IIT Madras

ONLINE DEGREE

Computational Thinking
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Below average students in two iterations (non-nested) and grade allocation

So we had seen something about how these students are doing, whether the boys are doing better than the girls in maths and so on. But I guess one thing which might be useful if you were a teacher in the class is to find out which students are not doing well, so that you can give them some help.

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Professor G. Venkatesh: In let us say if you want to do in Mathematics.

Professor Madhavan Mukund: Yeah, so first of all not doing well means maybe those who are comparatively not doing well. So those who are below the others in some sense.

Professor G. Venkatesh: What does it mean below the other, below the max? That means only one person is doing well.

Professor Madhavan Mukund: Yes, max is too much. So there maybe students who are not quite the max who are doing well but we also computed the average so maybe…

Professor G. Venkatesh: So should we, should we take people below the average?

Professor Madhavan Mukund: Yes that might be…

Professor G. Venkatesh: It is a good starting point.

Professor Madhavan Mukund: Yes, so we might say who is doing…

Professor G. Venkatesh: I mean average is a reasonable indicator. So let us say we want to find the average, and then find all the cards, all the students whose marks, maths marks is below the average maths marks. But that should be half of the cards? Will half of the students be like that? Should be no?

Professor Madhavan Mukund: Should be yeah seems reasonable.

Professor G. Venkatesh: Seems like a reasonable, but we will find out. Let us find out. So how do we do that, I mean if I want to find which are the students who are below the, should I keep a list of students who are below the average as we are computing the average, we keep modifying?

Professor Madhavan Mukund: Yes, as we are going along, we have an average that we, so I guess first of all we can, like we have computed max as we go along, we can compute average as we go along. We need the sum and we need the number, and we need to divide. So as we are going along, we can keep the sum of however many cards we have seen.

And then we know how many cards we have seen. So suppose we have seen 17 cards, we have sum of the 17 cards…

Professor G. Venkatesh: And the count

Professor Madhavan Mukund: Then we divide by 17 and we have the current average. Then we take the 18^{th} card, we add the sum, we divide by 18, we get…

Professor G. Venkatesh: But in that 17 itself we may have some cards which are below that average.

Professor Madhavan Mukund: Yes. So now…

Professor G. Venkatesh: but that average was only at the end we found it.

Professor Madhavan Mukund: Yes, so now what it happened is, the average after 17 is of course not likely to be the same as the average after 18.

Professor G. Venkatesh: So the average changes.

Professor Madhavan Mukund: The average changes and so what is below and above average also becomes a different set. So if we had a set of cards which we had identified as below average, perhaps the average moves up.

Professor G. Venkatesh: We should try that I mean should try to keep the track of all the cards which are below average and see how it goes.

Professor Madhavan Mukund: We can try, yes, let us try and see whether that work or not. So, so now, so we are going to do now two things simultaneously. One is we are going to keep the average as we go on…

Professor G. Venkatesh: We are going to keep a count variable in the sum variable.

Professor Madhavan Mukund: Yes, so for that we need a sum and a count. And we also need to keep a list of cards which are below the current average, below the average that we have…

Professor G. Venkatesh: Will the average go up? Can go up, right?

Professor Madhavan Mukund: Yes, if we get a new card which is above…

Professor G. Venkatesh: If it goes up, then the list is still valid, because those were below the average till then.

Professor Madhavan Mukund: Yes, but there may be some…

Professor G. Venkatesh: if the average goes down…

Professor Madhavan Mukund: no, both ways. If the average goes up also, some cards which we thought were above the average might now become below that…

Professor G. Venkatesh: oh I see, that becomes, that is even more difficult.

Professor Madhavan Mukund: Yes. And some cards which were below the average, if the average reduces might now become okay. So they might be have to be removed from the list. So we will have to keep going back and see the list…

Professor G. Venkatesh: we have to do the whole list again.

Professor Madhavan Mukund: Yes, we will have to keep doing the list again and again. So that seems little bit, because first we will have to do it say for 17 cards, we have to do the list. When we see the 18th cacrd…

Professor G. Venkatesh: we go back and see all the 17 cards again.

Professor Madhavan Mukund: Yes, we have to go through all the 17 cads again.

Professor G. Venkatesh: That is a very cumbersome process, because as you keep going, when you go to the 19th, you will have to see 18. Yes. When you go to the 20th, you have to see the 19 again.

Professor Madhavan Mukund: Yes, because you do not know really which ones get affected by this.

Professor G. Venkatesh: Does not seem like a very good procedure you are doing too many checks, right. Should be better way of doing?

Professor Madhavan Mukund: So ofcourse once we know the overall average, then the list is clearer. So if we know the total average of the whole class, this is what we are actually interested, we want to know whole class who is below average.

Professor G. Venkatesh: So unlike what we saw earlier, where we were keeping track of the average as we go along and then trying to do something whether we can solve, here in this case we cannot do that. We will go through the whole…

Professor Madhavan Mukund: yes I think it is better to first do, just compute the average.

Professor G. Venkatesh: Compute the average for the entire list.

Professor Madhavan Mukund: Yes and then do a single list of 30. Now this is going to be better than before, because earlier we were doing for 29, 28, 27, 26 where we are doing only once for all 30.

Professor G. Venkatesh: All 30 we will do.

Professor Madhavan Mukund: Will do and then…

Professor G. Venkatesh: So but we have to do two iterations. Yes. One iteration to find the average, then the second pass through the cards again to find all the cards that are below that average.

Professor Madhavan Mukund: Yes. So this was a little bit like, if you remember the words thing, where we wanted to find all words which were above a certain frequency, we have to first find all the frequencies and then go through and then identify those words whose frequency is too high and then remove them, right. So I think we have to first do this…

Professor G. Venkatesh: So it is a interesting kind of filter here, because even that word was also like a interesting kind of filter. Here you are basically determining the filter based on the properties of the cards. Yes. The earlier filters were saying basically look at the card and see whether it is a boy or a girl or something.

Professor Madhavan Mukund: Yes and it was saying…

Professor G. Venkatesh: now you were saying.

Professor Madhavan Mukund: Yes and the value that we were comparing like max or something was something which was complement by…

Professor G. Venkatesh: incrementally coming.

Professor Madhavan Mukund: Yes, whereas now we need a cumulative…

Professor G. Venkatesh: cumulative thing. So you are looking at all the cards coming up with some cumulative number, which is the average. Yes. And then using that average variable, we are going to filter…

Professor Madhavan Mukund: Filter to say below average…

Professor G. Venkatesh: Below average you take out, alright. That is good, let us try that.

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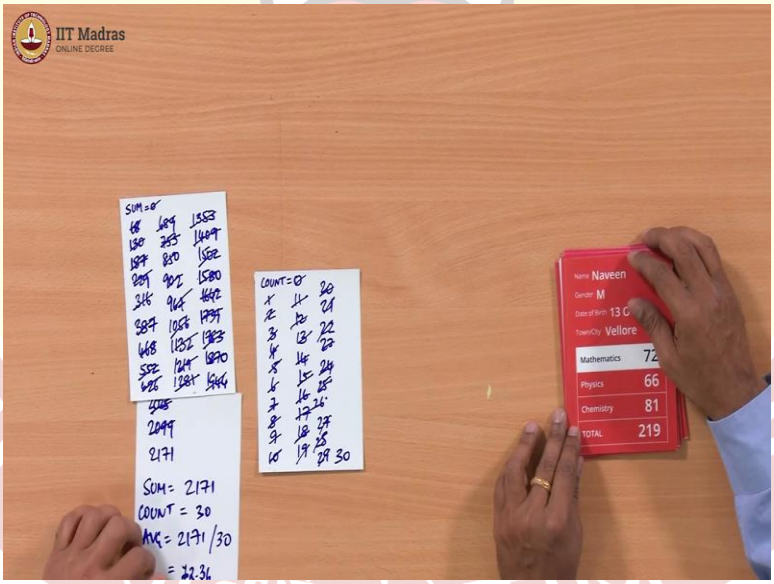

Professor Madhavan Mukund: So let us try. So…

Professor G. Venkatesh: So we have got to keep track of the count. So initially…

Professor Madhavan Mukund: so we will keep the sum.

Professor G. Venkatesh: Sum and count…

Professor Madhavan Mukund: which is initially 0 and we will keep the count, which is also initially 0. So we see now, the first card.

Professor G. Venkatesh: First card is 68.

Professor Madhavan Mukund: So the first card is 68, and now the count is 1.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: so that is now 130 and the count is 2.

Professor G. Venkatesh: 57.

Professor Madhavan Mukund: Okay, so that is 187 and the count is 3.

Professor G. Venkatesh: 42.

Professor Madhavan Mukund: so that is 229.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: 5^{th} card that is now 316.

Professor G. Venkatesh: 71.

Professor Madhavan Mukund: The 6^{th} card, that is 387.

Professor G. Venkatesh: 81.

Professor Madhavan Mukund: That is the 7^{th} card and that is 468.

Professor G. Venkatesh: 84.

Professor Madhavan Mukund: That is the 8^{th} card and that is 552.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: That is the 9^{th} card and that is 626.

Professor G. Venkatesh: 63.

Professor Madhavan Mukund: That is the 10th card and that is 689.

Professor G. Venkatesh: 64.

Professor Madhavan Mukund: So that is the 11th card (one second) and that is 753.

Professor G. Venkatesh: 97. (max candidate)

Professor Madhavan Mukund: So that is the 12th card and that is 851.

Professor G. Venkatesh: 52.

Professor Madhavan Mukund: 13th card, it is 902.

Professor G. Venkatesh: 65.

Professor Madhavan Mukund: 14th card, and this is 967.

Professor G. Venkatesh: 89.

Professor Madhavan Mukund: It is a 15th card and that is 1056.

Professor G. Venkatesh: 76.

Professor Madhavan Mukund: That is the 16th card and that is 1132.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: the 17th card and that is 1219.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: It is the 18th and that is (one second) 1281.

Professor G. Venkatesh: 72.

Professor Madhavan Mukund: That is the 19th card and that is now 1353.

Professor G. Venkatesh: 56.

Professor Madhavan Mukund: that is the 20th card and that is 1409.

Professor G. Venkatesh: 93.

Professor Madhavan Mukund: 21st card and it is 1502.

Professor G. Venkatesh: 78.

Professor Madhavan Mukund: 22nd card and that is 1580.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: 23 and that is 1642.

Professor G. Venkatesh: 97.

Professor Madhavan Mukund: 24 and that is 1739.

Professor G. Venkatesh: 44.

Professor Madhavan Mukund: 25 and that is 1783.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: 26 and that is 1870.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: 27 and that is 1944.

Professor G. Venkatesh: 81.

Professor Madhavan Mukund: we get another piece of paper to write on. So now we have 28 and we have 2025.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: That is 29th card and that is 2099.

Professor G. Venkatesh: The last card is 72.

Professor Madhavan Mukund: So we have 30 cards and the total is 2171. So we know that the total sum, so after this the sum is 2171. Count is 30. So the average is 2171 divided by 30. And this is 72.36 I think, alright.

Since all our marks were integers, we do not really need to know, we just know that anything 72 and below is to be averaged.

Professor G. Venkatesh: So should we go through the cards now?

Professor Madhavan Mukund: Yes, so now we should find out who is below average.

Professor G. Venkatesh: The last card was 72. We can go in any order.

Professor Madhavan Mukund: Yes, we can go in any order. Now we have this target. So we want to filter according to this number. So anything which is below this number, we want to move aside.

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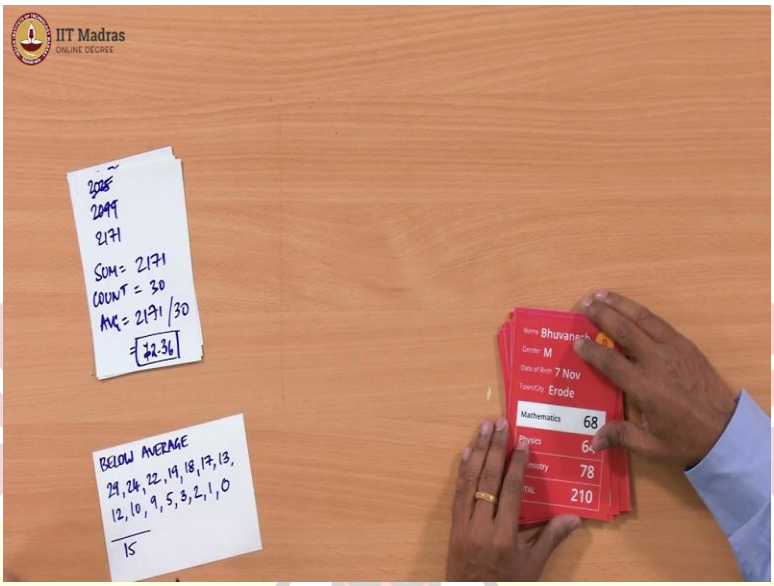

And we want to ideally keep track of…

Professor G. Venkatesh: The cards we are seeing.

Professor Madhavan Mukund: So now we are going in reverse order, but it does not matter. So below average, so we are just maintain a list of number card ID. So the first one is 29.

Professor G. Venkatesh: 29.

Professor Madhavan Mukund: So 29 is a card which is below 72.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: 74 is not below, so we skip it.

Professor G. Venkatesh: I can keep it in the same pile, does not matter, because you have to keep track for the numbers. Yes. 81.

Professor Madhavan Mukund: 81 is also not below.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: say 87.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 44.

Professor Madhavan Mukund: Yes. So card number 24 is below average.

Professor G. Venkatesh: 97.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: Yes. So card 22 is below average.

Professor G. Venkatesh: 78.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 93.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 56.

Professor Madhavan Mukund: Yes. So card 19 is below average.

Professor G. Venkatesh: 72, yes.

Professor Madhavan Mukund: Yes, 18 is also below average.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: Yes 17 is also below average.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 76.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 89.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 65.

Professor Madhavan Mukund: Yes, so card 13 is below average.

Professor G. Venkatesh: 52.

Professor Madhavan Mukund: Card 12 is below average.

Professor G. Venkatesh: 97.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 64.

Professor Madhavan Mukund: Yes, so card 10 is below average.

Professor G. Venkatesh: 63.

Professor Madhavan Mukund: 9 is below average.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: No. Marginally above.

Professor G. Venkatesh: 84.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 81.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 71.

Professor Madhavan Mukund: Yes, so card 5 is below average.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: No.

Professor G. Venkatesh: 42.

Professor Madhavan Mukund: Yes, so card 3 is below average.

Professor G. Venkatesh: 57.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: 68.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: So how many did we get?

Professor Madhavan Mukund: 1, 2, 3, 4, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15. It is exactly half. Actually it is exactly half.

Professor G. Venkatesh: Should it be always the case? Does it seem?

Professor Madhavan Mukund: Well actually I do not think it needs to be exactly half. For instance, supposing you had some students, supposing a lot of students had around 50 marks and one student had 100. Supposing everybody had 50 marks except one student had 100, so this one student who has 100 will make the average more than 50.

Professor G. Venkatesh: Yes.

Professor Madhavan Mukund: So all the people who have got 50 marks will be below average.

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Professor G. Venkatesh: Oh, I see. So if you had instead of the 30 students, if 29 out of 50…

Professor Madhavan Mukund: 29 had 50 and one has 100.

Professor G. Venkatesh: Then the average will be slightly more than 50.

Professor Madhavan Mukund: Yes. Will be something more than 50. So these 29 students will be below average. So I think we are lucky that we got 15, but there is no reason that why it should be 50.

Professor G. Venkatesh: So the cards are nice, the values of maths marks are kind of nicely distributed…

Professor Madhavan Mukund: Yes, below and above the average. But the average could be somewhere not midway. So I think that is another interesting thing. So if you just take this average, which is the sum divided by the total, this need not be the midpoint. Although in this particular case, this happens to be the midpoint.

But the useful thing we have found is that to do this separation or filtering, we had better do the average computation first and then do it otherwise it is very tedious to do this as we go along, because we have to keep revisiting the list. So this kind of a list, we have to keep going back and adding subtracting, adding subtracting as we go.

Professor G. Venkatesh: And that by looking at all the cards once again.

Professor Madhavan Mukund: Yes, we have to revisit all the cards once again. So we will have to see 1 card, then 2 cards, then 3 cards and 4 cards and so on. So that will be a lot.

Professor G. Venkatesh: That is very wasteful. So it is much better to just do the whole thing in two iterations, one to find the average and another to separate the cards.

Professor Madhavan Mukund: Yes. So we saw how to find out which students are doing poorly below average, but actually another thing that we might want to do is to kind of group these students according to how they have done. So usually we do that by assigning grades.

Professor G. Venkatesh: Like you could give guys above average A and below average it could be B.

Professor Madhavan Mukund: Yes, but that might be too crude, just two categories. So usually we have like people who have done really well close to the top, we maybe give them an A. Then those who have done reasonably well, we give them a B. So let us, I would say typically maybe 4 categories, A, B, C, D would be a good way to do.

Professor G. Venkatesh: But how do you? We have right now average which divides roughly we saw into two equal parts. So if you want to give two grades, then I know how to do it, but if you have to do 4 grades, then I do not know how to do.

Professor Madhavan Mukund: Well, see we could take the range of grades, the marks that students have and try to divide it up.

Professor G. Venkatesh: Range in the sense, I mean…

Professor Madhavan Mukund: Well, of course range is 0 to 100 but nobody has got 0 and nobody has got 100. So maybe it is more reasonable to look at the range of the students have actually got. So maybe we want to look at the lowest mark anyone has got.

Professor G. Venkatesh: Which is the minimum?

Professor Madhavan Mukund: Yes, the minimum then the highest marks which anyone has got, which is the maximum. So that gives us the spread of marks.

Professor G. Venkatesh: We have already found the maximum.

Professor Madhavan Mukund: Yes, we have found the minimum and maximum.

Professor G. Venkatesh: We have not found the minimum, we have found the maximum.

Professor Madhavan Mukund: Yes, we found the maximum.

Professor G. Venkatesh: We have to find the minimum.

Professor Madhavan Mukund: So if we know this spread minimum to maximum, then one thing could be we then find within that we decide how to separate the remaining people into say 4 categories A, B, C, D.

Professor G. Venkatesh: How do you do that? I mean I know, so let us say the maximum, you know the maximum is 97 in this. Yes. But I do not know what the minimum is. Let us say whatever it is, let us say 20. Then what do I do?

Professor Madhavan Mukund: So we have the range from 20 to say 97. So that is like 78 marks, 77 plus 1, 78 marks. So maybe you want to just take that segment of 78 and divide it into 4. Maybe 4 equal groups…

Professor G. Venkatesh: 4 equal parts?

Professor Madhavan Mukund: Yes, 4 equal parts. And whoever falls…

Professor G. Venkatesh: And hope they are equally divided.

Professor Madhavan Mukund: Yes, so we will create 4 bands and then…

Professor G. Venkatesh: Assume that there are 4 equally, equal each of those bands have equal number of students. We do not know, may have.

Professor Madhavan Mukund: Yes. So we have to first define those bands.

Professor G. Venkatesh: But then this requires us to find the minimum, maximum first.

Professor Madhavan Mukund: Yes, because we are only finding the bands between the marks that we actually have.

Professor G. Venkatesh: So minimum, so we saw that finding the maximum, it requires us to iterate through all the cards.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: I presume minimum also will require us to iterate all the cards.

Professor Madhavan Mukund: Exactly, same thing, we have to remember instead of maximum we have to remember the minimum.

Professor G. Venkatesh: And this business of separating into A, B, C, D as we go along, we will not be able to do…

Professor Madhavan Mukund: Because the bands will change depending on what…

Professor G. Venkatesh: Band keeps changing depending on the, just like the average what we did.

Professor Madhavan Mukund: Yes, so we will have to first do the maximum minimum calculation.

Professor G. Venkatesh: Find the minimum maximum.

Professor Madhavan Mukund: Then decide the bands. And then go through one more pass and move people into filter it into those four bands. So shall we find? Yes.

Professor G. Venkatesh: How do I find the minimum? I mean I know the maximum, because we said it is, it is basically keep on checking whether the current card is greater than max. If it is you replace the max with the current maximum, so what about the minimum?

Professor Madhavan Mukund: Minimum will be the same way in the reverse direction. So if something is smaller than the minimum, you will replace it with a new card.

Professor G. Venkatesh: But then what do I start with? I mean where do I start the value? There we started with 0 I think.

Professor Madhavan Mukund: Yes. So here we should take something which is definitely bigger than everything. So we know marks are out of 100. So maybe we can take 100 or even 101. Because we know that nobody will have 101 marks. So every minimum will be definitely less.

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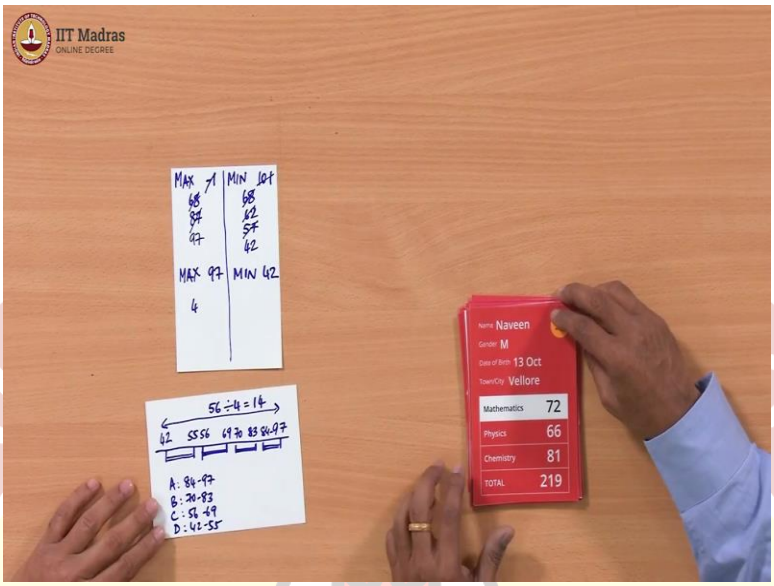

Professor G. Venkatesh: So let us take 101.

Professor Madhavan Mukund: Yes. And for the maximum, we could even take minus 1.

Professor G. Venkatesh: Minus 1.

Professor Madhavan Mukund: Minimum marks somebody could have got 0, so take minus 1. Let us start that.

Professor G. Venkatesh: Let us start that.

Professor Madhavan Mukund: So we say, so I will start, so I will keep two columns.

Professor G. Venkatesh: So you start with, so you have two variables.

Professor Madhavan Mukund: So I keep max, which I put as initially minus 1.

Professor G. Venkatesh: Minus 1.

Professor Madhavan Mukund: And I keep min, which I initially keep as 101.

Professor G. Venkatesh: Alright. So as we see each card, maths marks we will look at. And if the max is…

Professor Madhavan Mukund: Yes, if it exceeds the max, we have to…

Professor G. Venkatesh: We will update the max.

Professor Madhavan Mukund: And if it is below the limit, so it could be both. Like the first card will be both.

Professor G. Venkatesh: Okay, let us try. 68.

Professor Madhavan Mukund: So 68 is more than minus 1, so I will make the max currently into 68, with the min is also now 68, because it is…

Professor G. Venkatesh: okay, alright, okay. So the next one is 62.

Professor Madhavan Mukund: So 62 does not change the max. But it changes the min, so now the min becomes 62.

Professor G. Venkatesh: 57.

Professor Madhavan Mukund: Again 57 does not change the max, but changes the min.

Professor G. Venkatesh: 42.

Professor Madhavan Mukund: 42 again does not change the max, but changes the min.

Professor G. Venkatesh: Alright, 87.

Professor Madhavan Mukund: 87 is bigger than the max, so it changes the max, but does not change the min.

Professor G. Venkatesh: 71.

Professor Madhavan Mukund: 71 is between max and min, nothing happens.

Professor G. Venkatesh: Oh, I see.

Professor Madhavan Mukund: So 71 is smaller than max, so max does not change. 71 is bigger than min, so min does not change. So anything which is between these two will not change.

Professor G. Venkatesh: Will not change either of them?

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: 81.

Professor Madhavan Mukund: So 81 is again between.

Professor G. Venkatesh: 84.

Professor Madhavan Mukund: 84 is also between.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: 74 is also between.

Professor G. Venkatesh: 63.

Professor Madhavan Mukund: 63 is also between.

Professor G. Venkatesh: 64.

Professor Madhavan Mukund: 64 is also between.

Professor G. Venkatesh: 97.

Professor Madhavan Mukund: So now 97 is bigger than the max, so it changes the max. So now we have…

Professor G. Venkatesh: So you are dynamically finding the range, looks like we are getting the range. 52.

Professor Madhavan Mukund: 52 is in between.

Professor G. Venkatesh: 65.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 89.

Professor Madhavan Mukund: 89 is in between.

Professor G. Venkatesh: 76.

Professor Madhavan Mukund: 76 in between.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 72.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 56.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 93.

Professor Madhavan Mukund: Still in between.

Professor G. Venkatesh: 78.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: Another 97.

Professor Madhavan Mukund: See now all we want is range, so the fact that there are two 97s actually should not…

Professor G. Venkatesh: does not change anything…

Professor Madhavan Mukund: we do not need to know who has got 97.

Professor G. Venkatesh: Okay, 44.

Professor Madhavan Mukund: but it is still inside.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: 81.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: In between.

Professor G. Venkatesh: 72.

Professor Madhavan Mukund: in between. So we have found…

Professor G. Venkatesh: So we are done with all the cards now.

Professor Madhavan Mukund: Yes. So now we know that max is 97 and min is 42.

Professor G. Venkatesh: So the range is 97, 42 to 97.

Professor Madhavan Mukund: Yes. But you should be careful, so if you subtract this you will get 55. But it is actually 56.

Professor G. Venkatesh: because you have to include the…

Professor Madhavan Mukund: include the end point. So this is the range of, so 42, so if I take another card, maybe I will write it, so we have from 42…

Professor G. Venkatesh: to 97. And that has 56.

Professor Madhavan Mukund: This spread is 56.

Professor G. Venkatesh: This you want to divide into 4 parts.

Professor Madhavan Mukund: Yes. So 56 divided by 4 is, fortunately it divides. So we get…

Professor G. Venkatesh: 14.

Professor Madhavan Mukund: 14, so we can give 14, 14 marks. So for instance, we take the next 14 marks, so we take 14 that is 56. But we should stop at 55. So we say up to 55 will be our first band.

Professor G. Venkatesh: 42 to 55 both including.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: okay. Then next starting at 56.

Professor Madhavan Mukund: and then we go up to 60 minus, 70 minus 1, so we go to 69. So this will be our second band.

Professor G. Venkatesh: Okay, then it is 70.

Professor Madhavan Mukund: 70 to 84 minus 1, 83. This will be our third band. And finally 84 to 97 will be our fourth band.

Professor G. Venkatesh: So this is A?

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: This is B?

Professor Madhavan Mukund: No, no I think …

Professor G. Venkatesh: oh no sorry, yes.

Professor Madhavan Mukund: So A should be now…

Professor G. Venkatesh: A has to be the best, right? So 84 to 97 is A.

Professor Madhavan Mukund: B will be 70 to 83, C will be 56 to 69 and D will be 42 to 55. So now what we have to do is, now we have got the bands. So these are our grade bands.

Professor G. Venkatesh: Now we have go to the cards again.

Professor Madhavan Mukund: So now we have to assign to everybody a band.

Professor G. Venkatesh: A grade.

Professor Madhavan Mukund: So what we will do I guess is, we will keep for each grade, we will just write down the card numbers which fall into that grade. So we have four lists of cards again.

Professor G. Venkatesh: Four lists we will make. So you can write in this card itself maybe. Or you take a new one.

Professor Madhavan Mukund: May be I will just write a new one, so that we have, we make sure we have enough space to write.

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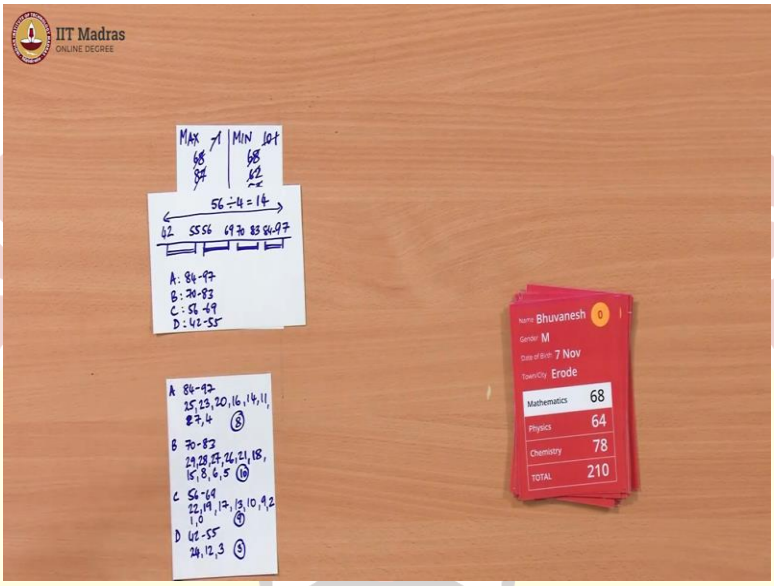

So we will just write down…

Professor G. Venkatesh: the grades A, B, C, D.

Professor Madhavan Mukund: A, B, C, D. And I will just write the numbers, so we know what we are doing.

Professor G. Venkatesh: Alright, okay.

Professor Madhavan Mukund: 84 to 97.

Professor G. Venkatesh: I can go in any order I presume right, because…

Professor Madhavan Mukund: Yes, now we know what to do. So these are our four…

Professor G. Venkatesh: and the guess is that you roughly have equal number, we do not know.

Professor Madhavan Mukund: We do not know, let us see.

Professor G. Venkatesh: Okay, we will see.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: So 72 is the first mark.

Professor Madhavan Mukund: So that now we have to compare it with each of these, but it falls into the B grade. So that is the first card here which is…

Professor G. Venkatesh: 29.

Professor Madhavan Mukund: So I will just write 29.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: 74 which is again in the same.

Professor G. Venkatesh: Card number 28.

Professor Madhavan Mukund: So this is card number 28.

Professor G. Venkatesh: 81.

Professor Madhavan Mukund: 81 is also here, looks like everybody is …

Professor G. Venkatesh: 27.

Professor Madhavan Mukund: is 27.

Professor G. Venkatesh: yes, card number 27. 74.

Professor Madhavan Mukund: Okay, so this seems to be popular…

Professor G. Venkatesh: 26, it is a popular band. 87.

Professor Madhavan Mukund: 87 is now in this band. So card number 25 gets…

Professor G. Venkatesh: we got our first A grade. Geeta. 44.

Professor Madhavan Mukund: Siddharth is got…

Professor G. Venkatesh: Siddharth is down into D grade, 24. Yes. 97.

Professor Madhavan Mukund: That is clearly an A.

Professor G. Venkatesh: Deepika, that is 23. 62.

Professor Madhavan Mukund: 62 is in the third band…

Professor G. Venkatesh: For the first time we are getting a third band.

Professor Madhavan Mukund: so we get a C.

Professor G. Venkatesh: 22. 78.

Professor Madhavan Mukund: 78 is again in the B grade, so that is card number 21.

Professor G. Venkatesh: 93.

Professor Madhavan Mukund: 93 is an A grade, so that is card number 20.

Professor G. Venkatesh: 56.

Professor Madhavan Mukund: 56 is best got into C…

Professor G. Venkatesh: just barely into C, alright 19. Alright 72.

Professor Madhavan Mukund: 72 is here, so that is 18 and a B grade.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: 62 is again a C, so that is 17.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: 87 is an A, so that…

Professor G. Venkatesh: Tauseef is A grade. 76.

Professor Madhavan Mukund: 76 is in B again, so that is card number 15.

Professor G. Venkatesh: 89, is another A I think.

Professor Madhavan Mukund: 89 is another A, 14.

Professor G. Venkatesh: 65. Is a C?

Professor Madhavan Mukund: 65 is a C, it is 13.

Professor G. Venkatesh: 52.

Professor Madhavan Mukund: 52 is in D, that is 12.

Professor G. Venkatesh: 97 again.

Professor Madhavan Mukund: 97 is an A, that is 11.

Professor G. Venkatesh: 64.

Professor Madhavan Mukund: 64 is a C.

Professor G. Venkatesh: 63.

Professor Madhavan Mukund: 63 is again a C.

Professor G. Venkatesh: 74.

Professor Madhavan Mukund: 74 is a B.

Professor G. Venkatesh: 84.

Professor Madhavan Mukund: 84 is just…

Professor G. Venkatesh: barely made it Aditya, made it to A. 81.

Professor Madhavan Mukund: Oh sorry, that was 7.

Professor G. Venkatesh: Yes, that is seven.

Professor Madhavan Mukund: 81 is B.

Professor G. Venkatesh: 71.

Professor Madhavan Mukund: 71 is also a B. So B is by far the most common.

Professor G. Venkatesh: 87.

Professor Madhavan Mukund: 87 is in A.

Professor G. Venkatesh: 42.

Professor Madhavan Mukund: 42 is unfortunately a D.

Professor G. Venkatesh: 57.

Professor Madhavan Mukund: 57 is a C, it is card number 2.

Professor G. Venkatesh: 62.

Professor Madhavan Mukund: 62 is also a C that is card number 1.

Professor G. Venkatesh: Final card 68.

Professor Madhavan Mukund: 68 is also a C, this is card number 0.

Professor G. Venkatesh: So how does it look?

Professor Madhavan Mukund: So we have 1, 2, 3, 4, 5, 6, 7, 8 of people who have got an A. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 people have got B. 1, 2, 3, 4, 5, 6, 7, 8, 9 people have got a C. And 3 people have…

Professor G. Venkatesh: So it is not the same.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: So it is clear that the, not the same.

Professor Madhavan Mukund: Yes, on the whole students are doing, so remember that our average was 72, but our B grade starts at 70. So if we actually look at people who are 70…

Professor G. Venkatesh: above average.

Professor Madhavan Mukund: If we take 70 as our cut off and not the real average, we would have seen that majority of the people have got above 70. So actually many people were very border line and below that average who got counted in, so there were 15 people below average, now there are only 12.

Professor G. Venkatesh: So is it a better way of finding out whether student is doing well or not than just taking average? Because it looks like above average or below average you are giving advantage, just giving too much advantage to somebody who is just marginally above average, and giving too much disadvantage to somebody who is just marginally below average, right?

Professor Madhavan Mukund: Yes. So there are many different ways I guess, and I think here I mean we had people who had got one mark this way , that way, so people had got 84, got an A. If they have got 83, they are all at B. So I guess there is some unfairness in everything, but if we want a good picture of how the class is doing, I think this gives us a better picture.

Professor G. Venkatesh: Slightly better picture.

Professor Madhavan Mukund: Because now we have an idea about. So one thing we can see for sure is that very few students are doing really badly. Yes. And the trend is to be in the higher half. So I think that means that hopefully the students are understanding what is going on in class. So this is a useful this thing.

But again the important thing for us computationally was that, we had to first find these bands.

Professor G. Venkatesh: Yes.

Professor Madhavan Mukund: So again we had to first do one iteration…

Professor G. Venkatesh: we could not do it…

Professor Madhavan Mukund: to find the minimum and maximum, then use that division of course, that range into equal, four parts, to find a band and then do a filtering.

Professor G. Venkatesh: filtering based on that.

Professor Madhavan Mukund: There is no way we would have done this filtering or no easy way to do the filtering while we are going along, because the bands will keep changing.

Professor G. Venkatesh: So it is two iterations, first iteration to get some aggregate values from the thing, initially it was average. In this case it is the bands.

Professor Madhavan Mukund: Yes. So min and max actually and then the bands.

Professor G. Venkatesh: yes, min and max then the bands and then use that basically as the filtering condition to basically select cards and classify the cards.

Professor Madhavan Mukund: Correct.