Spatial Informatics
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Lecture - 32
Remote Sensing and GIS – II

Hello. So, we will be continuing our discussion on Remote Sensing and GIS that in our this Spatial Informatics course. So, yesterday we discussed about that how what is remote sensing and what are the different types of payload things are there, also some definitions of GIS alright. So, today we will continue that discussion rather another one or two lectures or we will be discussing on those aspects right.

So, one as we have seen that one major aspects of the spatial informatics or spatial data science or to say is getting data alright or getting more accurate periodical datasets right. So, remote sensing has become a de facto mechanism to collect several types of spatial data right; like there are with our own sensors and like last day we discussed last day lecture like with our own sensors we can basically get data about different resources on the earth surfaces right.

So, those can become, those can be after definitely approach processing it becomes a source of data for the for this any decision support for various type of applications. So, remote sensing data it becomes a very important aspects of any specially natural resource monitoring or any type of even used in case of disasters like flood etcetera, what is the inundation layer etcetera. So, today we will continue that discussion.

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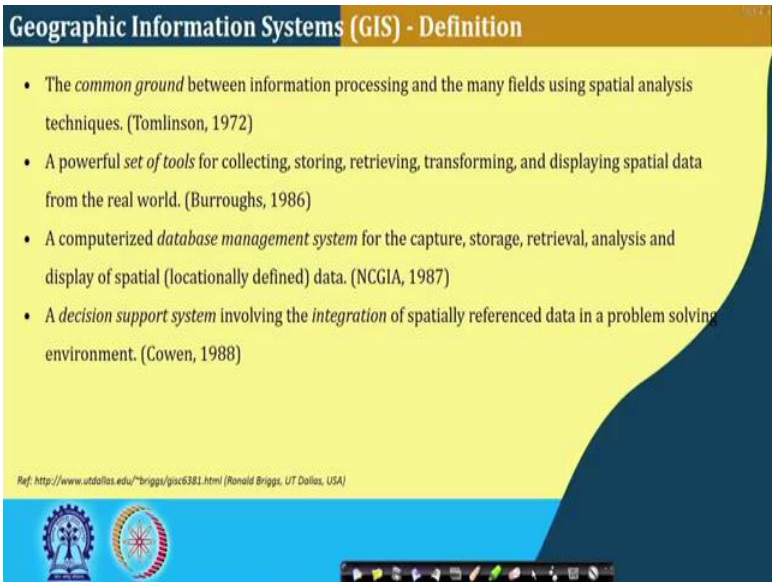

So, last class we have seen that when we talk about geographical information system rather geospatial information system also look at rather we have seen that system that is can stand for systems or science or different sort of studies of different type of things right. So, or in other sense there are different perspective of looking at this particular area alright. So, layer if you see that from early 70s to say late 80s there are some definitions, like common ground between information processing and many fields using spatial analysis techniques was there what was defined something in the 1972.

And, say it is a powerful set of tool for collecting, storing, retrieving, transforming, displaying spatial data from the real world. So, Burroughs was a definition or rather there are few famous books by Burroughs which are being referred. So, it is for collecting, storing, retrieving, transforming, displaying spatial data from real world right so, this is pretty important. So, our this satellite remote sensing or even aerial remote sensing or in remote sensing data can be a mechanism to harvest or these datasets right.

There can be other different sources of data like data as we are discussed the data collected by sensors or data are collected by some sensor based on means like pollution sensors and type of things. So, those are also some sort of we can say that is remote sensing more closer to the earth, but nevertheless the we have now different type of payloads. Some data collected by the satellite, some data collected by human things, some data collected by sensors on the on say maybe on the like post and type of things.

And, things like that in building etcetera which collects that air pollution control data or different type of other mechanism like balloons etcetera. Now, these datasets need to be integrated to take some sub take some reason. So, like I want to know that then I want to know that how much of the population or which area of the city is under threat of particular airborne or diseases which is affected by air pollution right.

So, I need to know the air pollution map, I need to know that population map right and of course, those should shit on a particular frame of reference which may be the city area like say Kolkata, Mumbai, Delhi or something right on any other city area. Now, in order to map then I need to have first of all acquire the data, some data we can get him from satellite or air bone or type of things. Some data are collected by surveys, human surveys, some data collected by different sensory systems and type of things and then I store these data on a particular frame of reference right.

So, it requires storing, retrieving, transforming because there need a transformation of especially that format transformation and type of things. There may be some other things of data, the detection of incorrect or outliers in the data set; cleaning the data set appropriately and type of things right. And finally, I need to display maybe I want to have not only the statistical data or not only the tabular data need to display that these are the pockets which are having affected on the things right. So, this have these are where the GIS come into play right.

So, the data source may be remote sensing, data source may be survey, data source may be something there, but this is the remote sensing. Not only that some of the things you may have a historical data sets right, like I say that in the say in say in the month of January or end of December or say somewhere in the where the month of January, February when the means when the winter is out going in this part of this world.

Then I have a history of this sort of pollution profile and I have a history of this sort of a disease created by these or people getting affected and type of things right. It may be a historical things like it happened it is happening for last few years right. So, that I can have a priori call that if it is the same thing is coming up and this is likely to be this type of things right and correlate with the present data. So, this sort of analysis or analytics are can be done using this GIS tool.

But, the sources of data one of the major sources of the data is this remote sensing or more specifically as we discussed we will be talking about satellite emergency data right. So, other things like it says about a computerized data base management system for capturing storing, retrieval, analysis of spatial data; that means, locationally defined or location specific or location dependent spatial data right. So, that others are the things which are there and a decent support system involving integration of spatially referenced data in a problem solving environment, this is going in a more on the decent support system.

So, looking at as a decent support system, but the data will be there pre-process keep things, I more of a reason suppose system for some processing or problem solving environment right. So, I have a problem to be solved and need to be there, like I can say that where the new police check post should come up in a particular region.

Suppose I have a or a new school should come up in a particular district right. I get a sanction we if there is a sanction of three more say high school level things then where this three should come up right. So, it has a dynamics education department has a process to this that it may have say it should cut out so much population or so much of potential population like student population.

And, it should be there may be a criteria that the schools would be somewhere too approachable by a road to should be located within say for example, 50 meters or 20 meters from a particular state road or village or a type of things. There should be some it should be within 1 kilometer of a hospital, it should be maybe within 2 kilometer of a police station or etcetera etcetera.

So, there are different criterias may be there for may making that particular school which is basically that particular domain expertiser there. Now, this may this GIS may help me with this spatial and some of the data are non-spatial data which are which can be related which can be integrated and I can have some functional model or type of things.

So, that I can have a to resolve this or solve this problem of finding best location of the schools right. So, that can be one of the major applications and widely used not for school not only for school was a various purposes right. So, these are some of the aspects. So, what we see that is different outlook for these GIS systems right.

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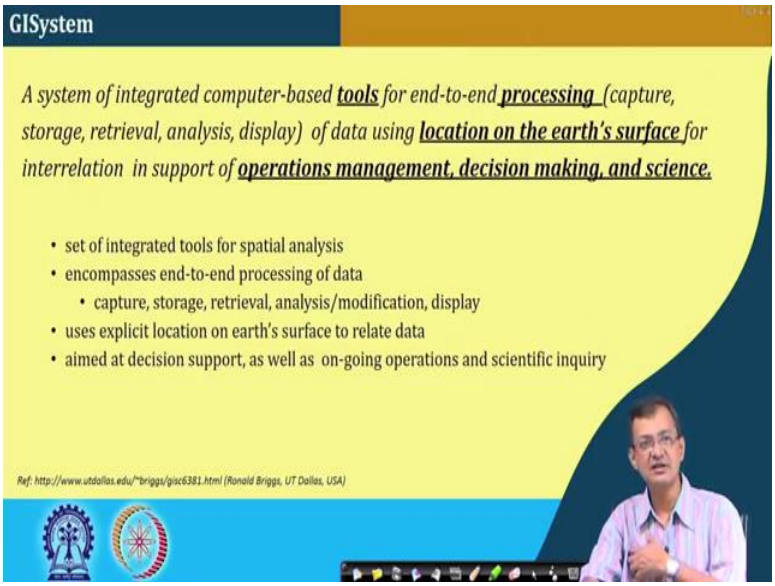

So, rather one definitions which is they are in several books also in this particular reference a system of not exactly in same phrase, but somewhere system of integrated computerized based tools right. So, or several applications go GIS applications for end to end processing capture, storage, retrieval, analysis and display of data using location of the earth surface for inter interrelation in support of operation management, decision support and science right.

So, what are the things important here? One is that data related to earth surface right, other is that it should support some sort of a decision support systems right. And, it can capture, store, retrieval, analysis, display right display or result generation. So, these are the different aspects which are important that is additionally what we can also look at it as that it should be able to handle or it should be able to handle this temporal data sets right.

Like I can have say I can have some predictive model, I say that if this is the condition then there is likely for previous years during this time there was rain or there was very heat waves etcetera; then I can have apriori prediction of the things right. So, it is time plus locating spatio temporal analysis. So, it should also promote or support spatio temporal analysis.

So, what we say a set of integrated tools for spatio analysis, what I get is a integrated package; for that matter any information system you say it allows you to do in that

particular domain. Say library information system, will allow you to capture this data or stored book related data, also retrieve that where the things are there. How many etcetera some sort of library science analytics can be done and also you can issue data and type of things right. At any point of time you can show that what is your library strength, how many users are there etcetera etcetera. So, it is a end to end phenomena from the whole thing.

So, that type of things are they are for this spatial information, major thing they for GIS type of information or GI system so, say spatial thing is that a it has a reference to this earth surface. So, set of integrated tools for spatial data analysis encompasses end to end processing of data. So, that you have now everything in one window or one particular package. Encompasses end to end processing, captures, store, retrieval analysis, modify you be required and display; display both in terms of; in terms of map or display or show result in terms of tabular data those things are possible.

Uses explicit location on earth surface to relate data right. So, I can have explicit location or earth surface or relate the data right; I can have things like that x y coordinate or a polygon type of things or a polyline type of things and say that this is the thing where things are there right. So, uses and aimed at decision support as well as ongoing operation and scientific enquiry etcetera.

So, primarily it is a uses for decision support or any ongoing operations. I may be allocating something based on this based on this demand and type of things right. Like based on the traffic mechanism and traffic on the road and type of things, I may be going on changing this traffic lighting mechanism means that things like how much time green, yellow, red will be there those things are being modest.

Or, I like based on your rainfall etcetera you take a decision of what whether any counter measure has to be there and type of thing relief operation and type of things right. So, it is something which is have and also we can have a scientific inquiries like or scientific analysis like what happened when and where type of things.

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So, geographic information system. So, it is a there is a map behind it, a spatial database behind it what we have seen right; spatial database with different type of spatial query, query optimization dealing with things all those things has to be there. So, a underlining spatial database is required, virtual representation of the real world and its infrastructure. So, what I am trying to do is a virtual representation or representation of a real world on some platform right, it can be desktop, mobile or any other things right.

So, a consistent as build of the real world, natural and manmade and type of things right so; that means, it should have a consistence with that what is there and how you are mapping on the thing. So, in other sense any decision you are taking based on this should have a one to one mapping or have a proper consistency over the real world. So, manmade which can be queried to support ongoing operations we can query, summarize to support strategic decision making and policy formulation right.

So, I may during flood want to do a strategic decision making of mobilization of things, using or boats or say some high means car, this trucks and type of things to evacuate people or supply of essential materials right; whether to deploy doctors etcetera based on the thing. So, it did not have a some statistic reason making where the resource needs to be optimized and put to the use right.

So, may be flood may be cyclone maybe even mass scale fire right in a particular city region which road should be block, which road to be detour, what should be the

mechanism of giving path to the things like fire brigade or firefighters and ambulances and type of things right. So, analyze to support scientific inquiry right. So, it can also I can analyze to support scientific inquiry, like I want to do that what should be the prediction model, forecasting model and type of things those can be supported by this. So, now, if we look at another thing what we missing.

So, now if you look at the this picture which is taken from this particular site, there are several layers right like here we say soil, natural water, wetland, inventory land wetland inventory, land use, elevation model, some raster graphics and there are digital line graphs and type of things right. So, there are different type of models right. So, and interestingly if you look at here we have a base map right or for which, think of this is a graph paper where you are putting all those things; that means, what we say there is a reference map right.

Unless there is a reference system, I cannot put the things together right; so, based on this reference system everything. So, I may be collecting like say for this particular soil, this may be collected from processing of satellite imagery right. National wetland also some part of the satellite imaginary, definitely ground to miss ground surveys are there with that the satellite imaginary has been classified or I can have this type of things. Digital elevation model maybe through survey right or there are other mechanisms to find out these elevation models.

So, it says that elevation models in the since that a particular region how much it is over the earth surface. So, based on the digital elevation model or sometimes what we say it is a DEM; we can create a slope right slope and aspect and type of things right. So, this is pretty important when we look at say situation like flood and type of things where things will be there, even it is used for visibility analysis right. If the elevation is high where I should put my camera or something so, that I can how much I can visible and etcetera.

And, I have lot of other application in the area of defense and etcetera right, also helps us in having some low fly aircraft or something path measurement and so and so forth right. So, digital elevation model self sustained different management in the especially in mountain or hilly terrain and type of things right. So, those things are maybe surveyed to the earth surface and type or they through survey mechanisms right.

And, then we have hydrography, hypsography, transport road network right, rail network, airport. So, these are all transport related stuff right or rather here also it is a pipeline and transmission lines which are not for physical transport, but it is a transmitting of some material and type of things right. So, these are the different resources, some of the things comes up or by capturing remotely, some are basically like pipeline.

It has been laid by some agencies like some government agencies or federal agencies. So, this is that maps are they are how it has been laid; so, that is put into this particular layer. So, similarly there are boundaries like municipality, some refuge and park and reservations and type of things. So, I can have state boundary, municipality boundary, city boundaries and different type of things. So, these are the things which are more of a administrative boundary.

So, somebody has to draw right; I cannot see the direct I cannot see the unless that is following a river or something. I cannot see the boundary of two state from a satellite or a airplane right airplane, because there is a administratively drawn right. So, that has to be drawn right so, but whatever you are doing, you are doing based on a coordinate system right. So, that coordinate system based coordinate systems need to be here as a what we see as a base map. So, everybody should sit as a on the base map right.

Now, suppose I want to do some analysis to find out that a which will be the say particular crop products and related things. So, I may require this soil thing, I may also require that say digital elevation model. I may require something that hydrography or something like that, I may require some other related stuff also right. So, these are the things when we those layers I do for analysis purpose right. I can do some of the scientific analysis like predicting some of the things and some of the things may be co occurred events are there right, that same type of things occurring in the same place.

So, different type of co-located, co-occurred and something is correlated that if this happens this will going to happen and I can do different type of things like as we have seen that spatial data mining, mining the data etcetera. So, these are can have a this may be a source of data. So, one is that getting the data from the remote sensing data then you have harvesting the data in a appropriate form. So, those things can be collected and analyzed ok.

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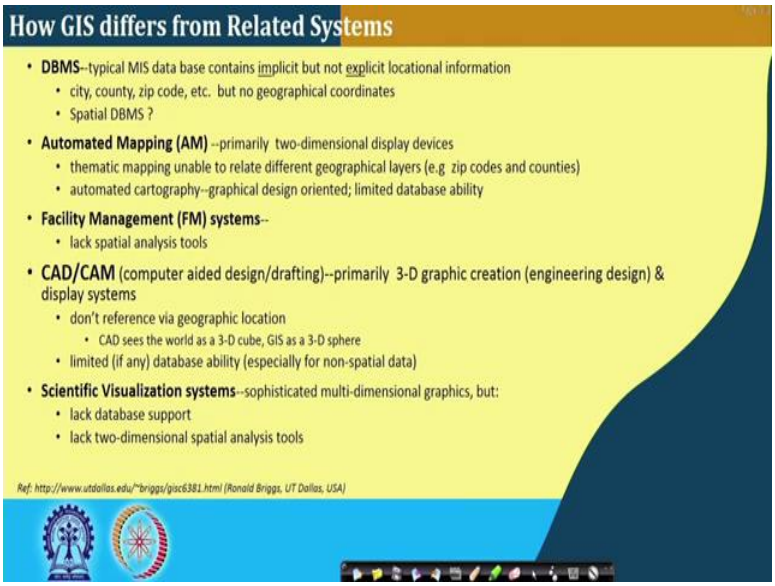

So, if we look at the different related system, how they primarily differ or why not that related a standard DBMS or any other things can be called as a GIS. Say DBMS typically MIS sort of database context implicit, but not explicitly location information right. So, it is not though most of the databases across the world has some location information you need, but that is not explicitly made toward that.

Whereas, in case of a GIS the location is the primary anchoring point; everything is located on the based on things right. Like city, county, zip code etcetera, but no geographical coordinate per say in our standard databases or standard address base right. So, we do have a spatial DBMS which tries to capture this location information and relate it to this attribute data of that type of things right or non-spatial data. Automated mapping is another aspect which is there for primarily two dimensional display devices right, climatic mapping unable to relate different geographical layers etcetera right.

So, there may be a automated mapping things, but it is not GIS per se; so, that can be input to the GIS right. So, that is why I say remote sensing is not the GIS so to say. So, it captures data which can be used by the GIS for processing the things right, facility management system like a lack spatial analysis tool right. So, facility management system CAD CAM, computer aided design drafting, primarily 3D graphics creation, engineering design, display thing etcetera.

These are also not GIS that these resources can be input to a GIS right, the pipeline or a particular cable network which are which has been laid or map through CAD CAM can have a input to this GIS systems. Limited if any database ability was especially for non-spatial datasets etcetera. So, there are limited database abilities etcetera for the CAD CAM, but that is not the exactly to the yes.

Scientific visualization, sophisticated multi-dimensional graphics, but lacks database support, lacks two dimensional spatial database and many of the things can be may not be the directly coordinate based or location based. Nevertheless, what we can see this can be a very much input to the GIS system right.

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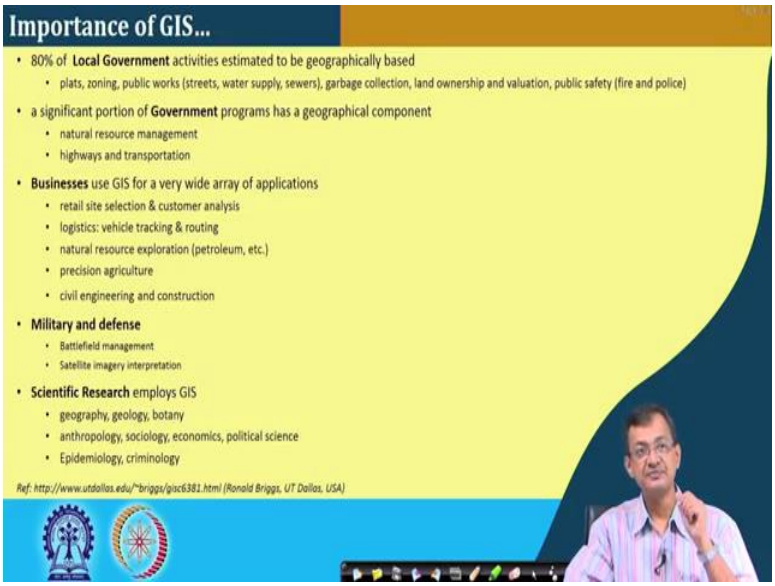

So, if we look at the importance of GIS today; so, even if you see in our country now with the there is act of parliament where NSDI the National Spatial Data Infrastructure was formed, we will discuss little bit on that. So, there are extensive use of spatial data also to say GIS systems for different type of planning and different type of development planning programs of the government, state government or central government type of things right or so, that it is properly realized and really benefits goes to the needed one.

So, 80 percent of the government activity is estimated to be geographically based or location based so to say something zoning or plots or public works or anything any government informations are related to the thing. A significant portion of government program has a geographical component like national resource management, highway and

transportation; these are have geo spatial data in the things. And, also business find a lot of or finding business or commercial lot of interest GIS for very wide application or different type of application.

Like retail site selection or customer analysis, logistic, vehicle tracking, routing these days this tracking that the vehicle etcetera especially transport vehicle is a now became a more or less defector that how these pickle movements are there. Natural resource exploration, petroleum etcetera, precision agriculture, civil engineering and construction these are different aspects of the stuff right. So, military and defense battlefield management, satellite imagery interpretation these are the other aspects of what we see in case of a GIS systems.

Now, there are several scientific research which uses GIS; like in area of geography, geology and botany, architecture, different agriculture and type of things which are there. There are aspects like sociology, economics, political sciences where the finding application; in a big way in public health, management and type of things like epidemiology or crime detection, hot spot crime, hot spot detection.

Or, prediction of the what we say probable next crime locations or any epidemic sprayed pattern of a epidemic etcetera those are things which are there in this case of a what we see in case of this type of spatial data type of analysis. Or, what we say geospatial information system or GIS for geographical information system.

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So, if you look at the application areas local government, public infrastructure management, planning and etcetera. There are application for the real estate, commercial, public safety and defense like as we are talking about crime analysis, emergency management, military defense. Natural resource exploration or extraction and petroleum mineral etcetera. Transportation: airline route planning, public health and epidemiology and geospatial industry, development application development and programming and types of things.

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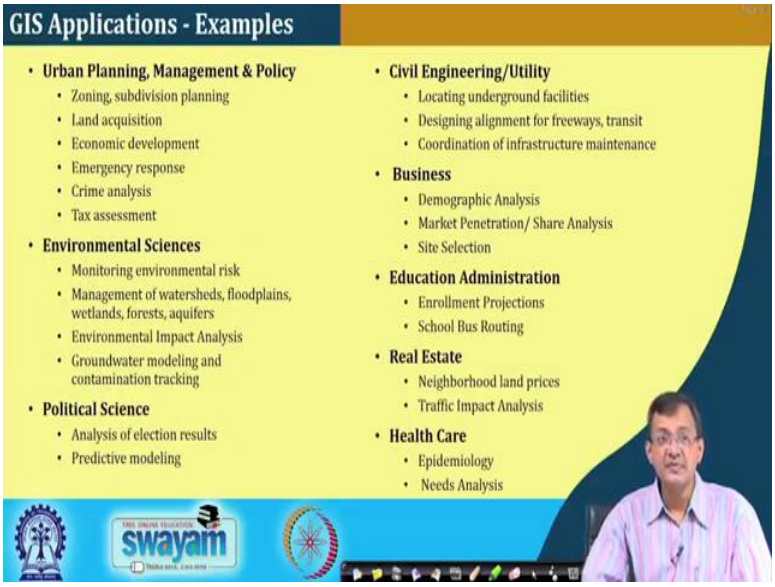

And we see various applications starting from urban planning management and policy not only urban, urban oblique rural that deploying different type of rural projects and type of things. Environmental sciences, civil engineering utility, business, political sciences, education administration, real estate healthcare.

Now, see it is a whole gamut of the things right, different things has a different type of different look at the system. But, incidentally all of them have some inherent location feature or location characteristic in them right. So, it make sense to use this type of system. So, GIS system should be versatile to handle those type of things.

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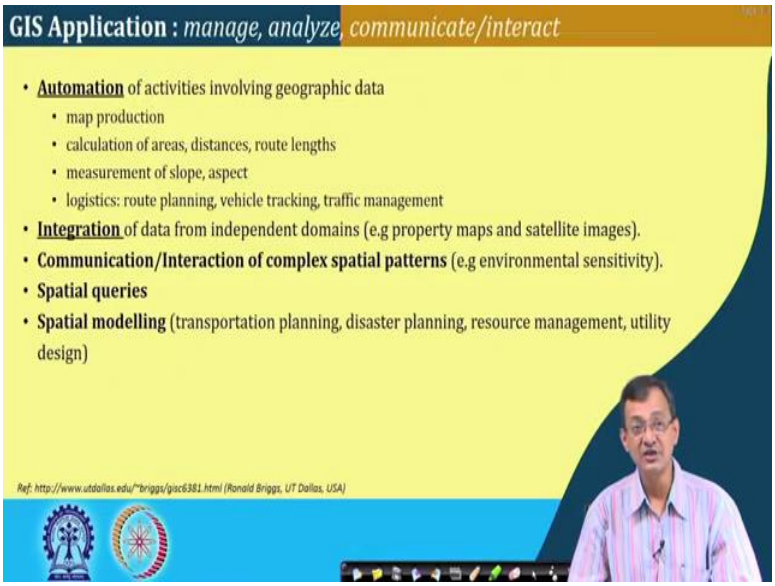

So, if you look at the basic motto or goal of the GIS application: one is the automated automation, automation of activities involving geographic data, map products and calculation of area, distances, route length and measurement of slope and aspects and so and so forth. Integration dependent of data from a heterogeneous sources; if you recollect what we discussed about OGC, spatial web services etcetera which enables you to take the data from heterogeneous sources in a service mode right.

So, or ensuring interoperability, communication or interaction of complex spatial pattern. So, that how to interact with different spatial pattern, spatial query we talked in details; spatially scale and type of things. Spatial modeling: transport planning, disaster planning, resource management, utility design and type of things.

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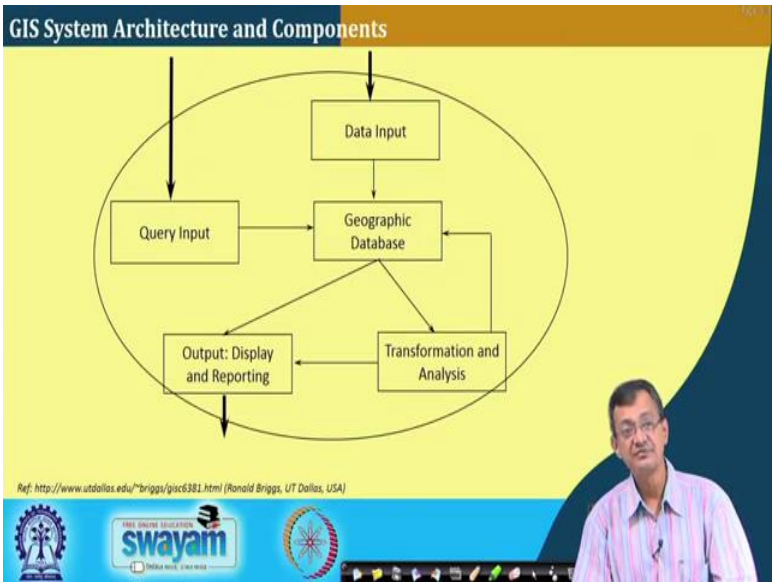

So, if we look at that different that inputs is that query as a input data input. So, geospatial database or spatial databases they are right which we have planned for that we require a spatial model things are there, from there we have a output of display and reporting transformation and analysis of the things. So, these are the different aspects what we see if we look at a whole system as a whole.

So, it does storing, capturing, analysis of the whole data set; spatially enabled data set which should sit on a common spatial reference systems for that particular area of interest of region of interest.

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And if you look at there are it is not only a computing and other systems are one part of it, but a good amount of parties on that knowledge or expertise from different sources. Like computing, computer science and MIS type of things as required for data management to querying, to security, to visualization and type of things right. On the other hands we require geography and related area for understanding of the cartography, geodesy, photogrammetry, landforms, spatial statistics where we need to know it and there are various application area already you have discussed.

So, these are the application people, there are systems or computing science and in between we have those type of things. So, convergence of technological fields and traditional discipline and domain expertise is goal of the things. So, it is not only have different data and layers which are integrated, it is required to have different type of people with different type of inputs to the whole system ok.

So, with this what we let us look at our what we discussed, that today what we tried to sue look at more of a of the geo GIS and what are the different application and type of things. We also tried to see that where these remote sensing come as a input to these GIS mechanisms. We will in the subsequent couple of classes we will also or lectures we will also look at the different aspects of remote sensing and different aspects of GIS and how strongly they what we say merge together or interact together and things like that.

Thank you.