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| Slide 1 |  | This refresher course guides a student through some of the fundamentals of viewing the physical environment that we live in. Converting the topographic features into a computer compatible spatial database model allows these features to be represented as spatial elements. These elements represent the basic geometry of features. For example, a section of road may be stored in the database as two coordinates marking the beginning and end of a section of road. This approach allows digital analysis to be undertaken on the elements. Through manipulation of the database, features can be viewed individually or collectively, in the form of a cartographic product, the map. |
| Slide 2 |  | The way a person views the world will depend on many factors such as their ethnicity, level of education, learning environment, intelligence, biases, constellation of beliefs and their knowledge levels. An engineer may focus on the structures on the earths surface, an environmentalist the conservation of the earth, a botanists the vegetation and an economist the financial health of the world. |
| Slide 3 |  | A map is a symbolic representation of the features on the surface of the Earth. Point, line and polygons are used to represent features such as bores, roads and forests. Spatial data is converted into spatial information through the use of cartographic design. Without cartographic design the database cannot be successfully represented as a visual model of the features.  The storage of features in a spatial database allows a map reader to make decisions based on viewing a model of part of the physical world. Information gained through the visual analysis of a map is greatly enhanced when digital analysis is also undertaken. For example, a map reader may wish to determine if there is a clear line of sight from one hilltop to another. Using the elevation values stored in the spatial database, digital analysis can be used to provide the answer based on the data model. |
| Slide 4 |  | The natural world can be stored in a computer compatible form by converting it into a spatial model. The geometry of selected features on the surface of the earth can be converted into coordinates representing nodes (points) and arcs (line segments).  Non-spatial attributes, such as the species of a tree, can be tagged to a coordinate. This spatial model then becomes a very powerful tool for the digital analysis of the environment. It must be remembered though, that such a model is a simplified representation of the features.  Using a spatial model the user can interrogate the database to answer questions such as “What area of land will be inundated if a dam, of a declared height, is built at a specific location on a river?”  A cartographic model, which represents all features as either points, lines or areas, can be used to visualise the outcome from the digital spatial analysis. Using the example of the dam, a map could be produced which showed the area inundated as a blue polygon bounded by the contour line which joined to the top of the dam. |
| Slide 5 |  | You wouldn’t measure the relative height of people if they were standing at different levels. Similarly elevation of the land (z) needs to be measured relative to one level. This level may be the mean high tide level. This then becomes the zero height datum from which all other heights are referenced.  Plane coordinates (x,y) also need to be measured in reference to one datum point on the plane.  To change the scale of the model of an area of land two reference points are needed. If you include the elevation then a minimum of three height points are needed to reference a surface.  The Earth has a reference grid, consisting of longitude lines, running north-south, and latitude lines, running east-west. The reference coordinate (0,0) is where the equator intersects the longitude line that runs through Greenwich, England. The world has adopted this as the reference framework for the earth. |
| Slide 6 |  | A cartographic database is used to produce a variety of maps very quickly using the one data source. All features are stored as x,y coordinates and the height (z) can also be stored. The maps produced from the database provide a visual representation of an area of land. A specific map scale may be used, for example 1mm on the map may represent 25,000mm (or 25 metres) on the ground. A specific map theme, for example vegetation, may also be selected as the focus. Using visual interpretation of the map a user can understand some of the relationships between features represented on the map.  A digital spatial database, on the other hand, is designed primarily to allow spatial analysis to be undertaken on digital data representing features on the surface of the earth. Every feature is represented by one or more x,y coordinate and height (z). Digital analysis of the database elements allows more complex interpretation to be undertaken. For example areas of land with a particular soil type, a particular land use and within 1 kilometre of a main highway can be determined quickly, using the power of computer processing. |
| Slide 7 |  | Output (primarily maps and plans) produced from a digital spatial database needs to be controlled by standards and specifications. Cartographic design rules also need to be adhered to, so that the information portrayed on a map is a reasonable representation of what is at that location on the ground.  A map produced from a poor data source will be a poor source of information and may lead to poor decisions being made.  A map produced from an excellent data source but with poor cartographic design will also be a poor source of information and may lead to poor decisions being made.  A map produced from an excellent data source and designed with due consideration to standards, specifications and design rules, will most likely be an excellent information source, from which informed decisions can be made. |
| Slide 8 |  | A **spatial entity** is a term used to refer to any feature on the surface of the earth, such as a windmill, road or lake. Entities are what we see when we view the physical world.  To be represented in a computer database each entity needs to be stored as an **object**. An object consists of the most basic geometry of an entity stored in x,y coordinates.  A single x,y coordinate, called a node, can be used to represent point features, such as the windmill.  A coordinate pair will define the ends of an arc. The arc is used to represent one segment of a linear feature, such as a road.  A set of coordinates, which begin and end at the same point, may define a polygon, which is used to represent an area feature, such as a lake.  **Graphic elements** (points, lines and area symbols) are needed to visually represent entities on a map. To be effective, such graphic elements need to closely resemble the entity, at least in the mind of the map reader. |
| Slide 9 |  | Spatial data is stored in a computer as layers in a spatial database. Each layer will represent a particular data theme, such as hydrology, vegetation, soil, land tenure, roads.  Specific layers can be selected from the database and overlaid on other layers. This not only provides for a visualisation of selected entities but it also allows digital spatial analysis to be undertaken on the selected layers.  Digital spatial analysis can be undertaken on one layer. For example, the area of old growth forest may be determined from the vegetation layer.  Digital spatial analysis may also be undertaken on a number of layers at the same time. For example, the area of old growth forest existing on private land, on a specific soil type and within 100 metres of a river could be determined by overlaying the vegetation, land tenure, soils and hydrology layers.  Overlaying and analysing data layers can provide decision makers with accurate analytical, and visual output, from which informed decisions can be made. |
| Slide 10 |  | Functions and their purpose:  **Overlay** – Allows the overlap area between polygons to be determined. For example the area which has a specific soil type and also a specific vegetation cover.  **Buffer** – places a boundary a designated distance out from an object. For example, a boundary enclosing land within 50 metres of a river.  **Proximity** – identifies an object, or objects, which fall within a specified distance from another object. For example, households with primary age children within 1 kilometre of a primary school.  **Network Connectivity** – determines the number of arcs connecting to nodes. The more arcs the stronger the connectivity.  **Boolean Logic**  A and B – Identifies all objects that have characteristic A and characteristic B.  A not B – Identifies objects that have characteristic A but not characteristic B.  A or B – Identifies all objects that have characteristic A, characteristic B and also objects with both A and B.  A or B but not both – Includes objects with characteristic A, or characteristic B, but not objects where there is overlap between A and B. |
| Slide 11 |  | A spatial database can be interrogated by undertaking spatial analysis on the data. The data can be analysed in many different ways depending on the purpose of the investigation.  For example, if a user wishes to locate all sites suitable as a campground then they must first determine the characteristics which would make an area of land suitable for this purpose.  They may decide that the area needs to be flat, within one kilometre of a road, close to potable water, with views of a nearby scenic feature and north facing.  Once the characteristics have been decided upon they can be input to the system as rules which must be satisfied. Analysis may require that the original data layers are manipulated to produce derived layers, for example when slopes are derived from the elevation layer. After each derived layer is created, spatial analysis functions, such as those outlined in the previous slide, can be used to analyse the content of the derived data layers to determine the most suitable sites. |
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| Slide 14 |  |  |