Remote Sensing and GIS
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Lecture – 21
Geographic Information System - I

Today we will start geographic information system that is GIS right. So, in this lecture, we will cover the basics of GIS as well as how we are using this GIS function in our remote sensing because, frankly speaking you cannot separate this remote sensing and GIS when you are involved in satellite image or airborne image interpretation right, GIS and remote sensing both are complementing each other. So here let us see what exactly GIS mean. So what is the definition of GIS? GIS is a system designed to capture, store.

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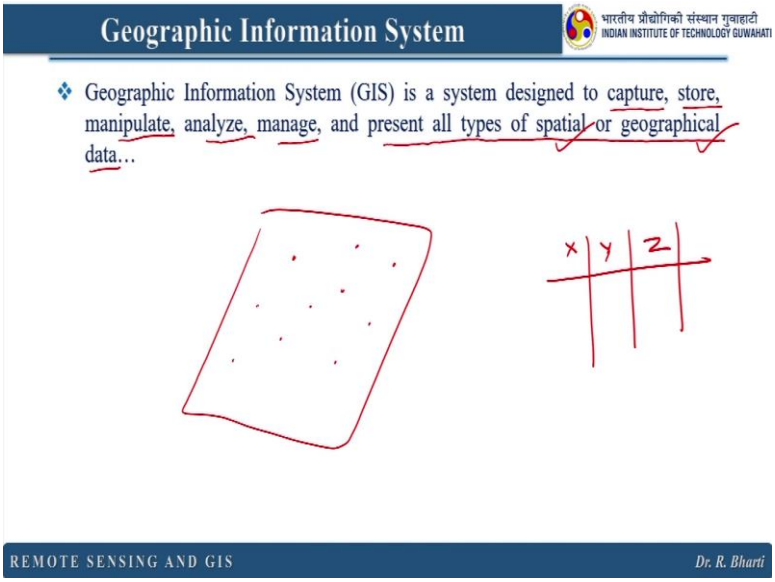

manipulate, analyse, manage, and present all types of spatial or geographical data right? It is very important here to note that we are talking about the Geographical or spatial data. So whenever we're involving GIS analysis, we always use spatial data or geographical data. Let us consider some parameters like x, y, and z. But here, this x, y, z, it can be any parameter, but we do not have any location values attached to these parameters.

But in this GIS we need to have location information in terms of either latitude longitude or the location name, if you know that place, it will be very easy to locate them in your map where exactly you have collected or measured these parameters right. So, this is the benefit of using GIS for your attribute data. So, here I have mentioned spatial and geographical. So, this was in terms of field investigated result.

Now, you think of using remote sensing data. So, in remote sensing data as we know we have location value attached to each of the pixel. So, here in GIS what we are doing we are capturing, storing, manipulating, analyzing, managing and presenting. So, we are doing everything from the scratch. So, the whole process comes under GIS right? So whenever we say I am working in GIS domain. It includes all these parameters, right in other words.

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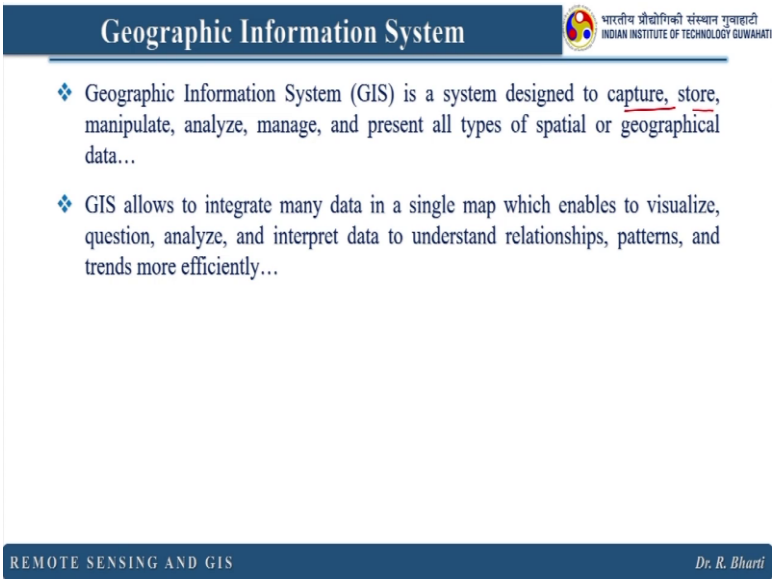

GIS allows to integrate many data in a single map, which enables to visualize question analyze and interpret data to understand relationship pattern and trains more efficiently. If you have 10 parameters collected in separately from a field during a filling investigation, and if you see them independently and separately, what will happen you will end up analysing only those parameters.

But if you have a flexibility or if you can bring them in GIS environment, where you can integrate n number of data sets together for an area. Then it will be easy to understand that particular study area in terms of your application right. So, here, GIS gives you a platform where you can visualize the data, you can run some queries. You can analyze the data you can interpret the data and why we are doing that.

To understand the relationship between different parameters, then patterns you need to decide if this particular study area is having some pattern in terms of some parameters. Then, accordingly decision has to be made. And trends can also be established here, right.

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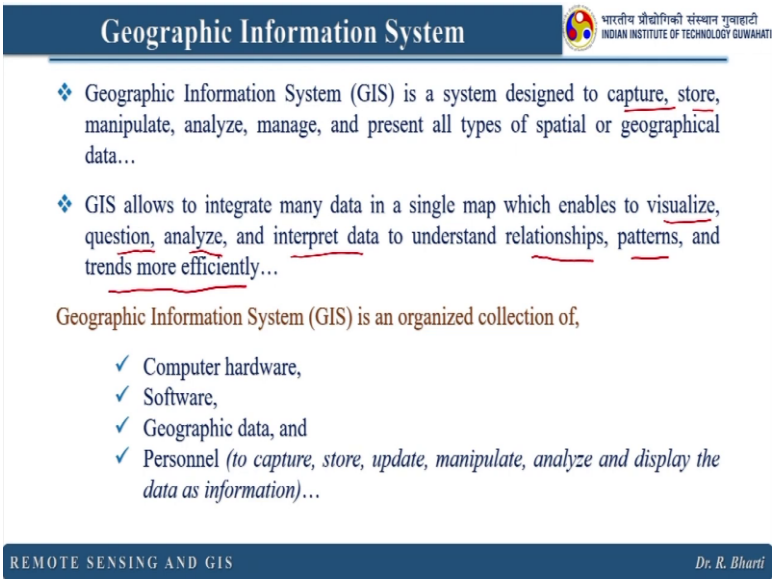

For GIS Geographical Information System is an organized collection of computer hardware, software, geographic data and a personnel who can capture store update manipulate analyse and display the data as information. So here basically what we are doing, we are using these things to store and visualize the data. But here, this is your input data. It can be spatial data or geographic data and the personnel here you can have groups of people who are involved in capturing the data. So one team will do capturing, another team may use to store them. Another team can just update the information at regular interval.

Another team or another group of people, they can play with this data to analyze and display. So that is why here you have an environment of people as well as the software and computers, where everything is integrated together, right? In GIS system, basically a spatial data or geographical data is needed, but for what to analyse and interpret or visualize them to establish some relationship or pattern or trends, but for all these processes, you need to have your input data. So, first let us understand what is the difference between data and information? Because here we are calling it geographic information system, but the input is your data. So, let us understand what exactly data mean and information means, right.

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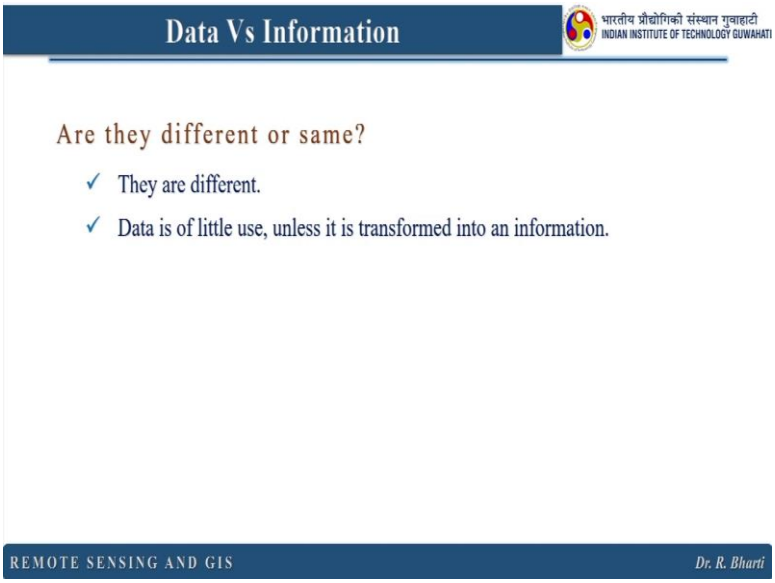

So, the first question which I am going to ask is, are they different or same? So, the answer is they are different, how they are different data is of little use unless it is transformed into an information. So, let us assume that you have collected groundwater depth for an area. And if you do not analyse that data, what is the use of that? That is meaningless. You don't have anything from that data. So whenever you are involved in GIS, we need to analyse that data.

So that is why we need to understand. What is the difference between data and information? The information is an answer to a query based on raw data. So basically, we want to transform this data into information, right? That is the process. So here, how we do that we study that collected information or data, and then we derive information. We transform data into information through the use of an information system.

I have an example for you. So you can see this is your data. Right? So these are some numbers. So, if I am not expert in analyzing these numbers for me, it is useless for me it may be meaningless data, but for you it may be of use right because you know how to interpret this data.

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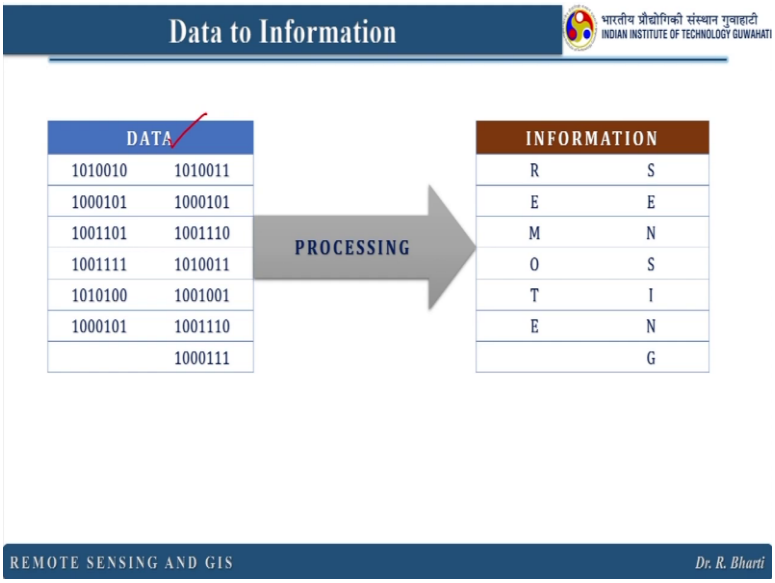

So, you can see here after processing you can transform this data into information and you can identify some letters here, right. So, that is the difference between data and information, I hope it is clear to you now. What do you mean by information system? I hope you have understood the difference between data and information. But nowadays, everybody is talking about information system. So, what exactly that information system mean? Right.

So, for that, I have a example again, this is a pictorial representation. So, whenever you have a doubt like if you want to learn some topic or you want to know, what is the meaning of remote sensing? Or what is the meaning of remote sensing in Hindi right, then what you do immediately nowadays. We Google it, and whenever.

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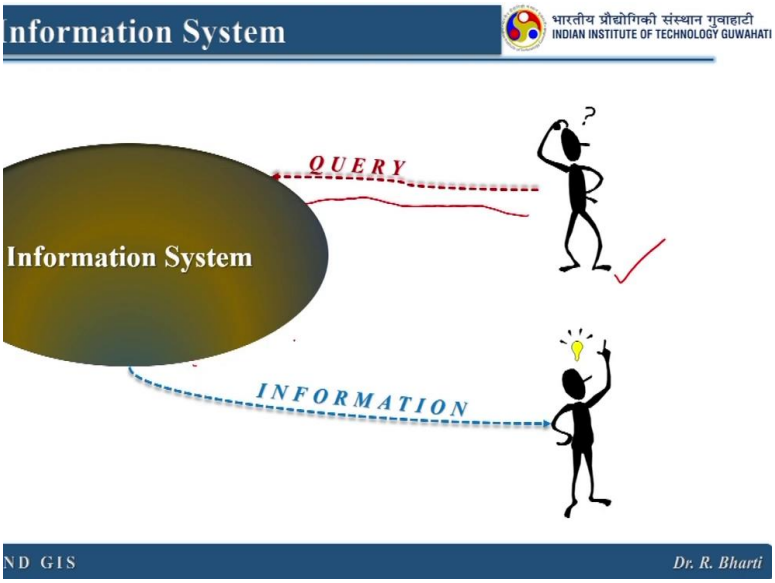

We send a query to information system, you will receive an answer. I am not saying that all the time, whatever you get that is hundred percent correct, but you get some answers. And based on your intellectual ability, you interpret that answer and then you have a option either to use that answer or not, right. So here, this particular person is having some query, maybe something related to maths, then he wants to learn and then he sent this query to this information system and the information system understand that question and then it provides some answer. So, that is the meaning of your information system. So, information system is system which can provide you answers about your questions.

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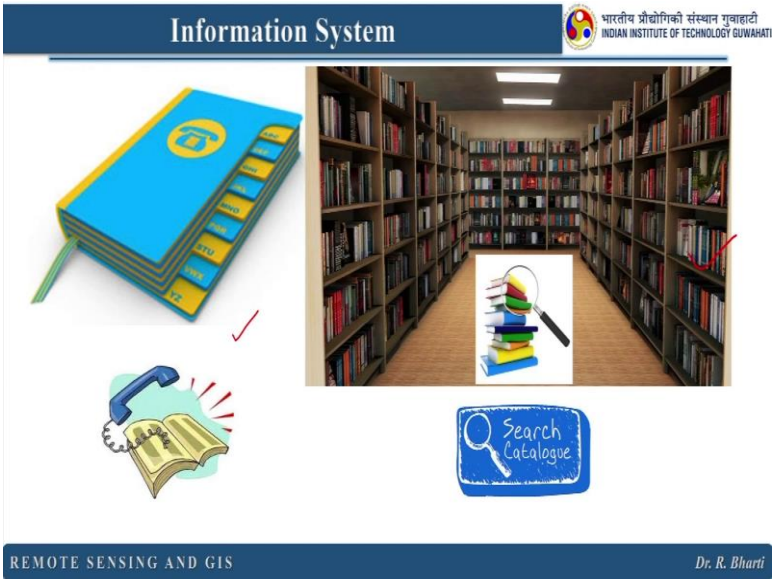

Now, these are very common example of information system. So, you can see whenever you want to call a person, you look for the telephone directory, right. So, you have their name, you just go to that page and then you identify the number and then call them. So, that is the best example of information system. Now, here in library all of us are using this library. So, here how do you identify the position of a book by using the catalogue?

Either it will be online or maybe offline, right. So, you just search with the laters of that book. Then you identify which rack which sequence thy are lying right and then you go and pick up that book. So, that is the best example of your information system. And nowadays, this Google, whenever you search when you want to learn something or when you want to know about some topic or some subject, you just Google you will get some answers and then you analyze whether it is correct or wrong. So, this was related to information system. Now, let us see what is the difference between information system and digital information system?

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So, this figure itself can explain what is the meaning of digital information system? So, nowadays, all our mobile phone, desktop PCs or hard disks are connected with this internet right. And through internet you are sending a query you are getting an answer. So, that is the meaning of digital information system. Suppose you have done a very good research, but everything is in hardcopy, and it is lying in your table.

In that case you cannot access or nobody else can access that information from your table. So, that will be your hardcopy information. So, whenever you convert them to digital form, and then you make them available in the internet, and if anybody across the world can access that, that can qualify this digital information system, right digital information system also applies for a group of people.

So maybe you have a very restricted information which can be accessed only by few individuals, that also qualifies this digital information system. So nowadays, whenever you go to field, you collect some data and from there itself you send to your office or lab, right? Or maybe somebody else has completed that field investigation and you want to access it can come to you through this digital information system.

So, slowly we are evolving ourselves and we don't want to repeat the same exercise again and again. So we want to make all our data sets available in the internet or maybe in our servers. So digital information system is an integration of hardware and software to enable advanced research, communication, education, awareness, etc. Now, you have understood what is the difference between data and information?

Then information system then digital information system. Now we are having geographic information system. So in geographic information system what extra we have we have location that is the additional value which is which has to be in this GIS domain right. So, let us see what are the different steps or different components of this GIS.

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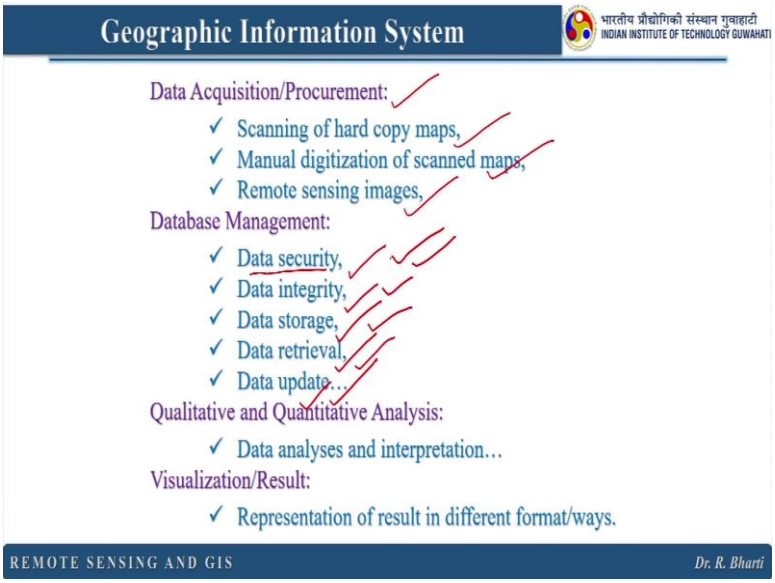


So, GIS acquisition or procurement to scanning of hardcopy maps, manual digitization of a scan map. Remote sensing images, these are part of your input data then in GIS we also make sure of the database management so, in database management you have data security, data integrity, data storage, data retrieval, data update. So, once you have made a database for let us say, what is the water quality of maybe Delhi.

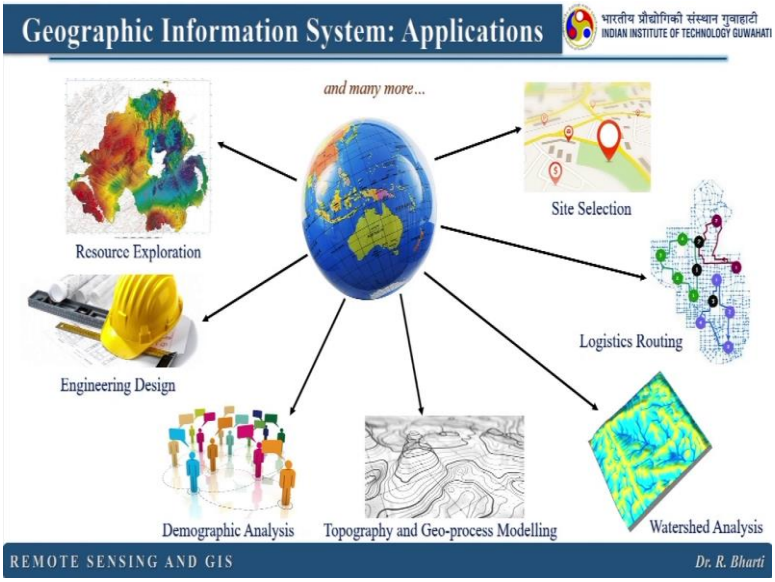
So what kind of water people are drinking in Delhi so that you have done extensive survey in 2019, and you have made a very good database. So, after five years will it be same? No, it will either improve or it will be worse right. So, in that case, you need to keep updating this data base, if you want to really represent this area characteristics.

So, for that data security first point, so, whether this data is allowed to use by anyone or only to a individual or only to a certain group of people, that you can manage by using some registration process or there are many other methods, then data integrity, what is the integrity of your data? Whether it is very good or whether what is the accuracy what methods you have used.

So, all those things, should be available in your portal then data storage , how do you store data, how you are making it available to others. Whether it takes time or it will be very fast then data retrieval, the same thing which I have explained, how do you retrieve by registration process or maybe someone send you an email, then you send them a link from where you they can download the data, then data update.

I give you one example for this database update. So, if you want to keep updating this database, then people may refer only your particular portal to get the information about the water quality of Delhi Right. Next is qualitative and quantitative analysis. So, data analysis and interpretation whether you have provided any flexibility to analyse search information which are available in your database.

And what methods you are using and then next point is visualization or result. So, how do you represent this result? So, because if you put a tabular data for let as say water quality of Delhi city. So visualization plays a very critical role in this GIS because you need to decide what method or what form you are going to use to represent your data so that the audience can understand it very easy. Now, what are the different applications of this Geographical Information System? **(Refer Slide Time: 17:46)**



So first one is resource exploration, which is here. Then, next is for engineering drawing, then demographic analysis, then topographic and Geo process modelling, watershed analysis logistic routing then site selection and many more because I cannot list all the application here because the application of GIS nowadays is in all the application in all the domain right.

Now, let us understand what type of data we are using in this GIS. So, for that we need to see what the major categories of data and how we are using this in GIS?

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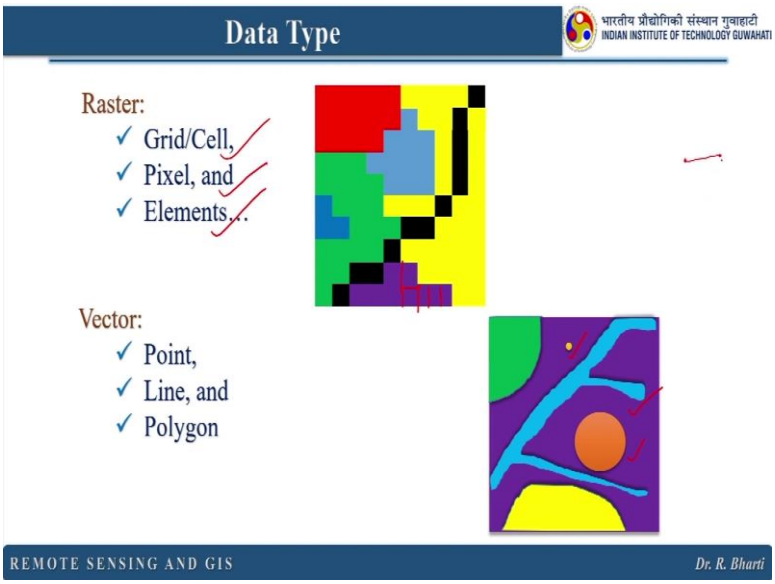

So, first one is your raster data. So, raster data is nothing but your remote sensing data in the form of images. So, here, raster data sets are basically those data set which has grid or cells or pixels or elements, right. So, if you have such elements in your data, that means they qualifies for the raster data. So, here in the raster data you can see you can easily find the pixels right.

The next type of data is vector where you have point, line and polygon. So, I guess you are familiar with point line and polygon. Now let us see how exactly it is different from raster. So here you can see this is one point, this is some lines and these are polygons to what is the difference between these three. So points are like individual features and two points if they're connected with a line right.

So a line will have two points and if this is enclosed, then they are known as polygons. So here you can see these are polygons. Let us understand what benefits or advantages we have when we have our raster data and what advantages we have when we have vector data. So, we will start with raster data.

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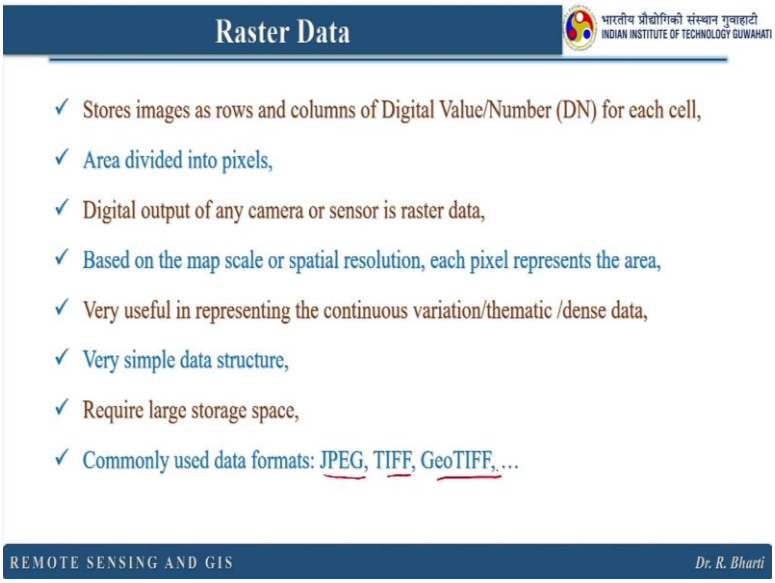

Here we stores images as rows and columns of digital number or values for each sale that exactly matches with our remote sensing data. The next point is area divided into pixels. Digital output of any camera or sensor is a raster data based on the map scale or a spatial resolution, each pixel represents the area very useful in representing the continuous variation or thematic or dense data.

So, when you are having too many data set, this kind of representation or the raster data type is very useful. Very simple data structure. Because in one column you will you will have latitude longitude and digital number right and then you can represent and you can store this in your pixels. So, each pixel will have three values right. So, like that you can store this raster data and requires large storage space because this area is divided into small pixels and each pixel will have associated values and those values need to be stored in your hard disc so it requires largest space. Commonly used data format says JPEG, TIFF, and Geo TIFF that you already know.

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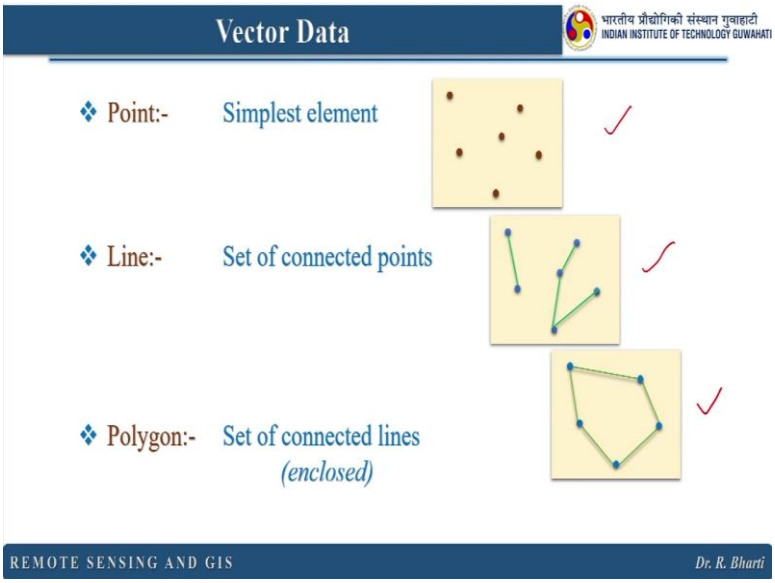

In victor data we have the simplest element that is known as point. So you have point data and the next one is set of connected points are known as lines. And third one is set of connected lines and which is basically enclosed, they are known as polygons right? So, here you have three different types of data in vectors. So, you have vector point vector line or vector polygon.

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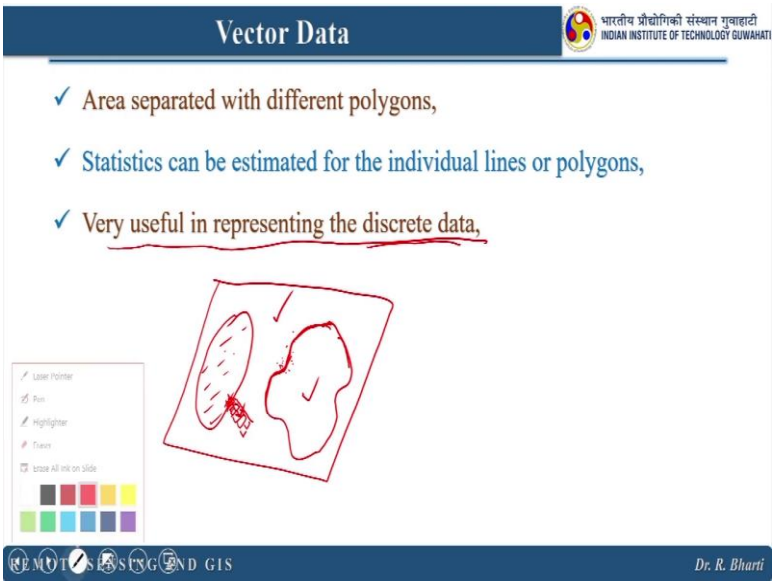

In vector data area separated with different polygon statistics can be estimated for an individual line or polygon. So, that is very easy here very useful in representing the discrete data. Now, let us understand what exactly it means when we are talking about raster and vector data. So, discrete means where you can find out one particular point where the values are ending or the classes ending.

So, let us see some example. This is one area where you have forest class and you have a water body right. So, forest will not end exactly at this particular point, there may be some trees here right. So, somewhere it may be less or more in vector data you have point line and polygon to represent such features. So, when you are using that, you have a restriction like you will decide a boundary from where you will say this is forest this is non forest right. So, in that case you are making a boundary for the discrete class. But in case if there is a mixture like here, if this is a wet land and here the classes are overlapping, so, slowly it is getting converted into another class. So, in that case what will happen this vector lines will not be useful. But in case if you know that this is the boundary of my class, then this vector data is very very good.

So, very useful in representing the discrete data where you know exactly where is your boundary. But in case of continuous data raster is good because you will have pixels here and does not matter how many pixels are coming here or there. So, you can always represent continuous data better with raster data and discrete with vector data. That is the advantage when you are dealing with vector and raster data.

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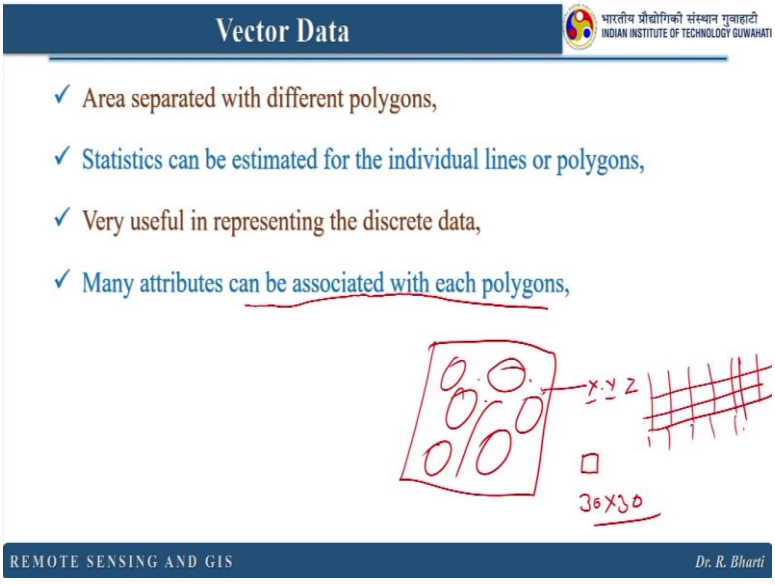

Now, the next point in vector data is many attributes can be associated with each polygon. So, suppose if this is your map, so, these are the polygons or lines or points. So, for each point you will have XY right what is the location then what is the unique ID? So, let us say Z and then you can make many columns here and you can save different parameters estimated are measured in the field or derived from any other sources.

So, this kind of information you can easily save here for a given particular location, but in raster data it will be difficult because the raster basically we have pixel and the pixel size may be 30 by 30 meter or 2 by 2 meter or 0.5 by 0.5 meter. So, the information which has been collected from the field may not be for the 30 by 30 meter or 2 by 2 meter or 0.5 by 0.5 meters. So, in that case you need to pinpoint where exactly this data has been collected. So, in that case, vector is very good.

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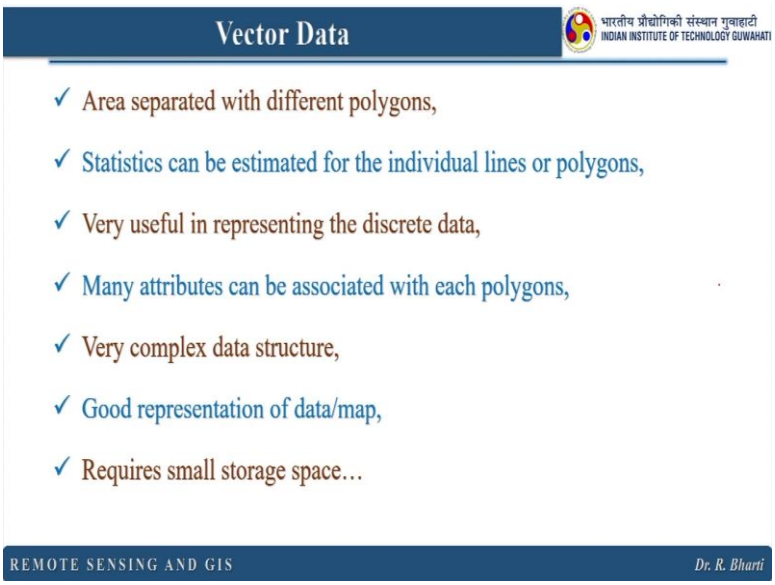

Next is very complex data structure because you can save many columns and many parameters. Good representation of data and map because here you can provide different colours texture. So, the representation or the visualization of your data will be very good requires small storage space because everything will be stored in ASCII format or in the values so you do not need much space for saving such vector data. So, apart from this raster and vector data, you have another type of data which is known as TIN.

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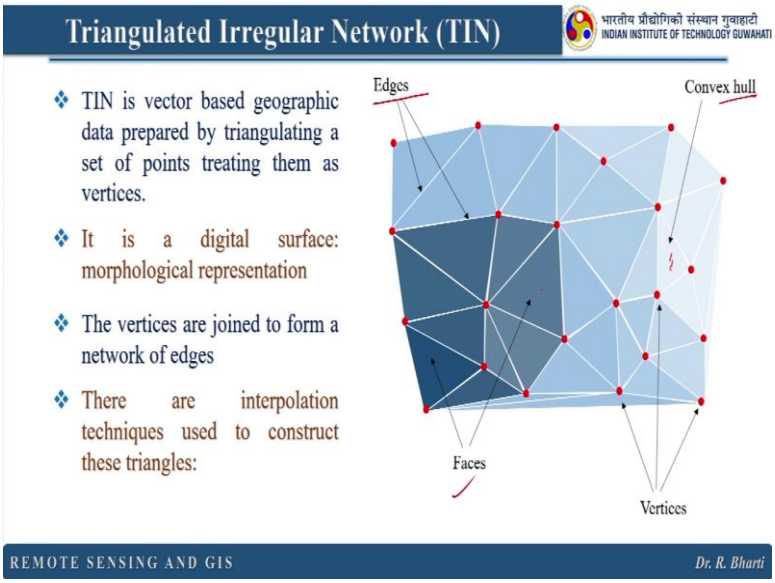

Triangulated Irregular Network. So, TIN is a vector based geographic data prepared by triangulating a set of points treating them as vertices now here you can see it is a digital surface where morphological representation is done, the vertices are joined to form a network of ages, you can just see this figures there are interpolation technique used to construct this triangles.

So, now, you just see these points basically the red dots, they are the places where we have collected our parameters, but we want to identify what is the value of that particular parameter in these places where we have not done any field investigation. So, in that case, this TIN data is very useful because that will give you the interpolated values between these two measured data. So, you are going to perform the interpolation here.

So, here you can see these lines are basically they are known as edges and the surface this is known as convex hull and faces are these places right. So, these three are very important in this TIN and the points where you have actual data they are known as vertices.

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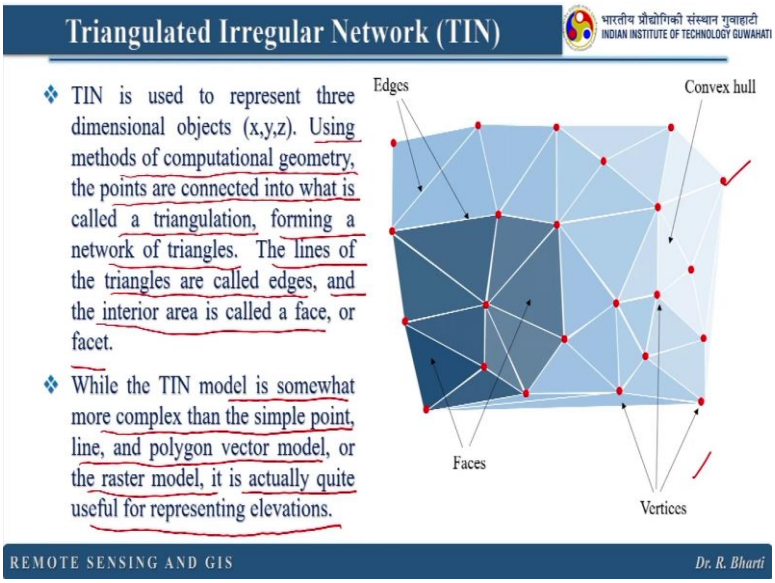

TIN is used to represent three dimensional object x y and z. So, this is very useful when we are working with topography. So, where we want to generate a digital elevation model. So, in that case, this TIN is very useful. So, using methods of computational geometry, the points are connected into what is called a triangulation forming a network of triangles. The lines of the triangles are called edges and the interior area is called a face or facet.

While the TIN model is somewhat more complex than this simple point line and polygon vector model or the raster model. It is actually quite useful for representing elevation because elevation is the value where you need the local variation right. So, for that we need many vertices so that you can have more accurate representation of the topography. So, this TIN data format is very useful especially in digital elevation model generation.

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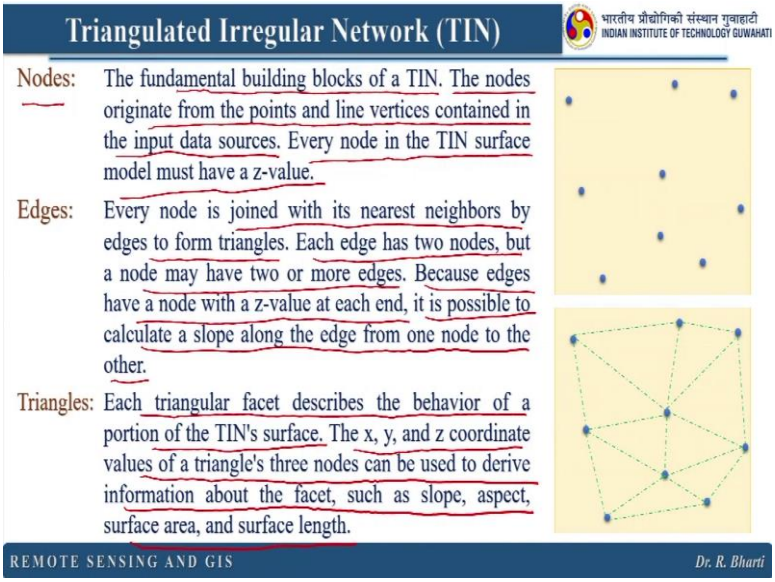

In TIN data, we have certain technical terms which you need to understand. So, first one is nodes the fundamental building blocks of a TIN. The nodes originate from the points and line vertices contained in the input data sources. Every node in the TIN surface must have a Z value, then only you can interpolate edges are basically every node is joined with its nearest neighbour by edges to form triangles.

Each edge has two notes but the node may have two or more edges. Because edges have a node with a Z value at each end, it is possible to calculate a slope around the edge from one node to another. Here you can see the triangles, each triangular facet describes the behaviour of a portion of the TIN's surface, the x, y and z coordinate value of a triangles three nodes can be used to derive information about the facet it such as slope, aspect, surface area and surface length. So these are some terms which we frequently use while working with TIN.

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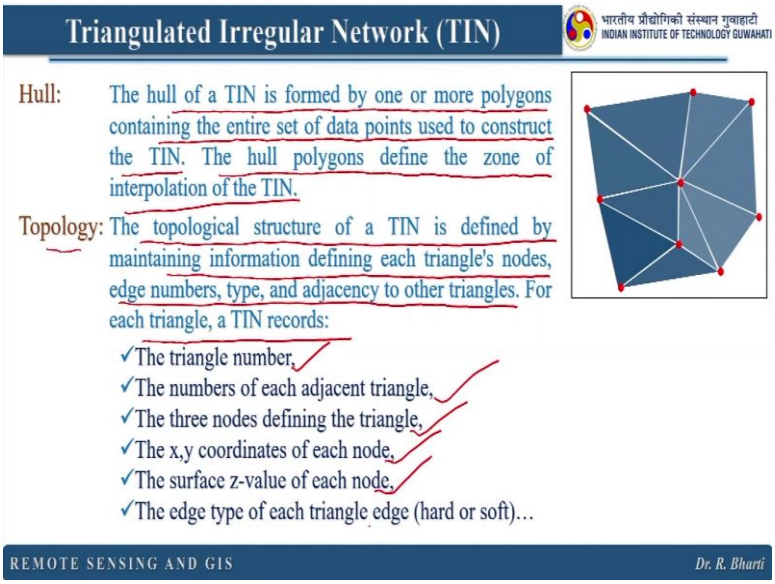

The next is hull, the hull of a TIN is formed by one or two more polygons containing the entire set of data points used to construct the TIN. The hull polygon defines the zone of interpolation of the TIN. So the next point is topology that topological structure of TIN is defined by maintaining information defining each triangles node, edge number, type and adjacency to other triangle for each triangle a TIN records.

The triangle number, the number of each adjacent triangle the three nodes defining the triangle, the x y coordinate of each node, the surface z value of each node, the edge type of each triangle edge, hard or soft topology basically deals or it records or it keeps a record of all the associated boundaries or the points or the surfaces to define the location, position of a

particular point. Now, let is see how we are representing our data in case if we have raster data vector data, so which one is more close to our real surface right. So, when we are dealing with that you can.

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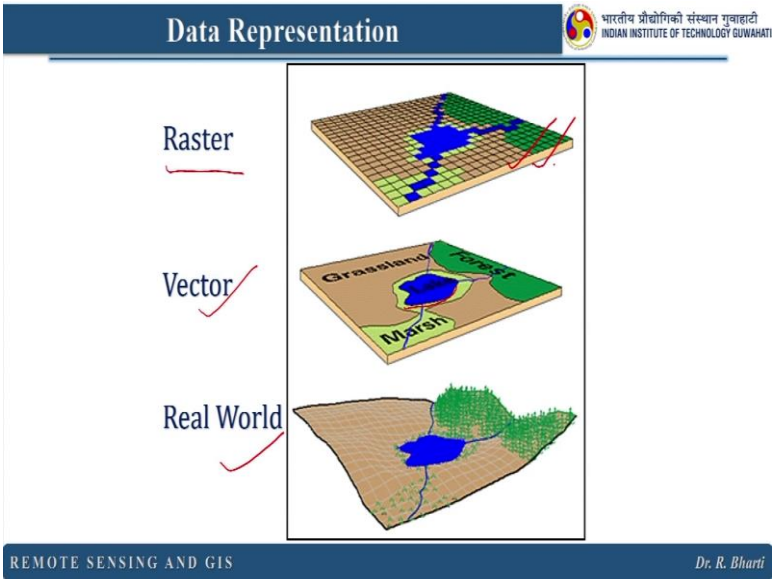

S ee here when we have raster data, so it will have all the pixels and where you can depict the continuous changes right. But when we are talking about vector data, we can mark the boundaries of some features right? And in the real world, we have both together because some of the classes they are changing slowly, but some of the classes which are changing abruptly. So, vectors are good to decide or define the boundary of any class.

But the local variation can be better depicted by this raster. So, if you want to display or represent your study area in better manner then you are supposed to integrate this raster and vector together. So, that it will be close to your real surface. I hope you have understood that with raster and vector we can add some other parameters also apart from the digital number and vector polygon ID. So, what are they? How do we do that? So, they are actually known as attributes.

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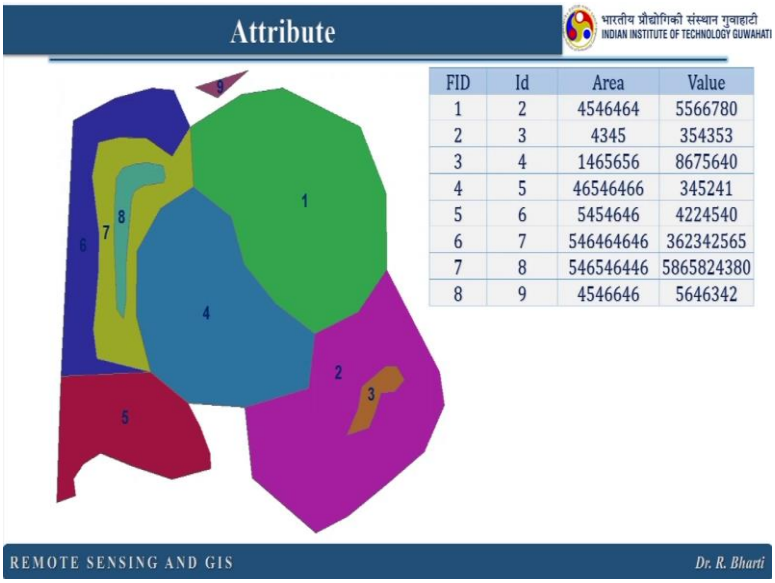

So, they are the additional information available in this particular polygon so, you can see considering this is our map, right, this is the boundary of your map. Now, here you can see this is class 1, this is class 2, this is class 3, this is class 4, 5, 6, 7 and 8 and the last one is 9 here. Now, by looking at it, can you say what are the parameters attached to this particular map?

No, because, as per this class 1 is represented with this colour 2 with this colour 3 with this colour and we do not have any other information, but when we are having or when we are dealing with attribute. We can add many more columns apart from this unique ID or class number and that can be used to represent this area. In this attribute table. You can see there are some information, which are not available in this map, but in this table they are listed.

So, if you see this ID 2 right. So, 2 is here. So, the area is this much. So, this is one example this is a dummy data, just I wanted to show you how these attributes look like. So, when you are having this attribute and suppose you are having a column of area, so, this is the area for this ID too. So, this is the area covered by 2 class, then 3 is this much and the value of this particular parcel is this.

So, such information or such attribute table you can create. I can give you some other example, like you have a point map and they represent some location in some area. And for these point, you have collected some information like first information is unique ID that you cannot change. So, that will be fixed. So, all the values will be decided and updated on the basis of UID. Now here the first will be your area, let us say, what is the population?

What is the quality of air right air quality, water quality, what is the depth of your groundwater. So, those information you can make a table and you can attach to that particular point map. And then, using this point map, you can run a query or because all the values are in the background, you have all the values whatever you have collected, maybe thousands of parameters.

For a single point, so, if you want to identify give me a location where x parameter is less and rest are high right or x is minimum from all the collected values. So, such queries can be run on this particular database and you can get the answer that is very easy. So, this is the advantage when you are dealing with vector and raster data in GIS environment. I have already discussed this topology in TIN but now let is see what is the utility of this topology in vector data because this topology is very, very important in all different types of vector data.

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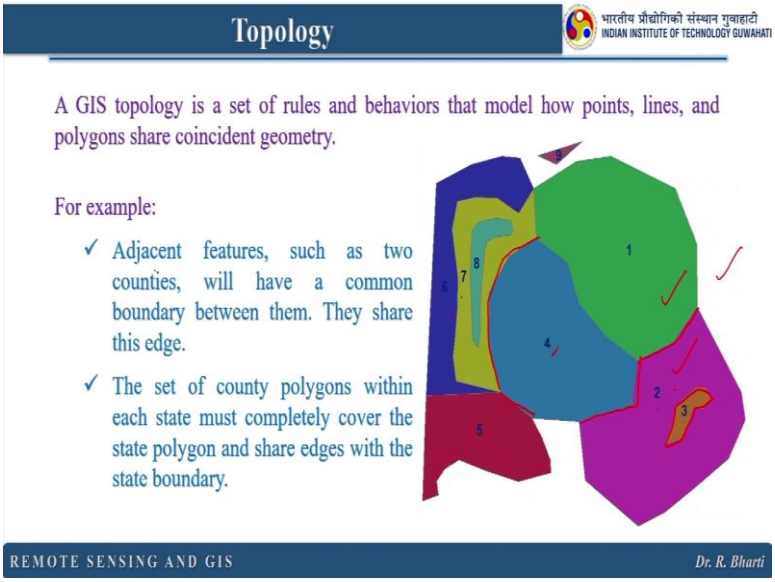

So, a GIS topology is a set of rules and behaviour that model how points line and polygons share their geometry right so, here the same map I have put here. Now you can see this particular edge this is shared between 1 and 2. And this particular 2 is setting this boundary with 3. So how exactly we are saying that okay, this line is shared between 1 and 2 and this line is shared between 4 and 2, this line is shared between 4 and 5.

And this line is shared between 4 and 7 and 8 is inside this 7 or 7 is sharing on right hand side of this 6. So all these location parameters, how do we define we need this topology to define

the area or a point where exactly they are and how they are placed. So, for example, adjacent features such as two counties, will have a common boundary between them. They share this edge. The set of country polygons within each state must completely cover the state polygon and share edges with the state boundary. Otherwise, they will be falling in some other state right. So, those things can be defined by or can be stored by defining this topology.

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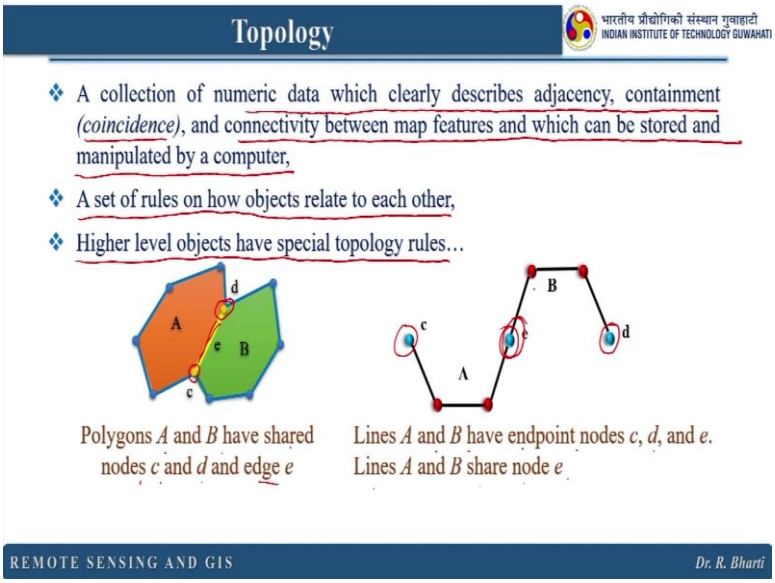

A collection of numeric data which clearly describes adjacency, containment, which is basically coincidence and connectivity between map features and which can be stored and manipulated by a computer. This also says a set of rules on how objects relate to each other. Higher level objects have special topology rules like here, you can see this A and B they are sharing this e line right.

So, polygon A and B have shared node c. So, this is node c and d right and edge e so, this yellow line is e here line A and B have endpoint note c right. So, this is node c d e line A and B shares e So, A and B shares e so that is how we are defining this topology of any given vector data here I want to show you a typical structure what we follow in GIS?

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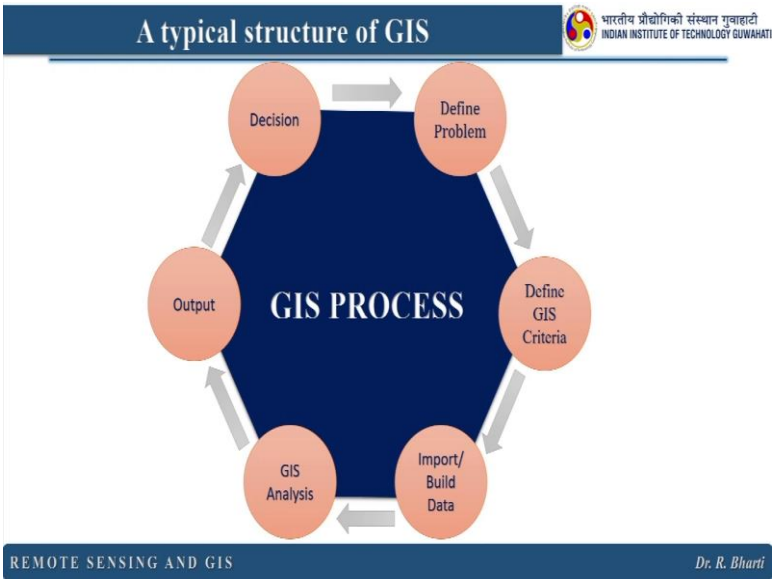

So, in GIS process we start with by defining our problem. So, we define what is our objective what we exactly want to do. And then we define what are the criteria we are going to follow to achieve this objective or aim of our study. Then we have to build the database. So, basically you will collect the data you will process them and then you will bring them into GIS environment then you will perform the GIS criteria whatever you have decided here, right.

Now, the next one is output where your output can be seen or you can represent your data in this result. Once you get the result, you can apply your understanding about that area or about that problem. And then you can take the decision and once you have done that, then it will be complete circle which we follow in the GIS. So, here we start with defining problem and we end with this decision.

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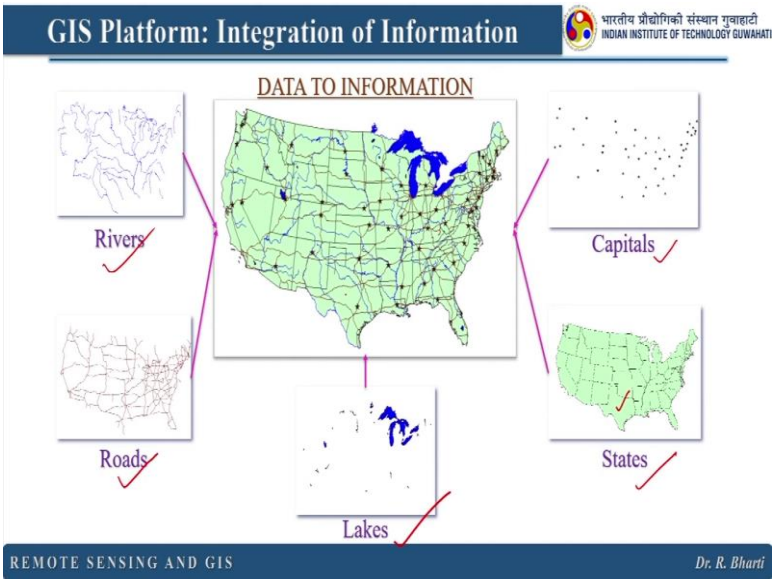

So, you have seen earlier that in GIS, we have a flexibility we can bring different information together. So, here you have one example, in this map, these points are basically representing the capitals. Here, you have a state boundary, here you have water boundaries. So you have lakes or rivers or maybe small ponds, then you have road networks. And then you have river boundaries or rivers.

Now, individually if you see them, they have some information, but can we bring them together. If so, then it will make more sense. So then ultimately what we do we bring them together and then we prepare our output. So that we can easily identify what are the different states are having more water or less water right. So at least those information can be interpreted immediately here in GIS. We have learned, what are the basic structures, what are the different data types, how we use them. Now, let us see what are the different application areas where we apply this GIS?

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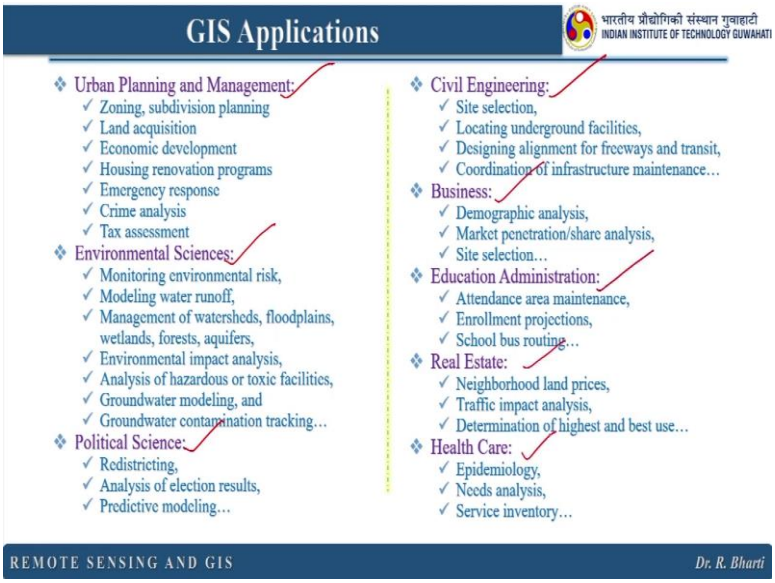

So, first one is urban planning and management. You can just read this then environmental science, political science, civil engineering, business, education, administration, real estate, and healthcare and there are many more which I cannot make a list because that list is endless. You can just remember, GIS gives you a flexibility where you can integrate the spatial and geographic data and you can perform any type of analysis.

So, that is the advantage when we are dealing with GIS. In GIS there is a very important function which is known as spatial data analysis. So spatial data again, we are talking about the data which has latitude longitude, the positional values, without that they are not qualified in this spatial data category. So in GIS, we can perform this spatial data analysis.

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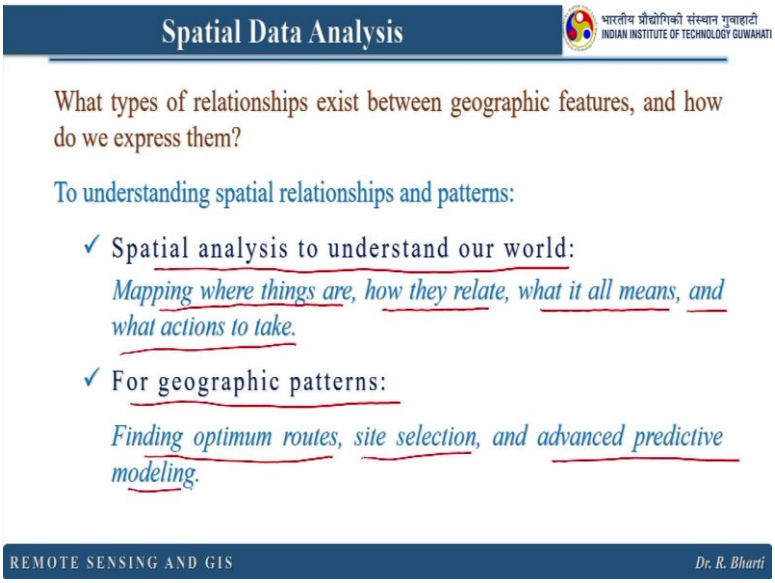

So what type of relationship exists between geographic features, and how do we express them? That we can do with this spatial data analysis to understand spatial relationship and patterns, we need to perform this spatial data analysis to spatial analysis to understand our world mapping where things are, how they relate.

What it all means and what action to take. So, everything can be done by the spatial analysis for geographic pattern finding optimum routes, site selection, and advanced predictive modelling. With this spatial data analysis, you can do many more things.

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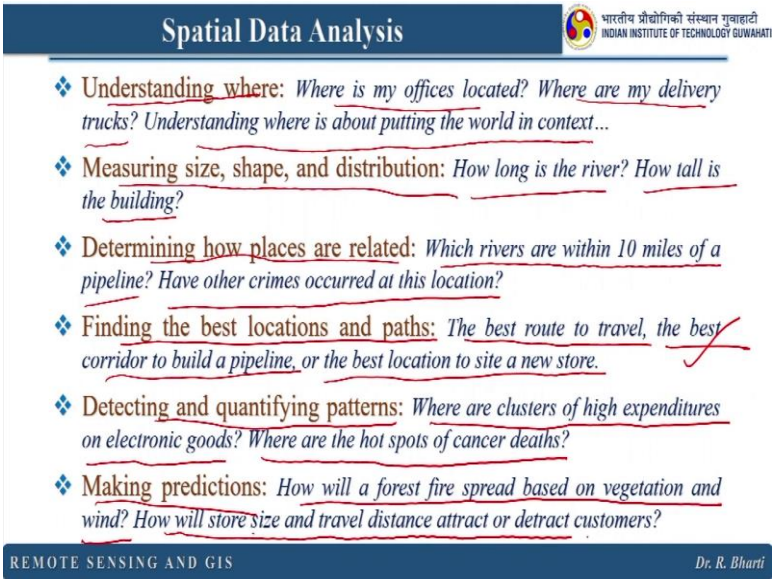

So first one is understanding where where is my office located? Nowadays, it is very easy with the Google Earth or Google Maps you can simply write the name or maybe latitude longitude. It will tell you where exactly it is with respect to this whole world. Where are my delivery trucks are? Are so you can just place a GPS locator in your truck and then you can monitor all the time, how they are moving, where they are stopping, and how much time they are taking to reach a particular position. Understanding where is about putting the world in context, measuring shape size and distribution. How long is this river? How tall is the building? So those things you can easily do with this GIS? Determining how places are related, which river are within 10 miles of a pipeline?

Have other crimes occurred at this location? Finding the best location and paths, the best route to travel, the best corridor to build a pipeline, or the best location to site a new store. So nowadays, it is very common whenever we want to reach a place we type the name of that

place or the latitude longitude of that place in Google Map and then we see how many routes we can follow and which is this shortest one which is having more traffic or less traffic.

So that we are always using in our day to day life detecting and qualifying patterns, Where our clusters of high expenditure and on electronic goods? Where are the hot spots of cancer deaths? Making predictions, How will a forest fires spread based on vegetation and wind? How will store size and travel distance attract or detract customers? So those things you can easily do with GIS?

So, there are different functions which I want to highlight which you can always perform using any GIS software or you can do it your own by using a programming language right. So let us see what functions we commonly use in remote sensing and GIS.

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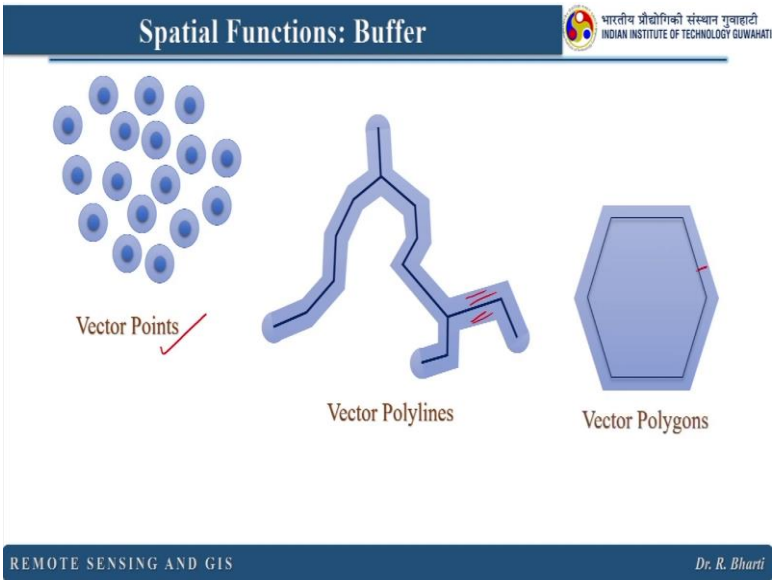

So, let us assume these are the vector points and buffer means you want to create a buffer from a centre of a place. So, from this point I wanted to create one meter buffer. So, this is the output. So, here you have vector points and you can see how they look like after putting the victor layer. So, it is very easy when you are dealing with the GIS and the next one is line. So, suppose this is a river, right? And you want to create a buffer so that all the buildings are all a settlement should be away from that. So, you decided to keep maybe 10 kilometres.

So, using that you can create this buffer and you can instruct people not to build houses in this places next is polygon. So, here in the polygon also you can create a buffer. So, this is your buffer depending upon your requirement. So, such buffer you can always create and it

will be very easy when you are working with GIS. Now, the next one is a spatial overlay function.

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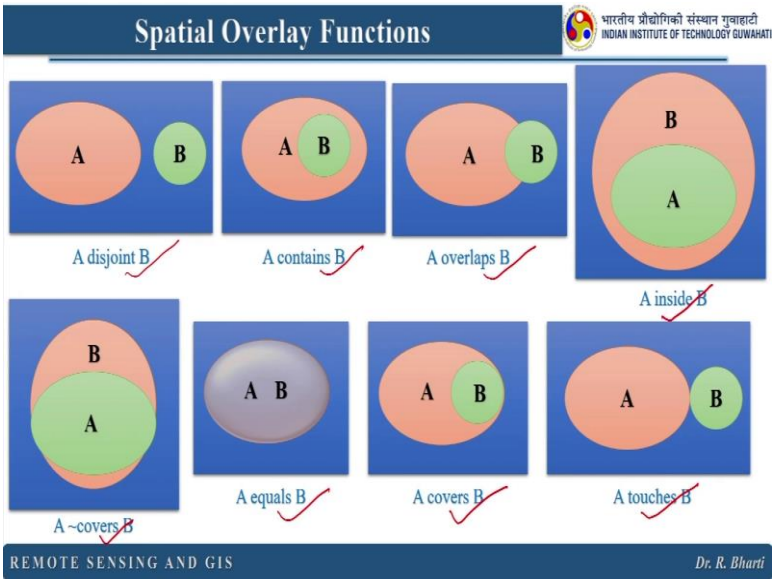

So, A disjoint B, A contains B, A overlaps B, A is inside B, A touches B, A covers B, A equals B, and A is almost covers B. So, these kind of functions you can always define in GIS environment. Now, let us see what are the utility or the spatial overlay function in our remote sensing application. So, when you are involved in some project, where you want to use this remote sensing data. How exactly this GIS is playing a role.

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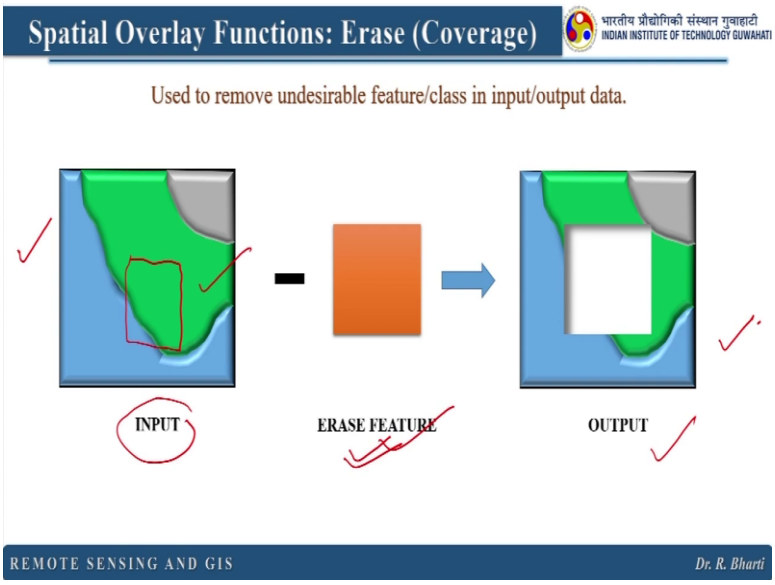

So, let us assume you have derived a map by using some classification techniques some data and you have this map output map do not see this input. This is the input for this function

erase function, but when you are dealing with this classified map, which has been derived from satellite data, but somehow you feel that this particular area is not relevant or maybe a particular class is not relevant to you or in your project.

Then how do you remove that class from your output? So, then we have to define a erase feature and then you can get this kind of output. So, assuming a problem where you have generated the land use land cover, and you do not want a class for water. So, then what you will do, you will digitize all the water boundaries in GIS. And then you will create that as a erase feature or maybe a mask.

And then you will mask out this original image that means your classified image and then you will get your output without that class. So, this kind of application you can always think of in remote sensing and GIS. Next one is identity overlay.

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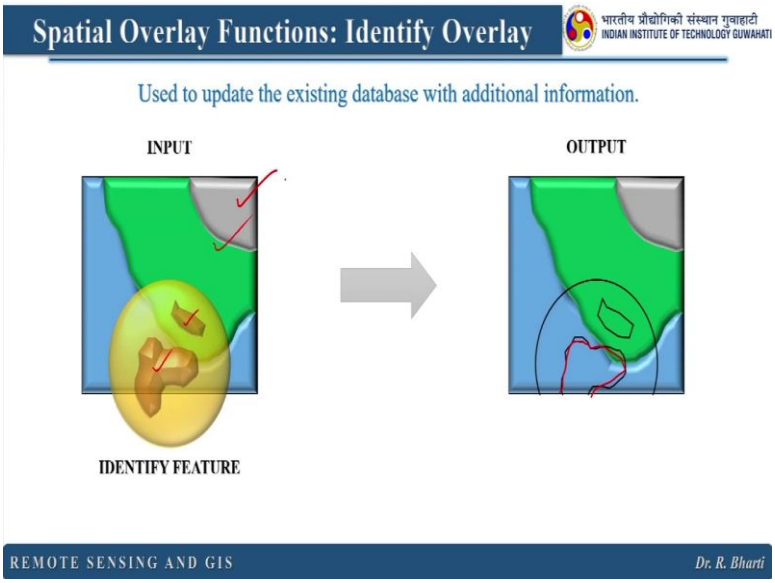

So used to update the existing database with additional information. As I told you in GIS, we always talk about the spatial data. And in case if you are having land use land cover map and every time you want to update your map as per the change in the Land Use land cover, then how do you update maybe from this classified map, you found that only these two classes are basically extra.

So, in that case what will happen, you will run this identity overlap and you will find that all the additional feature boundaries are coming on this particular input image. So, this can be done by using this identity function.

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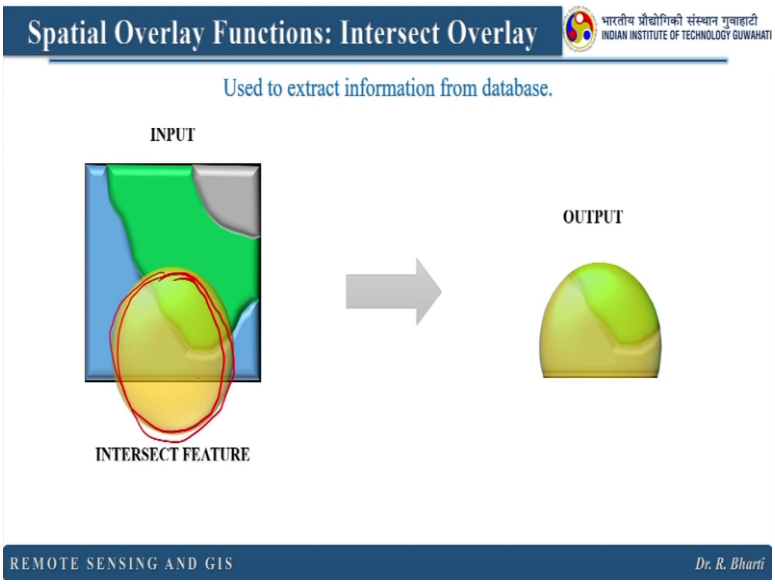

Now, the next one is intersect overlay so used to extract information from the database so, here the intersect means it will give you only for that layer you can see. So, here you can think of one application. You have a land use land cover map from an agency maybe later say from NRSC, you have purchased that land use land cover map and then you want to only perform some analysis for your study area that may be only one by one kilometre.

But you whatever you have purchased it may be for 1000 by 1000 kilometre. So, one by one kilometre you will make a mask this intersect feature and then you will run this and you will get only the classified or the land use land cover map for this particular area.

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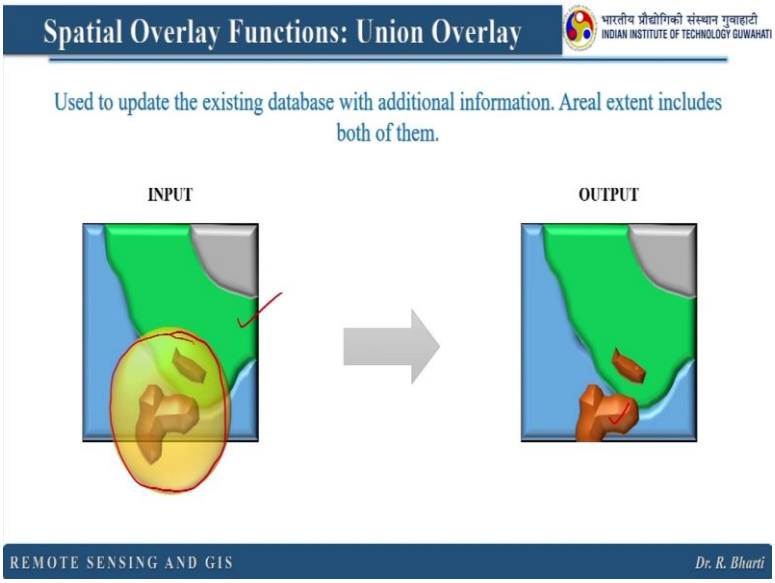

The next function is union overlay here it is used to update the existing database with additional information. Areal extent includes both of them. So, here you can see this is the input and this is basically your another layer. So, here what you want to do you want to union them, so then your output will have these feature plus the original feature right. So, both are updated.

So, this kind of application, you can think of when you are using or working in GIS, the next one is update overlay. So used to update and generalize the existing feature or database with additional information and here the area may also get changed, why because you are going to update. So, here, this is your original image. And these features are basically extra. So, you want to update the original map with this one.

So here the output will have extra features apart from this boundary, whatever it was right. So here the features are also updated and the area is also changed. So it depends like if you are both the layers are of same area, then you may not have any areal extent change, but if they are different then this condition may arise. So that is all for today. Let us see more about in my next lecture. Thank you.