Advanced Cognitive Processes
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Lecture-27
Problem Solving – II

Hello and welcome to the course Introduction to Advanced Cognitive Processes; this is the sixth week and we are talking about problem solving. In the last lecture I talked little bit about an introduction into problem solving what all aspects problem solving involve and I also talked about things like how to represent the problem correctly in order to get a solution get to solutions more easily.

We also talked about an approach of situated cognition wherein idea is lot of you know problems or lot of things that you learnt to solve are in some sense related very closely to the context and it might be a sometimes difficult to transfer learning in a specific context; such as in a classroom to a real life scenario and that it is advised that even classroom teaching for that matter should involve aspects that teach people be able to apply those problems in real life studies. So, that is basically how effective problem solving shall be taught.

Today am going to start talking a little bit about problem solving strategies and we will talk about how these you know how these strategies are efficient or inefficient.

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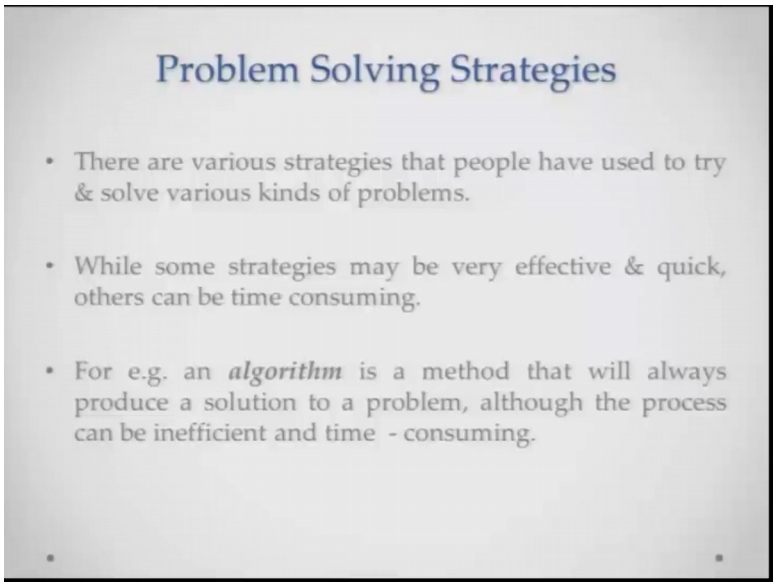

So, there are various strategies that people have used to try and solve various kinds of problems and; obviously, different strategies are used for different kinds of problems and one of the things that determine your success in solving a particular problem is the choice of the correct strategy. So, we will just take a couple of these kind of methods and so, strategies if you start discussing about strategies a some strategies might be very direct, some strategies might be rather straight forward, direct that takes less time and very efficiently and efficient at solving the problems.

While there could be other kinds strategies that people might erroneously pick which basically might leads to spending a lot of times, spending a lot of effort and still not really guaranteeing or giving us a good solution. So, one has to be very careful one has to be very vary of the fact that correct kind of strategies are selected to really as approach particular kinds of problems.

So, algorithms are one of those kind of strategies, now an algorithm is just a method that will always lead you to solve the problem that will always lead you to the almost a correct solution to a particular problem, but then algorithm in the sense because they are detailed in stuff can sometimes be very inefficient and it generally would take a lot of time.

Suppose you can take an algorithm as a very methodical approach to solving a particular problem, but a lot of times and you can link this to your real life scenarios as well a lot of times methodically and gradually solving a problem is not an option that we have and you have lot of time pressure and sometimes you really want to achieve something very quickly and then elaborate and elaborate algorithms even though they are almost guarantying your solution are not really chosen by individuals you know.

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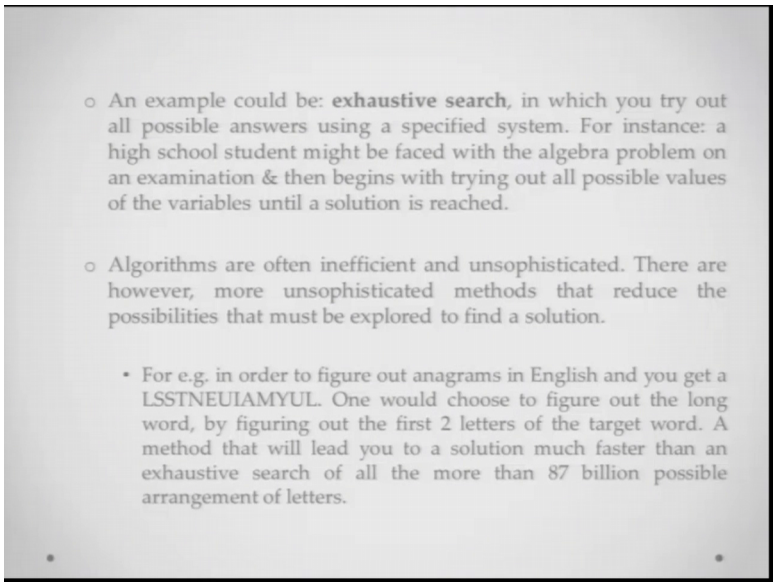

So, in that sense error things algorithms will not be really very productive an example of such an algorithm could be you know something like an exhaustive search. Now an exhaustive search as the name suggests is when you are trying out all the possible answers using a specified system.

Suppose for example you are solving an algebra problem and the algebra problem has let us say 2 variables X and Y and you have to solve for X one of the sure short ways of really doing this kind of problems is basically just assuming start from X is equal to 0 Y is equal to 1 and just start putting each of these values in the equation till you finally, reach particular kind of a solution.

Now even though this method will certainly and in guaranteed fashion give you the solution of equation, but the point is it is going to take lot of time and because it is going to take lot of time and effort, it is not really very efficient way to solve that problem. In that sense algorithms are often really inefficient and are often unsophisticated, but there are also even more unsophisticated methods that can come up with possibilities and that offer you particular kinds of choices to reach particular kinds of solutions.

Say for example, if you are given this task of finding out words from anagrams and stuff as suppose you will given this letter here this LSST and NEUIAMYUL and you have to figure out range in a particular way that you can figure out word that is made from these collection of letters. Now what you would need to do is you have to kind of workout

various permutations and combinations if you not really aware of the correct word you will kind of spend a lot of time if you are following things like exhaustive search mechanism you are going to spend an inordinate amount of effort before you are even closer to solution because they are so many words and it is very difficult because there are so many letters so, many permutation and combination that you will need to finally, reach this.

So, what you can do is you can actually pick up a strategy and a strategy could be suppose for example, I will just try and figure out the first 2 letters of whatever this big word is and once you start figuring out the first 2 letters that could basically be just you know 2 or 3 things. For example you can have s and t you can have s and u s and a s and i those kind of combinations and this one by the way from all the number of combinations possible.

Suppose if you are conducting exhaustive search and it has been calculated that you would basically they could be almost 87 billion possible arrangement of letters so; obviously, you know that is completely out of the question, but if you take such kind of a strategy just start by the first 2 letters and you know kind of figure out how the rest of the word could be that could lead you to a solution much easily in much more you know in much more efficiently and much less amount of time.

So, even though this is a slightly unsophisticated way of doing it even though this does not really guarantee your solution in some sense, but this is a quicker way of doing it.

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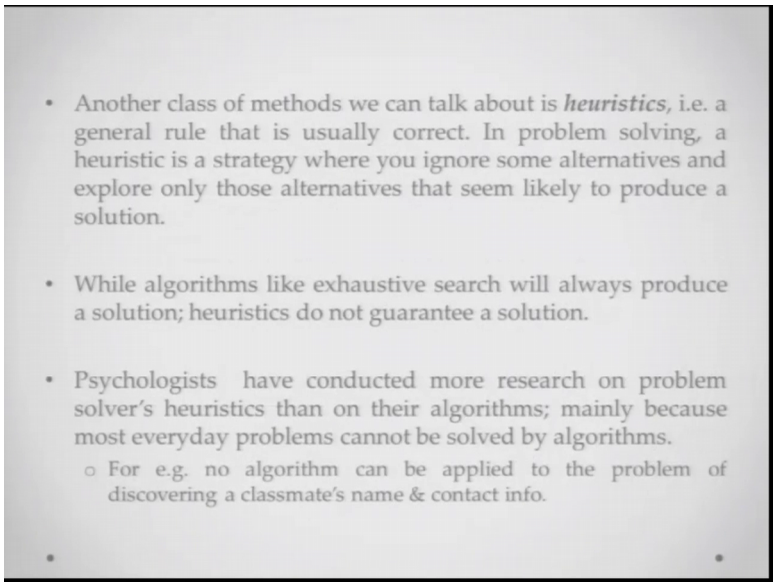

So, this kind of arrangement is basically referred to as what is called a heuristics you know. So, from all the possible solutions that might be there I picked up a method and I kind of bet my gut on it and said that there is a this person there is a next person chance I will be able to solve this problem using this method and I started trying that out and eventually figure out what the solution is.

These kind of methods these kind of general rules are basically referred to as heuristics and these are usually correct you know in problem solving literature heuristics are taken as strategies where you are; obviously, choosing to ignore some alternatives and kind of exploring only those alternatives that seem most likely to you to be able to produce a solutions. So, it is almost kind of a gamble it does not really guarantee a solution just like an exhaustive search kind of mechanism would give, but certainly offers a high chance good chance of solving a particular problem in a slightly more efficient way.

Psychologists have conducted a lot of research in heuristic psychologists have conducted a lot of research on kind of heuristics problem solvers used and much less on how what kind of algorithms they are. So, because a lot of problems in the real life you cannot really come up with an elaborate algorithm way to solve it I will you would see it most of people pick up a particular heuristic and then start using it.

Say for example, if you have to select you know the most appropriate life partner that you would want to have and exhaustive search mechanism would actually involve you

know testing all the possible you know partners that might be there, but then; obviously, nobody does that you kind of follow heuristic based on particular parameters and you know kind of playing around with those parameters that will help you make this decision; obviously, this is also this is not really guarantee this correct solution that will might guarantee your solution, but that is completely you know impossible to do this one this heuristic here suppose for example, you can go with a you know the I know go with a various factors that might be a importance to you and they might help you in zeroing down on a particular person.

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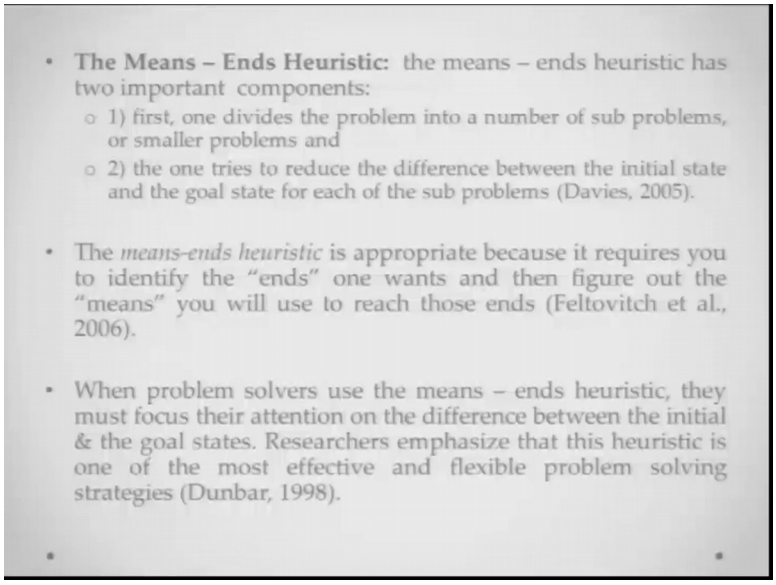

So, this is basically just to elaborate the difference between what is heuristic and what in algorithm is like. So, let us discuss little bit about different heuristic now one of the heuristics that people often use is referred to as the means ends heuristics. So, the idea is that it this one has 2 components, first is that you divide the larger problem into a set of smaller problems or sub problems, then what you have to do is you have to try to reduce the difference between the initial state and goal state.

So, whatever steps or manipulations you have to do basically you have to kind of start solving each of these sub problems eventually leading to solve the major problem. So, this is the goal state where you have you know where you have to reach this the initial state where you start solving the problem and in between are the steps that you take or let

us say there are so many sub problems that you need to solve in order to solve the eventual problems.

Now, the means ends heuristic is a is a rather appropriate heuristic because it requires you to identify the goal state or the ends the it also requires to figure out the means that is the steps that you would need to take reach those ends. When problem solvers use the means ends heuristic they must focus their attention on the difference between the initial state and the goal state. So, what you have to really pay attention to is where is the point that you want to reach, where is the point that you are and basically what are the steps that you could take or to shorten this gap to close this gap.

Researches emphasize this heuristic is one of the most effective and one of the most flexible ways of problem solving because there are so many sub problems it is not like that your kind of you know just decided and set on a single path you have to do that in order to solve problem you know, the difference of problems are contingent on so many different factors and you can be very flexible about which route to take which step to take and what point in order to eventually solve the problem.

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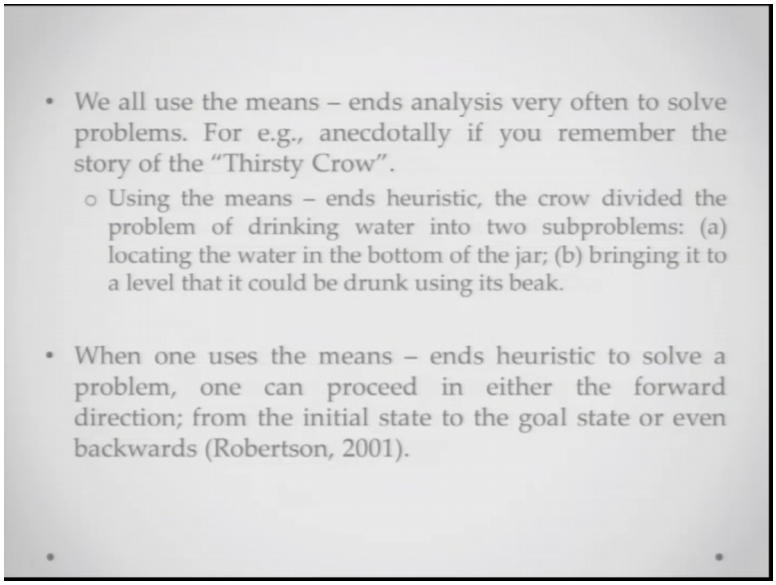

Now, and if you actually take a step back and think all the time we are using the means ends analysis you know very effectively and very often to solve so many problems I am reminded of the anecdotal story of the thirsty crow you know the crow is thirsty it is moving around in a jungle and there is no water all the ponds and stuffs have dried up

and then he figures out that this jar there and that jar has a little water at the bottom; obviously, the crow cannot get inside jar and drink it.

So, the crow decides to do is the crow decides to pick up stones and you know fill the pa jar up with stones so that the water comes up and the crow eventually is able to drink the water. Now what is the crow doing here, the crow is basically you know doing sort of a means ends analysis and then breaking the larger problem of drinking water into 2 steps, the first step is you know locate that there is water, the second is to bring that water up to a level that can be drunk using the beak.

So, the this kind of means ends analysis is something that we are almost doing on a daily basis and we are kind of using this rather successfully to solve a lot of problems that we encounter. So, when one uses the means ends heuristic to solve the problem one can proceed either in the forward direction from the initial state to goal state you just take series of cells 1, 2, 3, 4 to reach the step or sometimes you can just you know deconstruct the journey.

You can start from step 6 which is at goal state and start coming back this is what I have to achieve just one step before is what just one step before is what and stuff like that both are possible and there has been lot of research on means ends heuristics you know researches have demonstrated that how people organized their problem into sub problems.

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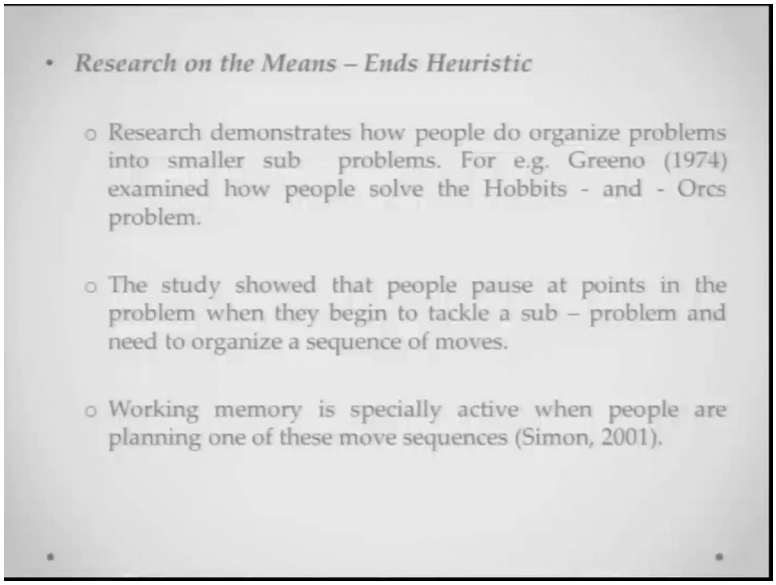

So, it has been shown that a people do organize you know the information there is given a problem in shorter into smaller problems and they use that to eventually reach good solution. Demonstration again from the Matlin's book is Hobbits – and - Orcs Problem this is the one that is actually similar to the boat and crocodile problem that I was referring to in the last lecture.

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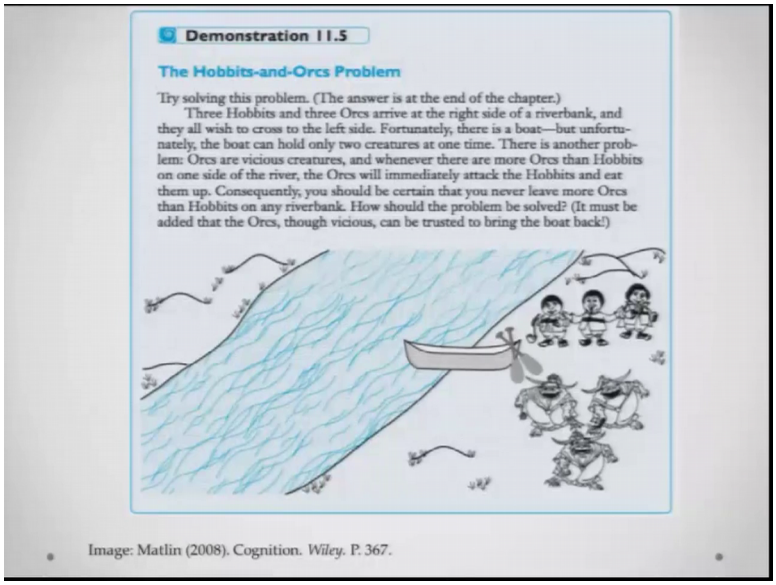

So, there is this, the problem is that you know there are 3 Hobbits and 3 Orcs, Orcs are violin creatures. So, if both of these groups are here in one side of the river and they just have one boat to go to cross river and go to the other side. Now the interesting thing is they can be only 2 persons that can travel on the sport and also what you have ensure is the fact that at any side if there are more Orcs and less Hobbits the Orcs will attack in each of the hobbits.

So, the goals state of the problem is that everybody crosses the river in a boat that has this capacity of 2 people and nobody ends up dead. Now one of the things that people use to solve this problem is basically that the larger problem is to go cross the river, but the smaller problem also is to ensure that there are at any point that never more hobbits then more Orcs and Hobbits on either side of the river. So, that is how people would kind of break this problem down and they kind of go about solving this big problem.

So, they did this study Greeno in 1974 he did this study and they kind of tried to examine how people are solving this Hobbits - and - Orcs problem and this study showed people

do pause at particular points and they have to try and tackle a sub problem you know now there are these number of Orcs and these number of hobbits in left side and these number of Orcs and these number of hobbits on the right side. Now how do I do it they sometimes plan ahead they sometimes come back and they kind of organize sequence of moves such that you know ensures the correct solution problem.

Now, in these kind of scenarios again just because I was talking about this in the last lecture as well the working memory is specially active you know because all of these manipulations and looking ahead and looking back is basically happening in your working memory and this is what the you know when people this going on when people are planning one of these moves sequences because you are have to in the real time evaluate whatever possible options are there.

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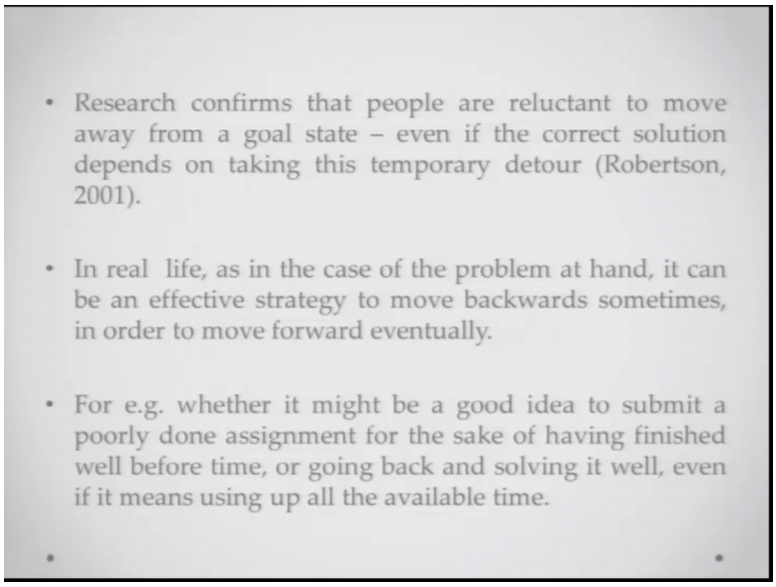

So, this is just the demonstration of how people might be using the means ends heuristic, now a lot of research by the way confirms that sometimes people are you know reluctant to move away from goal state even if the correct solution sometimes depends on taking the temporary detour. So, for example, the larger problem is crossing the river, but the you also have to tackle this sub problem because otherwise there are more Hobbits at once there are more Orcs at one side and less hobbits they will be eaten.

Suppose for example, somebody decides that even in first round itself 2 of the Hobbits you know jump up the boat and cross the at the other side the point is this is leading to

solution or the to the greater problem, but now on this side there is just one hobbits and 2 Orcs and 3 Orcs and they are just going to eat this one up. So, the idea is a lot of times people would need to plan and this happens in daily life as well if you have a larger goal at hand sometimes you would need to plan in such a way that you are engaged in doing things that are not directly leading to a solution, but eventually will lead you to a solution.

So, the idea is these kind of detours these kind of planning's need to be done in order to achieve good solutions to your problem. So, real life as well as I was saying the problem as in the problem at hand it can sometimes be a very effective strategy to sometimes move backwards and then you know move forward towards the goal state. Eventually you know people do the lot of this kind of things in games for example, in chess for that matter you know sometimes you would decide to sacrifice particular pons in order to achieve the larger goal.

So, that is again a very similar to how you know people solve problem in these abstraction scenarios as well. So, it might be a good idea say another example classroom example I could take that you know it might be you might kind of decide or debate this whether it is a good idea to submit a poorly done assignment just that just to ensure that you are the first one to submit an assignment or say for example, submit it just in time, but ensure that you are kind of you know doing it well and you are graded well for that.

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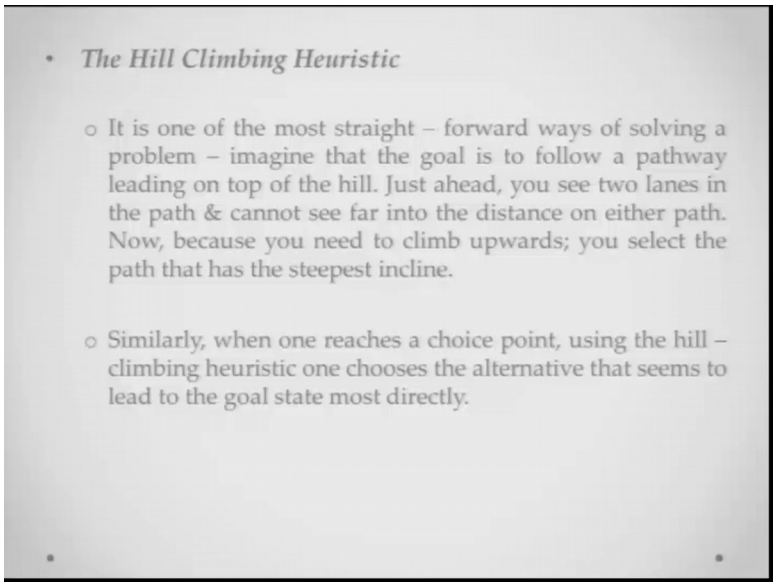

Finally, there is another heuristic that I would want to talk about that is the Hill Climbing Heuristic, now the hill climbing heuristic is one of the straight forward most straight forward ways of solving a particular problem, imagine say for example, there is a goal to follow a path way leading on the top of the hill now and there are two options that you have present it one is the direct path one is the slightly bounding path.

What you would want to choose is that you will probably want to choose direct path, the path which has the most steeper in climb because it is kind of guaranteeing it is kind of telling you that very quickly you will reach there, but and there is the other path which is bounding which is going to take lot of times.

A lot of times what people would do is, they will directly choose path that it has the steeping climb and you know gives the chance of solving this problem correctly, but you know when people in even in real life matter when people reach such a choice point. They use what is called you know this kind of scenario what is hill climbing heuristic to a pick up alternatives, that seem to lead to the goal state most directly you know quick fix solutions efficient and fast solutions.

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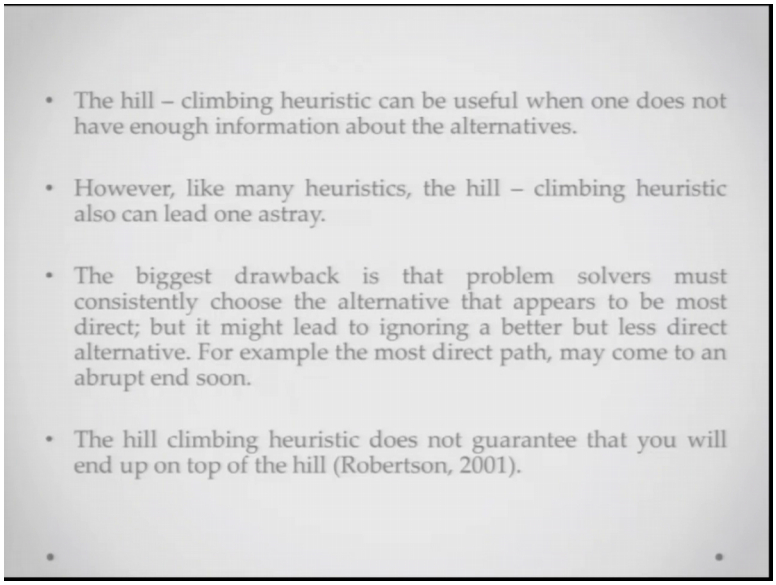

And the thing is that hill climbing heuristic can be useful when one does not really have enough information about the alternative you know because you do not have really lot of information about what is going to happen in future. You might be able, you might want to you know take these kind of quick decisions but like many heuristics the hill climbing

heuristic also can lead you a stray, you know the biggest drawback is the problem solvers must consistently choose that alternative that appears to be most direct, but in that in doing that you are ignoring slightly slower slightly a less direct, but a better alternative you know.

For example, the most direct path sometime may come to ban abrupt end the most direct path may offer dangers of falling down and stuff like that. So, the idea is the hill climbing heuristic is in that sense slightly risky heuristic to take each; obviously, as being heuristic does not really offer you a guaranteed solution and it is in that sense a high risk kind of decision. So, the hill climbing heuristic obviously, as I was saying is not guaranty that you will reach the goal state it just kind of allows you that kind of solution.

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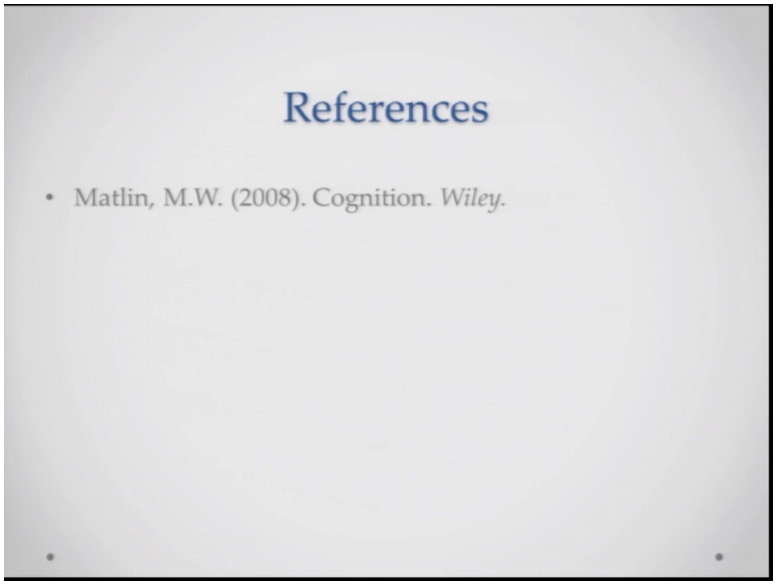

So, that is from, they solved from about heuristics and some of the strategies of problem solving that we discussed we will talk about more strategies of problem solving in the next class.

Thank you.