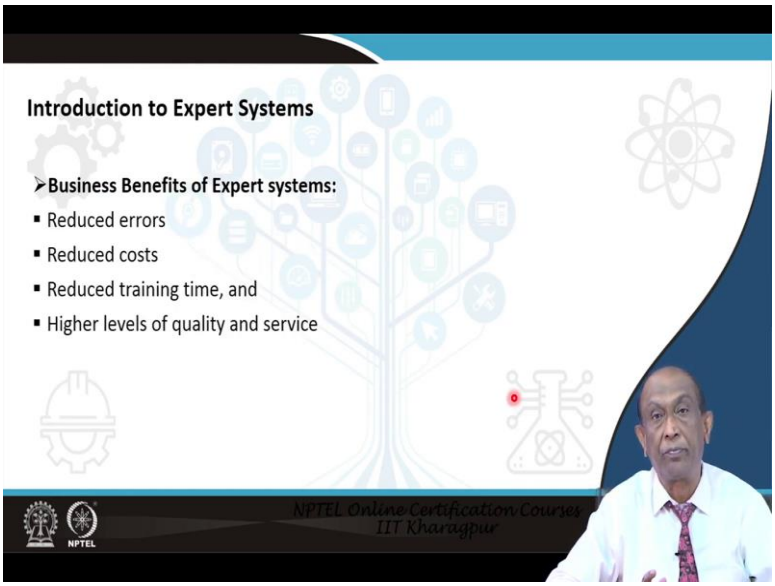

Business benefits arriving from expert systems comprises of you know reduced errors, reduced costs. It reduces the total time that is taken to impart the training and it ensures high level of service for a particular subject area.

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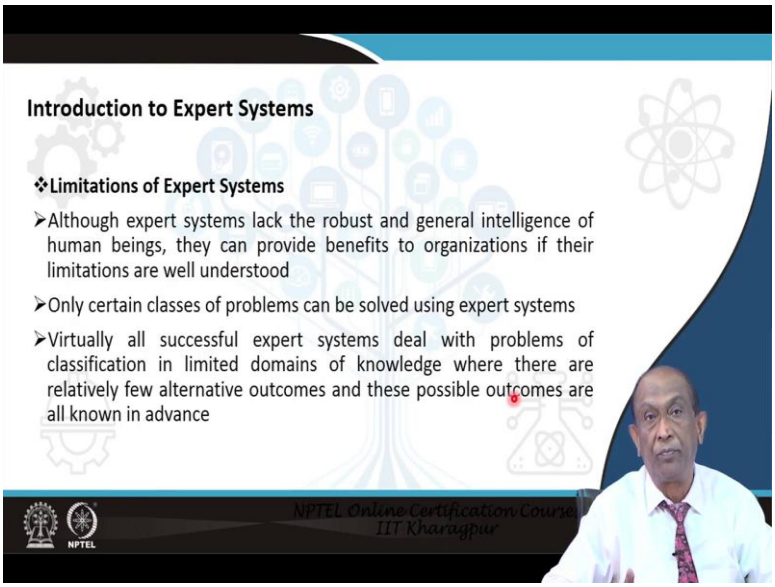

Of course, there are certain limitations. Although these expert systems lack the general intelligence of human beings, but if we understand its limitations then the organizations really can derive lot of benefit. First of all we need to understand that the expert systems can solve

only certain classes of problems, not everything and particularly those problems have to be structured ones.

Next limitation is that all successful expert systems, they deal with problems of classification in limited domains of knowledge; where there are relatively few alternative outcomes. And, these possible outcomes are already known in advance because these knowledge are being captured from the experts.

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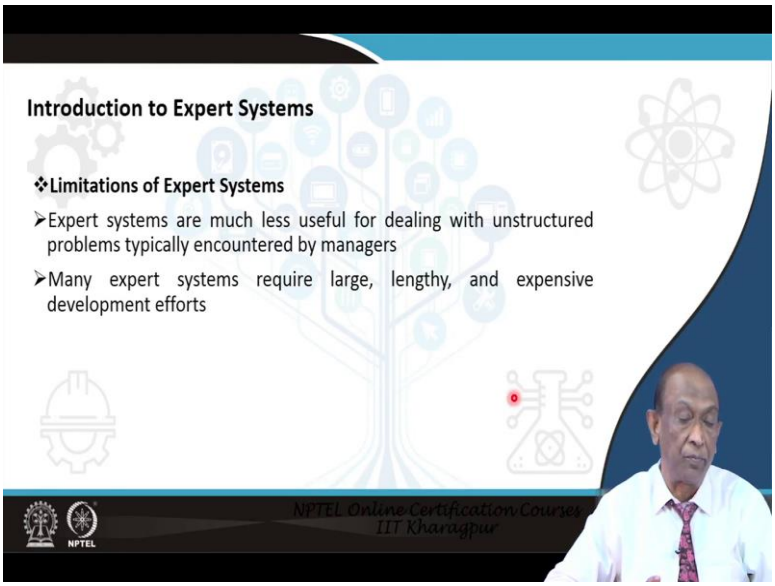

Expert systems are much less useful for dealing with unstructured problems, particularly those problems which the managers face in solving say strategy. Many expert systems, they require lot of time and the development efforts associated with these expert systems is also very expensive; that is also one thing to be kept in mind.

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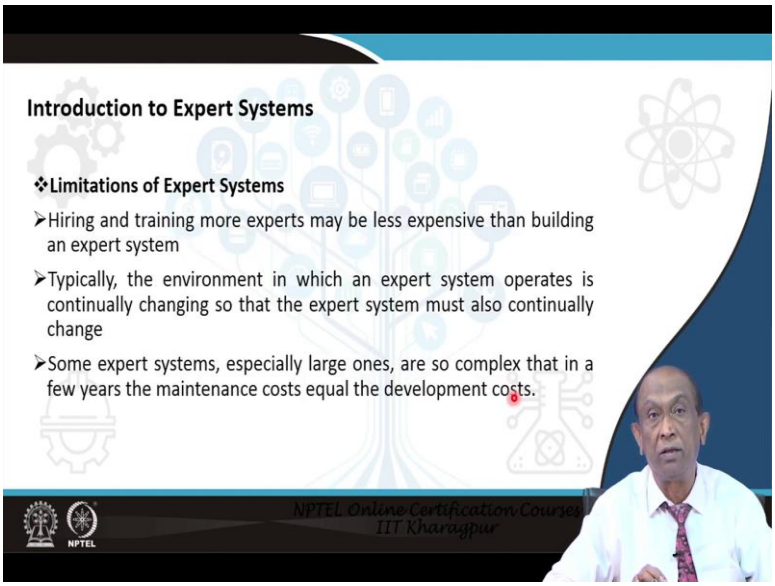

Hiring and training more experts may be less expensive than building an expert system at times. Typically, the environment in which an expert system operates is continually changing. So, that if the expert system has to give or suggest a practical real life solution then those expert systems need to be continually upgraded with the changing conditions.

Some expert systems specially, the larger ones are so complex that in a few years time, the maintenance costs for these up gradation and changing the rules are so costly that it may equal the cost of development of those systems. So, in that case, you know maintaining these kind of expert systems may not be of any real benefit.

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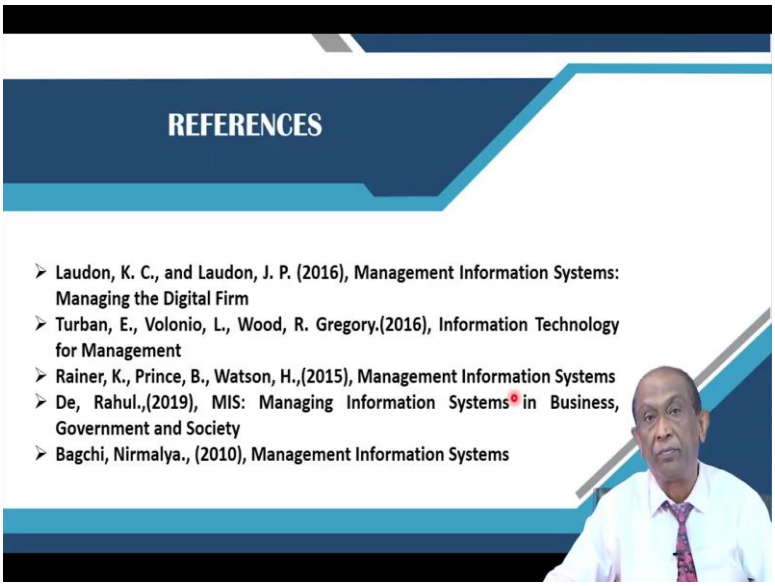

These are the references that we have used in compiling this particular lecture. You can go through these books as references which gives you a lot of detailed explanation about ‘expert systems’.

Thank you all for your patience!