Introduction to Cognitive Psychology

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Lecture – 24
Factors Influencing Problem Solving

Hello friends, welcome back to this lecture on Problem Solving. Now, this lecture is a continuation from the previous lecture which we in which we saw what is problem solving what is the nature of problem solving and what is the problem comprise of and after that looking at what the problem comprises of, we also looked at whether different kinds of problem to exist and we looked at Mayer's definition of number of type of problems which could actually exist.

So, we looked at five different kind of problem and we saw how these problems differ from each other, what is the nature of these problems and how do they differ from each other in what respects, then we looked at something about how to solve a problem. So, we looked at two basic approaches to the solution of problems. The first approach that we looked at was the approach that behaviour is to in terms of skinners idea of context idea of law of redness and, how does a problem solve in terms of associations which are made between correct responses and the consequences of it. So, that was one approach to solving problem in terms of the behaviourist in terms of the behavioural psychology.

And the next approach that we saw in last class, which helped us understand how to solve problem was in terms of the gestalt approach, which talked about problem solution as reorganization of the items or materials available in a problem or so, what this approach said is that problem solution is about reorganizing the problem elements, in such a way that a novel solution comes up and so, if they talk about something called the experience or the insight.

And so, this is what in brief we saw in the last class and, in addition to this we also saw the cognitive approach to solution a problem and there we discuss the idea of Newman Simons based on Newman and Simons idea of what information processing theory is the idea of a GPS the general problem solver. And so, this GPS basically then talks about how to break the problem into it is sub problems and then arriving at the largest solution

of the problem in terms of integrating smaller problems, or finding solutions to a smaller problems of the larger problem.

Now, what do I mean by this take a large problem break up into smaller problems, then arrive at solutions for smaller problems integrate them together and then arrive at a final solution of the larger problem and, that is what the idea of the general problem solver was and the concept of a general problem solver. Now, what are we going to do in today's class, now in today's lecture we will see what is a solution to a problem, how does solution to a problem arises and not only that we will also see what are the problems in solving a problem, what are the hindrances which are out there in solving a problem.

So, when problems solution occurs, or when we try to solve a problem what are the kind of obstacles that we face and how to go about these obstacles how to take care of these obstacles. In addition we will also see the several factors which go ahead and help us, or basically better or increase or decrease problem solution. So, let us starts today's lecture by something called representation of a problem. So, solving a problem by using any of the ways either it is a gestalts approach or using a behavioural way requires the first step of it requires to encode a problem.

Now, as I said problem formulation itself, or the idea of a problem itself is to understand some kind of hindrance, some kind of a uneasy state and representing, this uneasy state as a mental presentation is what problem is all about. So, basically the first step in problem solver solution is encoding the problem, or basically making a mental representation of the problem that one is facing. And so, several problems, or several hindrances or obstacles can arise at this very first phase, where somebody might not be able to represent a problem, or form good representation a mental representation of a problem.

Now, remember in long term memory one of the problems that we faced or one of the things that we looked into is something called forget and, one of the rules of forgetting or one of the theories of forgetting was in terms of the fact that the problem, or the information which was thought to be encoded in the long term memory was never encoded. And that was basically due to poor encoding, or due to non encoding of the problem forgetting happens. A similar situation arises here one of the problems or one of

the obstacles in problem solving could be at the very first stage of problem solution which is encoding, or forming of mental representation and that is called problem representation.

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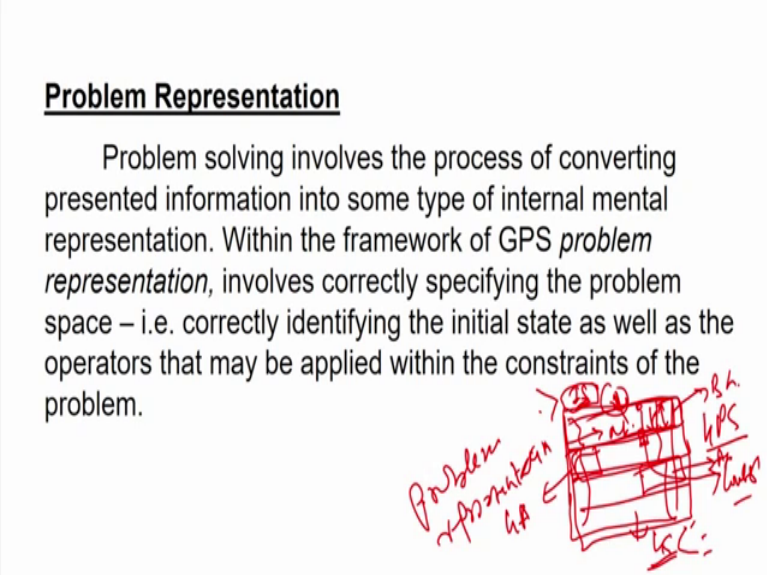

So, let us go ahead and look at what is problem representation. Now, problem solving it involves the process of converting presented information into some type of internal mental representation. So, as I said the first step in the problem solution is to take up a problem, or to take up the elements of a problem and then to do an actual encoding of it in terms of mental representation that is the first step. So, no matter what problem you face whether, it is writing a paper, or going somewhere, or eating something no matter what the problem is first you need to understand this problem first you need to understand the related items in this problem, or what is the problem the question that the problem is posing to you and then to go ahead and do exactly presentation, or do some kind of mental representation of this into the mind.

Now, within the framework of the GPS problem solver a problem representation involves correctly specifying the problem space, that we correctly identifying, the initial state as well as the goal state and the operators which must be applied and within the constraints of the problem. So, basically then problem representation in terms of the GPS solver, in terms of the GPS sequencing is about finding out the problem space defining the problem space, or laying out the boundary conditions of the problem space. So, what we

get to do here is that if this is the idea of my problem space problem representation basically involves defining the boundaries of this problem.

So, this is my GPS solver this space and not only defining the boundaries of this space, but it also leads us to understanding, or identifying what is the initial state where is the problem starting and where is my sub goal. So, these are the several sub goals which are there this is my initial state, or I guess I would write and this is my goal state GS I write. So, basically identifying this IS what are the parameters of these IS and what are the parameters or attributes of this goal state. So, what will the problem look like an initial state is what will the problem look like at the goal state. Also in addition to it a problem representation also involves finding out the constraints what are the constraints. So, given the fact that this is the boundary condition and these are the attributes of the initial and the final state the there will be several constraints in solving this problem. So, what are the several constraints?

Now, one constraint could be how we can divide the problem into smaller parts. So, what are the constraints, or sort of the rules into it? And further to that it may also defined about the different operators through a different solution for example, this goal state or this sub goal may be solved by using behavioural approaches, but this goal state may be solved by using the gestalt approach right, or this cold state could be solved by using another kind of approach which is the and so, each state or each sub goal here may be solved by using different approaches, but then what I am getting at final is this is the initial state of the sub goal and this is the final state of the sub goal. So, here I get the solution and, then I take from this solution and this solution now, becomes my secondary initial state and then I move on. So, this is what it basically involved.

So, in general what the problem representation really means is to find out the initial state of the problem face find out the goal state of what the problem will look like, identifying the constraints the hindrances which is out there which are there ready to block you for solving the problem and, also in addition to that the type of operators type of solution mechanisms type of solution on analysis that you will use to solve the problem. So basically, this is what is problem representation for example, look at this problem.

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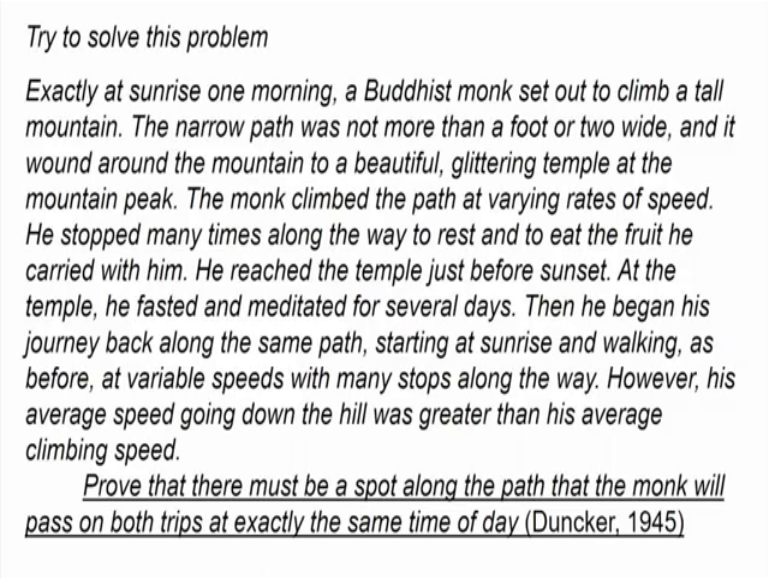

Now, I will give you one minute to look at this problem and come up with a solution. Let me see if you can come up with a solution to this. So, starting now I will wait for 1 minute. So, coming back to the problem I hope that you are able to solve this problem most of you would have been able to solve this problem. So, basically its it is the problem talks about 2 monks going up and down, or 1 monk going up a particular hill starting at sunrise and reaching there at sunset and, then starting at sunset and reaching towards the downhill position from where he starts at the sunset. So, basically what the problem ask is to find out to verify whether there is a point which the monk is going to cross, both while ascending the mountain and descending the mountain.

Now, you realize that what is the solution to this do you understand what is the solution to this. And so, most for most people who start writing mathematical equations to solve this problem, you will not be able to solve this problem by this and, this is what I mean by problem representation, which is basically understanding what a problem is and I am presenting you the solution, the easiest possible way to solve this problem is using a visualization. And so, what I am going to do is show you a visualization of the menthe problem and so, if you do the visualization like this again coming back to the solution. So, if this is the problem the solution is doing a visualization, and as you see.

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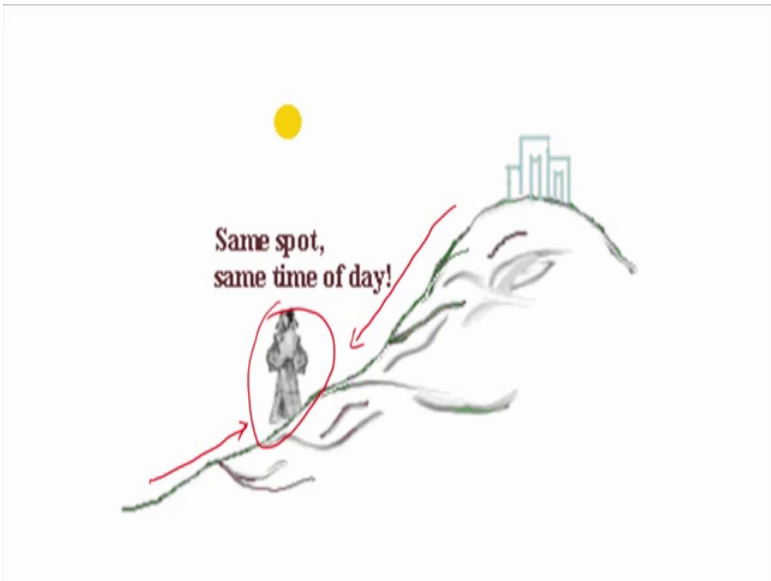

If I do a visualization these two people go up and down the mountain and so, there is a spot where they are going to meet. And so, the easiest way to look at this problem is doing the visual visualization, or visual interpretations of it. And so, if you use any other interpretation, or any other operator to solve this problem, you may not arrive very easily at the solution of this problem right. So, this is basically what problem representation to identify is what the problem is and to understand the sequence, to understand how it should be solved. Now, I give you another problem try to solve this problem.

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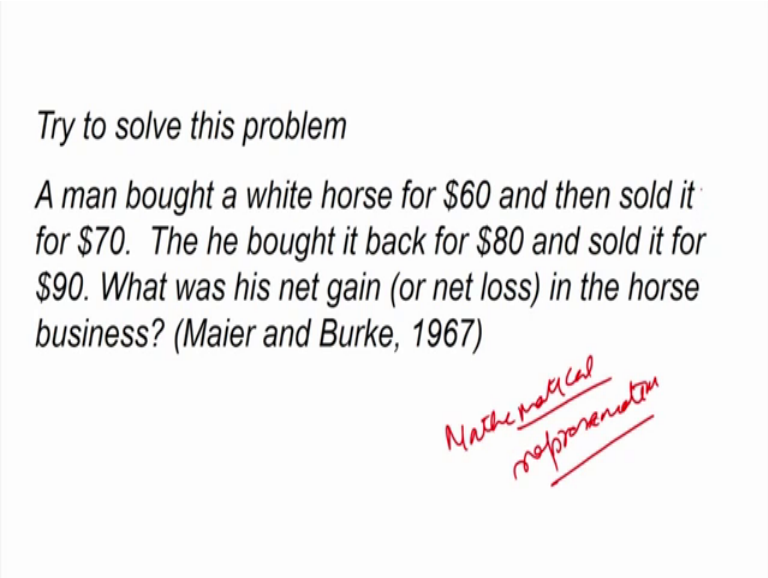

Now, give you 30 seconds it is a very easy problem, I will give you 30 seconds to solve the problem and let us see if you can solve this problem right. So, here goes the time and so, on more than 30 second over. So, basically then did you solve the problem and most of you would have been able to. Now, what we realize here is that in this particular problem what we need is we need a mathematical representation. So, in comparison to the visual representation that we used in the last problem the kind of representation, the kind of solution the kind of operator that we are going to use in this particular solution at this particular problem is the mathematical operator.

And so, in this way the problem gets solved easily. So, if you do a visual representation of this you are not able to solve a problem. And so, this is what problem representation talks about, it talks about that at the very initial phase, we have to understand how to solve the problem or represent the problem in the correct format.

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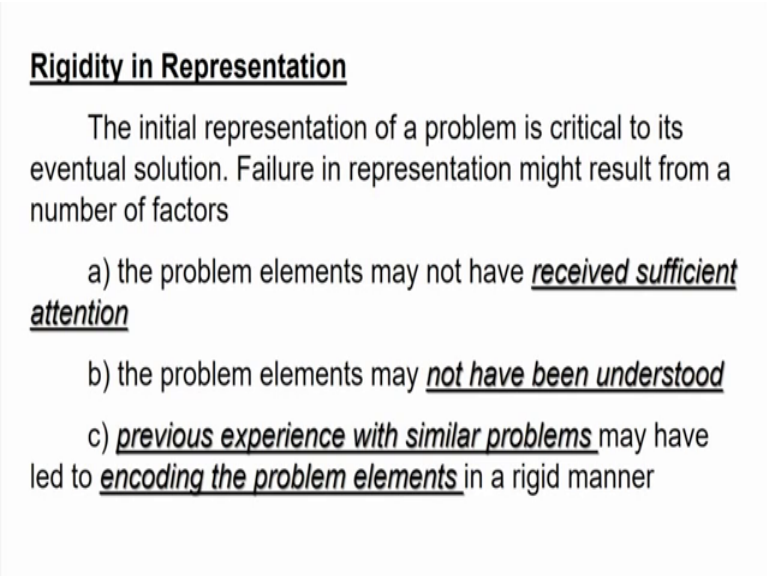

Now, rigidity in representation, now problem solutions to problem, or hindrances the problems, or a solution may arise because, people get rigid about solving a representation, or people become rigid in representing a problem. So, the initial representation of problem is basically its critical and failure to represent these kind of representations will lead to number of factors. Now, one of the first factor is that sufficient attention has not been given to the problem. So, when a problem is presented to you and if you do not pay sufficient attention to parts of the problem, or to the

problem as a whole what would happen is that you will not be able to identify the key elements of the problem and this will lead to you identifying the problem itself and representing it in the correct form. And once a problem is represented in the incorrect form a solution will not be most probably the solution will not be arrived at.

Now, the second problem or the second hindrance is that problem elements have not been understood, what would have happened, in this case is that even if you put some attention to it or more attention to a problem you did not understand the various elements of the problem, or what is it asking you. So, basically it is like looking at a question and not understanding what the question is asking you. And so, some people make questions like that which has a lot of so, basically in most open ended questions, or open textbook questions you get the question in such a way, that the question revolves around certain things, but there are certain key elements that you need to realize. And once you realize these key elements, you will be able to solve a problem. And so, another problem element or another factor which helps in problem solving, or which hinders problem solving is not understanding, or not realizing the various elements of the problem and what relation they have to each other.

The third problem that could arise or third obstacle that could arise is previous experiences similar problem may not have led to encoding the problem elements in a rigid manner. So, what would have happened in since some examples of the present problem and, this is basically called analogous problem solving. So, when solving a problem due to past experiences what we tend to do is not look at a problem in a particular way, but think of the problem in some fixed manner and that is basically a reason for failures in problem solving.

So, instead of thinking independently thinking about a problem, independently realizing a problem, or independent focusing your attention on to certain elements of the problem we tend to use a heuristic approach to it matches the problem to some already stored format of how it was all previously and that could lead to problem not being solved, or it into incorrect representation of the problem.

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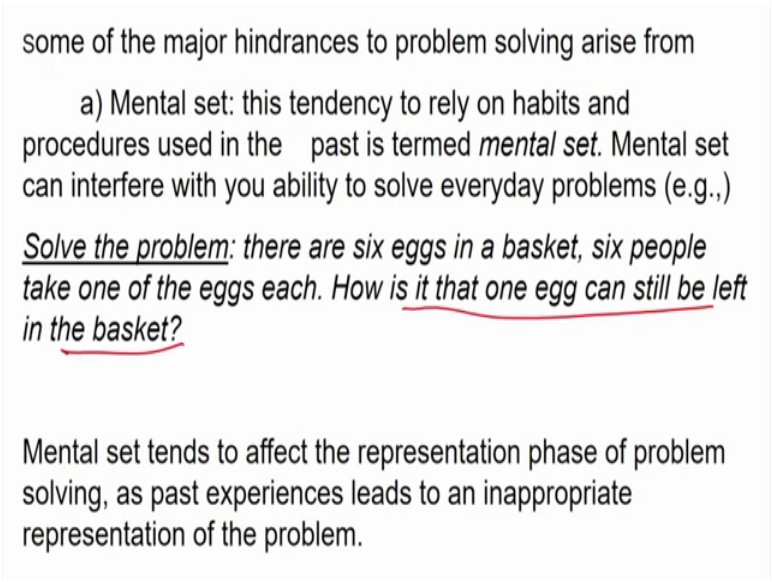

Now, some of the major entrances to problem solving arises from something called mental set. So, what is it is a tendency to rely on habits and procedures used in the past and this is what is mental said. So, basically if I know or basically if I think of solving a problem in a particular way, I tend to basically use that format and take a new problem and fit it into that format and, if I do that what happens is the solution becomes difficult. So, this basically idea this basic idea of using a mental set, or using a previous habit of solving a problem in particular may leads you to leads you to incorrect representation of the problem and thereby leads to solution, or the incorrect solutions of the problem.

Now, look at a question here, and so, this is the problem which I asked. So, there are six eggs in a basket six people take one of these each eggs. Now, how is it that one egg is still left in the basket. Now, most of you would worry about the fact that how does this happen, but then hidden within this is the representation problem and mental said says that six people took six different eggs. So, how is it that one the one egg is still in the basket the solution to this you have to realize, that was the last person who took the egg also took the basket with him. And, then it is possible that the last egg is still in the basket and what when you to think of this in terms of six different people the mathematical variable, then you think six people going away taking six different eggs and do not realize that the sixth person can also take a basket with it. And so, there is whether mental set is all about.

So, the mental said they tends to affect the representation phase of a problem solving as past experiences leads to inappropriate representation of a problem. So, what mental sets intends to do is that as I said there are certain past mental representations and these mental representations, or these inappropriate ways of representing a problem actually makes you think of a problem a solution in a particular fixed way and that leads to incorrect representation of the problem and incorrect solution to that particular problem.

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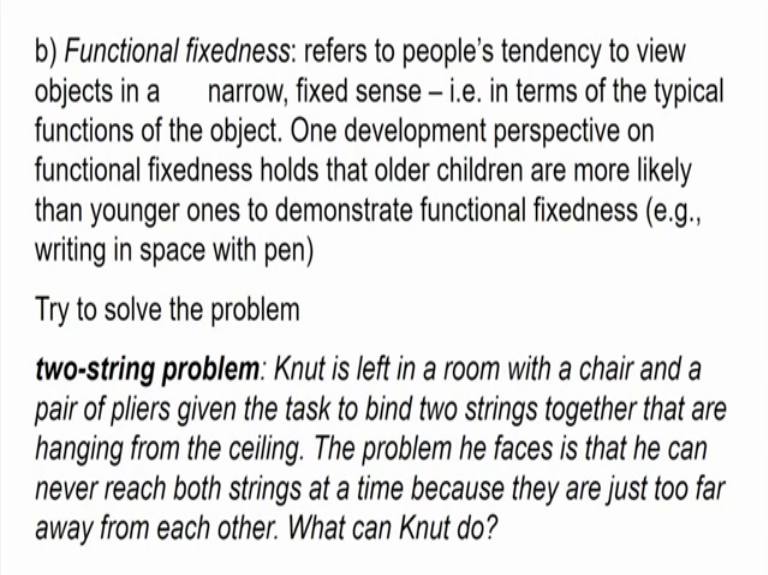

Another factor which is of importance or which is of any importance to solutions of problems, or in terms of representation a solution to the problem is something called functional fixedness, what is it what does it mean it refers to peoples tendency to view objects in a narrow fixed sense right, in terms of the typical functions of an object. So, in functional fixedness what we tend to do, is that we just look at something in a particular way in a particular manner. So, a spoon for example, should be looked at or is looked at only as a spoon something which is for eating, we do not think of a spoon as a lever.

And so, what we can do is you can use you can think of a spoon as a lever and, then use it to raise the upper part of a tin, or if you tin can and there is a lid to the tin can we can wedge the spoon between the tin can and the lid and apply pressure to it basic physics basic simple physics and, that can help us in opening the lid of a tip, but then we do not realize it and functional fixedness says that a spool is thought of as a spoon and so, it

should not be doing anything else, or using the down part of a toothpaste the bottom of a toothpaste as a tongue cleaner.

Now, the tooth I am sorry tooth brush and. So, the tooth brush is thought of as the tooth brush and so, we do not think of it as a tongue cleaner and so, but there are certain toothbrushes are available. And so, functional fixedness what it says is that certain objects are seen as that object are having a fixed function and it cannot be seen as having another function, or more functions out of it. So, one development perspective says that functional fixedness, they peak up or they start or they hold on to people as they grow older in age. So, younger children are more flexible in terms of functional fixedness, they can they are not harmed by or they are not troubled by functional fixedness, but people as they grow in age they become this narrow sense, they approach at this narrow sense of how a functional or water functional fixedness's.

Now, look at this particular problem. This is called the two string problem. Now, I will give you 30 seconds to look at this problem and tell me how to solve this and, I can bet you that due to functional fixedness you will not be able to answer this question. And though once you are able to see this problem pretty sure that you are not able to solve this problem. The reason here is that functional fixedness, the certain items which have been mentioned the chair the plier and all those have been represented as represented in your memory in a fixed way and so, you are not able to solve this problem.

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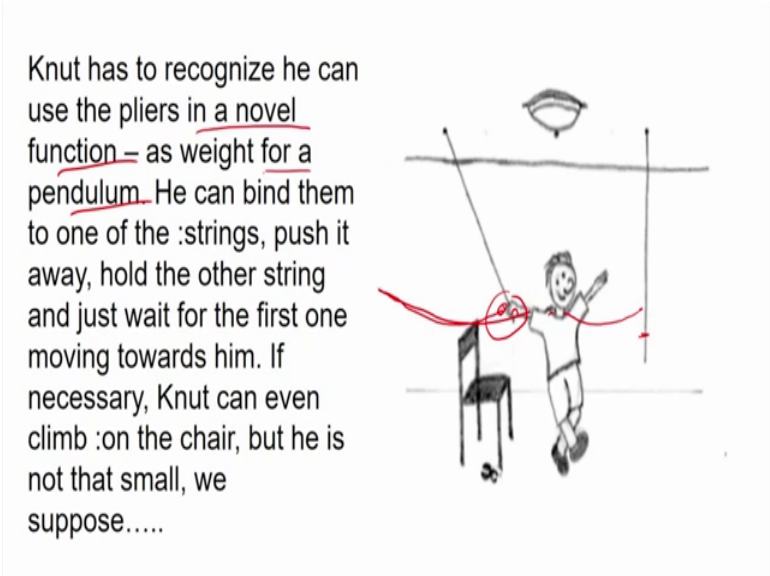

But a solution is there of this problem and this is the simple solution. What Knut has to do is? To climb up into the chair hold one end of the string, onto the other end of string he has to tie the pillar make a swing out of it go and stand on this chair and then basically hold on to this string.

Now, if you put a pillar here it will come back to you and, then you are holding on to this and so you can go ahead and then tie it together that is what is so, he has to recognize that he can use the pillar as a novel function, as a weight for the pendulum as I said this is the swing that it will do so, try the pillar here, it will work function as a pendulum and you can always go ahead and solve the problems.

And so, what people do not understand is the pillar is used the plier here is used for mechanical things for basically use or tightening of screws and all and so, you do not realize that the plier can also be used as an object for swinging, or for making a pendulum. And that way you can tie up that and so, this solution problem to solution arises from the fact that you are not able you are functionally fixated by certain functions of these objects.

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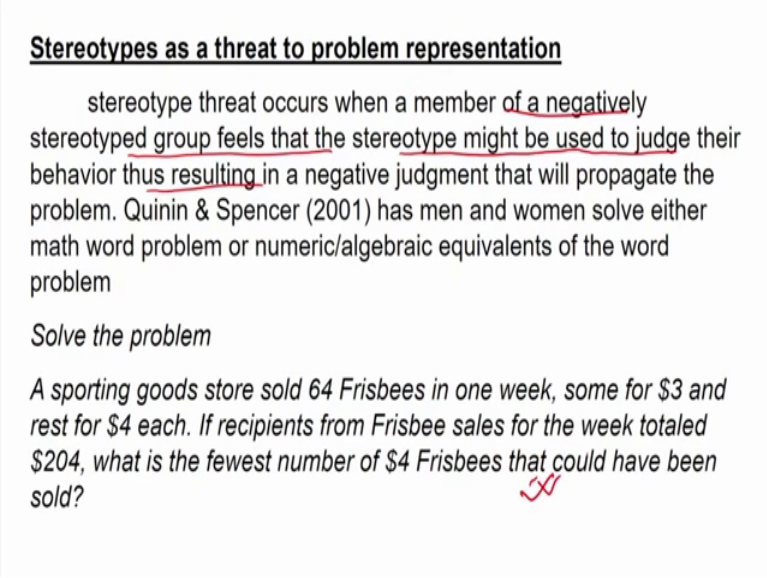

Now, another interesting thing the basic problem which can arise with solutions of problem is something called stereotyping. So, stereotyping threat occurs when a member of a negatively stereotyped group feels that the stereotype might be used as to judge their behaviour, thus resulting in a negative judgment. So, here in this kind of a problem

solution or present problem representation, what would happen is that since a certain groups have been stereotyped in certain way they are not able to register the problem or represent the problem in a correct way. And so, problem the problem if not represented in the correct way a solution could not be generated. And so, Quinin and Spencer in 2001, they use men and women to solve math problem by using either word representation of it, or a numerical representation of it and this is what they form. So, this is the kind of problem that is out there. And so, this problem represents a statement, or basically it is a word problem and so, this kind of problem was given to people.

Now, so this is a word problem it can this problem can also be represented in this particular format.

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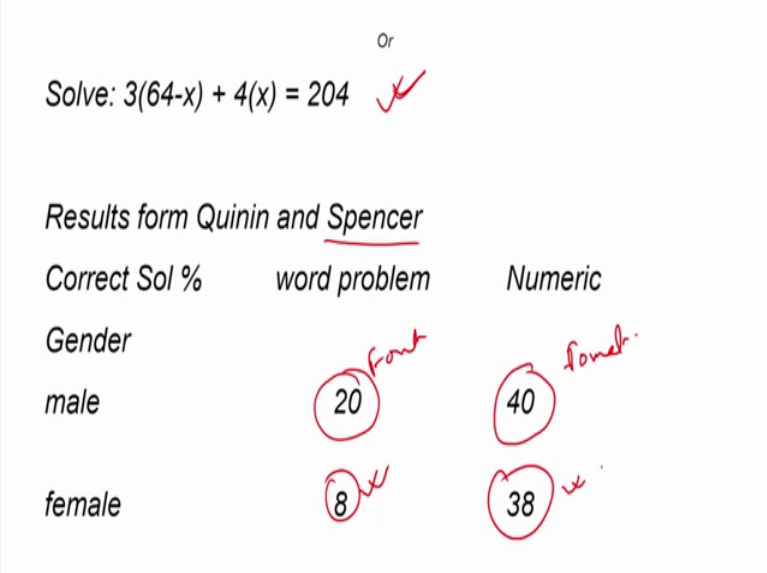

So, either you represent the form of the problem in this format which is now a word problem or I could use a algebraic problem, or an equation problem or equation format of it. So, 2 representations are that and so, it was believed that or there was a need, or they were just studied basically proposed that women would solve more of numerical problem then in word. So, what are the same problem in terms of what, when it is related in terms of word form, then when it is related in terms of an equation. And this is the results from Quinin and Spencer study it was found that the males and females. So, word problem more males were and less males were able to solve the word problem and, more

measures were able to solve the numeric format. So, this is the numeric format of the problem and this is the word format.

And in terms of the fact that now it was proposed that more women would be solving the word problem, more women would be attempting the word problem and solving it much easily, but the solution represents that only 8 women out of the total number of people which has been given this solution, only 8 preferred the word format for it most women format the or they use the numerical format, or they applied the numerical format and through the numerical format they were much easier for them to arrive at a solution. And so, this is basically gender stereotyping are basically stereotyping.

So, basically due to stereotyping initially it was believed that women would be more comfortable in solving the words representation of the same problem, but then this is not what the solution is and so, this is another reason for representation problem representations, or obstacles in problem representation.

Now, solutions to problems now once the problems has been successfully transformed from an externally presented information into an internally presented information, the next phase of problem solving involves searching for and testing evaluating of solutions.

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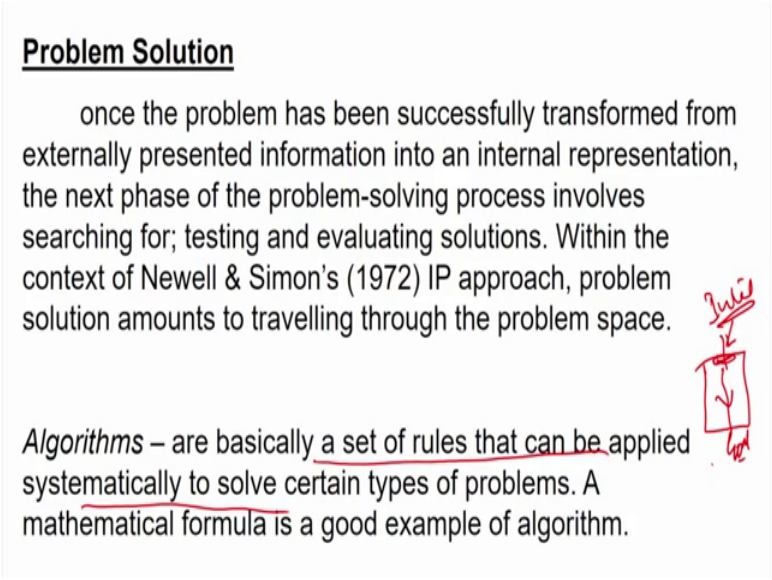

So, once a problem has been encoded in the right format, a right representation of it has to be done. Now, a problem solving process has to be evaluated or it has to be searched

of how to solve this problem. Now, within the context of Newell and Simons in 1972 IP approach information processing approach from the solution amounts to travelling through the problem space.

So, basically in terms of problem representation it is identifying the initial state what is the initial state of a problem. So, in a GPS solver in a GPS problem solving space the problem representation is basically at this point, where we need to identify what is the initial state of the problem, or how it the problem should be represent in the initial state whereas, the solution to a problem requires us to move to this state from the initial to the goal state and realizing how to move from the initial state to the goal state.

Now, there are several ways of how to solve a problem and, the first interesting way our first important way of how problems can be solved is using the algorithmic approach, or using algorithms. So, what are algorithms? Then, algorithms are a set of rules that can be applied systematically to solve certain type of problems. So, these are a set of rules these are a certain list of rules, which when applied in the correct format which when are applied in the correct sequence, or which applied which one applied sequentially will finally, always give you the solutions. So, that is the best part of an algorithm. An algorithm is a set of steps set of steps bounded by rules.

Now, once you use these set of steps, once you pass through all the set of these steps which have been there, then you really finally, arrive at a solution and that is guaranteed. So, almost algorithms guarantee a solution to it right. Now, mathematical formula is a good example of an algorithm. So, you have to go through the number of steps which is there a formal solution you cannot jump and if you go through a number of steps you are always going to solve the problem.

And, remember from a real classes of how an algorithm is written I am terribly sure that most of you had mathematics till plus 12. And so, if that is what it is then you do not know what a algorithm is. So, basically then how to define an algorithm for making tea the idea is that you have to describe a step 2 step process from right from taking water into a pan going heat it, or adding something into it and in the step by step manner you will always end up by making the tea. So, algorithm is a set of sequences, or a sequence of steps which when followed in the correct order it always guaranteed a solution. And so, one way of finding solution to problem is using the algorithm.

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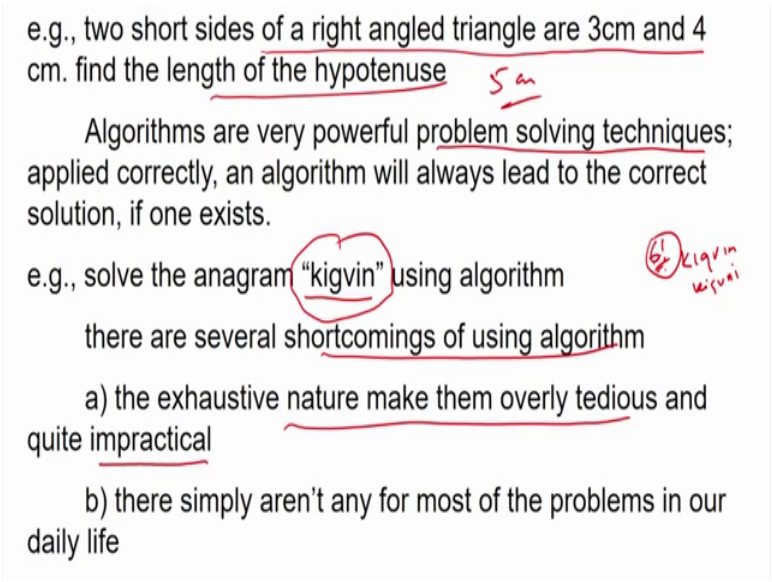

And so, the tool for example, look at this problem two short sides of a triangle at 3 centimetre and 4 centimetre. So, what is the hypotenuse it has to be 5. So, a square plus b square is c square that is how we look into it and so, then this way it has to be 5 centimetre and so, this is an algorithm that is a correct way of doing it. And so, we know that this is how it has to be solved. So, algorithms are very powerful problem solving techniques, applied correctly an algorithm is always giving you the correct solution if there is an existing.

Look at this initial problem that we encounter. Now, if we need an algorithm to solve this problem there, will be several obstacles or there will be several states, or there will be several steps into it for example, what would happen is it will lead to since it is 2 3 4 5 6 it is 6. So, it will lead to basically 6 factorial number of representations which is there. Now, what do I mean by this what will happen is that initially I will just change the last 2 letters. So, this next letter is n i, then I will change the 3rd letter and so, 1 letter at a time I can upon changing and then arrive at a problem, this is basically using the algorithm approach. So, in algorithm approach all the representations, or all changes within this letter all arrangements different arrangements will be there and from that final solution will be outputted.

Now, if you do that you would have to do these many number of representations of these many number of variations into it to finally, arrive at the answer that this will lead to

VIKING as the answer. Now, there are several shortcomings to using the algorithm as I said. Now, if we requires these many steps, if it requires these many variations which are out there if it requires us to do these many variations for arriving at a solution then, it is a it is a huge task. Now, when it is a huge task so, basically then there are some shortcomings to it.

And so, what are the shortcomings first the exhaustive nature make them overly tedious in quite impractical, what would happen is since 6 factorial times doing it these many times doing all representations all for all number of variations on this. So, each letter being varied in not only in relation to itself, but in relation to all other letters will be huge and it is to exhaustive. And so, it will require basically a computer for you to do this. And so if, but if you do this the correct answer is one of these sequences and so, one of the problems or one of the hindrances, or one other shortcomings of using the algorithmic approaches that it is very tedious in nature, it requires a number of variations and so, it is quite impractical nobody has that much time to go up and look at these many variations.

Now, simple code breaking password breaking, how do you do it one of the ways of doing a password hacking is basically using or to basically do ethical hacking is to use some people the brute force. Now, in the brute force what happens is all combinations that exist in to the dictionary is used by the computer to arrive at the password. Now, if we do that and if it is assuming that it is a 7 letter password. Then we will have to do almost innumerable number of representations right from A in the first place to A 26 different representations of the first place, 26 different representations A 7th place, 2nd place till the 7th place and then in relation to each other also using each representation.

So, huge numbers and so, this is one problem, or this is one shortcoming of the algorithmic approach. What is the second shortcoming? There simply are not any for most of the problems in our daily life. So, what would happen is since algorithms are the best way to come up with a solution and they always guarantee a final solution, what it turns out to be is that for most problems on our daily life we do not have an algorithm out there. And so, we do not have an algorithm out there then solutions are difficult and, then it becomes difficult for us to come up with a solution because, there is no algorithm there is no true method of doing it, why because each new problem daily life problem is a new one, it is not an exact replica of some problem that we have seen and so, that is one thing.

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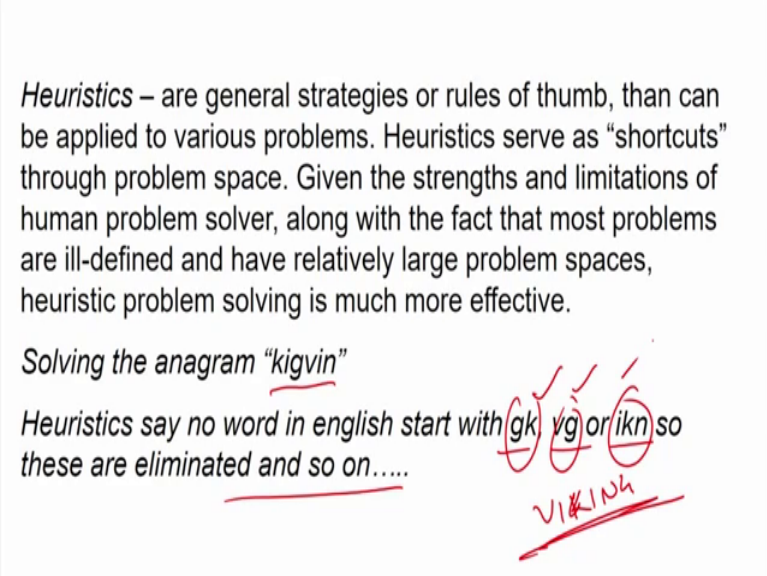

Another interesting way of coming up with solutions to problem is using a heurist. Now, what is a heurist? These are general strategies, or rules of thumb that can be applied to various problems. So, basically then one way is using the algorithm, another way of solving a problem is using a shortcut and this shortcut, or mental shortcut, or rule of thumb is called a heurist. So, this serves as a shortcuts through problem space, what heurists are it are these are fixed ways of solving a problem, or these are fixed ways of how do we go ahead and bypass the all algorithm some steps of the algorithm so, these are what are heurists.

So, given the strength and limitation of human problem solver along with the fact that most problems are ill defined, they are relatively large problem spaces heuristic problem solving is more effective. The reason is since the problem space is huge, since any problem requires a number big problem space and a number of sub problems into it what people tend to do while solving problem is using a heurist, what does the heurist do it gives you some kind of a shortcut. So, what is the shortcut it is in terms of bypassing certain types of the algorithm?

Now, since we know that if we come to know that 2 3 4 or 5 of an algorithm always gives a particular answer for example, mixing yellow with green gives a particular kind of colour and if we know that we need not repeat this each time, or mixing the tea leaves into boiling water and boiling water always gives a certain kind of colour, or a certain

kind of taste and flavour we need not repeat this again and again and so, we can jump by stating that, if you mix tea into it this is the kind of colour that, we are going to get and so, this is basically what is called the heuristic approach of problem solving.

For example how do we solve the same problem so, in terms of algorithms we saw that we will do n number of manipulations, we will do these six the different letters are there and we can manipulate we can do all number of arrangements out of it and then come up with a problem, a good heurist of how to solve this problem is that thinking of gk vk and ikn are not possible so, English words do not start with this kind of beginning and so, we can eliminate these kind of or these different starting with it and so, these are eliminated.

And we can since use more heurist and then, come up with the final answer that vi ki ng is the final solution. Because this is the heurist it says that if in your understanding, or in your in your life you have not seen, in your readings you have not seen any words starting with gk vk vg or ikn and so, these can be eliminated this can be ruled out.

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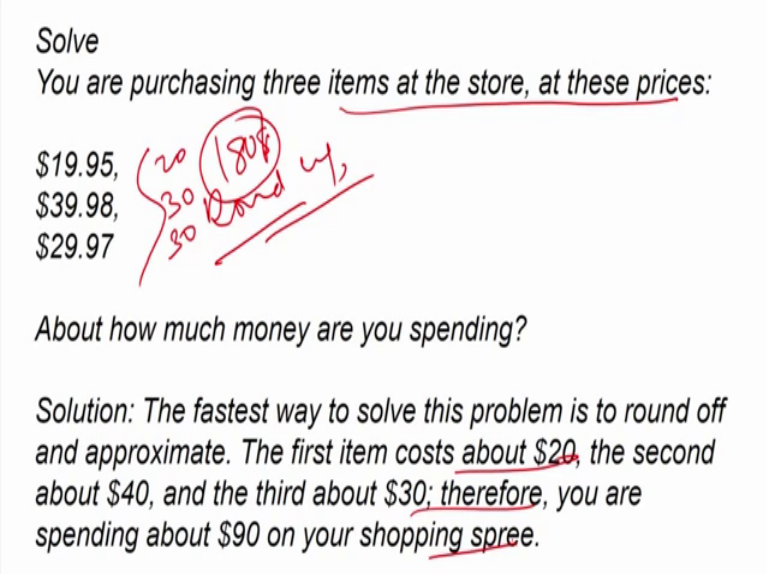

Also look at these particular things, now it is a daily shopping experience and if you do that basically, or if you would think that you are shopping what most people tend to do is something called roundup. And so, one easy way to solve this problem is rounding this to 20 and rounding this to 30 dollars and rounding this to 30 dollars. So, 30 36 78 is the answer so, 80 dollar is what you are spending, but algorithm the approach says is that we have to add up 9.95, 0.98, 0.97, generally speaking most people will say that I spent up

80 dollars. So, if you are purchasing three the item, it is 80 dollar which is there what I have done is I have rounded up and this rounding up is called the heurist, or this is the problem or this is the mental shortcut. So, the fastest way is to basically go ahead and round up and this is what is called the heuristic way of solving a problem.

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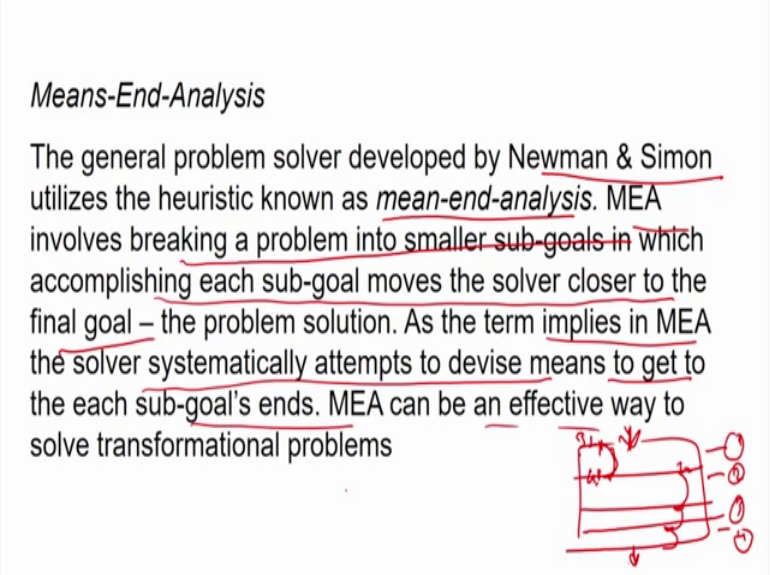

A third way of solving a problem is by using a means ends analysis. Now, what is a means end analysis, now basically the general problem solver, which was done by Newman and Simon it basically utilizes a heurists known as something called means ends analysis. Now, what is the MEA it involves basically breaking a problem. So, if this is my problem state initial state and this is my goal state and, what then happens is; that means, ends analysis says that, I take this problem and break into four different parts and each of it which is solvable. And then what I do is, I then this becomes this part then becomes my initial state 1 and this is my goal state 1.

So, I first think of solving this part of it and then, when this goal state now becomes my initial state to problem 2, I solve this part of it then I solve this part of it and then I solve this part of it. For example think about launching a rocket. Now, if I want to launch a rocket this is a huge problem. Now, I can then divide this rocket launching into several steps for example, thinking about the physics of it thinking about what material should be used, what kind of fuel should be used.

So, they would do people who will calculating the fuel, calculating how the rocket moves up, calculating things like what is the material that should be used and so, several people are this launching a rocket can be broken down into several tests rise from the physics to the chemistry of it the physics of it and several other systems in which should be directed through the electrical appliances and so on and so forth.

Now, I solve this one part one part by one part and then I come with the final solution. Or a simple thing that if you have a car it is not starting. Now, if the car is not starting brake this starting of the car into several sub part for example, check the key, checked some the ignition, check the battery and so, on and so forth. So, several solutions are there and I arrived from one solution say to the another solution says the first step is to raising up the bonnet to identifying where the battery is to testing the battery to basically, then testing some other facts the electrical circuit stressed in the fuse and then finally, arrive at solution of this problem how to start a car if which is not starting.

So, then the MEA it involves breaking up the problem into several sub goals, in which accomplishing each sub goal moves the solver close to the final goal of the problem solution. As I said if you attain the if you solve this huge problem, if you make this huge problem into smaller problems and solve it one by one, or solve parts of it one by one you will finally, arrive at the solution as the term implies in MEA the solver systematically attempts to devise means to get to the each sub goals, end MEA can be effective way of transforming the effective way for solving a transformational problem.

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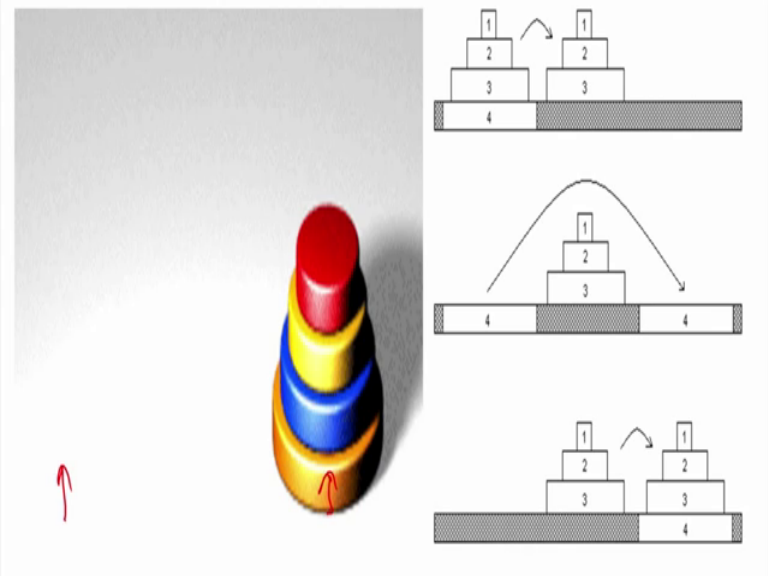

Now, look at this problem and if I want to solve this remember this is the solution to it. So, from state 1 where it was here, to state 1where it was here there is a solution to it and you can see the solution. So, on the on the right hand side I have the solution. So, this is how the solution really looks like, from moving from this state to this state this is the number of solutions. And so, it realizes or you have to realize that the problem has to broken down into sub parts, there are certain constraints and so, if you break the problem into sub parts you will be able to solve this problem as it is.

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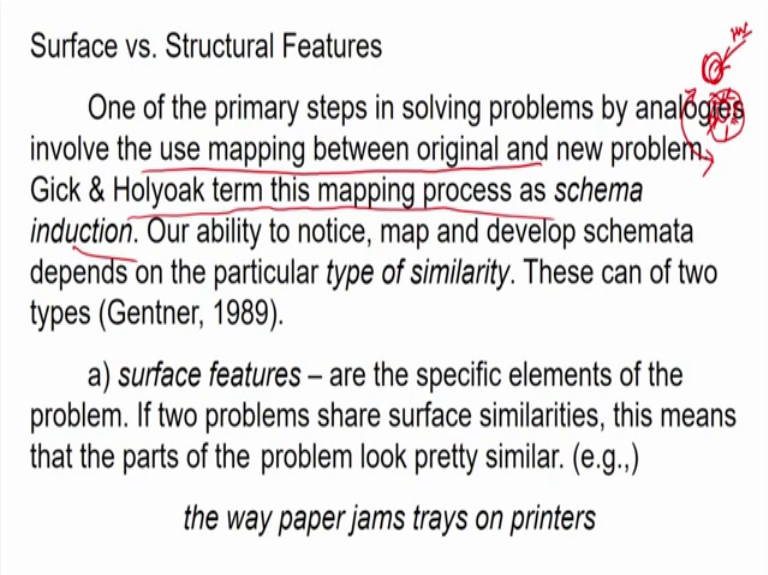

Now, when you actually another way of solving a problem is using analogous problem right; and so, what we do in analogous problem is that we think of a problem, when reaching at the solution of a problem, we think of a problem which is similar to the problem which is at hand and then we tend to borrow certain features, or we tend to look at the similarities with the problem which is at hand and then think of the problem which we are thinking about which is represented in our mind and then solve it.

For example I am giving you a problem. Now, the problem and I will give you a solution to it. So, the problem is that there is a person and he has to be treated with lasers now the fact is that if this person is given a high voltage laser a treatment, what would happen is or a high energy laser treatment what would happen is the single focus I mean single ray of laser light is given to you with high energy, what will happen is the organ which is diseased in this case that will disintegrate, or it will burn up.

And so, what is the solution, or what is the solution to this problem, how should we treat, but then this organ can take in small or can only take in small laser energy values right. So, it cannot take in a high energy laser it can take in small energy laser, if you if you give in a high energy laser from one direction, what will happen is the instead of curing the problem instead of curing the cell which is diseased the whole organ will burn up.

So, what is the solution? The solution here is using several lasers, which are low powered from several different directions. Now, what will happen is the since the whole organ is not surrounded. So, it is basically in this case what has happened is, if I give one laser with a high value high value laser this organ will burn up. So, what I do is I use several different lasers, which are smaller in energy from several size. So, then since it is each laser has a very low value, it is not going to burn up the organ, it is only going to heat upon the particular cells which are diseased and also the fact that the total energy of all these lasers will be the energy which is required to one of their cells. So, I can then distribute it across.

Now, analogous problem is there is a military officer, who was going to go ahead and capture a particular fort. Now, the only problem is the fort is bounded by certain bridges. Now, he require a certain amount of army and certain amount of tanks to be taken before fighting the war, but the fact is that each bridge is going to or each breach has a certain limited capacity of carrying the tanks. Now, he has to take ten tanks and, but each breach

can only take one tank and a few soldiers onto it. So, how do how does he go about solving this problem, analogous to what we have though if he if he can relate the his problem the major, or the commander of army can relate his problem to the problem of this particular laser thing what he could do is that he can use several bridges and each bridge will now hold one tank and, then each of it will arrive at the enemy fort and can actually win the war. And so, this is how analogous problem, or analogous problem solving really works.

Now, in analogous problem solving there are two things to look at once in terms of comparison one is the company called surface versus structural features. So, what are the primary steps in solving problems, by using analogy involving the use of mapping the original problem to the new problem, basically what happens here is that in terms of what we saw that you have to understand the commander of the army has to understand that how his problem of winning the enemy fort is similar to the medical problem that I defined before. So, he has to go ahead and map these two problems together, or basically make a one to one relation between his problem and the problem which was the medical problem.

Now, Gick and Holyoak they termed this mapping process a schema induction, he says that this mapping or this identification of one to one identification of the elements of the medical problem and the elements of this war problem, how they are related together is basically called schema induction. Now, ability to notice map and develop schemata depends on particular type of similarity. So, we look at similarities and the more similarity a particular section of the problem particular part of the problem has to the new problem which is out there, the more similar the more easier it is for us to solve. Now, these two can be of two types so, we look at two types of similarities, one is called the surface feature similarities.

Now, in the surface feature similarities what happens is specific elements or the problems are mapped, if two problems they share specific surface features we believe that it is same and then we go ahead and basically map the problem together for example, paper jams know. If there is a printer and all of you are very familiar with what a printer is. So, if you have a printer at home and it gives up paper jams, then if I take you to a new printer and if I introduce you a new printer, you will be more or less similar you will understand that the back of the printer is there the roller is and so, that is where the paper

jam is and so, it will take you very less time because, most printers work in the similar way.

It uses the same kind of roller mechanism and so, you will always look forward for where is the back button, or owning a printer. And so, you know that the central switch will be big and it will give you the affordance of pushing down. And so, no matter what printer I am giving you with the idea that the most printers require this kind of this kind of build up, you understand that pushing this button is what is going to help and so, this is called surface similarity mapping.

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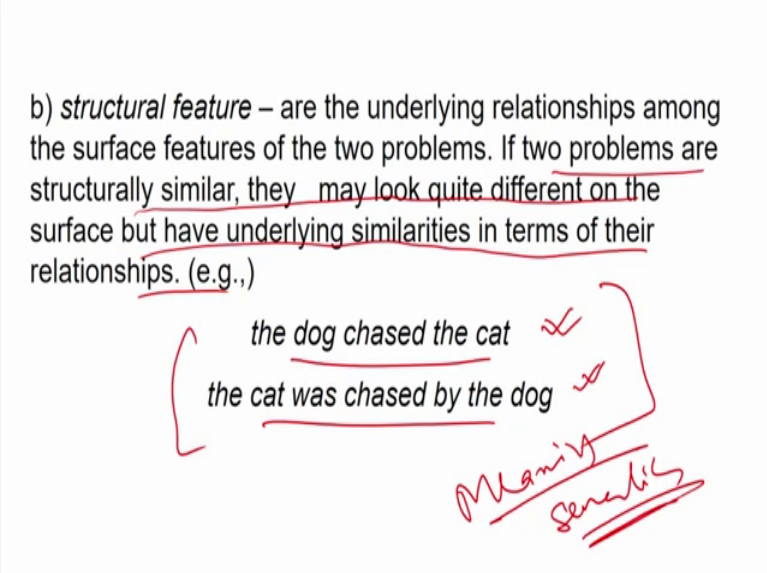

In structural features although the surface features although two problems may not look like each other, but then there are certain unique features are the certain meaningful features within the problem itself, which would look identical and that will make solution of the problem easy. And so, in the case that we described below the commander has to realize that although the other problem was a medical problem, but the same kind of solution do exist.

For example, in this case in understanding the structural features two problems are structurally similar, they may look quite different on the surface and underlying similarities would be there for example, looking at the two sentences one is active voice the other is passive voice, if we look into it the dog chased by the dog chased the cat, or the cat was chased by the dog both of them although structurally they are different, but

meaning wise in terms of the meaning in terms of the semantics of it, they mean the same thing. And so, both the problems are structurally similar.

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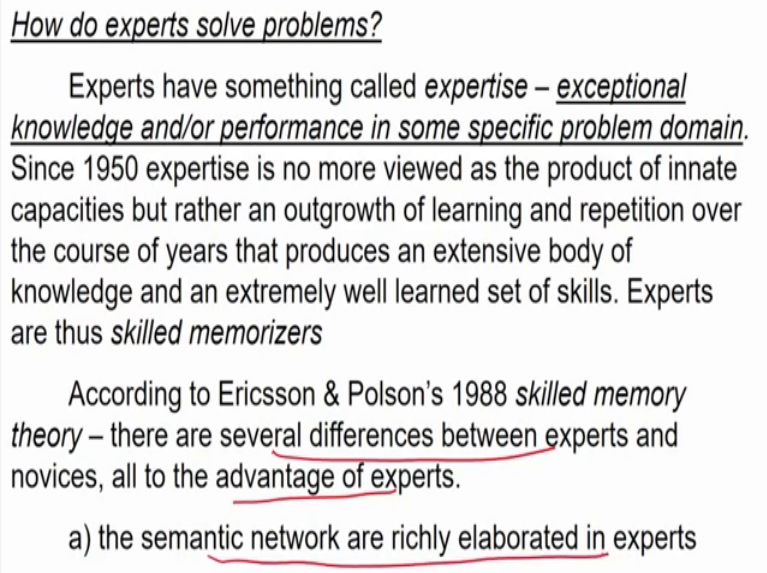

Now, another interesting thing to look at is in terms of how do expert solve problems. So, experts have something which are called expertise, which are exceptional knowledge performances is a certain specific problem domain area. So, so 1915s experts are now viewed, as the product expertise is basically seen as a product of innate capabilities, but nowadays in today's view expertise is seen as more of a skill memorizes. So, according to Ericsson and Polsons 1988, skilled memory theory there are several differences between how an expert, or how an novice solves a problem.

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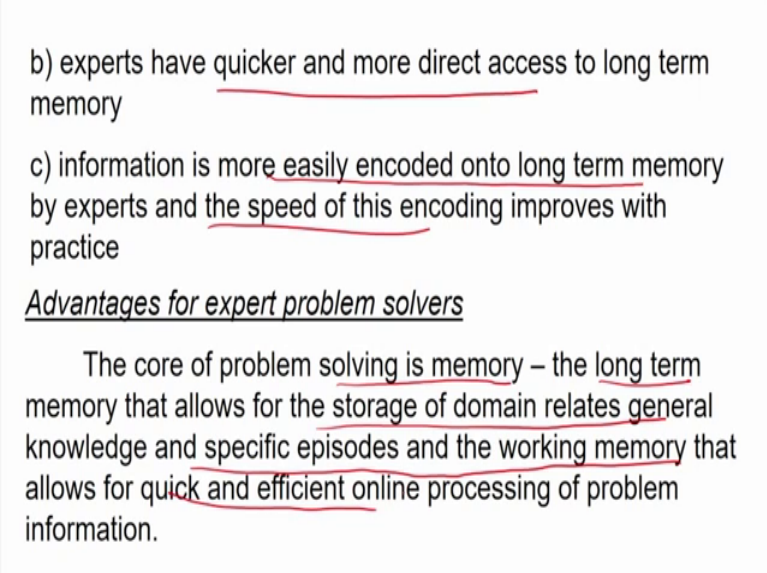

First experts have highly rich semantic networks. It basically means that the semantic network, the thinking network, the network through which they solve problems are highly developed or highly connected with each other. Experts have quicker and more direct access to long term memory. So, most experts can easily access long term memory because, they have done this problem solving this kind of a problem over and over again and so, they have quick access to long term memory, then in terms of what our novice could do.

And information is more easily encoded onto long term memory by experts and, the speed of the encoding improves it this. Now, if for an expert he can understand quickly the problem the parts of the problem quickly represent the problem in the correct format and, quickly find out the problem space also find out the correct operators and can solve it. For novices the problem is the problem arises the hindrance arises right from the very beginning where the representation of the problem as reacts as a hindrance and, even if the representation is there they might not find the correct operators. And so, this is the difference between an expert and a novice problem solving.

Now, what are the advantages for expert problem solver, the core of the problem solving is memory, the long term memory that allows for storage of domain knowledge and general information of specific episodes that working memory, there allows for quick and efficient online processing of the information.

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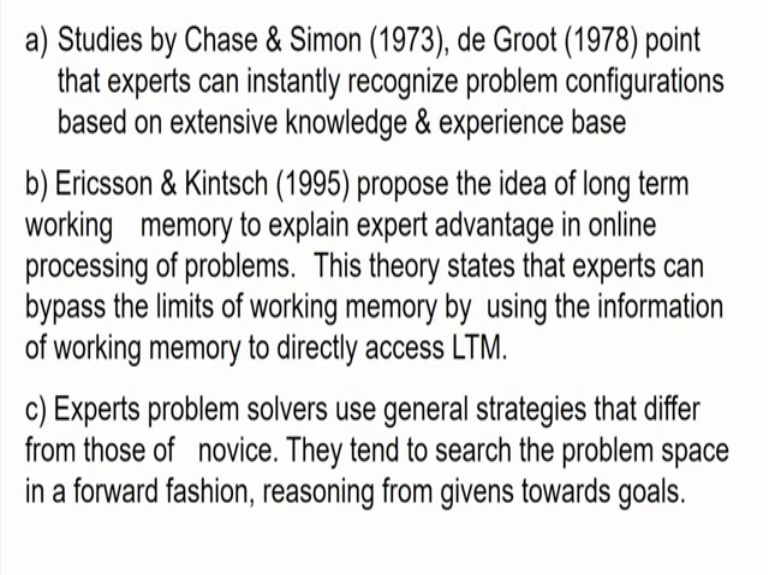

So, basically studies by chase and Simon 1973 and de Groot 1988, they point that experts can instantly recognize problem configurations based on extensive knowledge and experiences.

So, what experts tend to do is they quickly understand a problem when they look at a problem, they are very easy in understanding or they very quick in identifying the problem configuration, which means that problem representations is very easy an expert or they will very quickly identify a problem. Now, Ericsson and Kintsch in 1995, they proposed the idea of long term working memory to explain expert advantage in online processing of problems. Now, the theory states that experts can bypass limits of the working memory, by using the information or the working memory to direct access to LTM.

So, what experts can do is they can bypass these working memory storage capacity problem and, they can using the working memory directly access the long term memory and, though this is the way how experts are better. Also expert problem solvers use general strategies that differ from those are the novice, release to searching the problem space in a forward fashion, then reaching from the good. So, what experts tend to do is they when given a problem they do not think about the goal state and travel back from the goal state to the problem state, what experts tend to do if they use novel strategies they use effective strategies and, they always move in a forward direction from the initial

state to the goal state and, that is why they are faster in solving a problem, then coming from that goal state to the problem state.

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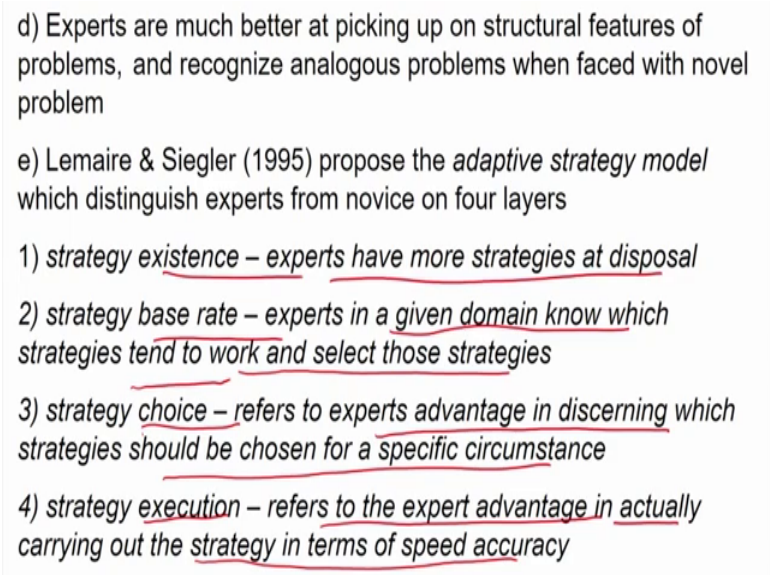

Experts are much better, picking up on structural features of the problem and recognizing analogous problem. So, experts are not fooled by the surface feature of a problem, they always look at the meaning, they always look at the conceptual level how a problem is different from some other problem. And so, they are easy they are easy and understanding the structure these structural problems and, identifying analogous solutions to it and Lemaire and Siegler in 1995 proposed that adaptive strategy model which distinguishes between experts and novise.

And what does he say the strategy existence experts have more number of strategies in disposal. Since they have solved problems in so, many ways or they are solve so many problems, they have something called the novice strategies or more number of strategies at the disposal, then novice also strategies based base rate experts in a given domain of knowledge, which strategies tend to work and select those strategies.

So, in a given domain of knowledge for example looking at math expert, they tend to know which formulas are going to work will formulas are not going to work. And so, there tend to be very choicy in using those strategies, or using those formulas which are going to work and not those formulas which are not going to work. So, they do not do

foolish acts what they tend to do is only those strategies are used by experts which tend to work and they use those strategies over and over.

And the third thing is strategy choice refers to express advantage, in discerning which strategy should be chosen for a specific circumstances. So, they are very quick in identifying which strategy should be chosen over which other strategies and, how these strategies choice works with in circumstances work with environment. So, what is the relation between environment and statically. And they are very quick in identifying which strategy is going to work and which strategy is not going to work, or which strategies to choose and which strategy to not choose. And for this strategy execution they first do that expert advantage in actually carrying out the strategy in terms of speed and accuracy.

So, basically even if they know our strategy novice would not be able to basically implement this strategy with speed and accuracy, but experts what they tend to do is since they have used strategy a number of times, they know what strategies going to work and, they have a number of strategies at the use they also can execute the strategy fast with higher speed and higher accuracy and that is how they differ from the novice, but then this is not the only thing there are certain disadvantages also.

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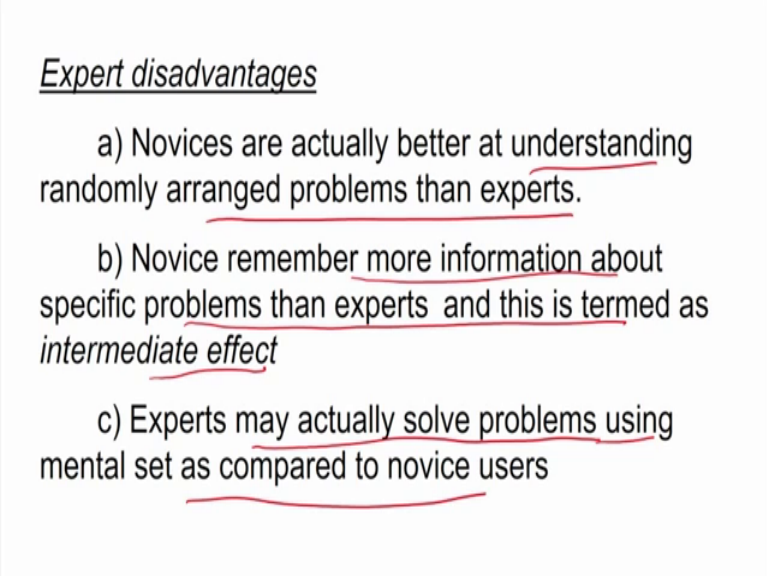

For example, novice are better at understanding randomly arranged problems and experts. Novice can focus on to problems or elements of the problem which experts will

not focus on. Since experts are always directed at solving a problem, they always look at those factors in a problem which require a solution, or which give them a hint towards the solution and so, they tend to overlook other features, or other answers in a particular problem. Also novice remember more information about specific problems, than experts and this is termed as immediate intermediate effect.

Now, what happens here is that novice since they look at a problem study the problem only, they understand all parts of the problem right, what experts tend to do is pick up only those configurations which need solution, or which have solution and so, one once you ask both the expert as well as the novice, about basic questions relating to what the problem was will tell you more about what the problem was and not the solution faster. But experts will not be able to tell you what the problem the overall problem was, they will only look at features of the problem and how to go ahead and solve it.

And experts may actually be solved actually solve, problem using mental set as compared to users, no experts make this mental set of a solution of how a particular solution should arise, how a particular problems will be represented in solution should we approach that, and they use mental set whereas, do not have these mental set. And so, they can have varied solutions they come up with multiple solutions although, if not correct it may not be correct, but they can come up with these things. And so, they are different from experts.

And so, in what we did in this today's lecture is we looked at the different type of problems solutions, which exists what are the hindrances to the problem solutions which are there need a comparison of various problem solving techniques. And at the end of it, we also looked at what is the difference between or how experts and novices, differ with each other in terms of solving a problem.

Thank you.