



IIT Madras

ONLINE DEGREE

Computational Thinking
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Systematic process of hypothesis verification to find relation between Mathematics and Physics marks using lists

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Professor. Madhavan Mukund: So, let us look at this card, I want to check something, so normally we say that we tend to believe that people who do well in maths also do well in physics for example. So, there is some relationship between the performance of chemistry sometimes tends to be lack here for instance I see that this student has 68 in maths, 64 in physics, but has 78 in chemistry. So, chemistry is quite different from the 2.

Professor. G Vekatesh: So, what are you saying? Are you saying that people who do maths, do well in maths do well in physics, or you saying people who do well in physics do well in maths or?

Professor. Madhavan Mukund: So, I would say that let us think of the following situation that somebody who does well in maths will tend to do.

Professor. G Vekatesh: well in physics.

Professor. Madhavan Mukund: Well in physics, so well in physics means that they should get a comparable score but maybe score is too precise.

Professor. G Vekatesh: So, do well in the class.

Professor. Madhavan Mukund: Yeah, it should be doing relatively well in the class.

Professor. G Vekatesh: So, you say well, so we have defined well. We say, earlier we had try to put students into grades with ABCD grading. So, should we say that student is doing well meaning that. So, student is doing well A grade for example is definitely doing well. He is doing relative to C and D they are doing well, something like that.

Professor. Madhavan Mukund: So, somebody who has A in maths for example should be getting an A in physics.

Professor. G Vekatesh: What about B in maths?

Professor. Madhavan Mukund: Somebody who is getting a B in maths should get at least B in physics, they could have got A or.

Professor. G Vekatesh: Similarly, C can do A, B or C and D should be getting A, B, C or D.

Professor. Madhavan Mukund: Yes.

Professor. G Vekatesh: Alright, so we can check that but how do we, first we have to put them into grades.

Professor. Madhavan Mukund: Yes, so earlier I think we had decided to kind of put boundaries based on marks.

Professor. G Vekatesh: We said min to max and then we divide into 4 groups.

Professor. Madhavan Mukund: Yeah, but now we can decide to roughly give equal number of grades may be in each, so there are about 30 students, so 7 to 8 per grade, so we could say that let the top 7 get A's.

Professor. G Vekatesh: So, which we have to.

Professor. Madhavan Mukund: So, then we will have to arrange it in descending order of, decreasing order, decreasing order.

Professor. G Vekatesh: We have to sort it by, so grades in maths and physics means we have to sort it for maths, we have to sort it also for physics.

Professor. Madhavan Mukund: Yeah.

Professor. G Vekatesh: Okay, so let us do that, let us sort it by maths and physics.

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Professor. Madhavan Mukund: The same insertion sort, so we start with 68, and 62 goes before it, 57 goes before it, 42 goes before it, 87 goes after, 71 comes between, so we had 68, 81 is, it is kind of difficult to see all of them but 81, 84, and 74, and 63 comes here, 64, 97 goes back, 52 comes here, 65 comes here, 89 comes here, 76 comes here, 87 again, 62 again, 72, 56.

Professor. G Vekatesh: Right now we are inspecting it right?

Professor. Madhavan Mukund: Yes, so I roughly know where it is, so I am just putting it in the right place.

Professor. G Vekatesh: But we are suppose to go first from the beginning.

Professor. Madhavan Mukund: 78, 62 again, 97 again, 44, 87, 74, 81, 74 again, where is 74, I did a mistake here, 81 will come out of this, then 72. So, now we do not really want to disturb these cards actually, but anyway this is alright, we did it once, we should have kept track of this.

Professor. G Vekatesh: Now, at least let us do it now, this is increasing order.

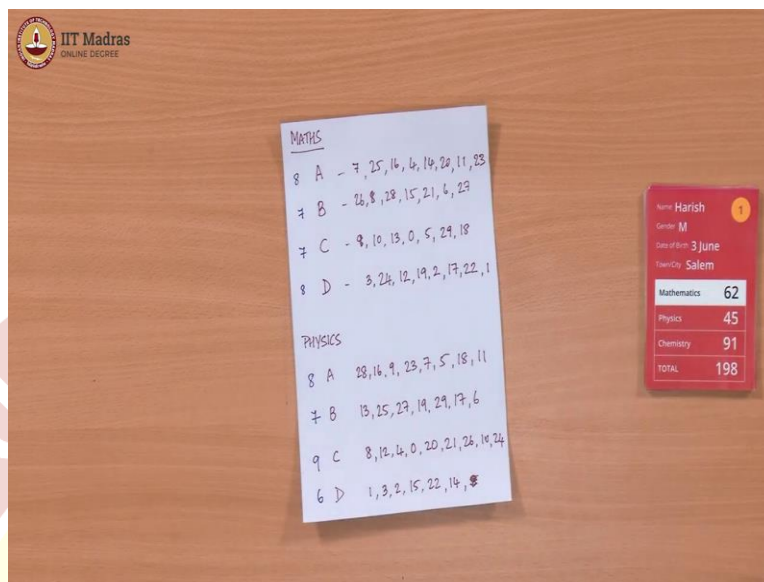
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Professor. Madhavan Mukund: Let us just check that is increasing order, because cards got little jumbled, 65, 68, 71, 72, 72, 74, 74, 74, 76, 78, 81, 81, 84, 87, 87, 87, 89, 93, 97, yes. So, we have totally 30 cards, so we have to divide 7, we take 7.

Professor. G Vekatesh: But now, if the boundary if you have same marks we should put it there.

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Professor. Madhavan Mukund: So, let us hope we do not have that, so we take the first, say the bottom 7, because we are starting with lowest marks, bottom 7 let us call it D. So, what we will do is we will write for maths A, B, C, D you have to put, so we will keep these 4 lists. So we will keep a list and list.

So, for D I will say 3, 24, 12, 19, 2, 17, I have got 6 one more 22, and who is the mark?

Professor. G Vekatesh: But this 1 again is 62, this was also 62, so I think we should keep it.

Professor. Madhavan Mukund: What about the next one?

Professor. G Vekatesh: 63.

Professor. Madhavan Mukund: So, we can keep, 1 also in D.

Professor. G Vekatesh: Unless you want to take 3 of them and put them. We have 3 62.

Professor. Madhavan Mukund: Okay, fine. So, let us have, so now we have 8. So, we will just say we have 8 Ds.

Professor. G Vekatesh: Now, we are going to C.

Professor. Madhavan Mukund: Yes.

Professor. G Vekatesh: So, 63, 9, 10, 13, 0, 5, 29, how many you got?

Professor. Madhavan Mukund: I have got 6, so may be 1 more.

Professor. G Vekatesh: 18.

Professor. Madhavan Mukund: So, the bottom half will be C or D.

Professor. G Vekatesh: Now, we have got, 74 which is alright, this is 72. Now we go to B.

Professor. Madhavan Mukund: Yeah.

Professor. G Vekatesh: 26, 8, 28, 15, 21, 6, 27.

Professor. Madhavan Mukund: So, we have got 7, so we could go 1 more we could stop here?

Professor. G Vekatesh: This is 84, I think this was, I think we should stop, 81.

Professor. Madhavan Mukund: So, then the top 8 are going to be A's I hope. Okay we will see.

Professor. G Vekatesh: 7, 25, 16, 4, 14, 20, 11, 23, you got 8?

Professor. Madhavan Mukund: Yes. So, we have essentially 8 A, 7 B, 7C, and 8D.

Professor. G Vekatesh: we have to anyway, it cannot be same pair.

Professor. Madhavan Mukund: 30 cards, right?

Professor. G Vekatesh: So, now we want to do the same thing for physics.

Professor. Madhavan Mukund: Yes.

Professor. G Vekatesh: Now, even if we disturb, because we have got the list. Ideally we should not disturb but it is alright, we will do it in the same way.

Professor. Madhavan Mukund: 53, 72, 64 comes after, 78 comes after, 54 comes before, 81 comes after, 62 comes here, 45 comes here, 88 goes all the way the end, 72 there is another 72, 73, 64 we had a 64, 92 can go at the end, 66. 92, 71 comes here, 64, 83 comes here, 58 comes here, 69, see this is where we have to actually search for the position, 82 comes between 81 and

83, 76 comes here, 92 again at the end, 75, 73 here, 86, 82, 83, 86, 64 comes here, 62 should be near that, there are lots of 64, 62, 68, 92 comes at the end and 91.

So, now we have, this is now we have sorted in increasing order of physics, so, again we go in the same way and do the first 7 or 8 we will do.

Professor. G Vekatesh: So, 1, 3, 2, 15, 22, 14, 8?

Professor. Madhavan Mukund: So, we have got 7 now, so if there is a tie we can decide otherwise.

Professor. G Vekatesh: There is a tie actually, 12, and this tie actually 1 more, there is 1 more. So, we should move to the other packet.

Professor. Madhavan Mukund: So, we have 1, 2, 3, so we have 8 was in that same tie, so, 64, 8.

Professor. G Vekatesh: Yeah, 8 you should.

Professor. Madhavan Mukund: So, we will just may be 6 here so we come up 8.

Professor. G Vekatesh: 8, 12, 4, 0, 20, 21, how many you have got?

Professor. Madhavan Mukund: 6.

Professor. G Vekatesh: 71, sorry 26, 10, 24.

Professor. Madhavan Mukund: So, maybe I will stop with that. So, we had 6 in the last, and we have here 9 so that is 15, so that is the bottom half.

Professor. G Vekatesh: That is good.

Professor. Madhavan Mukund: So, now we look at 8.

Professor. G Vekatesh: 13, 25, 27, 90, 29, 17, 6.

Professor. Madhavan Mukund: So, we have done 7, we can stop there.

Professor. G Vekatesh: Okay.

Professor. Madhavan Mukund: So, just check the mark here, 82. So, we have 7 and finally we should have 8.

Professor. G Vekatesh: 28, 16, 9, 23, 7, 5, 18, and 11.

Professor. Madhavan Mukund: So, now we have a summary of the performance across physics and maths for the entire class.

Professor. G Vekatesh: Now, what do we do?

Professor. Madhavan Mukund: So, now what we want to say is that everybody who is in the A list here ideally should be in the A list here and if it is then it is confirming, if it is not then it is refuting. So, we count, so we only have now 2 categories, either they confirm or they refute.

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REFUTE		CONFIRM	
25, 4, 14, 20	7, 16, 11, 23		
26, 8, 15, 21	28, 6, 27		
	9, 10, 15, 0, 5, 29, 18		
9, 5, 18	28, 16, 23, 7, 11		
13, 19, 29, 17	25, 29, 6		

MATHS	
8 A	7, 25, 16, 4, 14, 28, 11, 23
7 B	26, 8, 29, 15, 21, 6, 27
7 C	9, 10, 13, 0, 5, 29, 18
8 D	3, 26, 12, 19, 2, 17, 22, 1

PHYSICS	
8 A	28, 16, 9, 23, 7, 5, 18, 11
7 B	13, 25, 29, 19, 29, 17, 6
9 C	8, 12, 14, 0, 20, 21, 26, 19, 24
6 D	1, 3, 2, 15, 22, 14, 8

Name	Harish
Gender	M
Date of Birth	3 June
Town/City	Salem
Mathematics	62
Physics	45
Chemistry	91
TOTAL	198

Professor. Madhavan Mukund: So, should we write that down here, so draw a line. So, we start with 7.

Professor. G Vekatesh: So, 7 we have to go down the list 8.

Professor. Madhavan Mukund: 7 is here.

Professor. G Vekatesh: So, it is confirm.

Professor. Madhavan Mukund: 7 confirms.

Professor. G Vekatesh: 25.

Professor. Madhavan Mukund: 25, we come here and 25 is not there, it is in the B list, so 25, physics marks is less than maths, so it refutes.

Professor. G Vekatesh: 25 refutes.

Professor. Madhavan Mukund: 16.

Professor. G Vekatesh: 16 is here.

Professor. Madhavan Mukund: confirms.

Professor. G Vekatesh: 4.

Professor. Madhavan Mukund: 4 is way down, it refutes.

Professor. G Vekatesh: 14.

Professor. Madhavan Mukund: 14 also way down, refutes.

Professor. G Vekatesh: 20.

Professor. Madhavan Mukund: 20 is also way down, refutes.

Professor. G Vekatesh: So, far it looks very bad. 11.

Professor. Madhavan Mukund: 11 is here, confirms.

Professor. G Vekatesh: 23.

Professor. Madhavan Mukund: 23 is here, so at the A level it is 50, 50. We can either say it confirms or it denies at the A level. So, now we proceed to B. So, 26, so where is 26.

Professor. G Vekatesh: It should be in A or B.

Professor. Madhavan Mukund: But it is in C. So, 26 goes down here.

Professor. G Vekatesh: 8.

Professor. Madhavan Mukund: 8 is again in C, so refutes.

Professor. G Vekatesh: 28.

Professor. Madhavan Mukund: 28 is here.

Professor. G Vekatesh: 15.

Professor. Madhavan Mukund: 15 is way down, refutes.

Professor. G Vekatesh: 21.

Professor. Madhavan Mukund: 21 is lower, refutes.

Professor. G Vekatesh: 6.

Professor. Madhavan Mukund: 6 is B, so it is okay. 6 confirms.

Professor. G Vekatesh: 27.

Professor. Madhavan Mukund: 27 is also in the same grade, so 27 also confirms. So, again we are kind of among 7 we are roughly equal. So, basically it is not saying anything, they are not getting any information, but let us say, let us go on. C 9. So, 9 is up in A, so it confirms.

Professor. G Vekatesh: 10.

Professor. Madhavan Mukund: Now, you will get lot of confirmations, you should get lot of confirmations, so where is 10.

Professor. G Vekatesh: 10 is here.

Professor. Madhavan Mukund: so it is in the same grade, so it is fine.

Professor. G Vekatesh: 13.

Professor. Madhavan Mukund: 13 is here, it get confirms.

Professor. G Vekatesh: 0.

Professor. Madhavan Mukund: 0 is here.

Professor. G Vekatesh: 5.

Professor. Madhavan Mukund: 5 is also here.

Professor. G Vekatesh: 29.

Professor. Madhavan Mukund: 29 is here.

Professor. G Vekatesh: 18.

Professor. Madhavan Mukund: 18 is here, this is not telling us much, I am not so satisfied. Yeah, somebody gets a C in maths then there is a greater than 50 percent chance they have got a higher grade. Because only 6 people have not got a C. So, I think this is, up to here I think it is realistic picture.

Professor. G Vekatesh: If you have made 7 grades or 6 grades then you could have tried A, B, C and then later on D, E, F.

Professor. Madhavan Mukund: So this does not look like there is that much of relationship. Of course one could do the other way.

Professor. G Vekatesh: Check physics to maths. It is same we do not have do much.

Professor. Madhavan Mukund: So, may be we should be a little bit more relax, so what can we say, supposing we say that somebody is a let us do this, supposing somebody has a A or B in physics, then they have a A or B in maths. So, they could be plus, minus but within the top grades. Top half.

Professor. G Vekatesh: It does not mean above, it is on top half of students.

Professor. Madhavan Mukund: If you are on the top half in physics, you are also on the top half in maths.

Professor. G Vekatesh: So, if you are either A or B in physics, you want to check whether you are A or B in maths.

Professor. Madhavan Mukund: Yes.

Professor. G Vekatesh: So, which means that we will go down this list and check whether that element is there in your list or not.

Professor. Madhavan Mukund: Yes.

Professor. G Vekatesh: So, 28.

Professor. Madhavan Mukund: So, 28 is in the second list, so 28 confirms. So, this is a new question.

Professor. G Vekatesh: 16.

Professor. Madhavan Mukund: 16 is in the first list, so it confirms.

Professor. G Vekatesh: 9.

Professor. Madhavan Mukund: 9 is in the third list, so 9 refutes.

Professor. G Vekatesh: 23.

Professor. Madhavan Mukund: 23 confirms.

Professor. G Vekatesh: 7.

Professor. Madhavan Mukund: 7 confirms.

Professor. G Vekatesh: 5.

Professor. Madhavan Mukund: 5 refutes.

Professor. G Vekatesh: 18.

Professor. Madhavan Mukund: 18 also refutes.

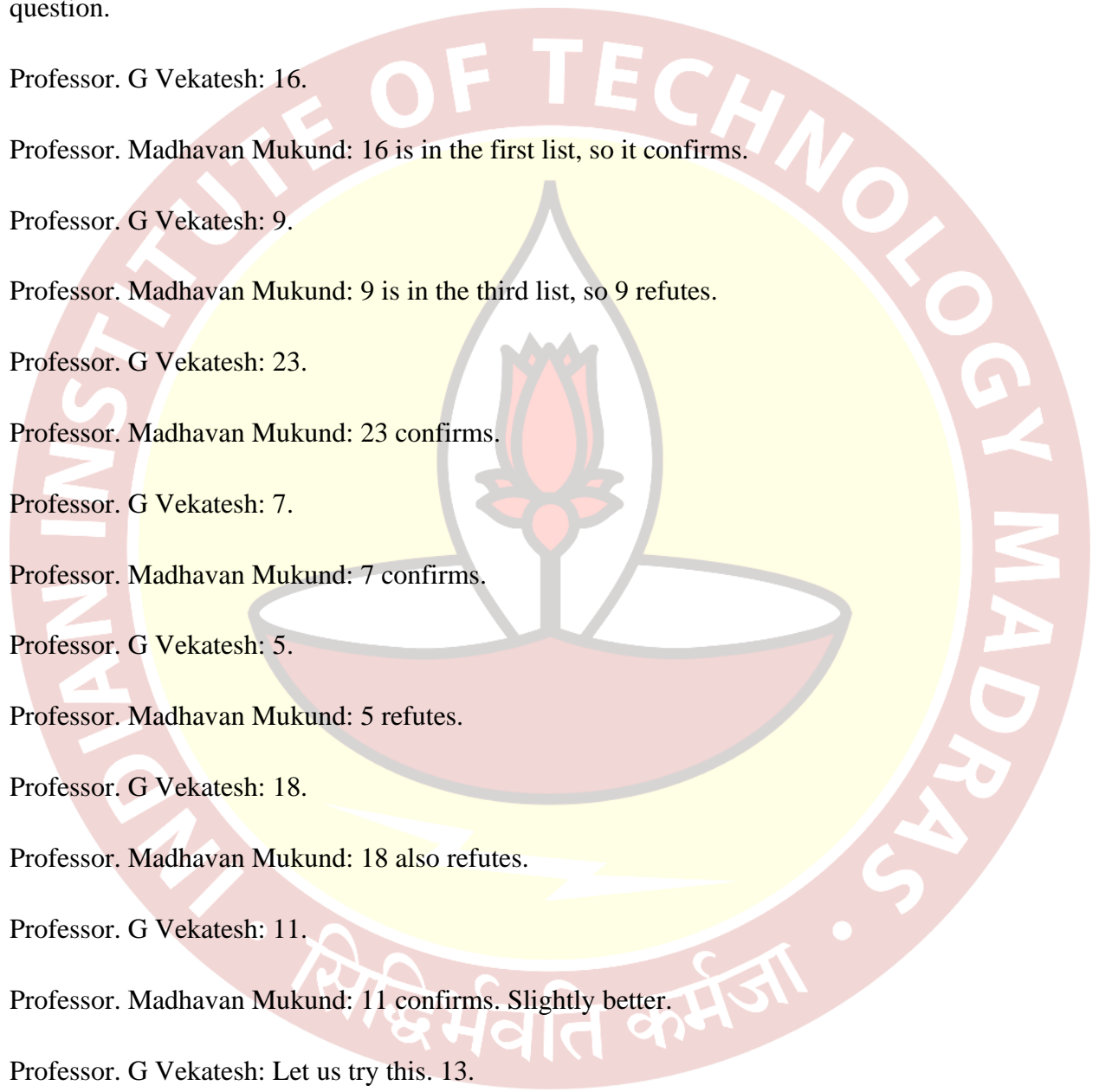
Professor. G Vekatesh: 11.

Professor. Madhavan Mukund: 11 confirms. Slightly better.

Professor. G Vekatesh: Let us try this. 13.

Professor. Madhavan Mukund: 13 does not confirm, because 13 is down, 13 refutes.

Professor. G Vekatesh: 25.



Professor. Madhavan Mukund: 25 confirms.

Professor. G Vekatesh: 27.

Professor. Madhavan Mukund: 27 is in second list, so that confirms.

Professor. G Vekatesh: 19.

Professor. Madhavan Mukund: 19 is down, so it refutes.

Professor. G Vekatesh: 29.

Professor. Madhavan Mukund: 29 is also in the third list, so it refutes.

Professor. G Vekatesh: 17.

Professor. Madhavan Mukund: 17 is right down, so it refutes.

Professor. G Vekatesh: 6.

Professor. Madhavan Mukund: 6 confirms.

Professor. G Vekatesh: So, how are we doing?

Professor. Madhavan Mukund: So, again it is kind of 7 versus 8. So, it is not say much.

Professor. G Vekatesh: So, basically we are saying that the maths marks and physics marks are not correlated. It looks like.

Professor. Madhavan Mukund: Half the people do well in both and half do well in 1 and not the other.

Professor. G Vekatesh: Good, so anyway I mean we get a chance to check out and help others by doing it systematically.

Professor. Madhavan Mukund: But the interesting thing was that we needed to sort it in order to get these grades. So, we could not have check this very easily if we had not done sorting, so that was really the key step in getting this process organized properly.