Introduction to Cognitive Psychology
Dr. Naveen Kashyap
Department of Humanities & Social Sciences
Indian Institute of Technology, Guwahati

Lecture – 23
Introduction to Problem Solving

Good morning friends. So, in today's course what we are going to do is we are going to take a new topic on Cognitive Psychology which is called Problem Solving.

(Refer Slide Time: 00:37)

And so problem solving is like the culmination point of any cognitive process. Now, when I say this problem solving is the culminating point of any cognitive process, what do I mean by that, now it is that process which comes right after something is encode, something is perceived, something is being attended to and then a problem is generated.

Look at any problem in this world look at the problem perception, or looking at a tree, or looking at a visual world around you. Now, the process starts by looking at the distal stimulus, then forming the proximal stimulus, then forming a percept out of it which is the process of perception, this percept is then a basically given attention, which is the process of attention a sustained attention and, through it is certain characteristics of the perceptor processed.

After that next process comes in is basically called storing this material that you are storing this visual information, which is in terms of mental representation of the visual nature, making or storing this representation into short first in the short term memory and, then storing it to long term memory. Now, once that gets stored into long term memory, it is then analysed. And the analysis of this percept for generating meaning is basically problem solving basically, what you have seen or as we as I describe this process the in the mentally presentation of what you saw as a distal stimulus, the meaning part of it the analysis part of it is called problem solving.

And so, looking at something in the environment is the start of the cognitive process and, the point at which you need to decide or before deciding the point at which you ask this question of what is it that I am looking at is called problem solving. And so, basically what is the problem here, the problem here is what are you looking at.

Now, problems are everywhere, if you look around anything that you do any cognitive process raises a problem and so, it is the next to last step in problem solving that is why the three sections of problem solving decision making and reasoning are called the higher cognitive functions, why are they called the higher cognitive functions because, these processes actually make you do the interpretation of the stimuli up till now, whatever we have looked at in terms of perception memory attention and categorization and language all these processes were required to take in information from the environment and then encode it or form mental representations of it.

The process of problem solving a process of decision making in the process of reasoning are the three processes which actually help us in making interpretations of things making interpretations of what the visual stimulus is, or what whatever problem is being put on to the cognitive system.

So, then let us look at the first slide which I have over here and so, this presents some basic problems in life. And so, what you see here are natural problems and I will also explain to you a natural problem of how what a problem is in a few minutes. So, in the first slide as you see the fish has a problem of having a problem with the fish food which is outside it is box. And so, the product the problem solving technique that it is using is basically to receive that it needs food represents this mental representation in the food is

realizes the food is outside the place in which the fish is the aquarium in which the fish is and so, decides to use this time anger to get the food.

Similarly, there are other funny problems like example, the one you see in the right extreme right top is the idea of solving a problem and so, we generally use this idea of thinking outside this box and so, this person has now come out of the box as the literal the metaphorical box that I am talking about and so, he has come out of the room from where the problem is you know he does not know how to get in and so, that is the problem for him. I so, he thought that he should think outside the box and so, he came out of it. And the last one and the or the bottom slides you see this cat having this problem of food which is in this particular box and so, what the cat decides is to use this kind of a problem solving technique, although the easiest technique would be to hit this bottle and get it out, but the cat decides to go on into this.

So, basically through these funny pictures, I am we are demonstrating water problem. And so, in your life also in your experience of everyday day to day experiences you have a lot of problems. And so, one of these problems could be taking an exam, or it could be to do your academy work. And so, when one of the things that happens in the academy is writing a paper, or writing a dissertation and so that could be also a problem. So, this kind of a thing the writing a dissertation requires certain kind of input, or certain kind of processes which you should go through to solve this problem and, this idea of how do we solve of writing a problem how do we solve this problem of writing a dissertation, or basically a paper for some course that is a that could be considered as a problem.

And so, solution to this lies in identifying something called the initial state which is the state at which you identify that what is the problem and, defining something called the goal state which is the state, or which is the point at which you have written the paper and certain rules and certain hindrances to it. So, certain rules of what you should do in what you should not do and basically a hindrances in terms of what can be done or what are the problems in your (Refer Time: 06:33).

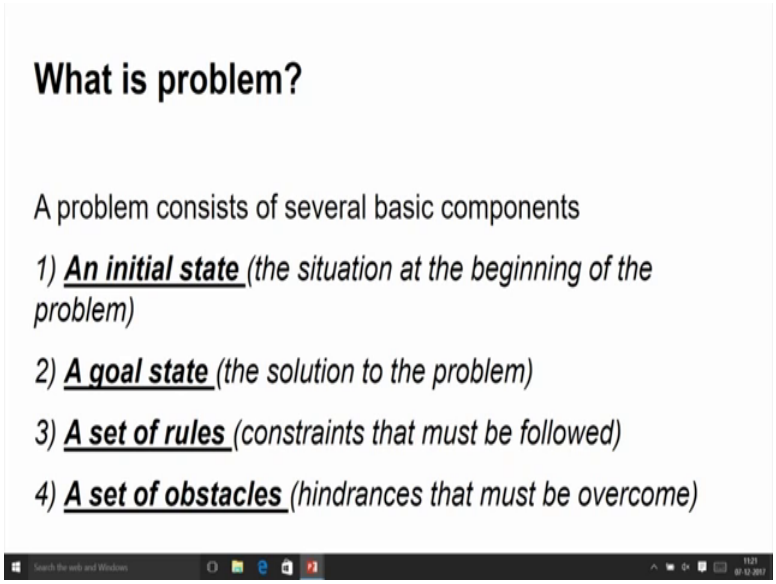
So, taking the idea of a problem of writing a paper for your academic course, this problem has an initial state where you are worrying about writing this paper, or we are thinking about writing this paper and this is the initial state. The goal state is that state where you have finished your paper and you are happy, or you have got A B or C or

whatever into that paper maybe an a I do not know, depending on your intellect you would get any numb any letter grades out of it. So, that is the goal state where you are finally, successfully written the paper and then there are certain rules.

The rules are that you have to follow certain sections certain kind of knowledge and, or certain kind of the strict adherence to for example, you cannot copy things from the internet you have to think about the genuine problem, use certain ways if it is arithmetic problems, you use certain kind of an arithmetic rule, or if it is a problem from psychology use certain kind of knowledge from psychology which suggests what can happen and what cannot happen. And, then basically certain kind of hindrance is the term of the fact that it may be you are hungry at this point of time. And so, that is an hindrance or the fact that you have to go with your friends out today evening and so, you do not get time to write the paper.

So, these are the hindrances, or hindrances could be a number of things. And so, basically then this is how the problem really works. So, this is how the demonstration of her problem is so, right. So, basically any problem will have these four parts. And so, let us discuss this in detail.

(Refer Slide Time: 08:06)



So, what is a problem, then what do we call a problem? And as I said as I explained to you with an example of what a problem is, generally a problem consists of a several basic elements. One the first part of it is called the initial state; this is situation in the

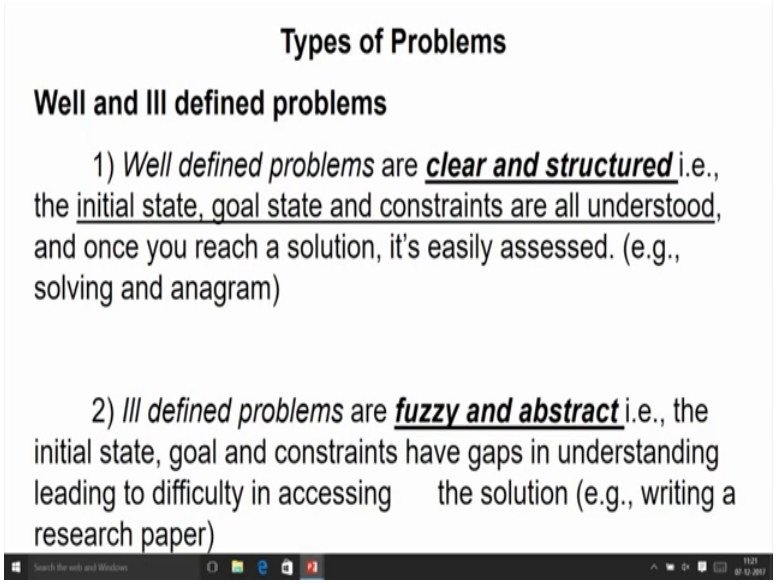
beginning of a problem. So, this is the state or this is the point at which a problem starts right. This is the state value this is the point do you realize that you have a problem and, this is the point when you start creating mental representations of the problem, or encoding the problem as such or realizing that there is a problem, or you have come to a point, or you have in your life, or in your cognitive process where something is creating hindrance of something is creating disturbances and so now, you to need to solve it.

So, the first state is realization that you have a disturbance and this disturbance should be cleared out and that is what the initial state is. Matching the initial state is a state which is called the goal state. Now, this is that state which you arrive after you have solved a problem. And so, this is that point which will come to you once you have solved the problem. Once you have acquired the solution to a problem and, then you become happy you become elated or whatever you do and, whatever feeling you have once you solve the problem that is called the goal state.

And then there are two sets certain, substrates for a set of rules, as I said constraints that must be followed. So, certain rules for example this is what can be done and what cannot be done what is allowed and, what is not allowed to solve the problem and a set of obstacles for example, hindrances that has to be overcome. So, as explained in the in the paper writing problem the hunger that you are feeling, or the fact that you have to go with your friends today evening all these things are called hindrances or set of obstacles which are all there.

So, basically then a problem definition of a problem has the problem has these four points on to it.

(Refer Slide Time: 10:00)



Now, obviously the question now comes in that what are the type of problems how many types of problem can exist and so, there are two basic categorizations which are out there, we will just look at these two basic categorizations the first categorization is the difference between a well defined and ill defined problem. Now, what is a well defined problem a well defined problems are those problems, which are cleared and structured and they have very clear and structured initial state goal state and constraints and all are understood for it for example, a problem of writing a paper.

Now, when you are thinking of writing a paper it is a very clear problem, you know that there is initial state the worry that you are having, the final state where you want to reach and you know all the hindrances which is out there and so, these are called well defined problems. So, those problems which present themselves in a very concise way, where you know where you start from and where do you want to go and you also are able to see, the set of rules which you need to follow and the set of hindrances that you need to that that you will face in the way is called a well defined problem.

For example think of a problem getting a license. Now, when you want to get a license there are said this the initial state is you do not have a license the final state is getting a driving license and, then there are certain rules for example, certain rules have to be followed you have to give a particular exam, or learning exam and then after the learning test you have to give the full test and in that you have to scroll the driving. So, you have

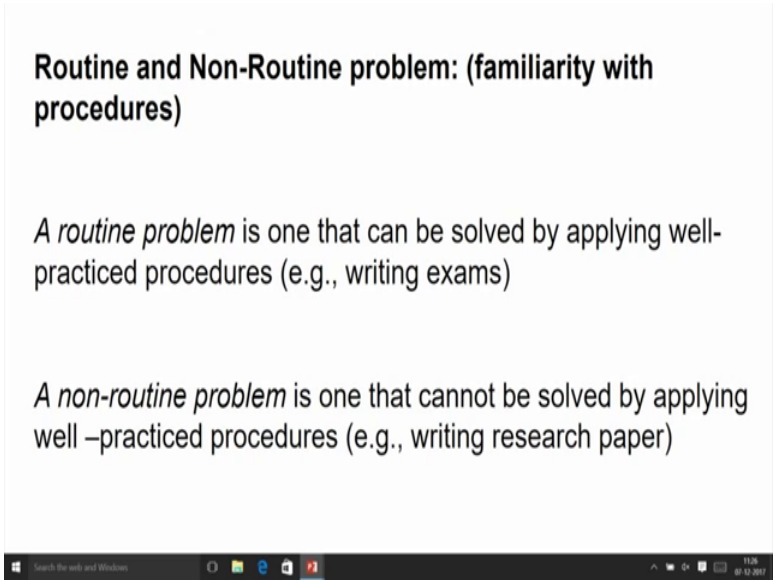
to learn and so on and so, forth. And certain hindrances the hindrances may be to study for the exam, to want to pass the first learning test and then to pass the second learning test, to make enough number of practices the fact that you do not own a car and then you want to learn car. So, basically then the fact that you have to go to someone who has a car and then get his permission, so these are the kind of hindrances which is out there and so these are well defined problem.

In addition to the well defined problems are ill defined problems. Now, what are these problems these are fuzzy and abstract problem, that is the initial goal state and constraints have gaps in understanding leading to difficulty in assessing the solution. Now, in this case what happens is there is a initial state there is a final state, but you do not know how to go from the initial state and the final state, or then you do not know how to what are the hindrances in it. For example, let us say that tomorrow I want to stand in an election and become a minister.

Now if this is the initial state I do not know what the final state would be of course, becoming a minister the final state, but I do not know how the process is what are the hindrances what are the steps to be taken and how do you become a minister, or what is a minister what kind of minister should I become and all those questions are there and, then the kind of rules that I have to follow. So, what are the rules of nominations, when they are there on what basis is my nomination can be rejected, how to stand from someone how to impress people to so, that they vote for you since it is a democracy. So, people vote for you and so, many other things are there.

So, I do not want this integrities, I do not know all these hindrances which are going to be there and all the rules which out there and so, this is an ill defined problem for example, about a person like me whose an academician to become a minister there is a set of itself becoming a minister itself is a ill defined problem, or going to the moon is an in defined problem, I do not know how to go to the moon right, where should I apply and what should I do to go to the moon. So, this is an ill defined problem.

(Refer Slide Time: 13:21)



Now, in addition to well define an ill defined problem, there is another categorization out there, which is in terms of routine and non routine problem and that is routine problems are those which you are familiar with the type of process that you have to follow and non routine problems are problems where you do not know what steps to follow. So, basically in terms of well defined and ill defined you can also have a match between routine and non routine problems. So, routine problem is one that can be solved by applying well practiced procedures right for example, writing exam making tea so, in making in tea you know what to do.

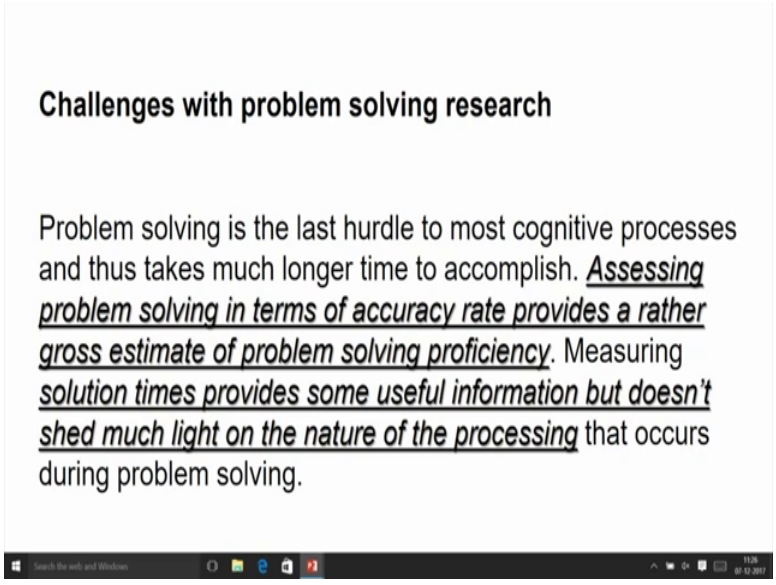
So, start with boiling the water put sugar into it to put milk into it, boil it for some time with tea leaves and then you get a tea. So, this is a well defined problem where you know number of steps that has to be there the kind of hindrances that is their initial state where you have water and other materials, other raw materials were from which tea is made and a final state where you finally, get that liquid which you call tea and enjoy and enjoy and so, this is a routine problem. Opposed to this is basically a non routine problem something that you do not face every day.

For example, let us say you have an accident and in this accident, or you have now got a twisted ankle now this is not a everyday thing for you and so, this is a non routine problem. So, how do you go ahead and treat this, or how do you go ahead and take precautions. And so, this is a non routine problem because you do not take this every day

or, the idea of writing a research paper because that does not happen every day you do not wait or so, on and so off and so often and so, that you are familiarity with this so, twisting an ankle treating a twisted ankle, or any other kind of problem which is not well defined which does not happen too often for you. And so, you are not familiar with the process is called a non routine problem.

So, basically then two categorizations one is in terms of well defined and ill defined problem. And the other in terms of what is a routine problem and non routine problem.

(Refer Slide Time: 15:14)



So, basically when this problems present there are certain ways to solve this problem, there are certain answers to solving this problem, but there are certain challenges out there which happens or which arise, when you solve problems. There are certain challenges which is out there for example, problem solving is the last hurdle to most cognitive process that I have been saying all along and, it takes a long time to accomplish. Up till now, you have seen those processes cognitive processes which help you in to encode information, make mental representations realize that some information is there store it and then basically that is the end of it right understand in which format is appearing and it and store it in some format and so on and so, forth.

This is the step problem solving is the step where, you realize what the problem is or realize what is to be done with whatever has been stored and, what is to be generated out of it right. So, that is the problem solving position and the solving problem does take

more time it takes more time because, you have to realize what where you are and where you want to go right, if you got if you have a problem you know you should have know where you want to go, if you do not know where you want to go then it is a not a problem solving technique, or this is not problem solving. So, you always know where you want to go or, what is the goal state in a problem. So, assessing problem solving in terms of accuracy rate provides a rather gross estimate of problem solving proficiency.

So, why am I saying that that accuracy is not a good idea, accuracy does not demonstrate how do you solve a problem. Now, a person could be very familiar with the problem it could be a very routine problem and so, his accuracy would be very high, but then that does not guarantee the fact that he the way he is solving a problem, how he is solving a problem, or what is the way in which he is solving a problem just with the fact that since he has seen problems like this. And so, basically he solves it much faster or more much accurate does not give any sense of what the problem is or how the solving technique is. So, being accurate is just a chance factor right and so, chance sector accuracy has nothing, or very less informative about the problem solving techniques.

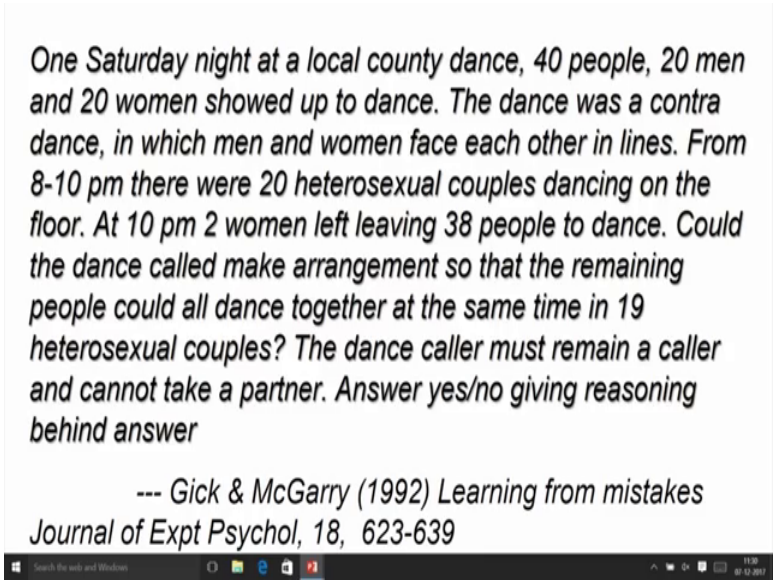
The other way to look into it is measuring solution times which provides some useful information, but does not shed much light on the result of processing. Now, how quickly you solve a problem again how quickly you solve a problem says, how can you move from the initial state to the goal state, but it does not tell you whether you realize the hindrances, whether you got through the real illnesses maybe you are too lucky and, the fact that a number of hindrances does not arise. So, you have not considered all the hindrances, or you have you are lucky to get a set of rules which actually take you through the problem space, we will come to the idea what a problem faces in the later section, but maybe that is the reason how you are solved the problem.

And so, basically solution times are no guarantee to how the processing, or what is the kind of processing which is happening. So, neither accuracy nor reaction time which are the two major things in terms of behavioural research, remember lecture one on methods of doing cognitive psychology. And one of the methods were the behavioural methods, in the behavioural methods we were looking at something called speed accuracy Tradeoff or Sweden accuracy as being two major ways of solving problems in cognitive psychology are dealing with cognitive psychology related problems. And so, both

accuracy in reaction time does not give you too much information about the solution process of how does it happen.

So, basically then there are other ways of also how problems under should happen. So, these are the two ways of solving the problem, but it does not tell you how the problem solution really happens. And so, solution of problems of how people actually went and solve a problem it is really a difficult thing to assess. And so, one of the ways to do to basically whenever methods, which are used to basically come up with the solution was called the idea of a verbal protocol, but even before we go there I have a problem for you and let us see how do you solve it.

(Refer Slide Time: 19:16)



So, this problem says that look at this problem and I will give you a minute to actually read that and, then basically come up with an answer. So, leave this problem and let us see if you can answer it. I will give you half a second to read this problem maybe 1 second to read this 1 minute to read this problem and come up with an answer. So, starting now here is your 30 second period for reading the problem and coming up with an answer.

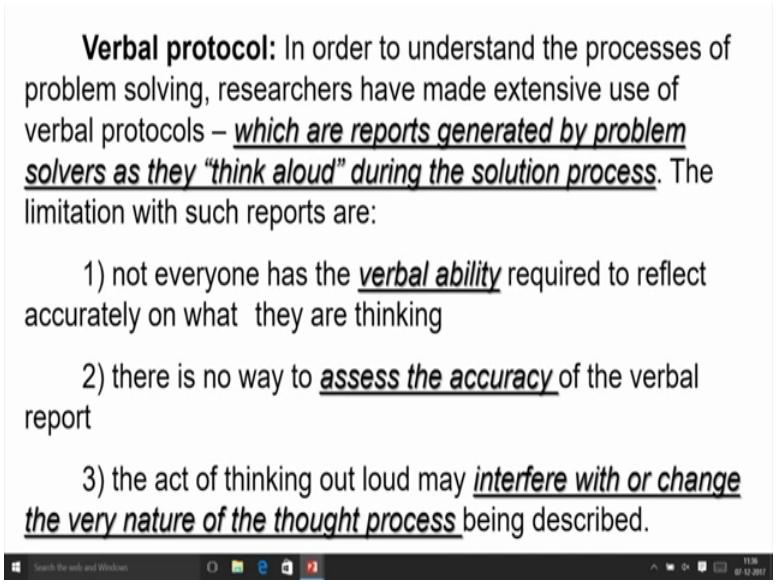
So, the 30 second period is up and I am pretty sure that most of you would have been able to solve this problem. Now, this is a famous problem by Gicks and McGarry and was published in Journal of Expt Psychology at some point of time, do you know the answer to this problem the answer is no. And so, those of you congratulation who could

have solved this problem and, those of you could not take this away there is no way that this is possible this kind of arrangement is possible. And so, they also found Gick and McGarry also found that only 50 percent of the people could solve the problem and 50 percent could not, in if it is rushed through time.

But given enough time, most people were able to solve it the answer is no it cannot be done. And so, this is basically the idea for problem. So, basically in terms of reaction time that reaction time does not say how problem is represented because, I really do not know how did you represent this problem and so, maybe you have seen a problem like this before ensue come up with an answer and the accuracy of it also does not know how you solve this problem because, I do not know how did you make the representations of it.

So, basically then what is the way in which I can understand how a problem is represented or how what is the process of representing a problem, or how did people solve a particular problem.

(Refer Slide Time: 21:38)



And one important way in which we can do this is something called the verbal protocol. So, what is the verbal protocol? Now, in order to understand the process of problem solving researchers made extensive use of something called verbal protocol. If you remember structuralism there was something called insight, and insight is much much a close brother to verbal protocol. And inside studies what was done is people were asked

to do certain kind of psychological tasks and then, they were are when they were doing this task they were asked to basically relate how the task was being done and this insight generation was something like this.

Verbal protocol is a similar procedure in which people are to report on how they generated the solution to a problem. So, which are reports so, basically what are verbal protocols, these are reports generated by problem solvers as they think aloud during the solution process. So, as you are solving the process or solving a problem people are made to go ahead and report loudly how they are solving it for example, the problem of how do you act 2 plus 2 right. Now, how do you go about it? What is the way of addition? And so, what you could do is first I will think about 2, then I think about something called addition, addition is basically this then I take the other 2, I use the operator addition, I go ahead and add this, now I come up with an answer, now I verify this.

So, this is basically how our protocol really works it. So, all the steps that you take in doing addition of 2 plus 2, or any other problem solution, what you have to do is you have to tell in a stepwise manner, what is going on or what is the process that you are using and so, this is what is verbal protocol. You see a problem here, I see and so, what is the problem here, there are several problems with this kind of a protocol. And the first problem is that everyone does not have the verbal ability required to affect accurately what they are thinking.

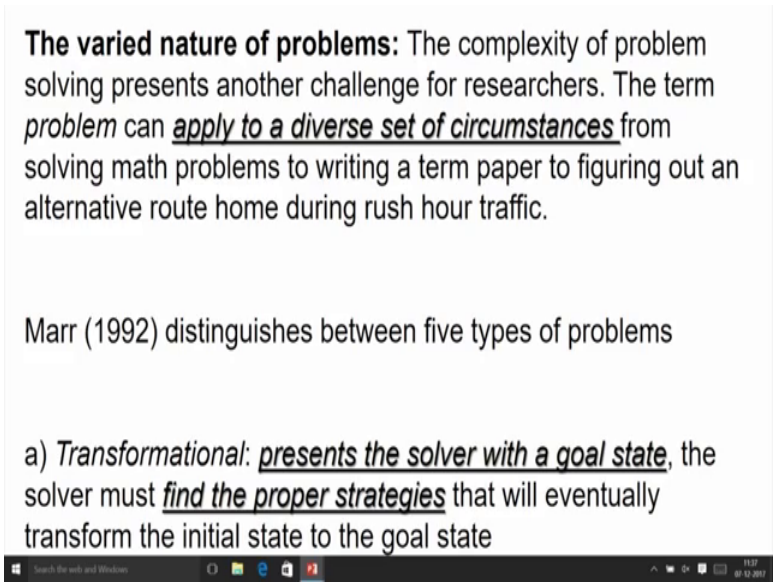
It is very difficult to verbalize what people are thinking and so, the I the problem here is that the ability of people to basically narrate what they are thinking is a major concern here, people are not able to narrate what they are thinking and so, verbal protocols fail, or the idea of loudly speaking out thinking aloud what they are doing fails because, people do not have the verbal ability they cannot generate, or they do not have the right verbal device or right verbal requirements and, enough words to speak out the problem.

The second problem is there is no way to access the accuracy of what the verbal reported. Somebody would may say something else and, they must be doing something else and so, there is no way to tell if people are lying, or cheating, or deliberately run deliberately in deliberately if they are coming up with problems or if they are inputting the right technique of how they are solving the problem. And so, there is no way of

accuracy testing and, the third is that the very act of thinking aloud it may interfere with or change the way and problem solution is thought.

And so, since I am doing a dual task right I am also going ahead and loudly shadowing the process of problem solution which is basically loudly also speaking it back. So, it is a dual task and so, this dual task may in the nature of the task itself the idea that I have to use also verbal memory or verbal information processing, verbal representations or basically repeat this thing back may create problems because, what will happen is this idea of verbally repeating it things back may interfere with a very idea of the solution, with a very idea of how the thought process of solution really works. And so, these are the problem with the verbal protocols of course, so, these are the problems with the solution of problem.

(Refer Slide Time: 25:25)

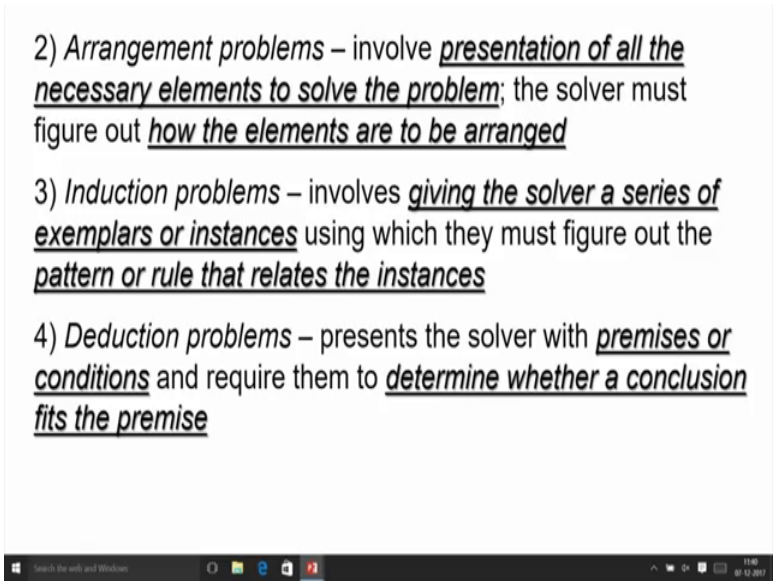


Now, another problem or another way why problem solution cannot be tacked on towards difficult to look at how problems are solved is because, problems are of varied nature. And so, the complexity of the problem solving presents another challenge for researchers the fact that there are different kind of problems and, there are device set of circumstances and from right from solving a math problem, to solve in the verbal problem, to solving a traffic problem, to solving n different problems. And so, with these such a circumstances there are a number of problems that may arise and so, all these problems may have different-different solutions. And so, that could be one of the factor,

or determining factor right problem solution or looking at problem salvation could be a problem in itself.

Now, Marr 1992 he distinguished five different types of problem that can arise. And so, we look into these problems one by one and then we look into the act of the problem itself. The first kind of problem that Marr in 1992 defined is called the transformational problem. And so, what is the transformational problem? It is a problem in which the solver is presented with the goal state and he knows the initial state and, then what he has to do is to find out appropriate strategies, to use those strategies and reach the goal state. So, you know the initial state you know the goal states and you have to do something, or use the appropriate problem solving technique, problem solving strategies and eventually reach the goal state. So, these are transformational problem, you have to transform from the initial state to the goal state using certain rules, or certain by navigating certain hindrances arrive at time.

(Refer Slide Time: 27:00)



The second prior type of problem are called the arrangement problems. So, what are these problems, these problems present the user all with all the necessary elements which are required for solving the problem, what is the role of the receiver then the solver of the problem, he has to then arrange all these elements together in a way that gives the final solution. So, you know all you are given all the solution elements, or you are giving

all the parts of how to solve a particular problem. The only job of a person here is to basically arrange them rearrange everything. So, that the solution comes out of it.

The third type of problem which arise here, or which people in always face, or which might define in his in his problem solving, or types of problem definition is called an induction problem. And what is the induction problem? Involves giving the solver a series of examples or instances so, is basically forming an analogy in solving problem by analogy. So, induction problem a number of instances, or exemplars are given to you and using this you have to figure out the pattern or rule that relates the instances together.

So, you have a number of exemplar number of instances are given to you and now you have to find the pattern, through which these instances are connected and once you know these rules one you once you form, or I understand this rule you will be able to find the final solution. So, induction problem certain things are given to you, certain kind of examples or instances are given to you, you have to find the rule of how they are connected and this rule will actually give you the final solution of how the how to reach from the initial state to the final state.

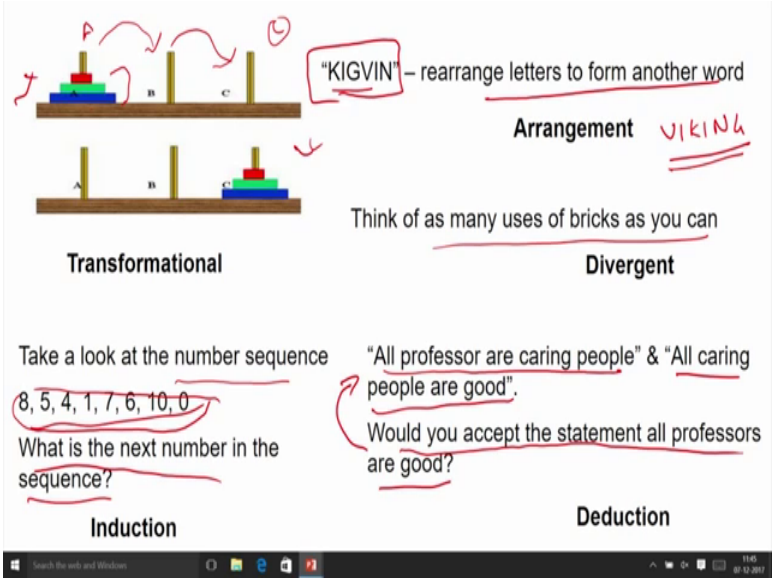
In deduction problem what happens is certain premises, or conditions are presented to people and they need to determine whether a conclusion fits the premises. So, certain kind of provides a certain kind of truth statements are given to people to start with and, then what people need to do is to they have the conclusion in front of them and, they have to look at the fact that given the fact that the premises are true the conclusions are also true. So, this kind of reduction problem we will see in the next section which is called thinking and reasoning. So, in terms of reasoning and the judgment and decision making, the next section that were thinking will see these kind of problems basically, these kind of deduction problems or this kind of premise rigid problems are syllogistic reasoning and the inductive reasoning and so, well look at that in the next session.

But for now what deduction problem does is some certain number of truth value certain number of truth statements are given to you and, what people need to do is to find out that given the fact that certain truth statements are out there, whether the conclusion fits these two treatments, or whether the conclusion fits the premises in certain way. And the last kind of problem which are there are called the divergent problem. So, what are these problems, they operate as in a way that the solver here has to give a number of solution,

whatever comes to your mind a number of solution. And so, that is how the problem solution really works, or this kind of problem really works. So, divergent problems are those problems there are a number of solution exists and the solver can then give you a number of solutions.

So, let us look at these problems one by one. The first kind of problem so, five different problem, the first kind of problem that you want to look at is arrangement problem.

(Refer Slide Time: 30:31)



Look at these words here can you rearrange the letters to form an answer the answer here is, VIKING very good for those of you who could answer it. So, this is an arrangement problem, everything is given to you here, what you need to do is rearrange the letters. So, that you get the answer.

Now, diverting problem as I said, it let us the solver give a number of solution and so, as you think the problem here could be think as many used objects. So, bricks could be used for beating someone, it could be used for a making a house, bricks can be used for as a weight, as a substitute for weight it could be paperweight, it could be used in selling something as in terms of standard weights or, so many other things right and so, these are divergent problems. This is a deduction problem so, certain premises are there and these premises. So, all professors are carrying people, this is the premise and this is true. The second premise are all carrying people are good this is again a premise which is true and so now, you have to validate this conclusion, which is drawn from these two premises the

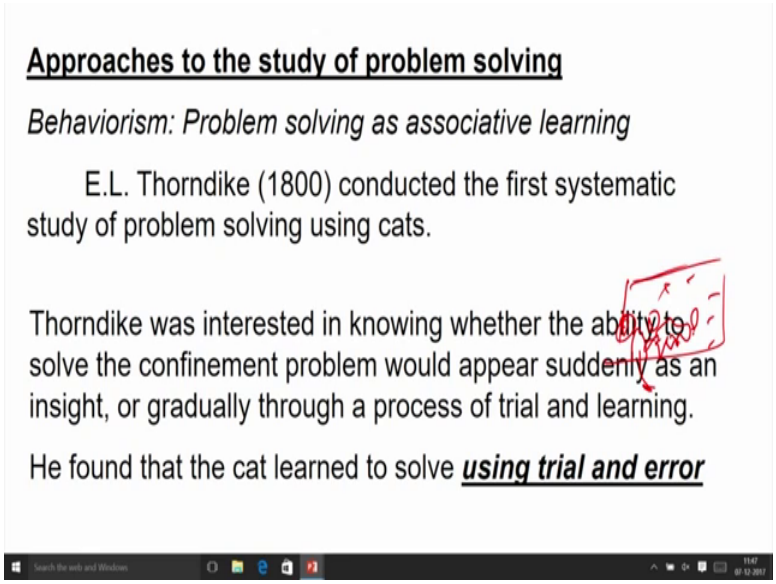
fact that would be accept the statement that all professors are good, whether all professors are good follow from these two statements and, these kind of problems are called the deduction problems right. So, certain premises are given to you and a conclusion has to be validated against the premise.

The fourth kind of problem is called the transformational problem. And so, what is here I mean transformation problem you have the initial state and the goal state known to you and, you have to use a particular strategy to arrive from the initial state to the goal state. And so, as you see this is called the tower of an eye problem. And, so you have to the fact here the requirement here is to move these three workers from position A to position C. So, same arrangement here, the only thing is you can make you can move or these circles one at a time.

So, one movement is allowed you can move from here to here, or here to here kind of a thing right. Also the fact that a smaller circle will never go beneath down on or a smaller circle cannot be beneath a larger circle. So, that is the kind of thing so how do you arrange from here to here and so, you are know that this is the initial state, this is the final state and so, by moving one at a time and this constraint using this constraint that a smaller circle cannot be beneath, or cannot be below a larger circle, you can solve this problem. This is called a transformational problem. And the last kind of problem is called the induction problem and this is look, and look at the number in your sequence and then come up with an solution.

So, this I will explain to you this is rather interesting. So, take your time solve this problem, I will give you the solution to this problem, but let us wait for it and because, I will use this problem as some other at some other places also. So, can you find out a rule through which these numbers are connected, there is a rule remember. So, if you go about 5 minus 4 is 3 or 4 5 8 minus 5 is 3 5 minus 4 is 1 4 minus 1 is 3, you will never come to the solution because, there is a certain rule to it I will tell you the rule, but with that will happen as we progress into this session.

(Refer Slide Time: 33:44)



So, how do I solve a problem what are the various approaches to solving a problem, the rest several approaches to solving a problem for example, the first approach is behaviourism solving problem and associative learning. So, two approaches I will describe here one is the gestalt approach, the other is the behavioural approach. Comes from the first section itself introduction to ready psychology, where we saw what is behaviourism is basically understanding stimulus response relations.

So, basically what behaviour is said is there is nothing called the cognitive system there is nothing called the human mind, there is a behaviour there is a response and making connection between these behavioural response, or behaviour in response is what behaviourism is all about. So, look at each behaviour look at each response find the most optimal response, the most optimal response is the correct response to the stimulus and this is associative running associating a response to a stimulus.

So, behaviourism presents a solution to problem solving, or gives a way to solve problem. And so, the people who started explaining problem solving s as be various as behaviourism where early behaviour is like (Refer Time: 34:48) and so, turned like 1800 he conducted his first estimating study of problem solving using cats. So, what he did was? He was looking at feline animals and so, he took this feline animal put it into some kind of a box a capture box and, the cats does not like to be captivated into box. So, what he did was? He took this cat put it into a box and enclosed the box. Within the box was a

liver the cat had to realize to press this lever. Now, look at the easiness of it what cats do when they and when you enclose it into some kind of a structure, or in some kind of a cage it tries to scratch it. And so, this liver was placed in such a way that it needs to be scratched down, or bend down from the paw. And so, the scratching ability would give the cat the idea to scratch this, or bend this paw and so, later sooner or later the cat will realize that if I scratch here. So, where the liver is so, this is my box and so, the cat is put here right. And so, here is the lever the cat initially goes ahead and scratches everywhere right, but once it scratches here there is a door which opens and the cat can now escape out of it. So, the cat has to realize that this is what and this is the solution to the problem.

So, Thorndike was interested in knowing whether the ability to solve the confinement problem would appear suddenly as an insight of gradually through the process of trial and learning. So, what he was want what he wanted to see is that whether cat did something for learning the solution that I if I scratch the right button window door will open and I will get out of it, or whether the cat sits and through inside through some kind of a magic, or through some kind of a internal problem solution will the cat be able to know that I scratch this. And so, what they found out then the cat learned by learn the idea that if I press this button, the door will open I can move out of it through something called trial and error and what is trial and error what the cat did was it is scratched everywhere and so, if it scratched a number of times slowly it realized and if I scratch at this button what is going to happen is the door is going to open and I am going to come back of it. And so, that is what he realized.

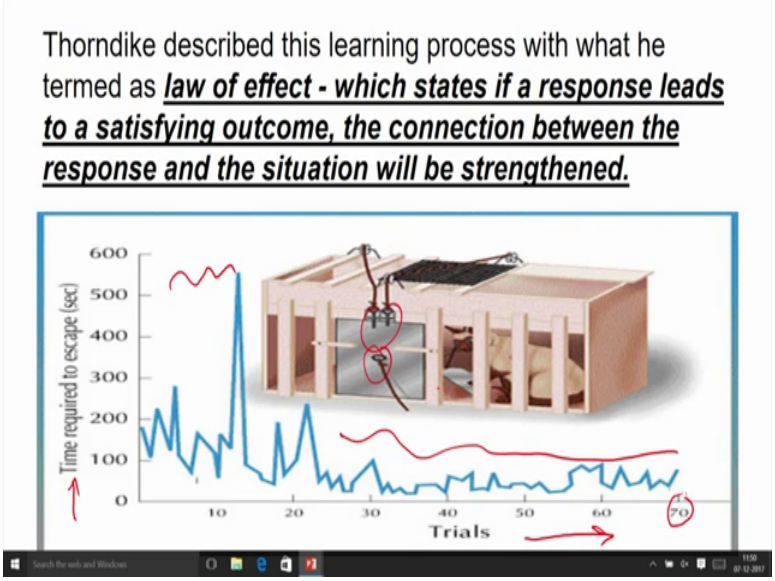
Now Thorndike describes the learning process with which is termed as something called the law of effect. And so, what is law of effect it states that if a response leads to a satisfying outcome, the connection between the response and the situation will be strengthened, but if it leads to not satisfying outcome this is deleted. So, scratching was the satisfying or scratching on livers scratching on things which was coming out of the cage was a successful response was the cat scratched on everything which was protruding out of the cage, but then it started not scratching on polished surfaces right.

So, this idea of scratching on to those objects which are protruding out, or protruding in, or which was shiny in the in Thorndike case lead to the freedom of the cat that is this association increase in assertion with this fact that I should scratch on those objects which are shiny, or those objects which are illuminated in some way, or this look which

looks like a liver will actually make me escape is what is called the law effect. And so, what a law of effect says that the cats learn that when I do a certain act and, if I am positively rewarded I will do this if I am not positively rewarded those acts I will not do.

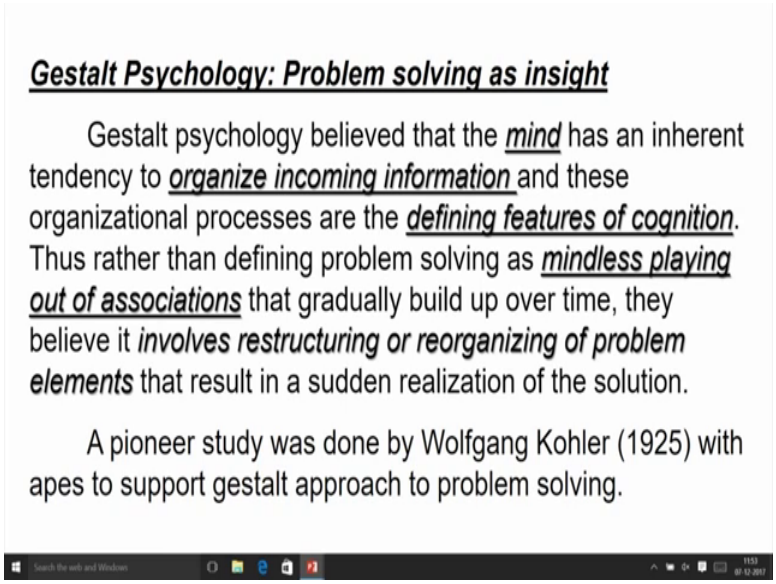
Now, say this is what the Thorndike box is all about and, what you can see here is the number of trials is the cat took and the number of time required to escape.

(Refer Slide Time: 38:26)



And as you see initially it is very high. So, this is trial and error and so, as the cat kept on doing it later on the time required was in terms of 100 seconds right, in the by the 7th plus 17th trial the cat was as fast as you put into it million 100 second it will escape, but initially it was requiring 600 seconds to find this idea. And so, if you can see this is where the cat is this is what the arrangement is all about and here, you see the latches and so, it needs to scratch, we scratched on the right surface with the door we open and that is what it was it. And so, what behaviour said is that the solution to problem is always in terms of trial and error.

(Refer Slide Time: 39:00)



In a position to the gestalt is which believed that by forming perfect associations between responses and stimulus can a problem be solved. So, problem solution is basically making up new associations and, rewarding those associations which give us a reward or learning those associations which give us a reward, gestalt is opposed this view they said that problem solving is basically insight related process, which basically means that it is not the act of doing something which solves a problem, problem solving happens because people restructure representations, people restructure the problem in certain way meaningful representations and, these restructuring of meaningful representation is how the solution generated.

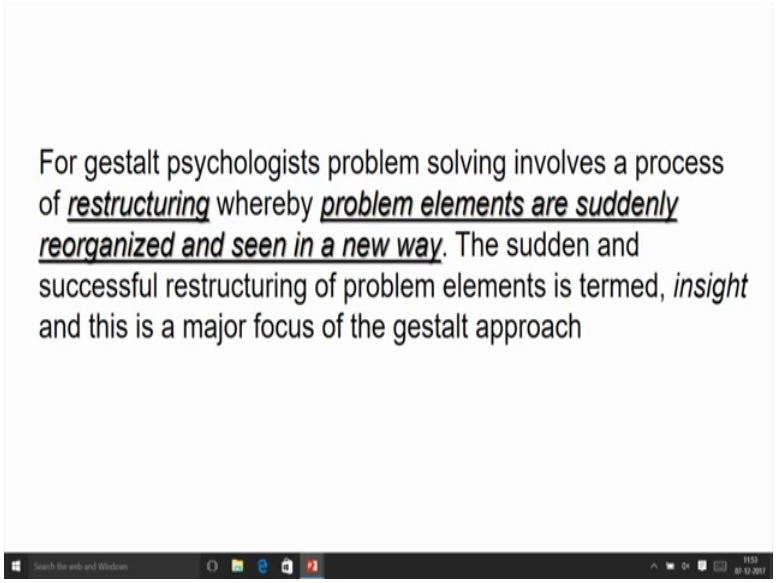
So, gestalt psychologists they believe that mind has an inherent tendency to organize incoming information. So, what the mind could go and we saw in gestalt theory what gestalt is proposed is certain gestalts law. And what does this get gestalt really say, it is say that the mind organizes the restructures information restructures mental representations and, this is this restructuring which gives solutions which make easy solutions right. So, what the mind does is it always organizes and restructures information right.

Now, defining features of condition thus rather the defining problem solution as mindless playing out of associations that gradually build up over time, they believe that it involves restructuring or reorganizing the problem. So, they believe that it is solution to problem

does not come from time again and again, making associations mindless associations between the fact that some time I will get rewarded, or at some point of time I will get rewarded, or some of my behaviour will get rewarded, they said it is not the solution. The solution is the solution from power to problem comes from the fact that, when I look at a problem and not only look at a problem I restructure it in certain way, I rearrange the problem elements in certain way such. So, that the answer comes to it that is what a solution to our problem is all about.

Now, a pioneer to the study a pioneer to gestalt gestalts school was Wolfgang Kohler and so, what he did was he found a popular way of basically, or he found a way to test this idea that insight leads to problem solution.

(Refer Slide Time: 41:11)



So, basically for gestalt psychologists then problem solve a solution involves a process of restructuring, where my problem elements are suddenly recognized and seen in a new way. So, what happens is they believe that the elements of a problem, the problem itself is restructured into a mind and it is kept on restructuring till the point of time that a solution suddenly appears to you. And, this is called insight or in some books it will be called as the experience. So, this experience leads the so, what happens is that problem solution has a stage, where people do not do anything they just sit, passively and reorganize the problem, or rotate the problem in certain way, mentally restructure the problem in certain way till a solution happens.

So, against the fact that what behaviour says that problem solution is all about making, or doing acts and learning a solution, what they believe it is mental restructuring which leads to reorganizing of information which leads to problem solution. So, the sudden successful restructuring of a problem element is termed the inside and this is the major focus of gestalt approach.

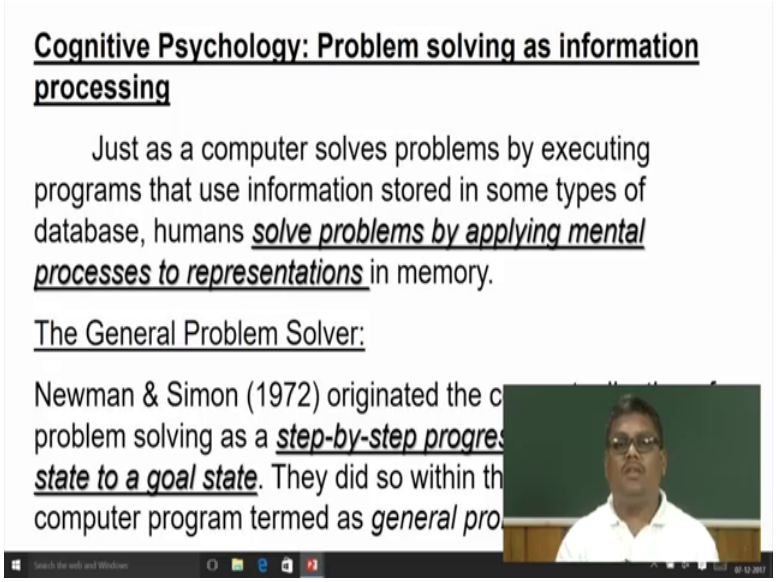
(Refer Slide Time: 42:17)

And so, how they tested it they kept certain monkeys and with crates. And then an appealing item. So, this is what an appealing item is here is the appealing item here, some banana were actually taken in they were held on to the roof and, certain crates were given to these monkeys and they were made to say, what Kohler found out is that initially the monkeys try to jump to the roof and take the banana. Now, that was not happening because, no matter how hard the monkey jumped they, were not able to reach the roof. So, what did they do they kept trying everything right, initially they kept trying everything and then after a period of time this sat there with the idea.

Now, the solution is right there in front of it there are number of crates, which can be put over one and another and a kind of a ladder can be generated. So, what these monkeys did was they sat there for a certain period of time. And then later on after a certain period time has elapsed, suddenly the idea came to them or they developed this idea by restructuring this problem. And so, they stacked the boxes in this way and now it is like a ladder and so he climbed on the ladder and takes the food. So, this is this wait time is

what is called the insight, or this wait time is what leads to the insight and the solution to the particular problem out there.

(Refer Slide Time: 43:32)



Now, cognitive psychology could also suggest autosuggest solution to problems. So, cognitive psychology also is a way of solving problem, in what is the suggestion here, now just as computer solvers, computer solves a problem by executing programs that use certain information stored on to it humans also solve problem by applying certain mental process to representations. So, what does computer to computer program takes in information in certain way arranges this in a certain way, does certain kind of processing on manipulations and come up with a solution.

Similarly, what earlier cognitive psychologists like Neville, he suggested that humans also saw problem in this way. The problem solution happens by applying certain processes applying certain rules, or applying certain methodologies to already stored representations. So, already stored representations which are coming from perception attention and so on and so forth the basic processes, these representations are basically taken in and certain processes are applied on to it and, these processes lead to least to finding the solution to a problem.

So, basically they gave these cognitive early cognitive psychologists gave the idea of something called the general problem solvers. So, what is the general problems solver, or the general problem solver is a conceptualization of the computer program which solves

the problem. And so, what are the general problem solver, does it takes in a problem breaks us into sub problems and then by solving this sub problem one by one attains the final goal state. And so, this is what the general problems server does and, so this is about Newman also said. So, Newman and Simon in nineteen seventy two they originated the conceptualization of problem solving as a step by step process from an initial to the goal state. So, what I do here is, if I have a bigger problem, if I have a problem of writing a research paper what I do is I break it into smaller problems smaller sub goals right.

And so, each sub goal I take the initial problem divided into in certain parts and, then each part now has a goal in a sub goal and, then what I do is start from the first part start initially from the first sub part reach to the sub goal, then start to the second part sample. So, writing a paper could be first going to the library and sitting there, achieving that, once I do that then reading something in the library, then understanding something, then finding a new problem, then reading a little bit of what that problem, then coming up with the answer of what the problem is then discussing that with certain professors, or looking at certain materials that and finally, writing the paper.

So, the writing the paper is now broken down into several steps and, similarly well this is what Newman and Simon did they said that larger problems can be broken down into smaller problems and can be solved by step by step process from the initial state to the final state. They did so, within the framework of a computer program which is called the general problem solver or the GPS.

Now, what is the GPS the GPS is basically a model of human computer problem solving sorry human problem solving; now, one that can be applied to any problem. So, basically it is equivalent to computer problem solution. So, basically the GPS is a model of human problem solving which is basically made, or which is basically developed out of the computer problem solving things. Now these approaches minimize the distance between the initial state and the goal state by breaking the problem down into a series of sub goals. So, what I do is if a bigger problem is there, I know the initial state I know the goal state and I do not know how to solve it, I take the initial problem I break it into it is part as I said making the writing paper problem into his part.

So, first I will go to the library first and achieve that thing. So, initial goal is starting from here final goes in which in the library. Once I reach the librarian see so, many people are not motivated. So, first problem solved in terms of motivation of writing it, then I will read some books the more I read books the more ideas will develop and when that happens, when I have more a number of ideas with me, I will then consult some professor, or some kind of a TV program, or some kind of internet websites where more information is given from there I could write a problem. So, basically this whole writing a paper problem is not broken down into sub parts this is what it is said here.

In the GPS also I minimize the distance with from the goal to back to the initial problem by creating sub problems, or by creating sub goals and, it is easier for a person to reach from reach the goal through sub goals, then to reach the goal on it is own. Now, the sub goal analysis is accomplished through the application of something called operators. So, how do you reach the sub goal though there are certain operators. Now, what is operator is basically a fancy word which is out there for problem solving techniques.

So, one subway technique is going to let us say the library and that there is one thing into it and then there is reading a book. So, how do you read a book there is a certain technique of motivating yourself and, then there is another technique and so on and so forth. So, basically these problem solving techniques taking a bigger problem and solving it require several techniques, a bigger problem could be how to find out how do people process first language right. So, if people have dual language proficiency let us say I have a proficiency of English and Hindi.

Now, something is spoken to me in English, how do I respond to this do I take this thing take this word in English and search for solution to it in English, or do I take the problem the word which is being spoken to me in English translate back into Hindi search for the solution in Hindi, then come up with the solution in English and then respond it back. Now, this is the problem how do I break it in a several problem, first is a behavioural part, second is the cognitive part the third is the mirror physics part.

So, first I do some behavioural analysis to see how the solution is and, then another sub part is there. So, part of it looking at behaviour response so, kind of design problems in terms of several problems could be developed in which a certain kind of a sentence is given to you an answer is looked into so, several kind of things is then we look at the

speed and accuracy of how you are doing it, then we will design a cognitive experiment, or maybe a brain related experiment EGRP experiment where we look at the time process, or the brain potential what happens in the brain when you are solving this problem.

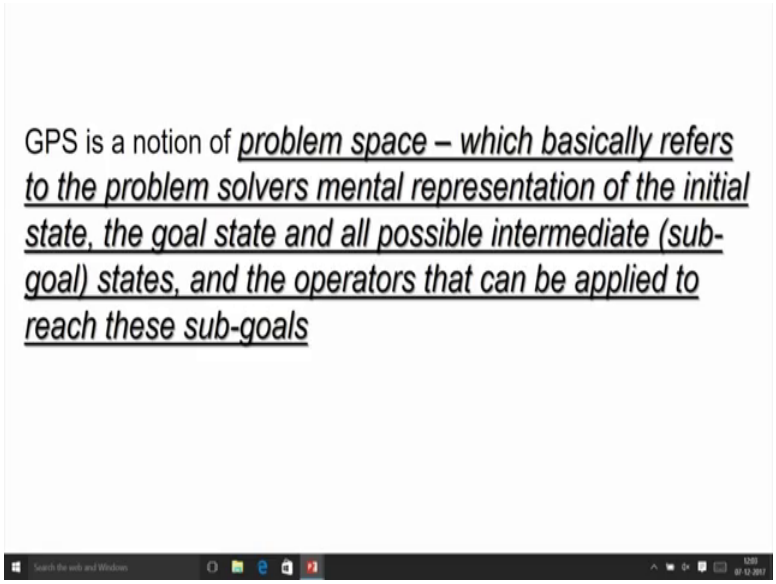
And by combining these two things together these two sub problems I can finally, say how do people think, or what is the way because the behavioural will only give you the result, what happens in the brain you do not know. So, you use brain imaging techniques to tell you what happens in the brain when this kind of problem dual language, or single language people solve a problem. So, basically that is what it is and so these, using those two techniques are called using the operators.

So, these techniques are applied at the micro level to reduce the differences between the current state and the sub goal state. So, what could happen is since I have created a bigger goal, I mean from starting from the initial point to the final point is as the bigger the problem says the bigger problem says, I would not divide the problem space into sub problems space. And so, I can use operators both at the level of micro level, which means navigating from navigating within the sub problem in the in the earlier case that I defined.

So, I can use certain operators or certain so, use certain techniques for studying only the behavioural part of it and, the electrophysiological part of it this is called the micro level analysis and, then to reduce the distance between the initial in the goal state, or I could use a bigger technique which is techniques of summation of results right. Reduction technique, or some other technique by you through which I can take the two results that I have the behavioural result and the electrophysiological result match them together and (Refer Time: 51:10) of the final solution.

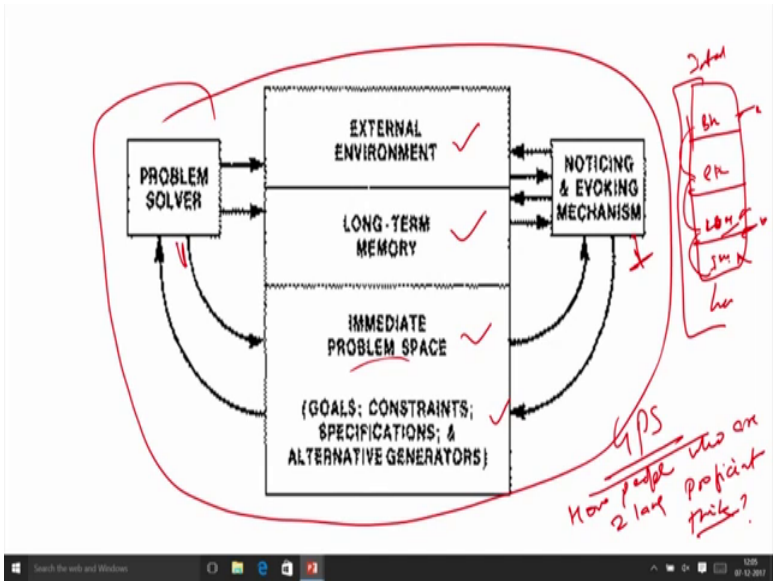
So, I can use operators both at the micro level, where each part of the problem how each part of the problem is solved, or sub problem is solved and then use techniques at the micro level of integrating these results together to give us the final solution of how do people, who have two language proficiencies really think. So, GPS is a notion of problem space which basically refers to the problem solvers mental representation of the initial state, the goal state and all possible intermediate sub goal states, and the operator that can be applied to these.

(Refer Slide Time: 51:41)



So, basically GPS talks about initial state a goal state and sub problems and certain operators into it.

(Refer Slide Time: 51:52)



So, look at this definition or look at this picture this is how the solution will really look at this is an idea of a human GPS general problem system. So, as you look into it this is the problem solver this is the noticing, or review mechanism external environment long term memory immediate problem space, goals and constraints this whole thing is called the GPS.

Now, how does it really work this is my GPS system. So, this is my initial state and then I have so, many inputs these are operators on to it, this is my goal state what I do is I break my problem into several parts. So, this is the behavioural part this is electrophysiological part, this is the cellular biology part, or cellular biological mechanism part, where I look at certain cells of how they respond to certain neurotransmitters which will how they will work and this may be another imaging this. So, this is electrophysiology and, this is a brain imaging and from all these I will combine the results together to come up with the solution of how people who are 2 language proficient think, or how do they come up with solutions. So, basically then this is what it is this is how the idea of a general problem solver is really done.

So, in this today's lecture, what we did first we talked about what is a problem first of all, definition of a problem and we saw different-different definition which are out there, then we looked at a number of problems a number of types of problems which exist out there. And, we discussed these types one by one and after that we looked at certain approaches to solutions of problems. We look at the gestalt approach the cognitive approach, as well as the behavioural approach. And, we saw how these, what these approaches has to offer as solution the problem.

In the upcoming lecture will look into how a problem is actually solved. And, then we look into something called creativity in inside of how do they go with problem solving.

Thank you.