Geo Spatial Analysis in Urban Planning
Prof. Saikat Kumar Paul
Department of Architecture and Regional Planning
Indian Institute of Technology, Kharagpur

Module - 01
Introduction to Geographic Information System and Geographic Distribution
Lecture - 01
Introduction to Geographic Information System

Welcome to this course on Geo Spatial Analysis In Urban Planning. We are in the 1st module, the module is structured as Introduction to Geographic Information System and Geographic Distribution. So, in the 1st lecture of this module we are going to focus mainly on the components of geographic information system and what this geographic information system is all about. So, we are going to have a very brief look on a GIS Information System, Geographical Information System.

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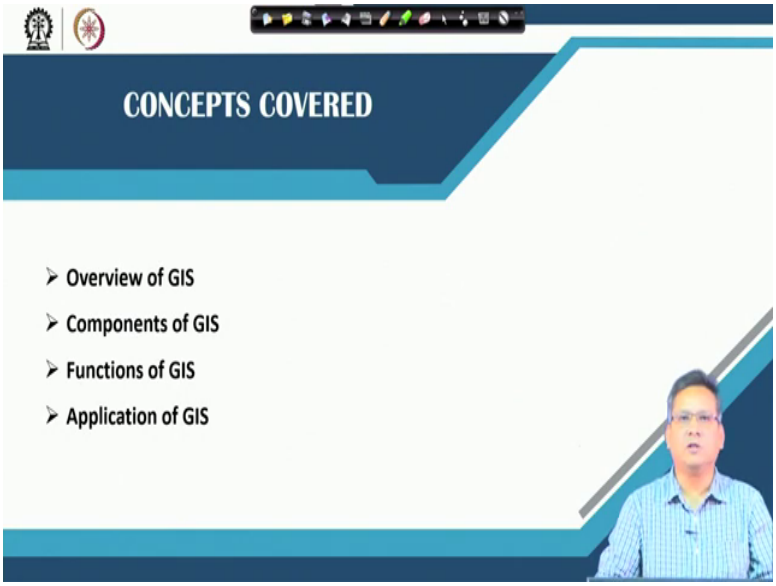

So, the concept that would be covered in this particular lecture is a brief or an over view of the GIS, the component components that constitute GIS, the functions of GIS and the application of GIS.

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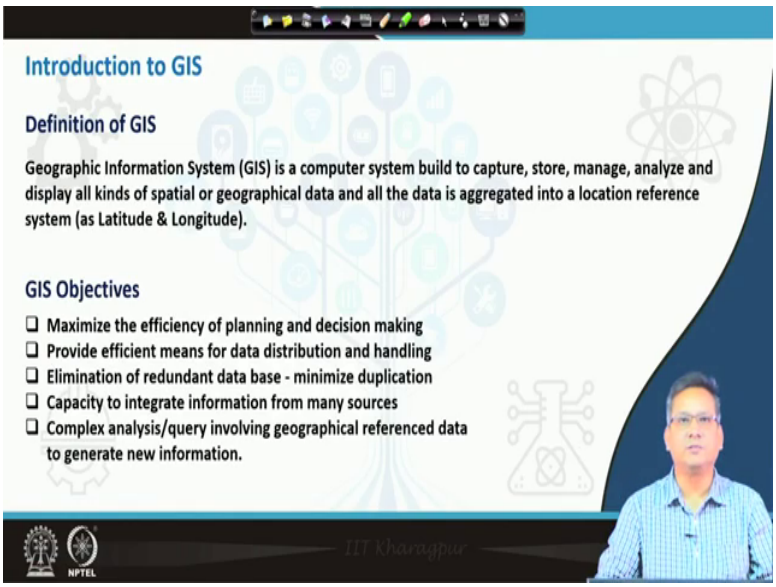

So, if we see the kind of applications that your GIS would have on the urban scape, we would need to know about what this GIS is all about. So, basically if we see the definition it includes computer system which basically would capture store, manage, analyze and the display all kinds of geographical or spatial data and it would run the queries and display them as maps.

And it has the data which is aggregated in a locational reference frame work or a kind of a locational reference system such as the data would be having your latitudinal or longitudinal coordinates or it might be having easting or northing in terms of meters or any distance

measure. Now, the objectives of GIS is basically to aid in increasing the efficiency of planning and decision making process.

We make lot of I mean planning judgments based on given scenarios, based on the existing data and we interpreted and which basically leads to particular solution to a given problem and GIS is a very effective tool in this particular process. Secondly, it provides an efficient means of data distribution and data handling.

So, we know in today's world I mean we have to handle I mean a humongous amount of data, so to handle it efficiently a we need a system which can do it real time, which can process the data real time. So, basically this particular system of geographical information system provides us with a platform for, I mean efficient way of handling the data and processing it in real time.

The next objective of GIS is to eliminate redundant data base and minimize duplication. So, in today's world we see that the same data is available from different sources. So, there could be redundancy in terms of the data that we might collect. So, we are talking about big data, we are talking about IoT systems wherein the sensors would be aiding in the processes of data collection.

So, there could be I mean redundancy in terms of the data base that we collect and there could be duplicity of the data. So, basically GIS system should do away with this kind of a duplication in terms of the data collection and it is archival, so that is also one of the objectives to eliminate the redundancy in terms of the data that we collect.

The next objective is to integrate information from multifarious sources. So, basically when we are talking about urban systems, we are not just talking about individual components in isolation, but we are talking about multitudes or difference sources wherein information is required and it gets collated into this given system. So, it should be able to integrate all the data from different sources.

So, when we talk about integration of the data we have to look into the temporal integration that is the data that you collect at different time points, we have to talk about scalability of this particular information at what scale you we are collecting this information. So, this system has to integrate all the information that is available from different sources, multifarious sources and integrate it in one platform. And it is very important to mention that all this data would be having locational reference, otherwise it would be I mean not so useful for our analysis and decision making.

The last objective that we can gauge for this particular system is to develop analytical models having queries of the data that we have collected in our, I mean we were talking about different sources where we can collect data for urban systems. So, this geographically reference data that we had collected needs to be analyzed and these analysis could be very complex analysis or it could be simple queries.

So, this system should be I mean robust enough to run complex analysis as well as simple queries and it should be able to do it in real time and display it as maps which would be easy to interpret.

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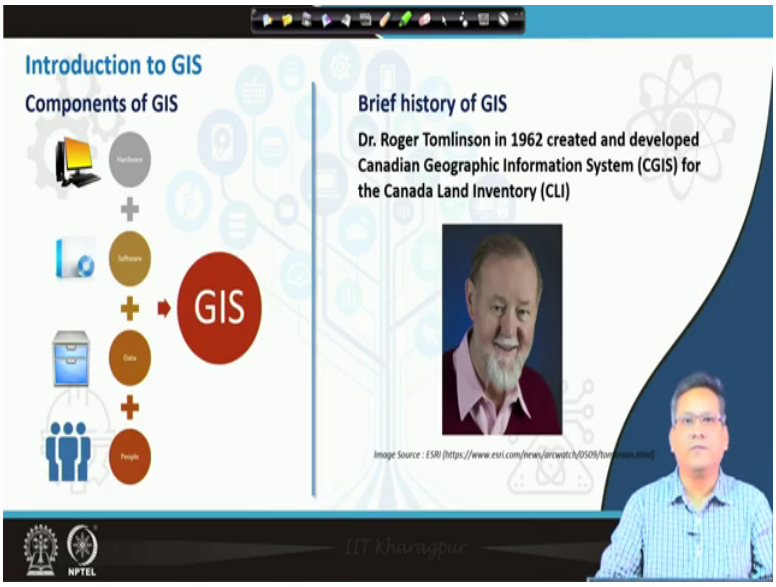

Now, if we look at the different components of GIS. The first component is information system on computer that is part of the hardware, then we would be having softwares which would be involved in doing the data processing part, collating the data, analyzing, I mean giving as a programming tool to basically write codes, to run processes, do simulations.

The next important most important component of GIS is the data base. So, we have talked about the multifarious data base that is required for any sort of an urban analysis which is which would have a geographical reference. So, this data base would be pertaining to different types of variables and the last but the most important component are the people.

Basically, when we are talking about urban planning we are dealing with planning issues that are pertinent to the people who are occupants of that particular place. So, people is I mean getting information regarding the people and their feedback, their apprehensions, their I mean

aspirations, it becomes part of the planning process. So, the last component of the GIS information system is the people.

If we talk about the history of GIS how this came into be. It was Dr. Roger Tomlinson who in 1962, he created and developed the Canadian Geographical Information System, the CGIS or the Canadian Land Inventory System. It was basically a land record system in which he created a frame work which can be used for basically I mean recording the inventory of the individual parses, its usages and the various other related parameters in such data base. And interestingly Dr. Roger Tomlinson prior to doing this particular work he was a fighter pilot in the royal air force.

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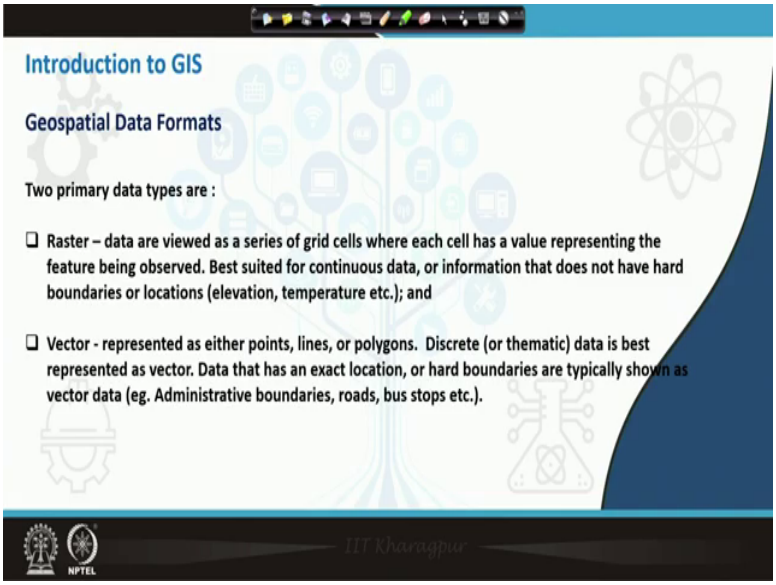

Next, if we see the different types of data formats that we use in this particular data base we had talked about the different components of the GIS and data being one of the most

important component. So, it is important for us to store the data in different formats. So, primarily there are two different types of data formats that we use to store data.

The first type is the raster data, you most of you are familiar with raster data, when we take pictures using our cameras, mobile cameras or cameras we generally I mean take the reflectances and record them as pixels. So, it is a grid or series of grid cells wherein each grid cell would be a value representing the features that are being observed. So, we basically record the reflectances as digital numbers and basically it is stored as an array of grid cells which is recorded as the raster data.

Now, this particular type of data GIS data is best suited for acquiring continuous data, wherein you are not basically interested in containing I mean you are recording point information, but a continuous data an information that would not have hard boundaries or location. So, I mean as an example we can say when we want to acquire the temperature, values of all the grid cells in a given city, say suppose we are doing a study on the urban heat islands, we would be interesting in capturing the temperature values.

So, the raster data format would be ideally suited to do such an analysis. Next example could be of elevation of a given area, wherein if you want to find out the kind of run off in case of an urban flood. So, the elevation could be stored in for each and every point and we can there after convert it into either contours or we can find out the slope map, we can find out the aspect map. So, that could be another example where we could record the data, the continuous data as raster data point.

The next type of data that are basically used in GIS and which is extensively used are vector data. So, vector data, I mean we have been using vector data in CAD systems, wherein the data basically is recorded as points, lines or polygons. So, we in this particular data frame work, we record the discrete data which is represented as vector.

So, this data would have exact location or hard boundaries and these would I mean entail the boundaries of say administrative boundaries or if you are acquiring the linear data points or lines line information, examples could be that of road the point data could be stored I mean

for bus stops in a given urban area. So, this could be some of the examples of data which could be stored in vector format, specifically as polygons, as lines or as points.

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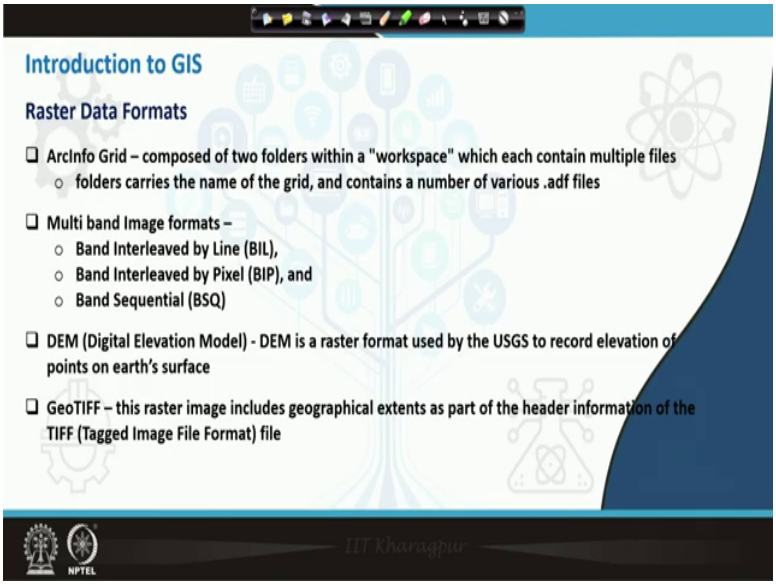

Next, we talk about the different types of raster data formats in which we would be storing data GIS data. So, first data format is the Arcinfo Grid Data Format which is commonly used and basically it is the proprietary format of Esri and it is comprised of two folders, wherein a workspace would contain multiple files and it would carry a folder which would have the name of the grid and it would carry number of various adf files which would have the reflectance for each of the pixels or the values of each of the grids aggregated as Arcinfo grid.

The next image types would be Multi band image formats and there are different types of formats in this. The main major formats that are used for this type of raster data are the band interleaved line format, the other formats are band interleaved pixel and band sequential. So,

in this three types of formats we would be able to store multiple bands of information or multiple layers of informations, not just three layers as we see in photographs mostly the red, green and the blue bands.

So, here we can store multiple bands. So, this would be very useful when we are acquiring image or data from multiple sources. The next type of raster data format is Digital Elevation Model. It is I mean very popularly known as DEM, which is used by USGS to record the elevation of point features on the earth surface. So, this also is an example of continuous data and it is stored as raster data point format.

The next data type the raster data type is GeoTIFF. So, this is basically a tagged image file format in which it is geographical geographically referenced. So, the image in its header information would have the geographical extents as the part of the file.

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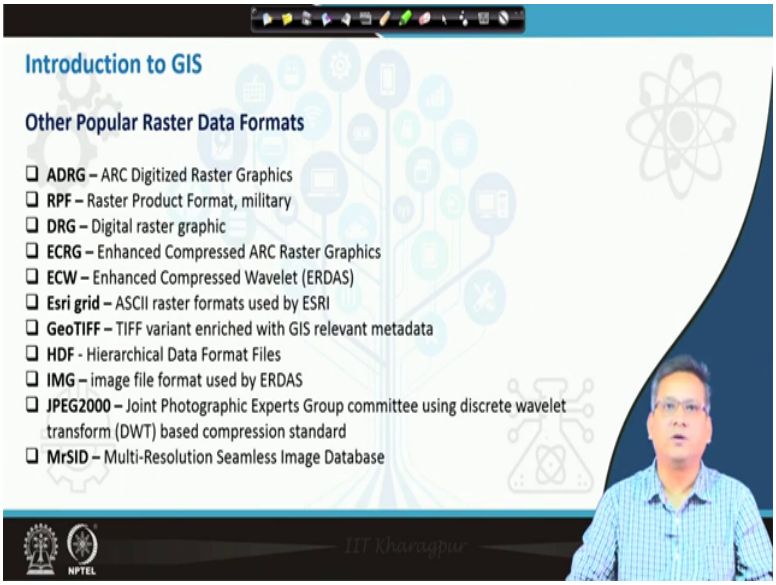

Now, we would have other popular raster data formats while we are dealing with GIS. Some of these formats are ADRG format, it is Arc Digitized Raster Graphics. RPF format that is Raster Product Format, it is I mean in the military domain, this is often used. We have the DRG format, which is the digital raster graphic. ECRG format which is the acronym for Enhanced Compressed ARC Raster Graphics.

ECW format which is enhanced compressed Wavelet format which is a ERDAS format. Esri grid format, which is ASCII raster format used by ESRI, we have already talked about it. We have already talked about the GeoTIFF format which is enriched with TIFF file enriched with GIS coordinates. HDF format which is the hierarchical data format files.

IMG format which is the image file format used by ERDAS. We have the Joint Photographic Experts Group committee the JPEG format and it is popularly known as the JPEG2000 format which uses the discrete wavelength transformation for compression. And then we have the MrSID which is the multi resolution seamless image database.

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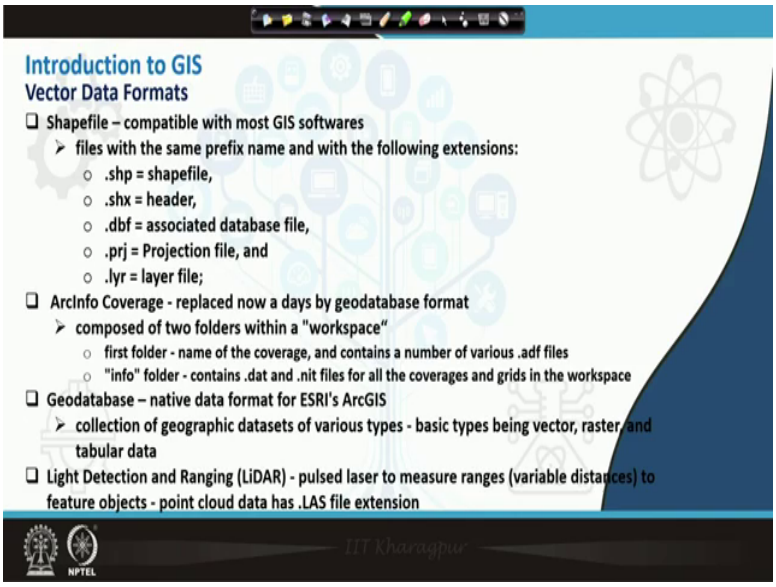

The next data format is the vector data that we extensively use in GIS to record basically discrete data points. So, the most commonly used file format is the shape files and this file format is mostly compatible with most of the GIS softwares either proprietary or open source softwares that you would come across.

So, this particular file format has a group of files associated with it and the file name would have different types of prefixes such as dot shp which is the shapefile wherein the data content is there, shx which deals with the header and has the meta information regarding the file. You would have the associated database information in the dot dbf format. The projection file which records the geographical projection of the database which is recorded in a dot prj format and then we would have dot lyr files which are basically layer files.

The next vector data type is the Arcinfo coverage which is nowadays which has been replaced by geodatabase format and it is comprised of two folders within a workspace. The first folder has the name of the coverage and contains a number of adf files and the second folder is the info folder which contains dot dat file and dot nit files which basically contain the data base information regarding the vector entities.

The next type of vector data format is the geodatabase information and it is the native data format for ESRIs, ArcGIS software. So, basically it is a collection of GIS data sets of various types, I mean it could be vector, raster or tabular data and this is aggregated as geodatabase.

We also have I mean data from LiDAR sensors, that is Light Detection and Ranging sensors which are basically pulsed laser to measure the range values that is the distance values and which would give you the variable distances to feature objects and this information is stored as point cloud information and this file generally is has a extension of dot LAS, LAS.

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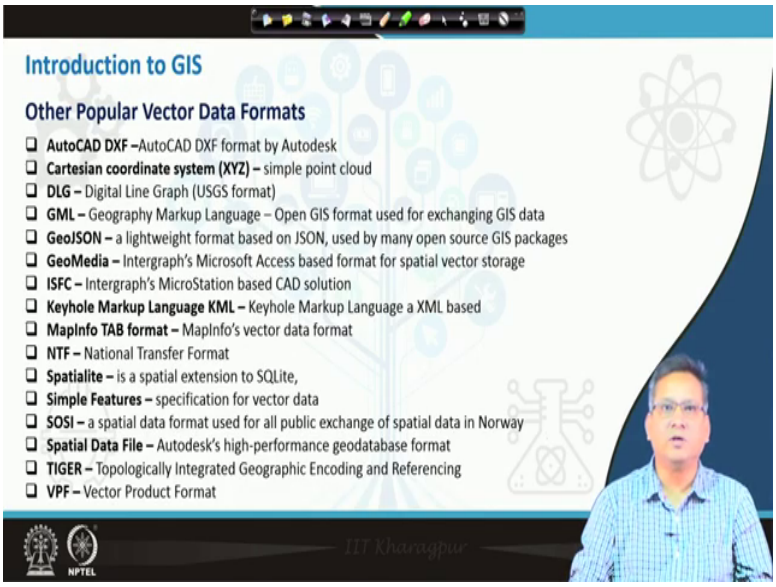

Now, other popular vector data formats are AutoCAD DXF. So, this is the format by autodesk and this is either in a binary format or it is in a ASCII format. So, if you have a DXF ASCII format you can very well open it in a notepad or a WordPad and see the contents of that file how the data values are stored for point entities, for line entities or polygon entities.

Next we have the Cartesian coordinate system which is simple point cloud. The DLG that is the Digital Line Graph which is basically a USGS format, it is extensively used by USGS. GML format which is the Geography Markup Language, it is a open GIS format used for exchanging GIS data. Also we have GeoJSON format which is the light weight format based on JSON which is used in many open source GIS packages. So, this two formats are very useful for us this GML and GeoJSON formats.

The next one is the proprietary format which is GeoMedia, it is Intergraph's Microsoft access based format, for I mean specifically the vector storage, data which are of vector types. We have the ISFC format which is Intergraph's MicroStation based CAD solution. We have the KML format which is I mean extensively used by Google. It is known as the Keyhole Markup Language which is the XML based language for storing vector information.

We have MapInfo TAB format, again this is proprietary format. This is the MapInfo softwares vector data format. We have the National Transfer Format NTF. We have Spatialite it is a spatial extension to the SQLite, it is again a open source format. We have simple features which is specification for vector data. SOSI format which is spatial data format used for most of the public exchanges and this is used in Norway.

We have the spatial data file which is the autodesk's high-performance geodatabase format. We have TIGER format, which is Topologically Integrated a Geographic Encoding and Referencing. And we have the VPF format which is Vector Product Format. These are some of the I mean proprietary and open source format which are extensively used while collating or handling vector data information.

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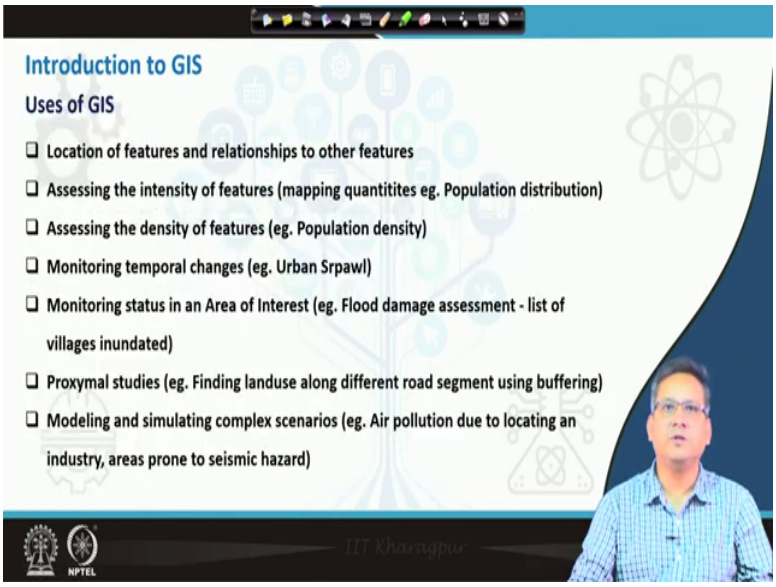

So, now let us see what could be the uses or applicability of geographical information system and it could be in various context. But we will focus more on the urban applicability of GIS specifically for issues related to urban planning. First is to basically create the data base to have an inventory of the data, which would be basically point specific, location specific and we would also be able to code the relationships between the feature data. So, we would be able to determine the casualty of an event in a urban area.

Second, would be to assess the intensity of the features. Now, say suppose let us take an example of an urban area say suppose we have a urban area, wherein we are talking about different wards, it may have different I mean types of, I mean the number of population, it would have different attributes related to say economy or say educational attainment or the ratio of male to female, the amount of working population. So, these attributes can be added

to or tat with the vector data types and could be stored. So, it could be used to assess the intensity of different features in a given area.

Next is to assess the density of the features. So, we can gauge the intensity of these features per unit area. Say for example, we can calculate the population density in different wards and find out what is intensity of development in different areas. So, similarly I mean in a given urban area we could see that some of the wards are would have high raised buildings, some of them would have slums, some of them would have low raised structures, so we could we can identify the intensity of development or the development density using GIS platform. We can also monitor the changes that would happen over time and monitor the growth of a given city in a temporal frame work.

So, in this context the remote sensing images, I mean this images are generally stored as raster data format, so they provide us with valuable resource when we want to monitor the temporal changes that happen in the urban context. So, we could work on urban sprawl based applications to see the zones where the urban growth is fast and take necessary measures for providing infrastructure and services in these areas, the temporal modeling or temporal changes and we can also preclude growth; I mean we can do I mean simulation based on the historical growth transacts and we can also portray how the city might be growing in future.

So, we can also do a kind of a projection. So, we can monitor the temporal changes and we can also predict temporal changes using different modeling approaches. Then we can monitor the status of in an area of interest. If we have flood in a given area we can identify the areas where flooding has happened and we can enlist the number of villages or the wards or the total population that is affected by this flood event. So, we can monitor the status in an area of interest.

We can create a area of interest which is generally referred to as AOI in common parlance of GIS and we can find out what is the status or monitor the I mean how things exist, what is the I mean condition of the people, what are the condition of the infrastructure and I mean

different aspects of urban services. So, this monitoring can be done in a area of interest based studies.

We can also do proximal studies finding your say land used along different road segments using buffering. So, I mean what lies in proximity to say given features can be studied using GIS, specifically in the context of urban planning.

We can also model complex scenarios and simulate complex scenarios, I mean I was just talking to you regarding modeling urban sprawl, we can also model complex scenario such as air pollution. And we can use physical models like Gaussian plume model or say I mean line source pollution models or area source pollution model or point source pollution models in simulating these kind of deposition the air pollution deposition, and I mean identifying the areas which are prone to such kind of pollution.

Another example that comes to my mind is areas prone to seismic hazard. So, from I mean our understanding of the parameters which affect seismic events, we can find out the factors which contribute to the seismic hazard in given areas and we can study areas and we can isolate and identify areas which are prone to seismic hazards. So, these are some of the examples and uses of GIS.

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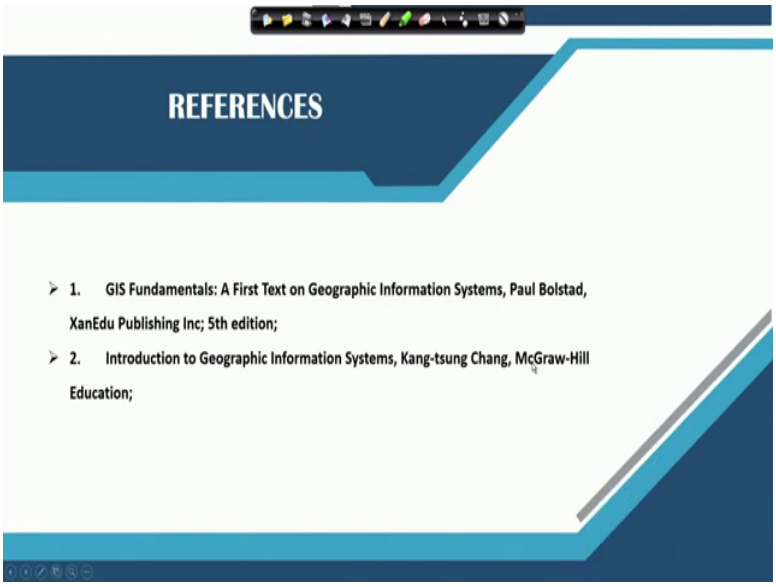

So, this comes, I mean with this we would conclude this particular first lecture of this series. For your reference you can go through these two books which are enlisted here by Paul Bolstad and by Kang-tsung. And the second book is very fundamental book and it would, I mean help you getting through the ropes of learning GIS.

Thanks, for this I mean for the your patient hearing.