Problem Solving through Programming In C
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Lecture – 01
Introduction

Good morning, welcome to the course of Problem solving through programming in C.

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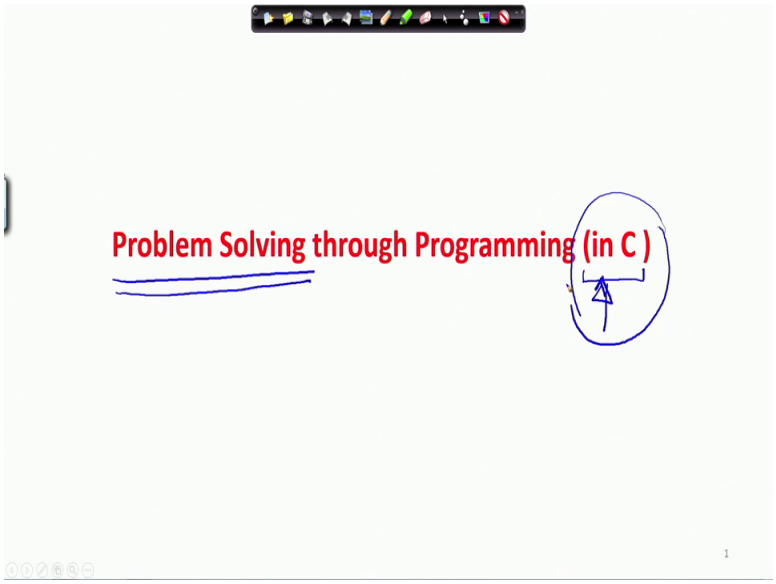

This is a course of programming no doubt about it the first course on programming for many of you, but also the focus of the course is to show you how we can carry out problem solving; that means, solving different problems using programming. We encounter a different types of problems all the times in our life and some of them can be solved using programming, why I am saying that some of them can be solved not all can be solved there is a reason for that we will come to that later, also there is another thing in the bracket you can see that we will be discussing programming in C.

Now, C why I have put it in the bracket the reason is the C is just one of the means one of the languages using which we can do programming, there are different other languages like as many of you know Java, C plus plus and others using which we can also do programming. Now our objective is to not to just think about the c programming language, but also some programming principles, some programming logic, some programming methods that are adopted while solving problems all right.

Now, let us think of some of the problems that we often encountered in our regular life, let us start with a very simple problem of there is there is a large volume of data large volume of data maybe integer or may be numbers different types of numbers.

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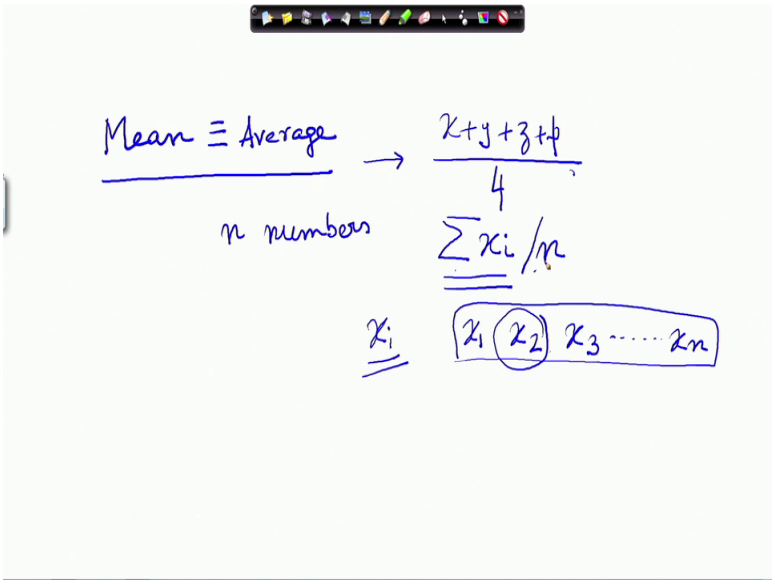

And we have to find the mean of that and mean of that many of you know mean is nothing, but the same as average. Now how do you find out the average of a large volume of numbers now all of you know how that is done, that is a relatively simpler problem. We can also have, this is this has got some standard formula if you have got 4 numbers say x y z p you add them and divide them by 4 that is how we find out the average right.

Now, also for n numbers if thereby n numbers then we can write it as sigma x i by n what does this mean, this means I am taking what is xi, xi is each numbers, x1 is one number, x2 is another number, x3 is another number in that we are up to xn. Now each of these numbers any of these numbers I can represent with xi and by replacing different values of i, I can get any of these numbers. So, sum of all these numbers sum of all these numbers can be designated as x sigma of xi this sigma means summation and, I do the summation of this and divide by n when it was 4 number I divide it with 4 here since there are n numbers I divide it with n.

This is a very well known mathematical formula mathematical approach that all of us the school children will, Now, therefore, we can very easily translate this problem and solve

this problem into programming, we will see how we can translate it to programming also we will also discuss why we should translate it to programming all right. Let us take a let it I mean a little different problem suppose there is a text all right there is a text of 20 sentences all right.

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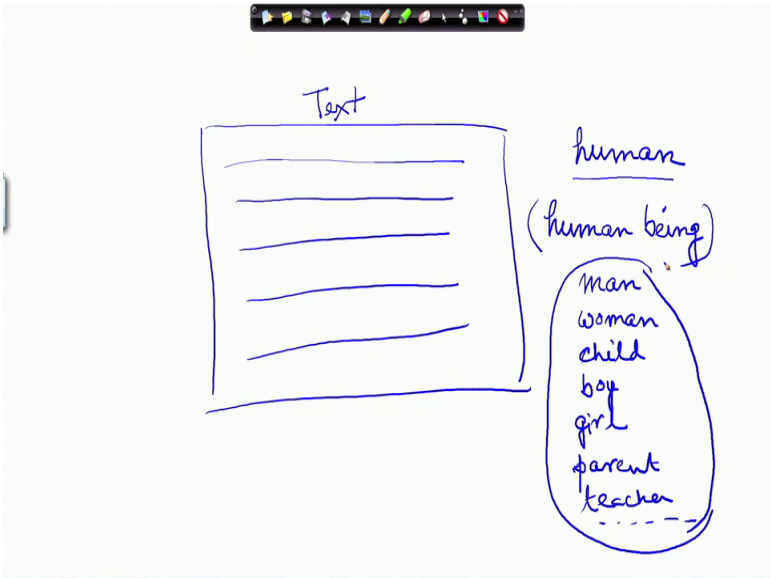

We will have a text of 20 sentences all sentences are here and I say that find out how many times the word human occurs in this text, this is my text and I want to see how many times the word human occurs in this text also the problem can be much more complicated.

This is another type of problem where I have to look every word and see is it a human no is it a human yes. So, accordingly I will have to go on counting all right now I can also say that how many times does, the word pair human being appear in this text, so that is can also be, I get human, but I do not get being after that, I do not count it all right. If it be human followed by being then I count it once in that way I can formulate different steps by which I can solve this problem. If you just spread your imagination you can think of making the problem even complicated for example, human being and man, woman, child, boy, girl, parent, teacher etcetera all of them are human beings.

Now, if the problem is posed in a way that find out how many times earlier what the problem was earlier the problem was how many times the word pair human being appeared as it is. Now if I modify the problem statement and say that find out how many

times human being has been referred to in this text; that means, if it be a man then also it is a human being, if it be a woman then also it is a human being, if it be a child then also it is a human being, if it be a grand grandparent it is also human being, In that case the problem becomes a little more difficult little more difficult than the previous version of it where we wanted to just find out the word pair human being this is an example of a second problem and third problem.

The third problem is a little more complicated as you can see, we can go on adding examples of problems let us take another one suppose you have got a fixed amount of money.

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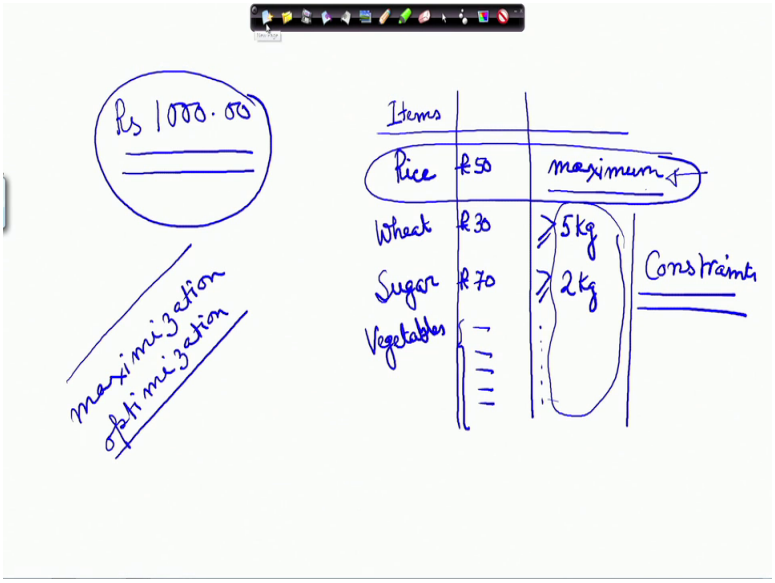

All right whatever that amount is suppose you have got 1000 rupees and you have got you have been asked to buy some items may be rice, wheat, sugar, vegetables etcetera and each of them have got a price rice may be rupees 50, wheat may be rupees 30, sugar may be rupees 70 and vegetables depending on the variety there are different prices all right.

Now, suppose you have been told that you have been given this amount of money and you have to buy the maximum amount of rice possible the maximum amount of rice possible. So, with 50 rupees you can have 20 kgs of rice, but there is a constraint, there is a maximum amount of rice you have to buy, but you have to buy at least 5 kg of wheat, at least 2 kg of sugar, at least some amount of vegetables. Now given this you can buy 5

kg of wheat, you can buy 6 kg of wheat, 7 kg of wheat, you can buy 2 kg of sugar or 3 kg of sugar etcetera you can do many things, but you have to see that how you will distribute this so, that even after satisfying these requirements you can find you can buy the maximum amount of rice.

There is another problem when you go to the market I mean in such a thing is always told or we have got in mind that we have to cover these items and there is a fixed there is a cost for that and we have to satisfy the cost. This is another type of problem we can see this is an maximization problem or in problem solving terminology we also sometimes call similar problems as optimization problems; that means, I want to maximize the amount of rice that I want to buy, but these are the constraints that I have to satisfy right. So, I have to satisfy these constraints after satisfying these constraints, how can I maximize this, this is another type of problem relatively much simpler maximization or optimization problem.

Let us now move to another type of problem say I have got a number of places let us name the places A B C D E.

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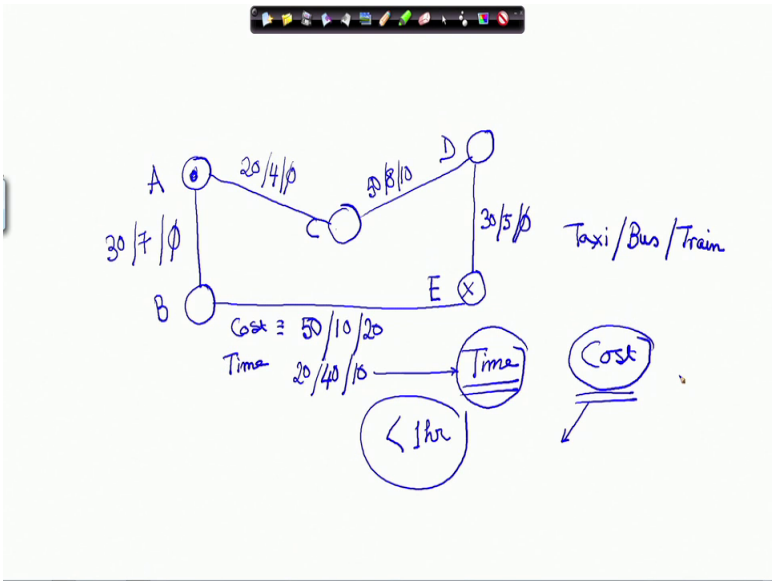

Now, suppose these are, suppose some cities and we have got direct paths among some cities and there is no direct path among some cities all right suppose this is the scenario. So, I can directly reach from A to C, but I cannot directly reach from A to D I can directly reach from B to E, but I cannot directly reach from B to C like that moreover

along with each of these paths we have got some cost associated the amount of money the amount of expense that we will have to bear in order to make this travel possible, suppose this traveling B to E I have got a different options say for taxi first I put the taxi thing first, then I put the cost by bus and then I put the cost by train now suppose from B to E I can go by bus taxi and train both.

So, suppose by bus it is 10 rupees and train it is 20 rupees and also of course, there can be I mean according to the mode of transport that I take the time taken will also be different, say from D to E I can go by taxi and that will cost me 30 rupees and by bus it will cost me 5 rupees and there is no train between these 2 all right, there is no train no I put it null here. So, A to B suppose I have got taxi of course, 30 rupees bus may be here in this route it is a little expensive 7 and there is no train here, A to C I have got 20 rupees by train, 4 rupees by bus and there is no train, here C to D there is 50 rupees, again 8 and by train it is say 10 rupees.

This is the picture now I am here and I have to reach this point from A to E now I can go via A to C, C to D, D to E or I can travel A to B, B to E right, if I come by from A to E by taxi then it will be 30 plus 50, 80 rupees required, if I come via this path it will be 20 plus 50, 70 plus 30, 100 rupees required, but if I come here by train there is no train. So, so I cannot come between these 2 by train if I come by bus 4 rupees and now by train 10 rupees 14 and here there is no train I cannot do that right, I cannot take train from here.

I will have to take again bus from here, in that way I have to solve the problem of how to reach from one city to another with some constraints now these constraints are coming every time and this constraints actually generate the fun in this what are the constraints that we can have in this problem the constraints it will be satisfying the time how fast I can move I have not shown the time information here that time information should also be kept here for example, from B to E by a taxi it takes 50 rupees and say takes 20 minutes and by bus 10 rupees, but it takes 40 minutes and by train is 20 rupees, but it takes 10 minutes like that.

So, if the time information is also there I may be asked to minimize the time and also what is shown here this is cost, I have got the cost and the time, I may like to minimize the cost also. I may be asked that I am not much bothered about time I am relaxed it is a weekend I can devote time, let me try to minimize the cost then the problem will have

one color right one form. If I just say that well now I am little pressed with time, I will be selecting a vehicle or selecting a mode of transport I do not mind the cost, but I have to minimize the time then the problem is something different also it may be that I am with the total time spent between a less than one hour less than one hour even this constraint minimize the cost, in that way different forms of this same problem can be put forward and often we have to solve such problems in our real life.

Let me, that is the best way to reach a place right this is how we can find a best way to reach a place.

Now, I come to another interesting problem, this problem that was there it is a again an optimization problem again you could see now say let us take another example.

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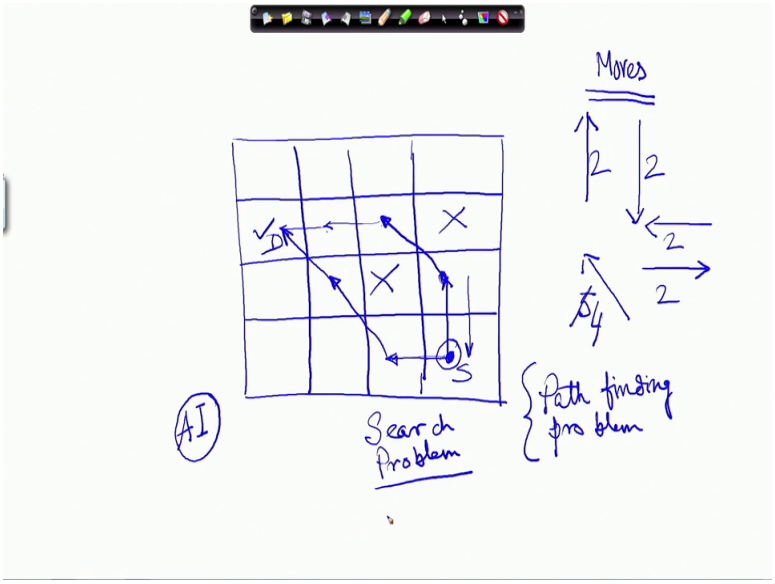

Although I am showing it as a game it can act as a model for many real life scenarios. This is a maze and I am here and I have to reach say here, this is my source, this is my destination and from here I can either from any place each of them are places from any of these places I have got 3 moves, either I can have an up move, I can have a down move, I can have a diagonal move all right.

So, for example, from here I can with a diagonal move I can come here with an up move I can come here I cannot apply a down move now this up and down moves are allowed only if there is no bar or there are other moves also I can move left or I can move right. I

cannot move diagonally down suppose these are the moves that I have and any of these moves can be applied only if the corresponding destination place is not bared or if the destination place is free for example, if this place is bared and say this place is bared then from this point source I cannot apply the diagonal move why because this place is not free.

Suppose I apply the up move, I can I will go from here to here now I am here at this point I have what are the moves that are applicable left move cannot be applied this cannot be applied this is out of question, up move cannot be done down move I can do you see down move I can do I can come back alright and diagonal move is possible suppose I come to I find if I apply the down move I come here then; obviously, if I again apply this move then I will be just doing these 2 repeatedly and I will not progress any further may be once I come back here because of some thought I can apply this move all right.

Let us see once again let us start suppose I was here now apply a up move, then I can apply a diagonal move and then I can move a horizontal move, another horizontal move 1 2 3 4 assuming that all these moves are having the same cost, same effort all right then with 1 2 3 4 moves I can reach my destination. Let us see if I had instead of going up if I had taken this move 1 because I could not go diagonally then I move diagonally 2 then with 3 moves I can reach the destination assuming that the costs are same then this is a better move.

If the costs that is scenario becomes a little more complex when each of these moves I have got different costs it is I have to pay more or I have to put in more effort for moving from this point to this point, from this point to this point in a diagonal manner is much more easier to move in a horizontal manner all right. This is another type then the problem would have been little more complex right in that case suppose the diagonal move will costs you 5 and all other moves cost you 2, then what would be the cost in this 2 5 7 8 9 10 11.

In this path let us do it again 2 because up is 2, 5 because diagonal is 5, 7 8 9 10 11 units if I have done in this way 2 5 7 and 5 12. So, in that case this is becoming costlier, but; obviously, if the diagonal move was 4 and not 5 then what would have happen let us see

2 4 6 7 8 9 10 and if I do it in this way what it would be 2 4 and 2 6 and 4 10 in that case both of them would be equal.

This is another problem where again you can see that we are trying to look at the cost and solve a problem, this you can think of a path finding problem or a search problem what are we searching here I am calling it we are search problem. So, what are we searching here, we are searching for the path through which we can move we can reach the objective, now this is a very simple example of the type of problems that we solve in artificial intelligence, say a robot has been asked to move from this point to this point how the robot will find it is way given some obstacles.

So, this is another type of problem that we can solve using programming now having said that is it that all the problems that are there in the world can we solve them by programming when you say problem solving we are not actually meaning to address all possible problem solve the problems that are in the world we are not saying that all of them can be solved by programming for example, the problem of hunger cannot be directly solved by programming some person is feeling depressed he is feeling sad that is a problem we are not addressing that sort of problem here.

So, when we say problem solving through programming then we are talking of not all kinds of problems, but certain categories of problems, that is that will be discussing in the next module what are the problems that can be solved by programming and we will progress further.

Thank you for this module.