Real Time Systems
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Lecture 59
Characteristics of Temporal Data

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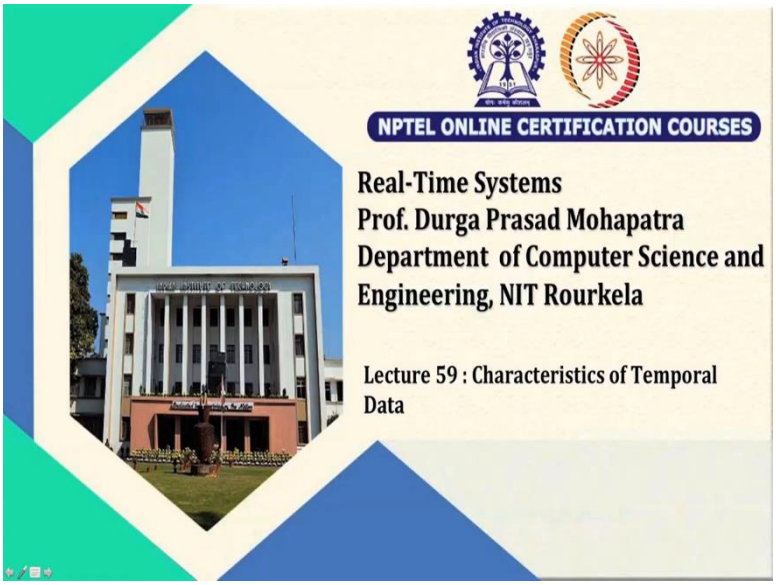

Good morning to all of you. Last class we have discussed what are the differences between the conventional databases and real-time databases. At that time one point I have told one difference is the temporal characteristics of data. So, in real-time databases, the data is associated with some time or some value of time.

So, but in normally this traditional database these data are normally they are not associated with any time or timing values. So, and we say that property that the temporal characteristics I have already told you in last class that real time databases and the conventional databases between them one method or one significant difference is that temporal characteristics of data. So, today we will discuss about the some of the characteristics of the temporal data.

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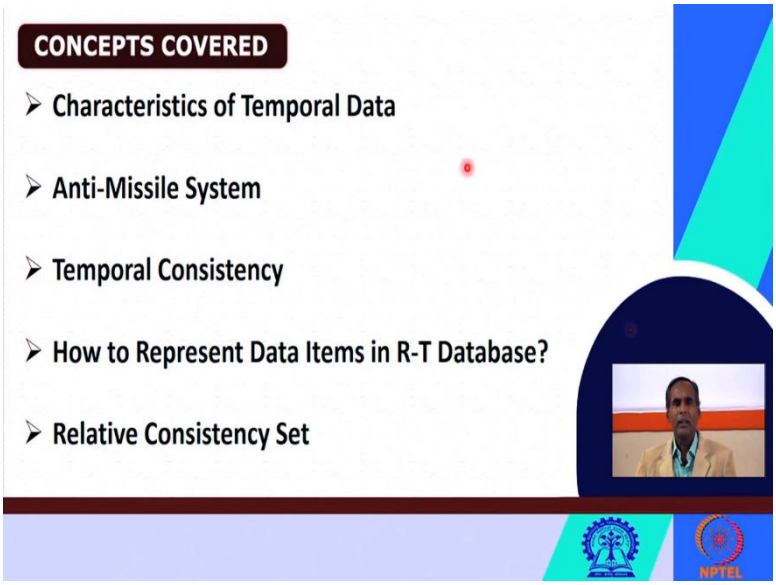

So, we will see about the characteristics of temporal data. Then we will see these characteristics of temporal data with a suitable example with an anti-missile system, then we will see what are the different types of temporal consistency.

Two types of consistency I have already told yesterday that is the absolute consistency and relative consistency that we will see. Then we will see in a real-time system, how can we represent the data items in a real-time database and finally we will see about what do you mean by relative consistency set.

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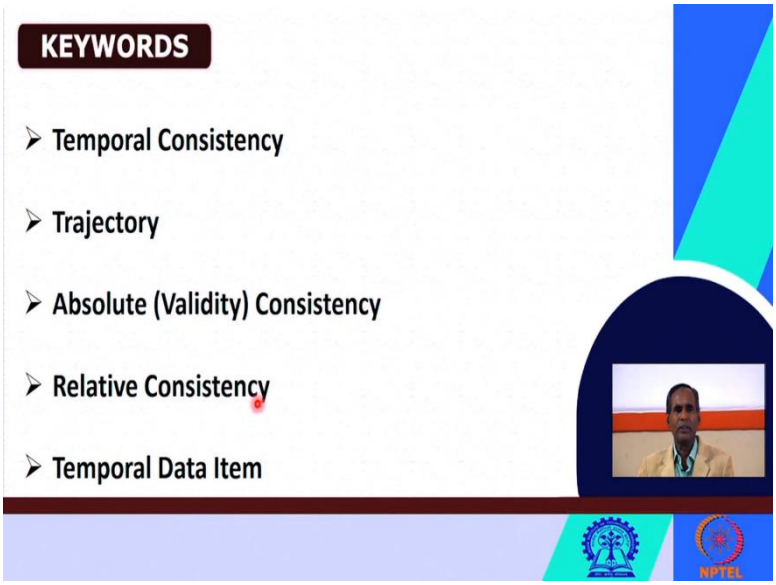

These are the keywords we will be using. Temporal consistency, absolute consistency, relative consistency, trajectory and these two consistencies I have already told you absolute consistency

and relative consistency. Some of the books, this absolute consistency it is written as absolute validity. So, almost similar things and we will see what do you mean by a temporal data item.

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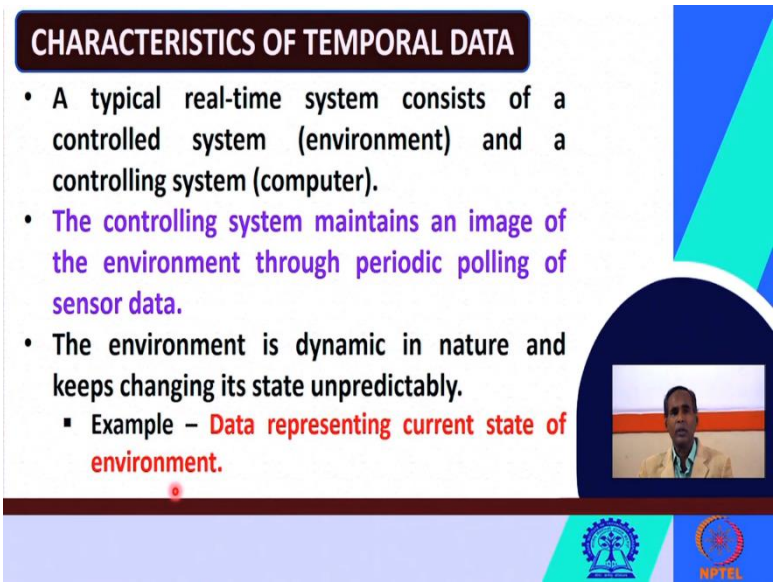

We will start with the characteristics of the temporal data. Normally, what happens a typical real-time system it consists of a control system and a controlling system. So, what is the control system? The environment is treated as the control system and the computer is normally is treated as a controlling system.

So, what is the job of this controlling system? The controlling system it maintains an image of the environment through periodic polling of sensor data. What the control system, controlling system does, the controlling system it maintains. Maintain what? It maintains an image of the environment.

So, what is happening in the environment, it gives the image of an environment. It maintains an image of the environment how? Through periodic polling of sensor data because what in the environment we have put some sensors. So, this controlling system of the computer, it periodically pulls this sensor, it receives the sensor data through the sensors. It what maintain this image of the environment through what periodic polling of this sensor data. So, if the computer or the controlling system, it extracts data periodically from the sensors, you know that normally the environment is dynamic in nature, it is changing, it always almost keeps on changing and it keeps on changing its state unpredictably.

The state of this what environment, it changes frequently and it also changes very unpredictably. The example you can see, the data representing the current state of the

environment is a very good example of this dynamic environment because the data which represents the current state of an environment it frequently changes.

You take the example of this an aeroplane is flying. So, its data like at a particular point of time, what is the acceleration, what is the velocity, what is the position etc. every one second you will see this data is changing. So, data representing the current state of the environment, it always changes and how it will change you cannot predict the behavior. This changing behavior, this changing behavior is unpredictably the state change is unpredictably in case what environment which is dynamic in nature.

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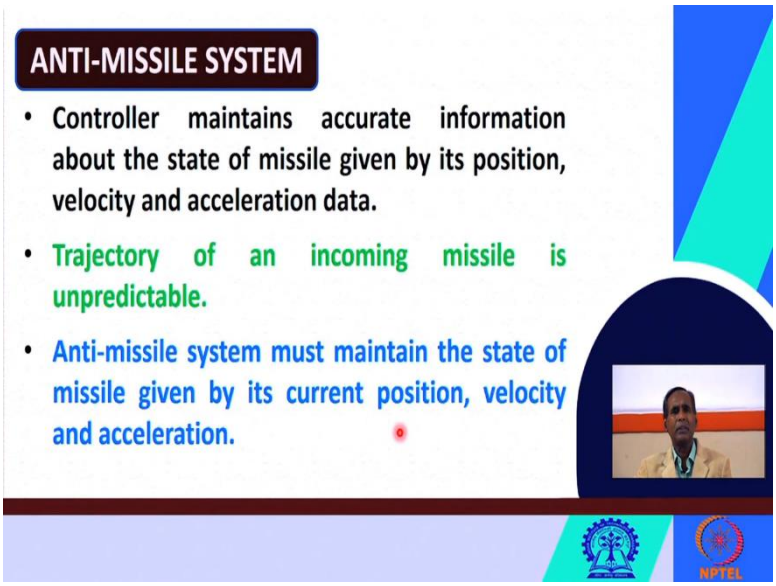

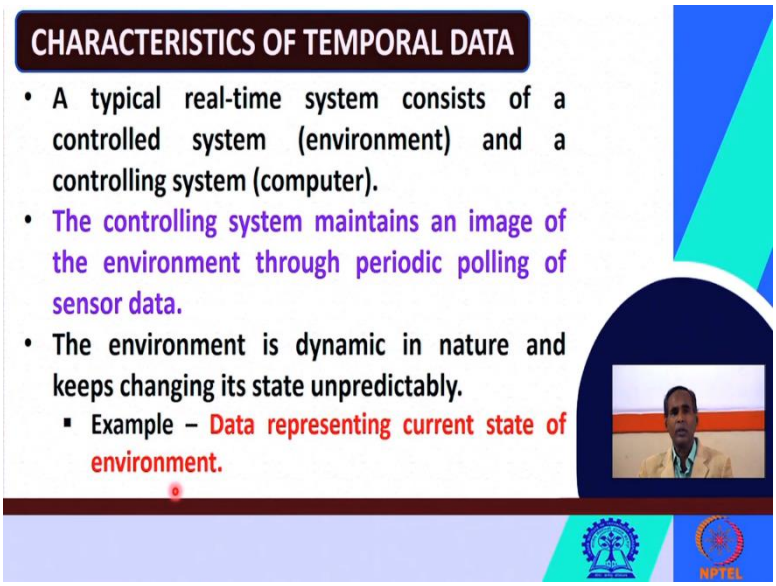

We will explain these characteristics of temporal data through an example of anti-missile system. I hope you have already known about on anti-missile system. Every country they are

having their own anti-missile systems. So, in this anti-missile system, as I already told you, there are two important components, a control system and the controlling system. So, in this anti-missile system, the controller, it maintains the accurate information about the state of the missile. So, what is the state of the missile?

The controller maintains the accurate information about the state of the missile and how we can represent the state of the missile? The state of the missile can be repented by what is its position, velocity and acceleration data. So, this is the state and you see, this is the temporal data and you see this is keeps on changing. So, this temporal data the position, velocity and acceleration of this missile it frequently changes. So, the state is unpredictable. The state is changing and the controller maintains the accurate information about these temporal data.

Now, let us see suppose a trajectory, suppose a missile is coming from the neighbouring country and you know, this trajectory of the incoming missile is unpredictable. How it will come, where it will fall down? So, the trajectory of an incoming missile is completely unpredictable. So, the anti-missile system what it should do? The anti-missile system, it must contain the state of the missile given by its current position, velocity and acceleration.

So, the anti-missile system, it must contain what? It must contain the state of the missile and the state of the missile can be represented by its current position, velocity and acceleration and this state is frequently changing. So, that is why the anti-missile system it must be maintained properly, accurately the state of the missile which is given by this temporal database such as its current position, velocity and acceleration.

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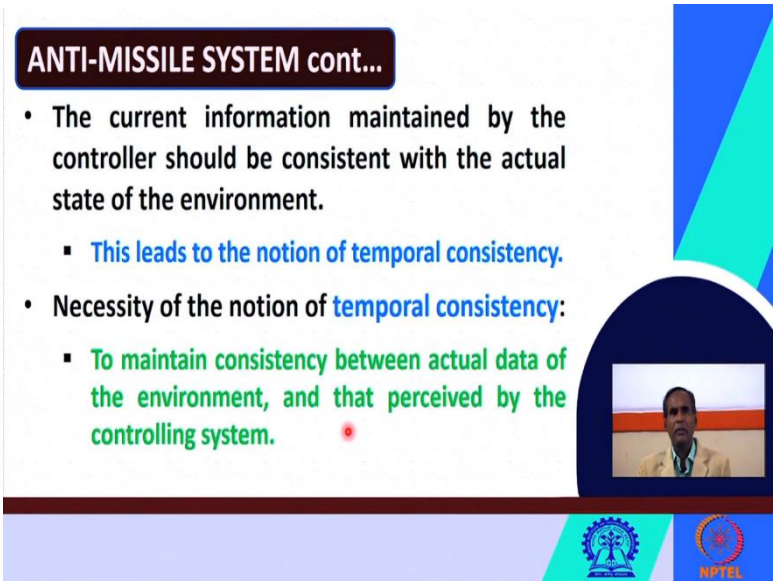

The current information maintained by the controller; it should be consistent. So, what the current information that is maintained by the controller, it should be consistent with what, it should be consistent with the actual state of the environment. So, you are maintaining data on a computer and some data is there we are getting from the environment. So, the data that you are receiving or that is happening, that is occurring in the environment that must closely match to this data you are maintaining in the computer.

So, these two data that is the actual data in an environment and that you are storing in the computer, they must be consistent, they should be closely what resembles. They should be very much consistent, the current information maintained by the controller should be consistent with the actual state of the environment. So, this property that this data maintained by the controller and the data that is happening or occurring in the actual environment, they must be consistent. So, this property leads to the notion of temporal consistency.

So, this property of closely matching the information maintained by the controller with the actual state of the environment that should be consistent. So, this property is known as temporal consistency. What is the necessity of this temporal consistency? What is the need of the temporal consistency? Let us say, the necessity of the temporal consistency is as follows. So, we require temporal consistency in order to maintain the consistency between the actual data of the environment and that perceived by the controlling system.

So, in order to maintain the consistency between the actual data of the environment and that it is perceived or that is maintained by the controlling system, there must be what, consistent.

They should resemble. They should properly match or very minor difference may be allowed. This should be consistent with each other. So, that is why we require this temporal consistency.

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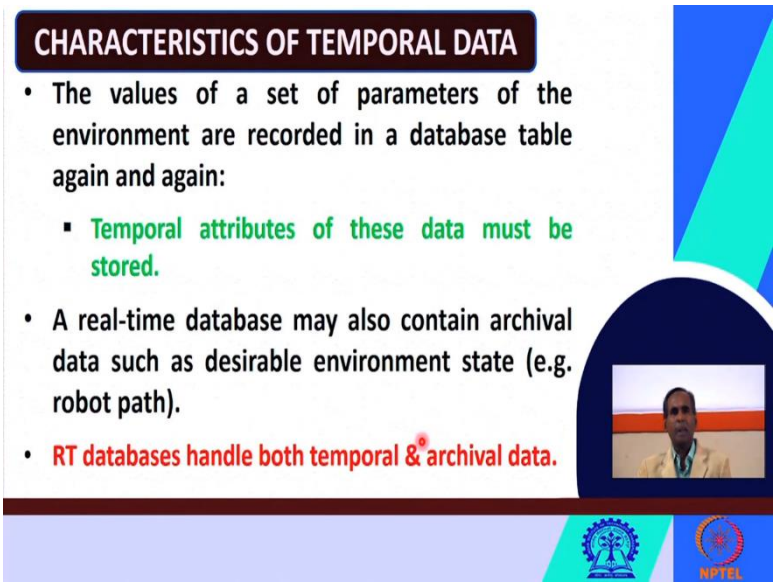

Let us see some of the characteristics of temporal data. The values of a set of parameters of the environment are recorded in database table again and again. So, set of the parameters maybe your temperature or maybe pressure or if a what aeroplane is applying the set of parameters could be velocity, acceleration, position etc. So, the values you have a set of parameters of the environment they are recorded where? They are recorded in your database table again and again. So, temporal attributes of these data must be stored.

So, what data you are storing? The temporal attributes of this data must be stored properly. Next, we will see what do you mean by this temporal attributes of this data? So first of all, I have said that in your database, what you are storing, some temporal attributes of this data. We are storing the temporal data. Besides that, or additionally, a real-time database may also contain some archival data, some archival data examples are that suppose a robot is moving. What is the path, in which path it is moving? So, that we can see an example of an archival data.

So, besides this temporal data, a real-time database may also contain some archival data, such as the desirable environment state, for example, the robot path. So, what I can conclude? Real-time databases, they can handle both the temporal data as well as the archival data. So, in a real time system, you might find some data are temporal data and some data are archival data.

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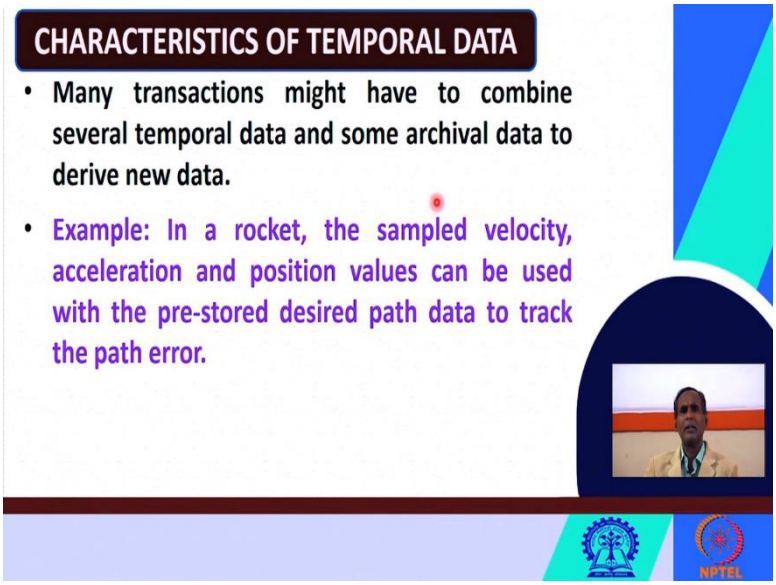

You will see in many cases, many transactions they might have to combine several temporal data and some archival data to derive new data. So, in many cases, you will see many transactions, they might have to combine some several temporal data and some archival data. So, these temporal data and archival data may be combined to derive the new data. For example, if we say that a rocket is flying. In a rocket what are the temporal data in case of that rocket is flying? Like the sample velocity, acceleration, position values, they are all temporal data. So, they will be maintained as well as what is the pre-stored desired path data.

So, the when the rocket is flying, so, always a pre-stored desired path it is already pre-stored. So, this can be treated as the archival data. So, we have to take we have to combine this temporal data such as velocity, acceleration, position values etc. and the pre-stored data such as the desired path data. If we will combine this thing or by combining these two types of data, we can track what is the path or whether the rocket is moving in the desired path or it is deviating, we can easily track the path error.

So, this is a very good example where the temporal data and archival data they can be used to combiningly in order to derive some new data. Here this temporal data is like velocity, acceleration, position etc. The archival data is the pre-stored desired path. These two data may be combined to track the path error, to know whether the rocket is moving in the desired path or any deviation is there.

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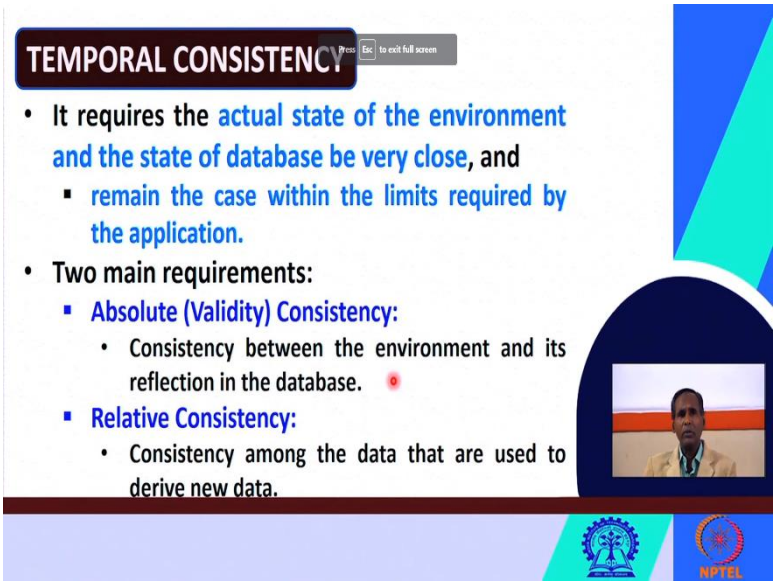

Now, let us see temporal consistency. I have already told you that the actual state of the environment and the state of the database that you have stored in a computer, they should be very much close there should be consistency This is known as temporal consistency. It requires so, what is temporal consistency what does it do? It requires the actual state of the environment and the state of the database, they should be very close.

So, temporal consistency it requires the actual state of the environment and the state of the database that you have stored in your computer they should be very close and they should remain the case within the limits required by the application. So, every application they require these values within some limits. Say maybe 100 to 200 milliseconds or so. So, these data they should remain the case within the limits which are desired which are required by the application. There are two such main requirements.

One is absolute validity consistency; another is relative consistency. In some of the book, this absolute consistency is written as absolute validity. Like in Rajib Mall's book they have taken absolute validity. In Krishna Sain book, they have taken absolute consistency, but the idea is remaining same. So, absolute validity or absolute consistency means the consistency between the environment and its reflection in the database. This already this definition I have already told you in the last class. So, absolute consistency is defined as the consistency between the actual environment and its image and its reflection that is stored in the database.

What do you mean by relative consistency? It is the consistency among the data that are used to derive new data. So, relative consistency means this is defined as the consistency among the data that means among a set of data which are used to derive some new data. Now let us explain

the absolute consistency and relative consistency by taking some examples. But before that, I think we will see how the data can be represented in a real-time database.

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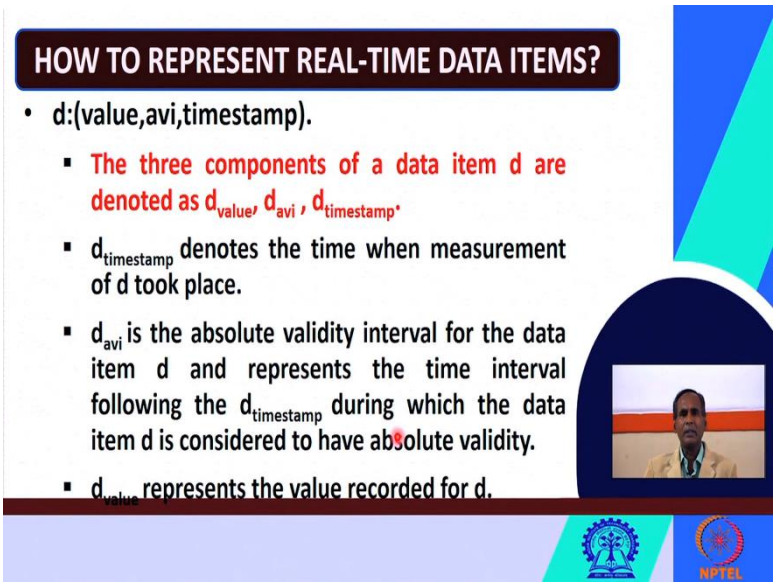

So, let us see first how to represent real-time data items in a real-time database. Let us see, to represent the real-time data items in the real-time database, a real-time data d can be represented as a triplet called as value, avi and timestamp. A real-time data d can be represented as a triplet that means there are three components. What are the three components? The three components of the data item d are denoted as dvalue, davi and dtimestamp.

So, what is this dtimestamp here? dtimestamp denotes the time when measurement of d took place. I have already told you, you are discussing temporal data. Temporal dimension means you must have to associate some timing value with your data. This is happening in real-time database but normally in ordinary database, conventional database these timing concepts may not be associated with the data. dtimestamp it denotes the time at which you have taken the measurement. So, dtimestamp denotes the time when the measurement of d took place.

And what is davi? davi is the absolute validity interval. davi stands for the absolute validity interval for the data item d and what does it represent? It represents the time interval following the timestamp during which the data item d is considered to have absolute validity. I am repeating again. davi means it is the absolute valid interval for the data item d. What does it represent?

It represents a time interval after this dtimestamp that means after when you have measured this value, up to some interval during which interval the data item d its value is considered to

have absolute validity and after that interval what will happen, that data will be no more valid. That may become obsolete or that may become relevant. I will take an example and what is dvalue? It says represents simply value recorded for d. So, dvalue means what is dvalue? That is recorded for d. So, in this way we can represent the real-time data items.

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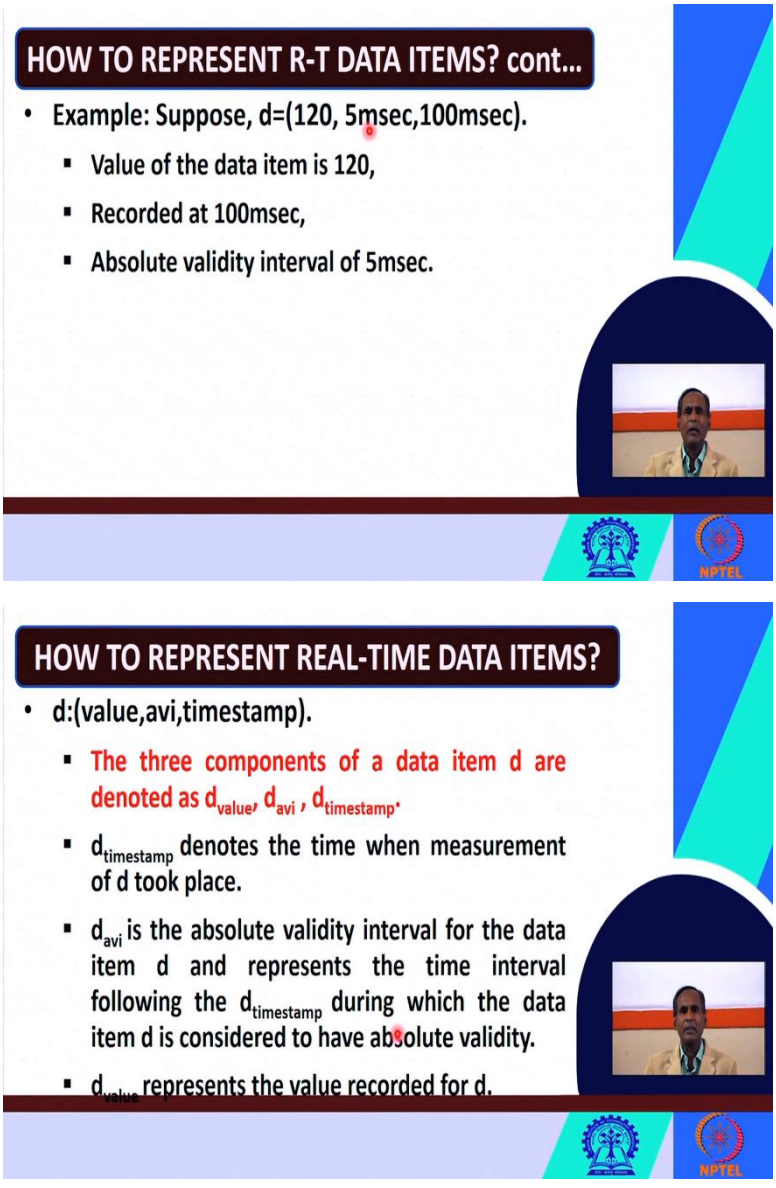

Let us take a small example. Suppose somebody has represented the d as such follows. 120, 500 millisecond and 100 milliseconds. So, how does it represent? I have already told you there are three components, value, avi and timestamp. So, this 120 represents what? This is the first component that is value, that means value of the data item is 120. That value maybe what your position or the velocity or the acceleration or whatever or temperature or pressure whatever. The value of data item 120.

Accordingly, you have to select the unit. And what is the second item is what? Second item is avi and third item is timestamp. So, second item I will come later. Let us see what is the third item, 100. So, what does the third item represents? Timestamp that means timestamp means at which time you have taken the measurement.

That means it say that you have taken the measurement, you have recorded this data at time t is equal to 100 millisecond. Then what is the middle one? Davi. What is avi? avi stands for the absolute validity interval. So, here absolute valid interval is 5 millisecond. What does it mean absolute validity interval here? That means I am repeating again. What does it say? This represents the time interval following the dtimestamp or after the dtimestamp during which the data item d is considered to have absolute validity.

Here you can say you have recorded the data at 100 millisecond, davi is 5 millisecond. That means this data what you have recorded as the 100 millisecond, it will be valid only for 5 millisecond. That means 100 to 105 millisecond. So, this data value 120, it will remain valid for 5 milliseconds starting from 100 millisecond that means what, the data will be valid up to 105 millisecond. After 105 milliseconds, this value of d will be irrelevant or it will be obsolete. This is how you can represent the real-time data items in a real-time database.

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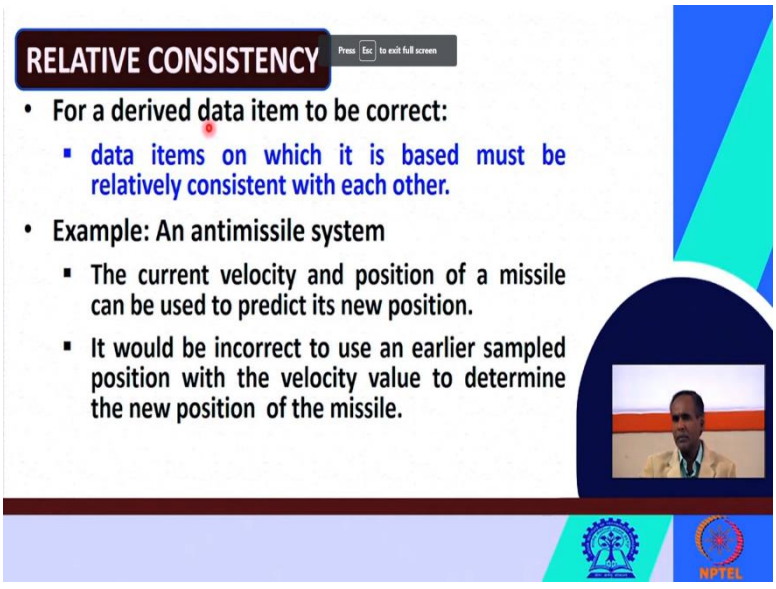

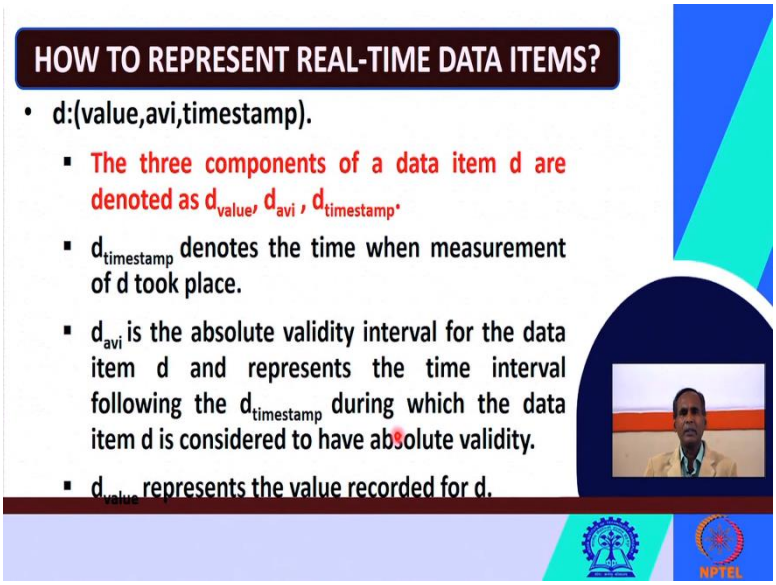

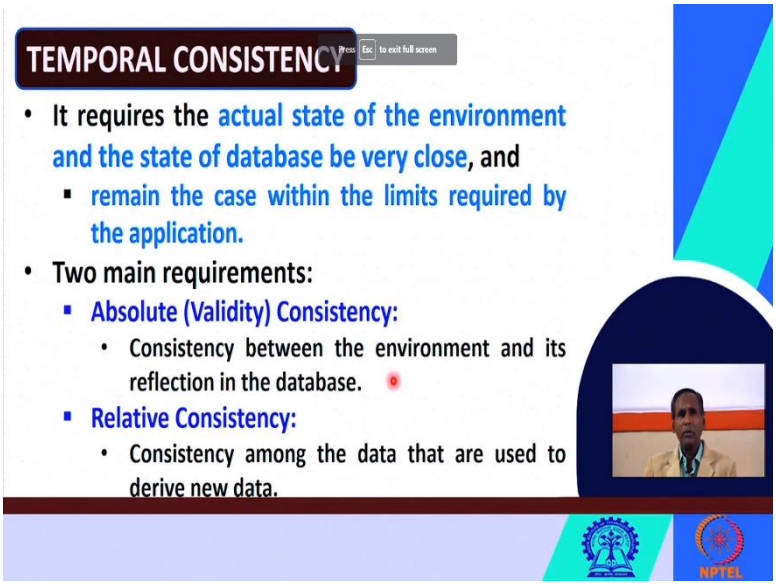

Now, we will see these two what the consistency, absolute consistency I have already explained. Here I have told you how to represent the real-time data items. Then let us quickly see about what is relative consistency, then we will see a mathematical expression in order to determine whether the data set is absolute consistent or not or relative consistent or not. For a derived data item to be correct, the data items on which it is based must be relatively consistent with each other. So, suppose you have derived some data item from some existing data items. So, for the derived data item to be correct, what should be satisfied?

The data items on which this derived data item is based on it must be relatively consistent with each other. What is relatively consistency I have already told you. Relative consistency means what, a consistency among the data that are used to derive new data. So, I will explain this relative consistency with an example. For a derived data item to be correct, the data items on which it is based must be relatively consistent with each other. Let us explain this concept of

relative consistency with a small example. Suppose, you are using an anti-missile system. You have known in an anti-missile system, the current velocity and the current position of the missile they can be used to predict the new position.

So, these are the temporal data items velocity and position. So, the current position and the current velocity they can be used to predict what will the new position of the missile. But suppose somebody has not taken the current velocity. That means time, time ti it has not taken. It has taken some earlier time, time ti minus 1 or time t minus 2 something. And he is predicting the new position, then this is not relative consistent. Then we say that this is this new position that you have computed by using some earlier sample data for this position on this velocity that is not consistent. It will be very much incorrect.

So, as we know that the current velocity and position of a missile, it can be used to predict its new position if we use some earlier sample data, some previously collected data and by using those data, we compute the new position, then we said that is incorrect, this is what inconsistent. It would be very much incorrect to use an earlier sample data, some previously sample data that means earlier sample position with the velocity value to determine or to compute the new position of the missile, then we say that it is not correct it is incorrect and what it is not consistent. So, in that case, we say that the data these are not relatively consistent these are relatively inconsistent.

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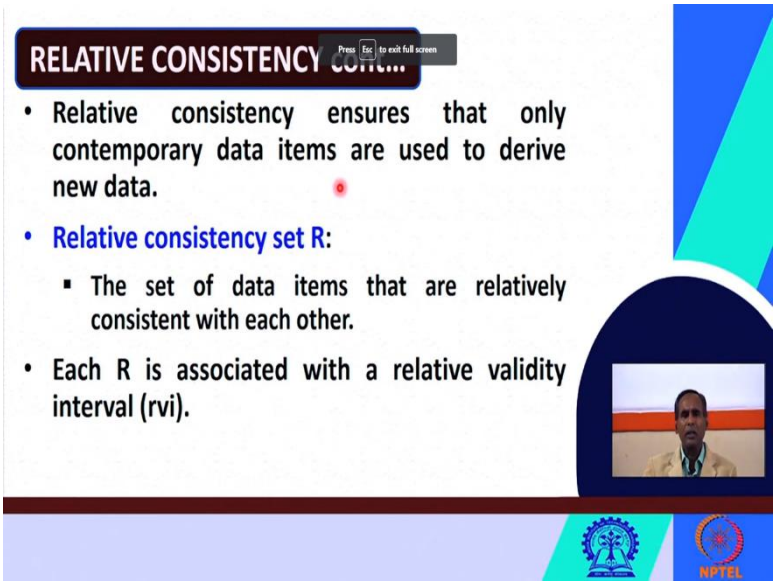

Relative consistency ensures that only contemporary data items are used to derive new data which that the data items which are contemporary, they are used to new data. So, relative consistency ensures that only contemporary data items they are used to derive new data I will

explain it through an example. So, the based on this concept of relative consistency we will form a set called as R. We call it as relative consistency set. So, relative consistency set R is defined as the set of data items which are relatively consistent with each other.

So, relative consistency set R, it is defined as the set of data items which are relatively consistent with each other. If we have taken two sets of data items, these two sets of data items must be relatively consistent with each other. Now, I will give a mathematical expression by looking at which you can say that whether the two data items are relatively consistent or not. So, each relative consistency set R is associated with a relative validity interval called as rvi just like avi, we have seen absolutely valid interval. So similarly, each relative consistency set R is associated with an interval called as a relative validate interval or rvi.

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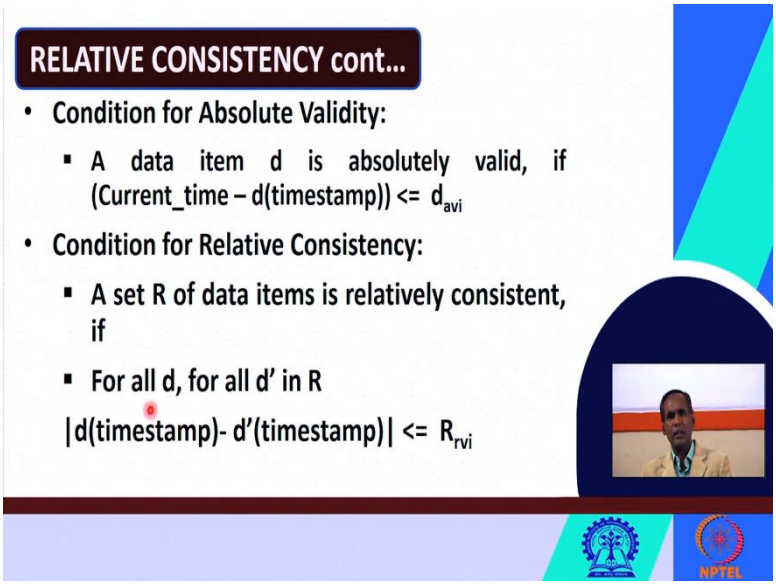

Now, let us say about the conditions, what condition has to be satisfied for having absolute validity, what condition has to be satisfied for having relative consistency. So, the condition for absolute validity is stated as follows. A data item d is said to be absolutely valid, if the current time minus the dtimestamp is less than equal to davi.

That means, what is the current time that is there, what is the present time current time minus dtimestamp that means the time at which you have to measure the value, if this difference is less than this davi, that means davi is the absolute validity interval for d if it is less than or at least equal to davi, then we say that that item d is absolutely valid. When you will say that relative consistency is satisfied.

So, the condition for relative consistency is as follows. A set R of data items is relatively consistent if the following holds good. A set R of some data items is relatively consistent if and only if for all the data items d and for all the data items d prime, suppose let us take here we are seeing a set of data items, let us assume that only two data items are there. One is d and another is d prime. So, a set of a set R of data items is relatively consistent if for all d and for all d prime in R.

So, any two pair you take one is d, another is d prime, for all d and all d prime belonging to R, if the dtimestamp minus d prime's timestamp then take the absolute value, it is less than equal to R of rvi, then you say that a set of data items is relatively consistent. I am repeating again, a set R of data items d and d prime is relatively consistent if for all d and all d prime belonging to R, dtimestamp minus d prime timestamp modulus is less than or equal to R of rvi.

That means the time when you have collected or measured the data d minus the time at which you have measured the data item d prime take the absolute value it is less than or equal to the given R rvi. rvi stands for relative validity interval. We will explain it through some examples.

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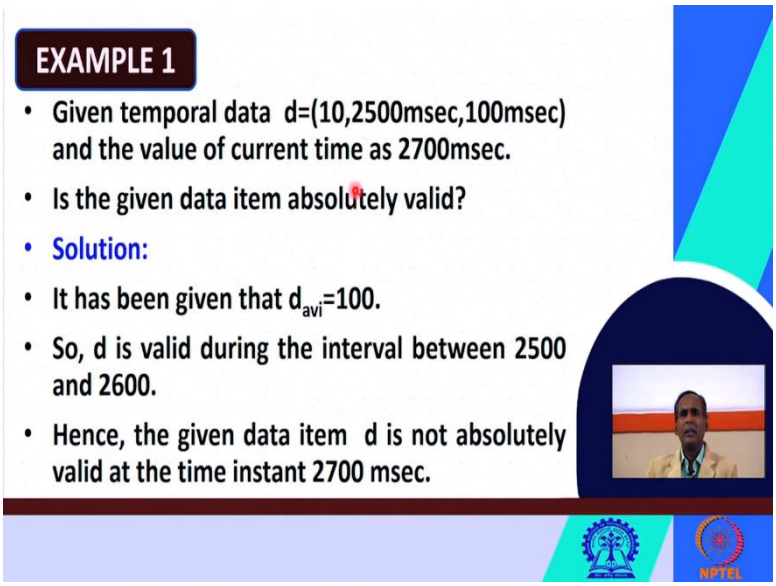

RELATIVE CONSISTENCY cont...

- Condition for Absolute Validity:
  - A data item d is absolutely valid, if (Current_time – d(timestamp)) <= d_{avi}
- Condition for Relative Consistency:
  - A set R of data items is relatively consistent, if
  - For all d, for all d' in R

$|d(timestamp) - d'(timestamp)| <= R_{rvi}$

HOW TO REPRESENT R-T DATA ITEMS? cont...

- Example: Suppose, d=(120, 5msec,100msec).
  - Value of the data item is 120,
  - Recorded at 100msec,
  - Absolute validity interval of 5msec.

HOW TO REPRESENT REAL-TIME DATA ITEMS?

- d:(value,avi,timestamp).
  - The three components of a data item d are denoted as d_{value}, d_{avi} , $d_{timestamp}$.
  - $d_{timestamp}$ denotes the time when measurement of d took place.
  - d_{avi} is the absolute validity interval for the data item d and represents the time interval following the $d_{timestamp}$ during which the data item d is considered to have absolute validity.
  - d_{value} represents the value recorded for d.

Let us take the first example. Given the temporal data d is equal to 10,2500 millisecond and 100 millisecond I have already told you how the real-time data items can be represented. It is can be repented using a triplet or three components. First component is what the dvalue, second component is what davi. avi is the absolute value, absolute valid interval and the third one is the dtimestamp, at what time the value is recorded.

So, here they said that what does d represent? The value of the temporal data item is d is 10. It has recorded at the time 100 millisecond and the avi, absolute validity interval is 2500. It is also given that the value of the current time is to 2700 millisecond. What is the question, the question is whether the data item is absolutely valid or not? How to decide? Let us go to the formula. Formula says that a data item d is absolutely valid if the current time minus the dtimestamp is less than equal to how much, d of avi.

So, what is the current time? 2700. What is the dtimestamp? 2500. So, 2700 minus 2500 it is equal to how much, 200. It should be less than what? It should be less than the davi. And what is this davi here? So, here you can see that davi I am sorry, a little bit difference I am sorry. So, here actually these two columns have been actually swapped.

So, 10, 200 millisecond and 100 millisecond here little bit changed, actually, here the current value is changed. The order is a little bit changed. The current value of the time is 2700 millisecond. And the time at which it is observed is 2500. This is the second component here is the dtimestamp. So, the avi is 100 milliseconds. I am sorry, there is a little bit change here.

So, either you can change this this one like this. So, here avi is the middle and last dtimestamp. So, these are user defined you can write in any way. But this should be consistent for the whole database. First is avi value then you can write avi or timestamp and later on you can again write the timestamp for avi. So, this avi and timestamp can be swapped. So, in this example, it was a first value then avi then timestamp, but here it is a little bit swapped that is nothing wrong in that but you should understand it should consistently. So, 10 is the value and 2500 millisecond is the timestamp and 100 millisecond is the avi.

So, current time is to 2700 and we know the condition for absolute value is that current time minus dtimestamp should be less than or equal to the davi. So, here I have already told you. So, current time is 2700 and this dtimestamp that means the value was recorded as 2500 millisecond. So, 2700 minus 2500 is coming to how much, 200. But what is the avi? Avi is given as only 100 milliseconds. So, condition says that this difference should be less than the

avi but here we see we have seen that the difference is greater than 100 milliseconds. That is greater than the avi value. So, what does it represent?

It represents that the given temporal data is not absolutely valid, it is absolutely invalid. So, whatever I have already told you, I have explained here that it is given that davi is equal to 100. So, d is valid during the interval of what, 2500 to plus on that, that is it is valid up to 2600 millisecond. But the given that item is not absolutely valid at the time of 2700 millisecond because the difference is now how much, 2700 minus 2500 coming to be 200 which is greater than the d of avi value that is 100. So that is why this is not absolutely valid.

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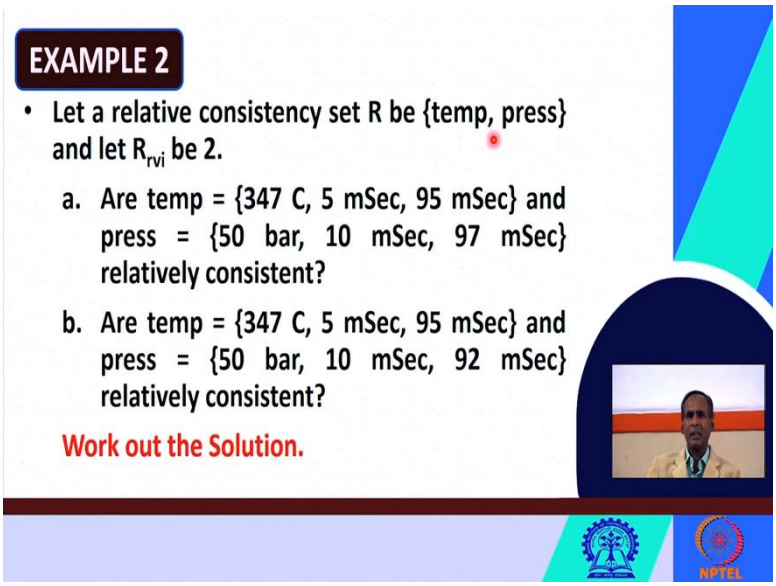

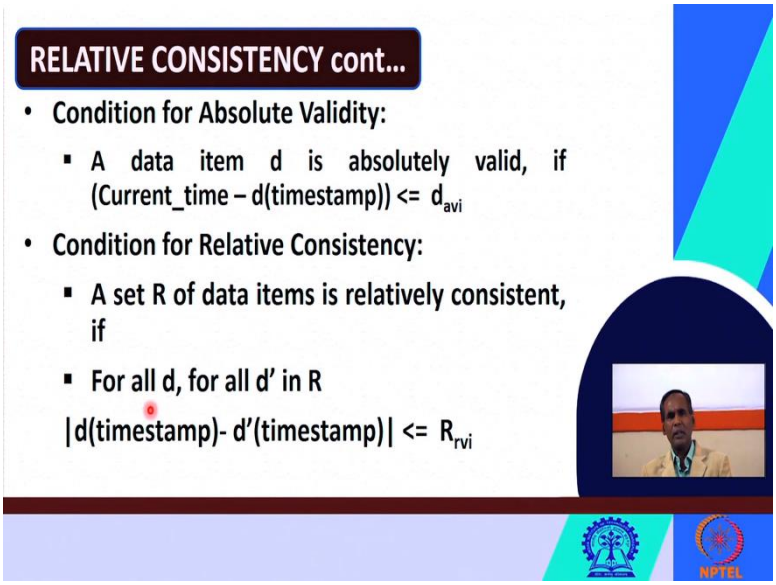

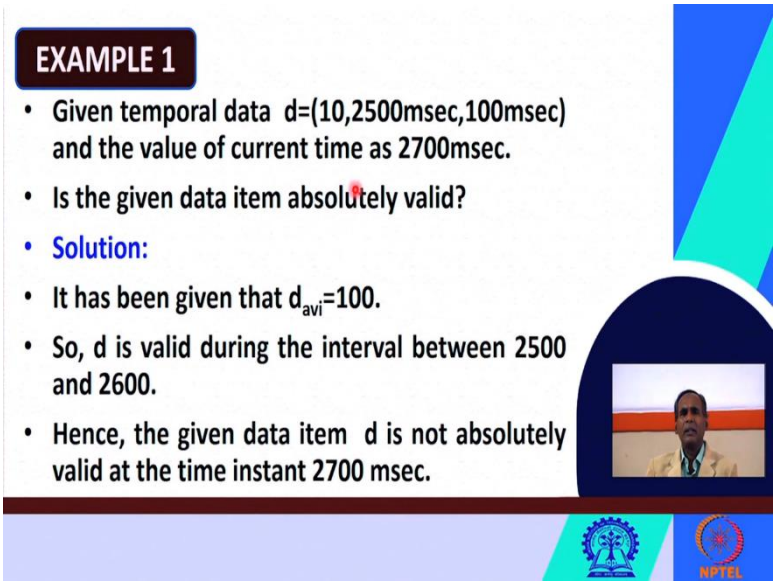

Take this second example. Let the relative consistency set R be temp and press, the temperature and pressure and R of rvi value is given as 2. The temperature data this is a temporal data it is given 347 centigrade, 5 millisecond, 95 millisecond and pressure is given as 50 Bar, 10 millisecond and 97 millisecond. So, now the question is the asked whether these two data items, temperature and pressure they are relatively consistent or not.

So, in order to know the relatively consistent thing, what do we have to do? Let us see the formula says that d of timestamp minus d prime of timestamp, it should be less than or equal to R of rvi. You have to take the absolute value. Here you can see what it is this first, again you can see value is 347. Here this is correct, avi is equal to 5 millisecond and the timestamp is 95. For pressure value is 50 then avi is 10 and this timestamp in 97. So, in order to be relatively consistent, what we have to do these two timestamps, their difference should be their absolute value of the difference should be less than or equal to Rrvi.

So, now, you can see one is timestamp 97 another is 95. So, 97 minus 95 sorry 95 or 97 anything you will take the absolute definition. So, how much it is 2 and rvi value is given how much, 2. So, the relation is satisfied. So, this is relatively consistent. What you will see take the second example. So, here almost the same only this timestamp, now it is reduced to 92. Again, we will apply the same formula take this difference and take the absolute value. So, 95 minus 92 is equal to how much, 3. So, 3 is not less than the given rvi value 2. 3 is greater than 2. So that is why the second data items they are not relatively consistent that I have written here.

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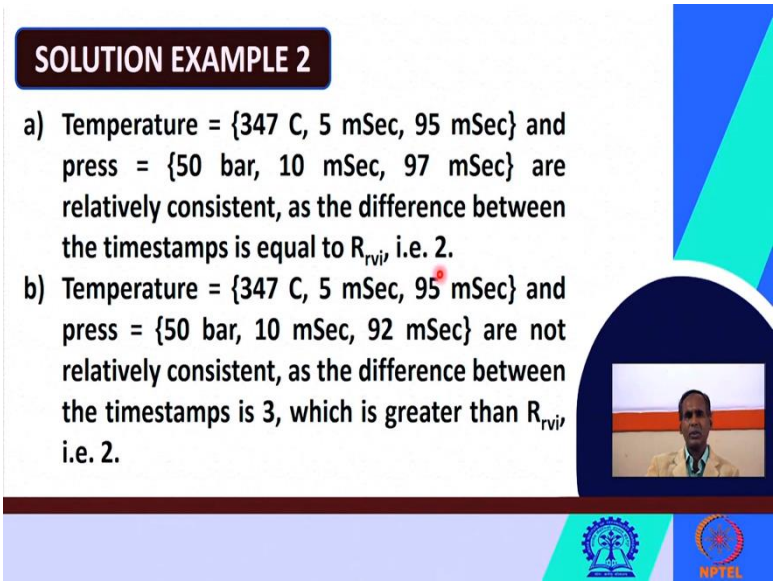

So, the first one is relatively consistent because the difference between 95 and 97 it is equal to exactly 2 which is the Rrvi value, but in the second case, they are not relatively consistent. The difference between the timestamps is how much, 95 minus 92 that is 3 which is greater than the given rvi value, what is the rvi value? It is greater than the given rvi value 2. So, in this way, we have seen how you can decide whether two real-time data items are relatively consistent or not.

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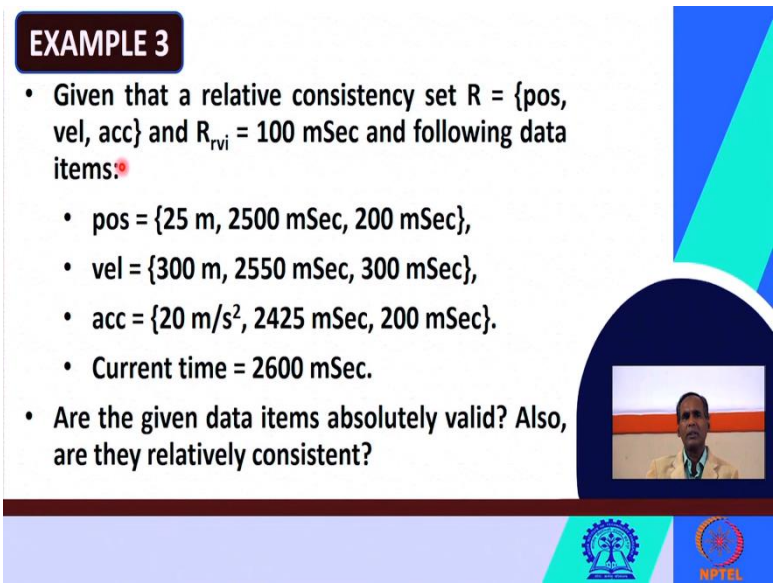

We will take one more example quickly. Given that a relative consistent set R is equal to position, velocity, acceleration. Maybe you consider a rocket is moving or missile is moving. So, this is a temporal data, the data items are the position, velocity and acceleration. This is the relative consistency set R and Rrvi is given as 100 milliseconds.

The data items are given as like such position is given to as 25 meter, 2500 millisecond, 200 millisecond. Velocity is given as 300 millisecond and 2550 millisecond, 300 millisecond. Acceleration is given as 20 meter per square and 2425 millisecond and 200 milliseconds.

So, here you can see that the first components are values. Second components are these what dtimestamp that means, when these values are measured and the third components are the what avi values. So, or it is also given that the current time is given as 2600 millisecond. What is the question? That whether the data items are absolutely valid and also, we have to check whether they are relatively consistent. Let us see first whether they are absolutely valid or not.

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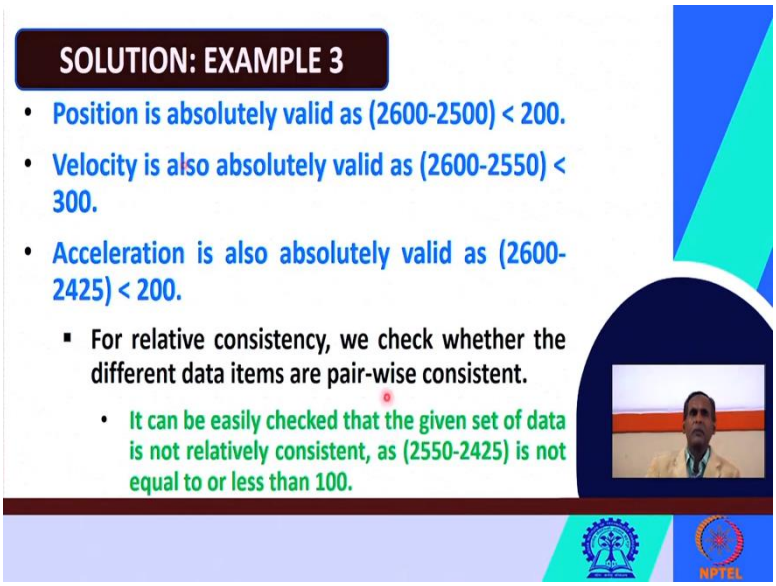

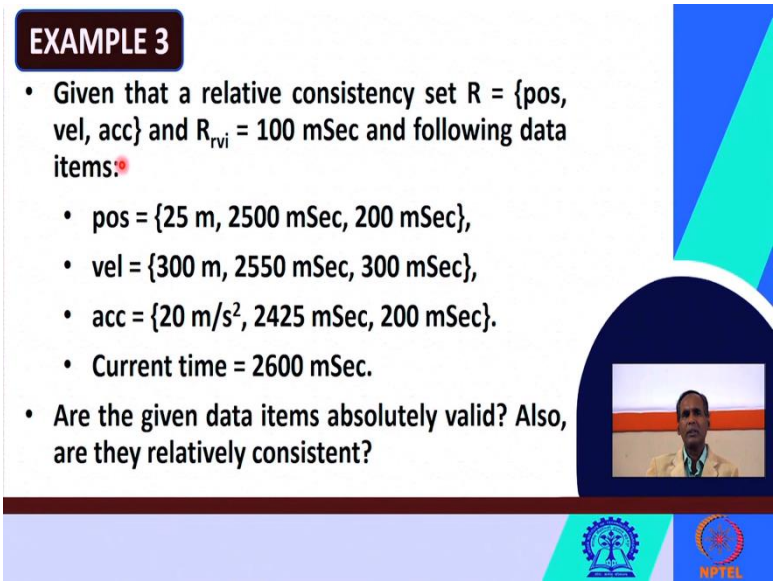

First is the position. What is the condition for absolute valid? Just find out the difference between the current time and the time when you have what measured the data, that is the

dtimestamp. So, current time is 2600. This time is 2500. So, if you will take the minus operation is equal to how much? 2600 - 2500 = 100. So, 100 when we are writing, we have to see what is the corresponding davi, corresponding d of avi, it is 200.

So, 100 is less than what, this corresponding davi 200 that means, the position is what it is absolutely valid. Similarly, you can calculate for velocity. 2600 - 2500, it is 50. 50 is less than 300 milliseconds that means, it is also absolutely valid. For the third one, 2600 - 2425 this is coming to be how much, 175. So, 175 is less than 200 milliseconds.

So, this is also absolutely valid. So, we have seen that all these three given data items, they are absolutely valid. So, what is about their relative consistency property? Let us see, if you will see the relative consistency you have to find out only the difference between their corresponding timestamps.

So, if you will take these two suppose, 2500 and 2550. If you will take, the difference is how much and the absolute value 50. 50 is less than rvi, yes 50 is less than 100. That means that these two are what, you can say that position and velocity may be relatively consistent. Similarly, you can say that what this one, position and acceleration what is the difference, 2500 minus 2425. That is only 75, it less than 100. That is also what relatively consistent but when you will take a velocity and acceleration, what is the difference.

This difference is 2550 minus 2425. So, this is how much? It is 125 which is not less than 100. It is greater than the rvi value 100. So, we say that the all the data items, all the data items they are not relatively consistent because for at least one pair is there like velocity and acceleration, for these two data items, this condition for relatively consistency is not satisfied. The difference between the timestamps it is not less than the Rrvi value, it is greater than the Rrvi value.

That is why even if position and velocity, they are relatively consistent and position and acceleration they are relatively consistent, but since a velocity and acceleration they are not relatively consistent so, we say that these data items they are not relatively consistent that I have told here. All the data items position, velocity and acceleration they are absolutely valid because current time value minus the what dtimestamp value it is less than this what avi value the corresponding avi value.

But for the relative consistency, we have to check whether the different data items they are pairwise consistent or not. And we have seen that position and velocity they are pairwise consistent. So, position and acceleration they are also pairwise consistent, but velocity and

acceleration they are not pairwise consistent because the difference of their timestamps is greater than Rrvi value that I have told here.

For having relative consistency, we have to check whether the different data items they are pairwise consistent or not. You can see that it can be easily checked that the given set of data is not relatively consistent. Why? As because this what these two values velocity and acceleration, when you are finding out they are the difference between their timestamps, it is greater than the Rrvi value.

It is coming to be 125 which is greater than this, what Rrvi value of the Rrvi value is given as 100. So, it is the difference of their timestamps that is the difference of the timestamps of velocity and acceleration, it is greater than given Rrvi value here Rrvi value is equal to 100 but the differences is 125. So, the difference of their timestamps is greater than these Rrvi values. So that is why the given data items, they are not relatively consistent.

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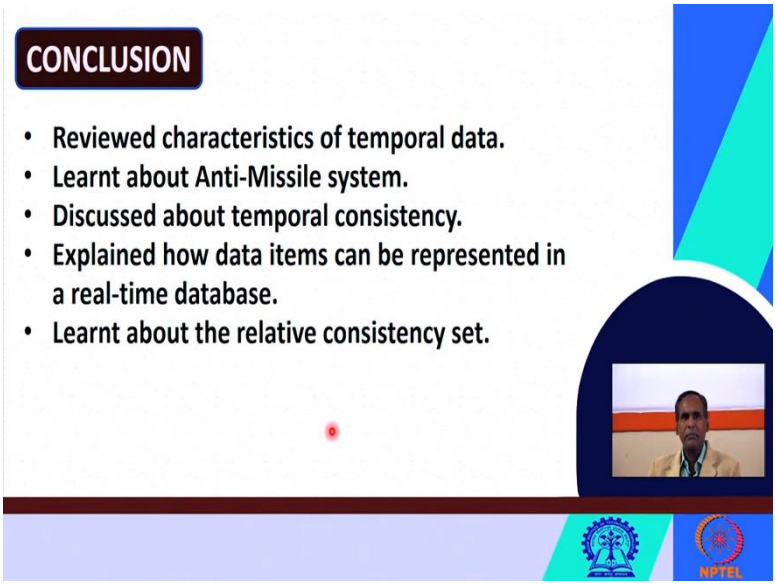

So, today, we have discussed some important characteristics of temporal data. We have explained those characteristics of temporal data with an example of anti-missile system. We have discussed about temporal consistency; we have seen that there are two types of the temporal consistency that is absolute consistency and relative consistency.

We have also explained how the data items can be represented in real-time database. I have already told you the data items can be represented using three components. The first one is this value. Second one is this avi value that means absolute validity interval and third component is the timestamp that means at what time you have measured the value. We have also learnt about the relative consistency set, we have also seen how we can determine whether some data items they are absolutely consistent or not, they are absolutely valid or not and they are relatively valid or not.

We have seen the conditions I have already told you. We have also taken some examples on how to decide how to determine whether a given set of data items they are absolutely consistent or not, and whether they are relatively consistent or not.

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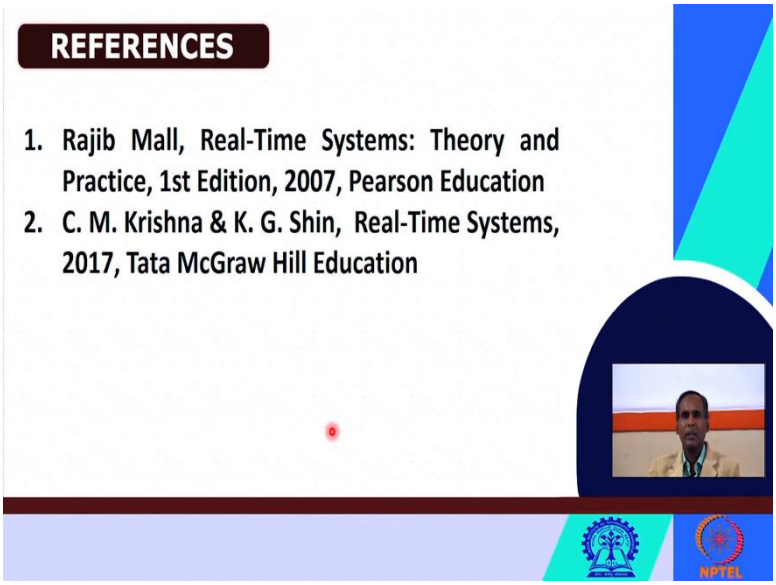

We have taken these things from these two books. You can find the much more things in these two books on any internet sources.

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Thank you very much.