



IIT Madras

ONLINE DEGREE

Computational Thinking
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Introduction to Course

Professor G. Venkatesh: Hi, my name is Venkatesh.

Professor Madhavan Mukund: And my name is Madhavan.

Professor G. Venkatesh: Together we are going to introduce this course which is called Computational Thinking to you which is the first starting step to learning programming actually and the reason we are calling it Computational Thinking is because before we start doing any programming work we required to organize our thinking in a very specific way.

So, that this thinking process is systematic and can be communicated to another person or to computer or whatever it is for which thought process has to be organized in a very very specific way and all that we will teach you in this course essentially is to help you to organize your thought process like this.

Professor Madhavan Mukund: So, we must remember that computer is just a very precise machine which can execute some commands if we tell it to like to add some numbers or to divide some numbers or to move things around you know rearrange something. So, what we are really doing when we instruct a computer through a program is to follow a specific sequence of steps to achieve some goal.

So, this is nothing very special about computers, the same thing happens when we talk to somebody else about how to do something, for instance if you have ever experienced cooking show or cooked yourself then you would follow a recipe. So, a recipe for cooking is just a sequence of steps, it tells you what are all the ingredients that you need, then it will tell you how to process this, it will tell you chop something fine, it will tell you to put something into a mixer and grind it into a powder.

And then it will tell you to heat something, put something, that will be a sequence, you add something first, add something second and of course how much detail these instructions are depend on what is the expected understanding of your level of expertise. So, if I think you are an expert cook I would just say chop something fine. But if I think that you are cooking for

the first time then I might tell you that by fine I mean that each piece must be roughly say 2 millimeters by 2 millimeters or it should be 5 millimeters by 5 millimeters.

So, let us take an example. So, suppose I am trying to arrange a function in a hall and I want to get this hall ready for the function. So, if this, if there is a team of people who do this regularly, then I just have to tell them a function is going to start at 10 o'clock tomorrow there will be 50 people, please get the hall ready.

And this will be enough but supposing this is a new team, a people who have never done this before then I have to be much more elaborate, I will have to say may be that you should make sure that the hall is cleaned half an hour before, if it is warm weather may be turn on the air conditioner at 9:30, then if there is supposed to be 50 people how do you arrange the chairs? I might have to say put the chairs in 10 rows or in 5 rows with 10 chairs per row but then keep a gap in the middle, so you have 5 gap and 5.

So, depending on how much I expect the person who is going to understand and do the instruction, execute the instruction, how much they can do without further explanation, I will give a suitable level of instructions. So, this is what we do when we talk to computer, so we tell it certain steps and those steps are based on our understanding of what the computer can do easily like add, subtract you know flip left and right and so on. So, this is the language of talking to a computer and this is programming. So, in this course we are not really going to talk about specifically programming in any one language. We are going to discuss rather the general steps that we use when we do computational things, which will eventually be done on the computer.

Professor G. Venkatesh: So, as Madhavan explained the whole idea of doing programming is to convert a given problem into a sequence of procedure which is a basically sequence of steps and what we will find, well we do this course what we will find interesting is that, there is a pattern for a problem, when you look at the problem the problem do not all look very different, actually they all fall into certain patterns. And when I say patterns what it means basically is that the sequence of steps for one problem can look very similar to the sequence of steps that we use to solve another problem.

And so basically if we do one pattern if we find for a single problem, we find the pattern which is what kind of steps that we need. Then one might be able to take this steps and apply them to a completely different problem coming from a very different problem domain, and this pattern can be simple for simple problems and can be extremely complex for complex

problem, so there can be a gradation in the complexity or the difficulty of the pattern, in some sense.

So, just as an example, consider for example you know at home we dry clothes and so on. So, we get the clothes from the (dryer) washing machine, so it is in a bucket or in a tub and we have these clothes lines and we need to take out these clothes and hang them on the clothes line. So if we go about it haphazardly you might take the clothes and hang them and then after you start hanging them on the clothes line you will find there are gaps between the clothes that you have hung there. And so you have to find the appropriate cloth that will go in that gap.

So, to make it easier what you might say is that let me start do it in a more systematic way. So, let me start in the clothes line from the left to the right. So, I take the biggest piece of cloth that is there hang it on the left side put a clip then pick the next biggest one put it next to it put a clip and go like that.

At the end when I have a small piece of space, I will find this most appropriate you know cloth that can hang in that place and so I feel that clothes line and then move to the next clothes line, so that can be one way of doing it. So, this is a pattern, this gives me a pattern so the pattern basically says look for the biggest piece of cloth hang it on the left side of the clothes line this is a pattern.

Now, if you look at another problem, for example, I have a bunch books that I have in a box and I have three shelves and I want to put these books on the shelf. Again I have to do something, I have to pick something and put it on the shelf again I can do it haphazardly or I could do it systematically. I can take the biggest book keep it on the left side of the first shelf and then put the next biggest book next to it and so on and go like that.

And if you look at the pattern for the books, looks very similar to the pattern for the clothes how you hang the clothes on the line. So, in a sense there is a, even though the problem statements are very different, one is saying arrange books on a shelf, the other problem is saying hang the clothes on a line, the way you approach this problem can look very, very similar and a single pattern you might be able to write which does both. So, that is what we are going to explore in this course, how do we find this kind of patterns which solves very large class of problems coming from different domains.

Professor Madhavan Mukund: So, in order to illustrate these patterns and how we move from simple problems to more complex problems, what we will do is we will work with some sets of data. So, in our next lecture we will look at this data sets in detail and explain exactly what we are going to do just to give a quick introduction we have these cards, so we have some data about school marks, so we have cards representing the marks of students in a class. We have some shopping data which talks about shopping bills and how customers spend on their bills.

And then we have some data taken from a paragraph of text, where we talk about words and how many letters there are in each word and what type of speech and all that. And using these different there is simple pieces of data we will illustrate these ideas about looking for patterns and computing quantities in a systematic way.

