Lesson 1: What is ArcView Spatial Analyst?

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Goals

In this lesson, you will learn:

- ArcView Spatial Analyst functionality
- what spatial analysis is
- what a grid theme is
- about the raster and vector data models
- how surfaces are represented within ArcView Spatial Analyst

What can ArcView Spatial Analyst do?

ArcView Spatial Analyst enables you to create, query, and analyze cell-based raster maps; derive new information from existing data; query information across multiple data layers; and fully integrate cell-based raster data with traditional vector data sources. The grid theme is the primary data source used by ArcView Spatial Analyst.

Grids are especially suited to representing traditional geographic phenomena that vary continuously over space, such as elevation, slope, and precipitation; they can also be used to represent non-geographic phenomena, such as population density, consumer behavior, and other demographic characteristics.

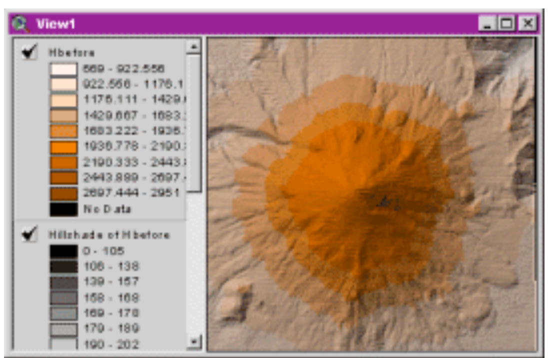
Grids work well for spatial modeling and for the analysis of change over time--whether measuring flows over continuous surfaces, as is done in hydrologic modeling, or the dynamics of population change

Concept

ArcView Spatial Analyst capabilities

ArcView Spatial Analyst represents geographic phenomena with cell-based grid themes. Instead of using points, lines, and polygons to model geographic features, grid themes use cells.

The software provides several tools to perform spatial queries, overlay analysis, and surface analysis calculations such as distance, proximity, density, slope, aspect, hillshade, viewshed, and contours. The graphic below shows a hillshade grid theme of Mt. St. Helens before its eruption in 1981.



Mt. St. Helens grid theme. This is a grid theme of elevation with a hillshade theme applied as a brightness theme. [Click to enlarge]

Grids used in ArcView Spatial Analyst can be derived from many sources, including digital elevation models (DEMs), ASCII files, feature-based themes, and several image formats

Concept

Spatial analysis

If you want to resolve issues such as finding the best location for a new store or identifying corridors for a new freeway, you can use a process known as spatial analysis.

Spatial analysis helps answer complex geographic questions. Uses for spatial analysis include:

- evaluating suitability and capability
- estimating and predicting
- interpreting and understanding

Spatial analysis involves modeling and the examination and interpretation of the model results. There are four traditional categories of spatial analysis: surface analysis, linear analysis, raster analysis, and topological overlay and contiguity analysis.

It is important to note that spatial analysis does not always lead to one definitive answer; instead, you may wind up with several alternative solutions

Concept

Spatial modeling

Spatial modeling uses analytical procedures to abstract and simplify complex geographic systems. Spatial modeling uses geographic data to describe, simulate, or predict a real-world problem or system. For example, a model could simulate the movement of wildfire under a given set of conditions, predict its course, and suggest firefighting tactics and strategies.

There are three categories of spatial modeling functions that can be applied to geographic features within a GIS:

- geometric models, which calculate the Euclidean distance between features and which can then be used to generate buffers, calculate areas and perimeters, and other tasks
- coincidence models, such as topological overlay
- adjacency models (pathfinding, redistricting, and allocation)

All three models support operations on spatial data, including points, lines, polygons, TINs, and grids. Functions are organized in a sequence of steps to derive the desired information for analysis.

The following books are excellent introductions to modeling in GIS:

- Goodchild, Parks, and Stegaert. *Environmental Modeling with GIS*. Oxford University Press, 1993.
- Tomlin, Dana C. *Geographic Information Systems and Cartograhic Modeling*.

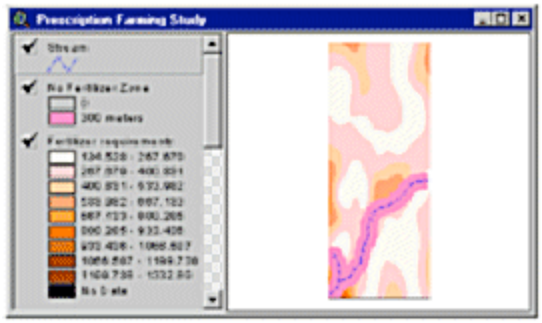
Example

Overview of ArcView Spatial Analyst applications

ArcView Spatial Analyst is useful in a wide variety of application areas. Land use planning, market research, agricultural planning, and site analysis are just a sampling of possible application areas. Following are some brief examples to help you learn what ArcView Spatial Analyst can do.

Creating a surface grid from sample points

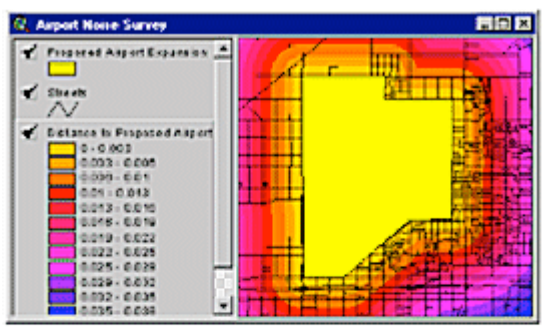
Chris is a farmer who wants to reduce the cost of fertilizing his fields. First, he measures soil nutrients at a number of sample points. From this point theme of sample data, Spatial Analyst then generates a surface map of estimated nutrient levels across the entire farm. Because Chris knows the optimum level, he can create a grid of fertilizer requirements by subtracting actual from ideal values. While he's at it, he draws a 300-meter buffer zone around a stream to help him avoid polluting the water. Chris saves money and gets a more consistent crop yield by applying fertilizer intelligently.



From a point theme of soil samples (not shown), Spatial Analyst creates a continuous surface grid. Chris uses this grid to make a map of fertilizer requirements. He adds another grid theme that shows a 300-meter buffer around the stream. [Click to enlarge]

Creating a distance grid from polygons

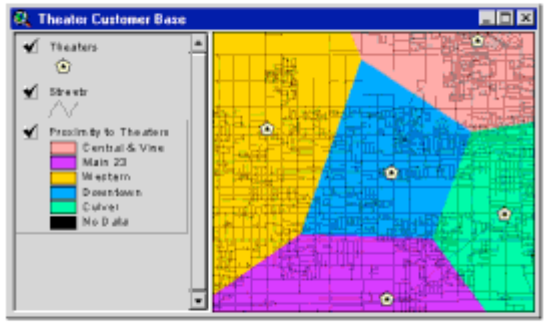
Michelle is on a committee studying the possible increase in noise levels associated with an airport expansion. She uses Spatial Analyst to create a grid theme that measures the distance from nearby homes to the expansion zone. (Each grid cell's value is its distance from the nearest edge of the polygon.) She can then overlay this distance grid with a noise-decay grid to show which city residents will be most affected.



Michelle uses a polygon theme (Airport Expansion) to create a grid theme of distance. In the grid theme, the area around the airport is divided into cells. Each cell's value is its distance from the airport. The cells grade from orange to violet as distance from the airport increases. [Click to enlarge]

Defining areas nearest to points

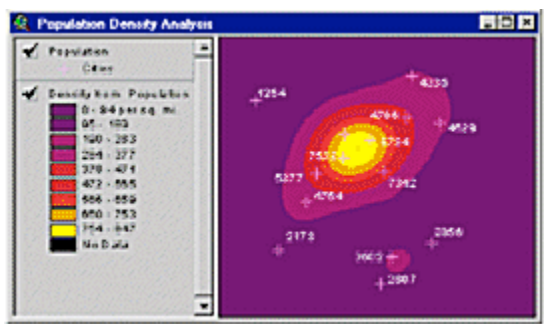
Rob owns a movie theater chain. Each theater manager is responsible for distributing fliers and coupons to the neighborhoods within the theater's customer territory. To determine each territory, Rob creates a proximity grid theme. Spatial Analyst measures each grid cell's distance to each theater, then assigns each theater to the nearest territory.



Rob uses a point theme (Theaters) to create a proximity grid theme showing the area served by each theater. Each cell in the proximity grid theme receives a value according to which theater is nearest to it. Cells with the same value (and color) are nearest the same theater. [Click to enlarge]

Distributing values around points

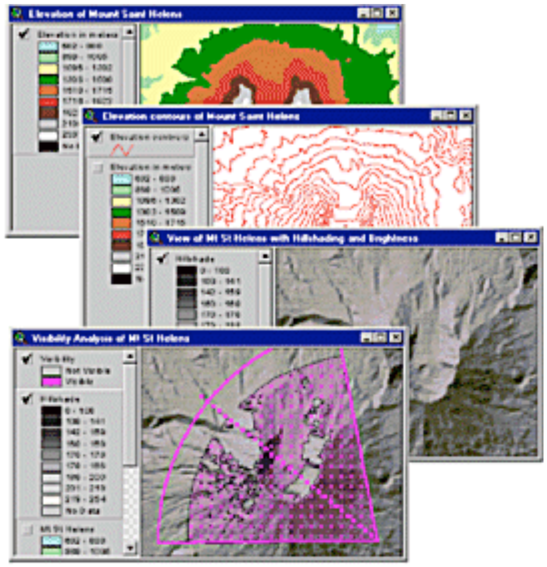
Regina is a planner for a health care provider. She's researching locations for a new urgent care clinic. She uses a point theme of cities (with a population attribute) to create a population density map for the entire area. Regina can see where the population density is greatest and use that as a factor in her evaluation.



From a point theme of cities, Regina distributes population values according to a formula that takes into account the locations of nearby points. The result is a grid theme of population density. [Click to enlarge]

Creating contour, hillshade, and visibility maps

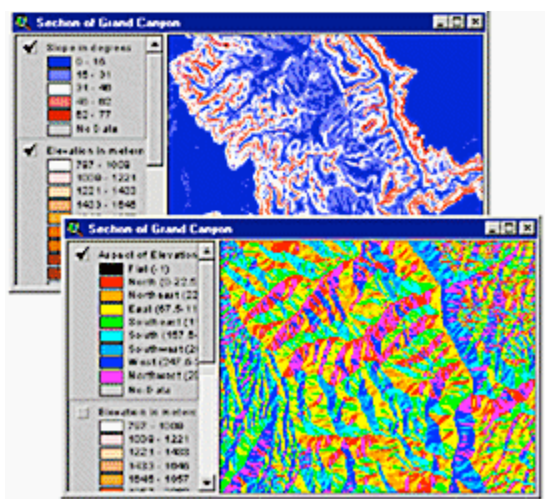
Gary, a geologist, wants to create maps of Mt. St. Helens to show how rock was redistributed by the eruption. From a Mt. St. Helens digital elevation model (DEM), he uses Spatial Analyst to generate elevation, contour, and hillshade maps. The hillshade map simulates a three-dimensional image. Gary wants to take aerial photographs, so he draws a proposed flight path over the mountain. Spatial Analyst creates a visibility map that shows the areas that can be seen from a given point by a plane flying at 3,500 feet.



From top: Gary first creates an elevation grid of Mt. St. Helens from an imported elevation file. He uses the elevation grid to generate a contour map. The elevation grid is also used to make a hillshade grid. Finally, he creates a visibility map based on the height of the plane and the camera's view angle. [Click to enlarge]

Creating slope and aspect maps

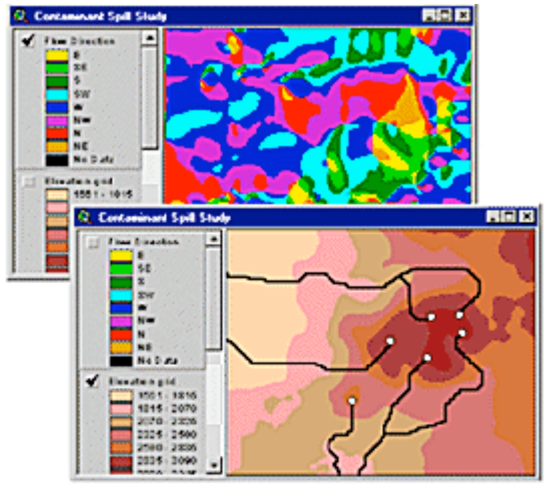
Lisa is a botanist studying plant species in the Grand Canyon. The native vegetation types have specific slope and sun requirements. From elevation data, Spatial Analyst can create slope and aspect maps. Slope measures the steepness of terrain; aspect shows the compass orientation (north, south, and so on) of the slope. Lisa can predict where certain plant species will be found by looking at these maps.



Top: Lisa creates a slope grid from an elevation model of the Grand Canyon. Bottom: From the slope grid, she derives an aspect grid, showing the direction of slope. [Click to enlarge]

Creating hydrology maps

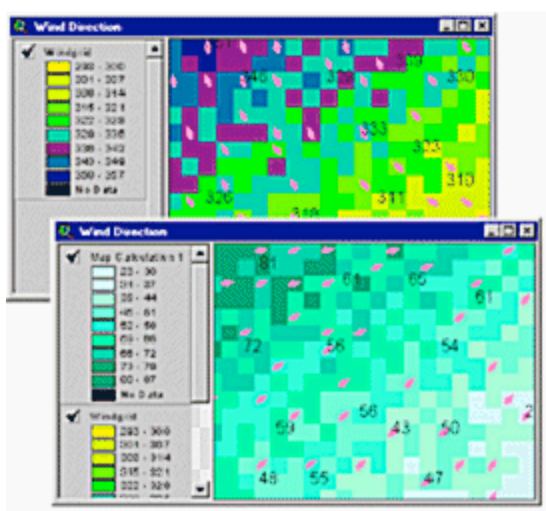
Randy is a hydrologist who wants to study a potential effects of a pollution spill. He uses an elevation grid to create a map of flow direction, which measures the direction of downhill slope. He then chooses points on the elevation grid that represent hypothetical spill sources. Spatial Analyst traces the probable path the pollutant would follow downhill.



Top: Randy derives a flow direction grid from an elevation grid. Bottom: He then marks hypothetical spill points, shown by white dots, on the elevation grid. Spatial Analyst uses the flow direction and elevation values to compute the contaminant's probable downhill path. [Click to enlarge]

Changing values in grid cells

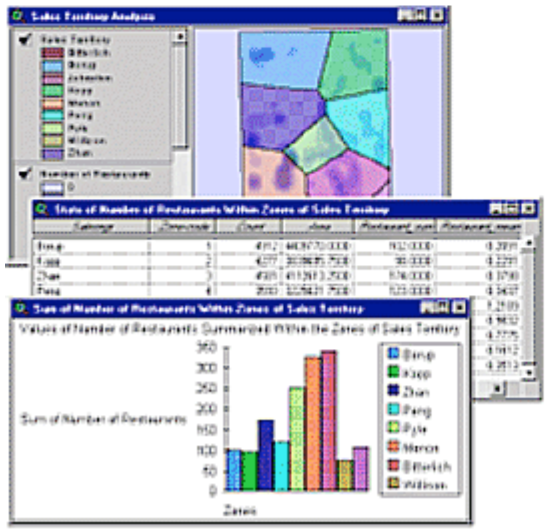
Melinda, a meteorologist, is modeling the behavior of a tropical storm over the ocean. One component in her model is a grid showing wind directions within the storm. Each cell in the wind direction grid has a numeric value from 0 to 360 degrees. By adding a constant value to each cell, Melinda can simulate a shift in the storm's direction. She uses the wind direction grids with other grids to make assumptions about where and when the storm might reach land.



Top: Original wind direction grid. Bottom: Using Spatial Analyst, Melinda adds 90 degrees to each cell value in the first grid to generate a second wind direction grid. [Click to enlarge]

Creating statistical tables and charts from a grid

Paul is a sales manager for a restaurant-supply company. He's decided to review his salespeople's territories to make sure their workloads are equal. In one grid theme, called Number of Restaurants, each cell's value is the number of restaurants it contains. Paul overlays a polygon theme of sales territories. Spatial Analyst uses each polygon to divide the grid theme into zones, then counts the number of restaurants in each zone. The results are stored in a table and charted, so Paul can see how many restaurants lie in each salesperson's territory. Several other statistics, such as minimum, maximum, and mean values, are also stored in the table.



Paul uses polygons from the Sales Territory theme to count the number of restaurants within each territory. The numbers are stored in a table and charted. [Click to enlarge]

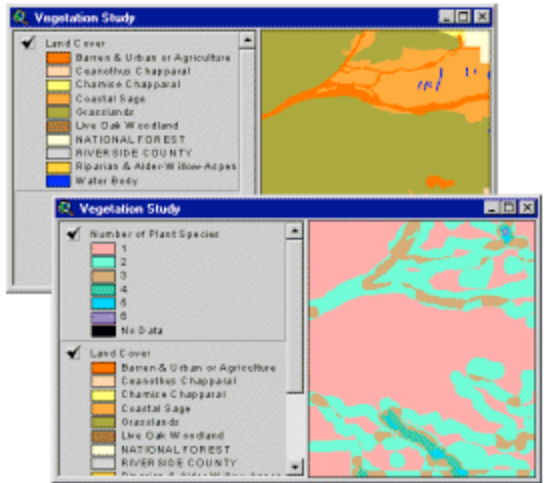
Using a graphic to get grid statistics

Tina, a financial analyst for the Water Department, is studying the revenue impact of a proposed water tower. Using Spatial Analyst, she draws a circle around the area that will draw water from the tower. Because different rates are charged to agricultural, industrial, and residential customers, Tina needs a breakdown of land use by area within the circle.

Tina uses Spatial Analyst to calculate the area of land use types that fall within a circle drawn on a land use grid. [Click to enlarge]

Measuring variety

Jorge, a biologist, wants to measure the diversity of plant life in a region. He has a grid showing the types of vegetation found in his study area. Using Spatial Analyst, he counts the number of different kinds of vegetation surrounding each cell. Cells whose neighbor cells have many different values are part of a more biologically diverse area.

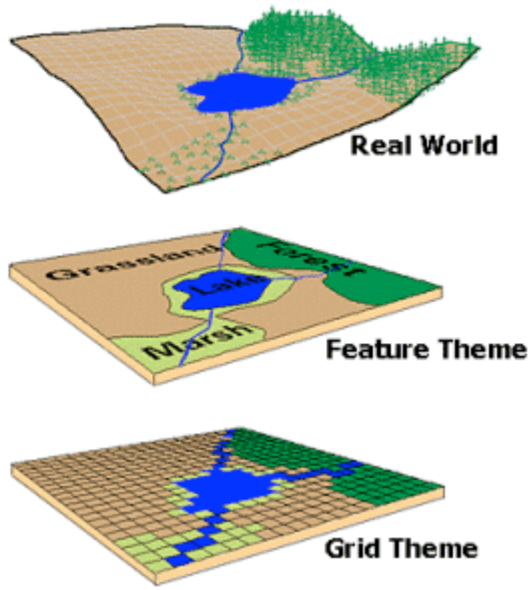


Spatial Analyst looks at the cells surrounding each cell in the Land Cover grid and counts the number of different values. Jorge creates a new grid in which each cell's value is the number of different neighboring land cover types

TOPIC2: Introduction to grid themes

How do you store spatial information, such as wells, rivers, and land parcels, in a format a computer can understand? Two spatial models for storing geographic data are the vector data model and the raster data model. (A third, the TIN data model, is outside the scope of this course.)

The vector and raster data models have similarities and differences. They are similar in that they represent a layer or set of geographic features. They are different in the way they model or represent spatial data. In the raster data model, a matrix of square cells represents geographic information. In the vector data model, geographic data is stored as coordinates.



Geographic features in the real world can be represented as vector or raster themes. Before adding any information to your database, you must choose the most appropriate spatial data model. ArcView Spatial Analyst supports both vector and raster themes and can integrate one with the other.

The main component of the ArcView Spatial Analyst is the grid theme, which is a raster data model.

Concept

Vector data model

In a vector data model, you can represent point, line, and polygon objects on a map as a collection of x and y coordinate pairs stored in a table. The x and y coordinates represent the point's distance from an origin point.

You store a point object on a map, such as a city or a building, as a single pair of x and y coordinates in a vector theme.

To represent lines, you store the x and y coordinates of the beginning point (the from node) of the line and the end point (the to node) of the line. If the line is not perfectly straight, you can represent curves or changes in direction as a series of x,y coordinate pairs, known as vertices, at each direction change between the beginning point and end point of the line. Lines have a length.

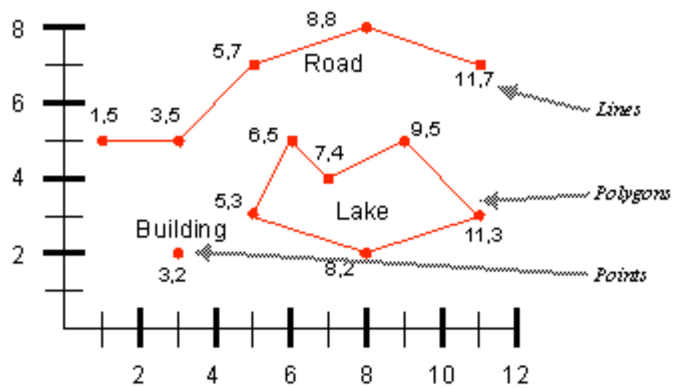
To represent an area (polygon), you enclose it with a perimeter line, making the beginning and ending points of the line the same. Polygons which share a boundary are called adjacent.

Two important topological concepts related to the vector data model are:

- Connectivity: The topological identification of connected arcs by recording the from and to node for each arc. Arcs that share a common node are connected. Connectivity allows you to identify a route to the airport or connect streams to rivers.

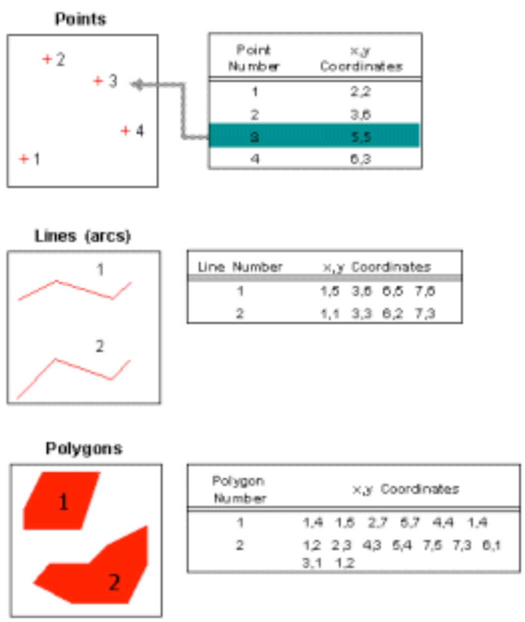
- Contiguity: The topological identification of adjacent polygons by recording the left and right polygons of each arc.

The diagram below shows how real-world objects can be represented on your computer monitor by x,y coordinates. For example, the coordinate pairs 1,5 3,5 5,7 8,8 and 11,7 present a line (road); and the coordinate pairs 6,5 7,4 9,5 11,3 8,2 5,3 and 6,5 represent a polygon (lake). The first and last coordinates of the polygon are the same; a polygon always closes.



Representation using a vector data structure.

To keep track of many features, each is assigned a unique identification number, or tag. Then, the list of coordinates for each feature is associated with the feature's tag. The diagrams below show how the objects you see in a vector theme are actually saved in the theme table.



Top: Each point is given a unique identifier. The x,y coordinate for each point is associated with its tag. Middle: Each line is given a unique identifier and is composed of an ordered series of points with a beginning and end point. The x,y coordinates for each line are associated with its tag. Bottom: Each polygon is given a unique identifier and is composed of a series of ordered x,y coordinates defining line segments that enclose an area. The x,y coordinates for each polygon are associated with its tag. [Click to enlarge]

Vector themes can be represented in ArcView as either a shapefile or a coverage.

A shapefile is ArcView's own format for storing features and attributes. You create shapefiles by converting other spatial data sources (such as ArcInfo coverages), by drawing shapes in themes you create, or by using tabular data containing location information. There are a couple of advantages to using shapefiles: they display more rapidly in a view than other spatial data formats, and you can edit a theme that's based on a shapefile.

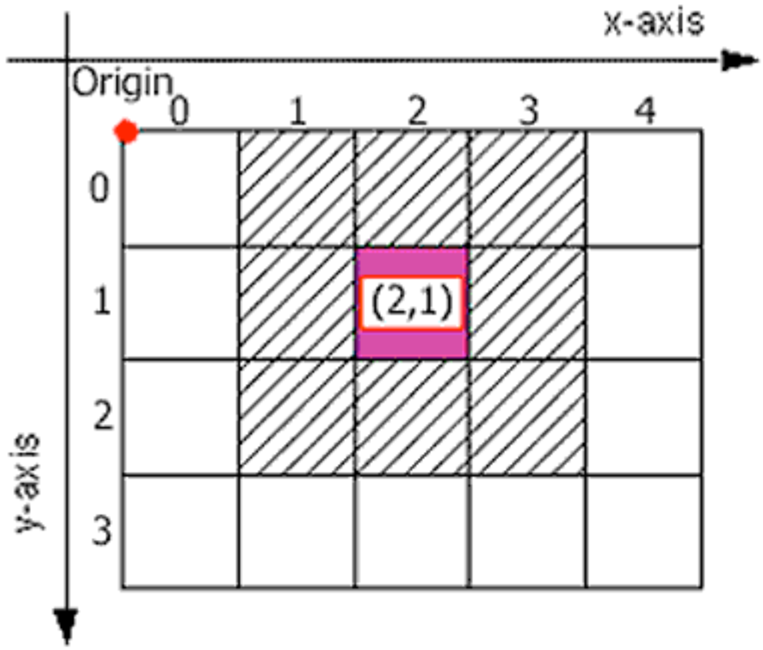
A coverage is ArcInfo's format for storing sets of features and their attributes. A coverage can be represented as a theme in ArcView. Some ArcInfo coverages contain more than one type of feature; ArcView requires a separate theme for each type

Concept

Raster data model

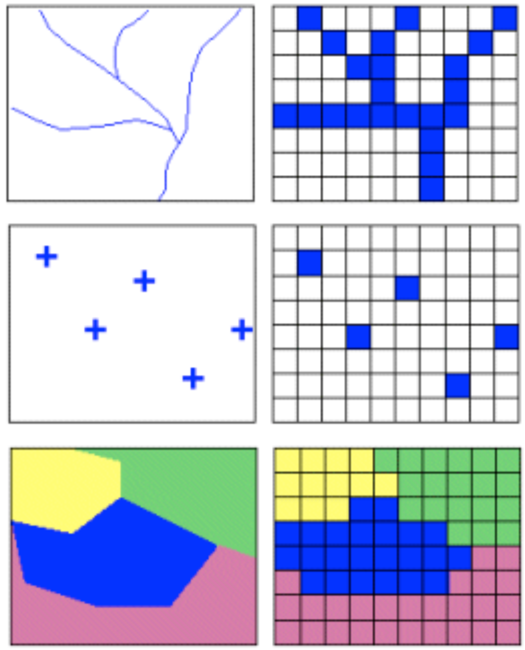
In the raster data model, the Earth is treated as one continuous surface, and each location is represented as a cell. Cells can be organized into a matrix of rows and columns called a grid. Each grid contains cells with numeric values attached, and these represent some kind of geographic phenomenon. The cells' numeric values can represent any kind of information about the geography--an elevation measurement in meters, for example, or a code number that specifies a type of vegetation.

Cells are identified by their position in the grid. Notice that in a grid, a cell has eight neighbors (except those on the outside edges): four at its corners and four on its sides.



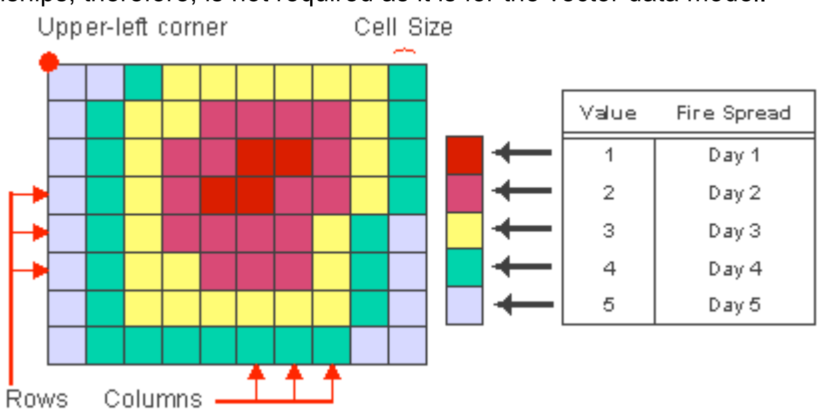
In this diagram, you see a representation of a raster grid. Each cell has eight neighbors, except those along the outside edges.

Like the vector data model, the raster data model can represent discrete point, line, and area features. A point feature is represented as a single cell, a linear feature as a series of connected cells, and an area feature as a group of connected cells.



How point (top), line (middle), and polygon (bottom)
features are represented in a grid.

Because the raster data model is a regular grid, spatial relationships are implicit. Explicitly storing spatial relationships, therefore, is not required as it is for the vector data model.



Continuous features represented in a grid.

Raster themes in ArcView can be represented by either image or grid themes.

Image data is a form of raster data where each grid cell, or pixel, has a certain value. Common examples of image data include information from satellites, scanned data, and aerial photographs. Images can be analyzed in ArcView using the Image Analysis extension.

ArcView GIS Spatial Analyst stores raster themes as directories in the ARC GRID format. This format is the cell-based equivalent of an ArcInfo coverage

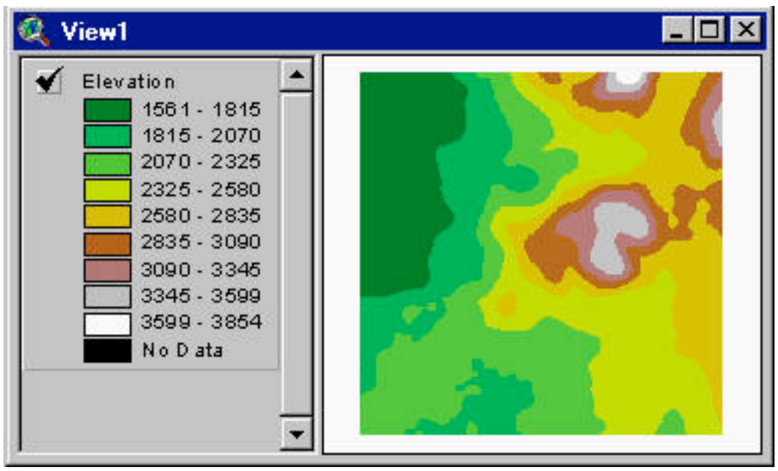
Concept

What is a grid theme?

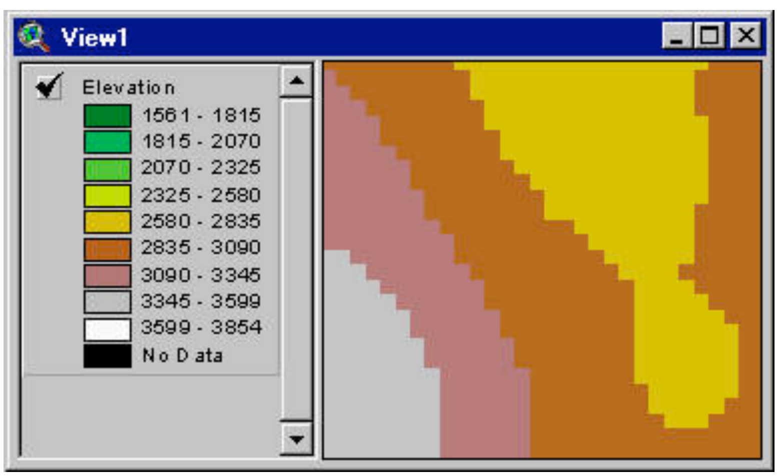
A grid divides geographic space into uniform blocks called cells. Every cell represents a certain specified portion of the Earth, such as a square kilometer, hectare, or square meter. Each cell is given a value that describes its location, such as the elevation at that spot or the kind of soil that exists there.

Grid themes often represent these kinds of continuous phenomena, which change only gradually across a wide surface area. Grid themes can also represent points, lines, polygons, and surfaces uniformly, treating all feature types the same way. This uniform structure is important when combining or comparing data types. Representing all data types (points, lines, polygons, and surfaces) in the same format creates uniformity. When all the data types are in the same structure, they can be combined with no prior preparation.

The top graphic below shows an elevation grid. It looks smooth but as the zoomed-in graphic below it indicates, it's really composed of thousands of small cells. Each cell stores an elevation value for the space it covers (about 16,000 square feet per cell in this grid.)



An elevation grid theme in 2D perspective.



A zoomed-in view of the grid. The surface is composed of a matrix of identically-sized square cells.

There are two types of grids: integer grids and floating point grids. The only difference between them is that integer grids store cell values as integers, while floating point grids store values with decimal points. Depending on the data being represented, one or the other may be more appropriate.

Grid themes with integer values have a theme table attached to them. This is called a value attribute table (VAT), and it stores the codes and categories of the grid cells. Floating point grids have no theme attribute table.

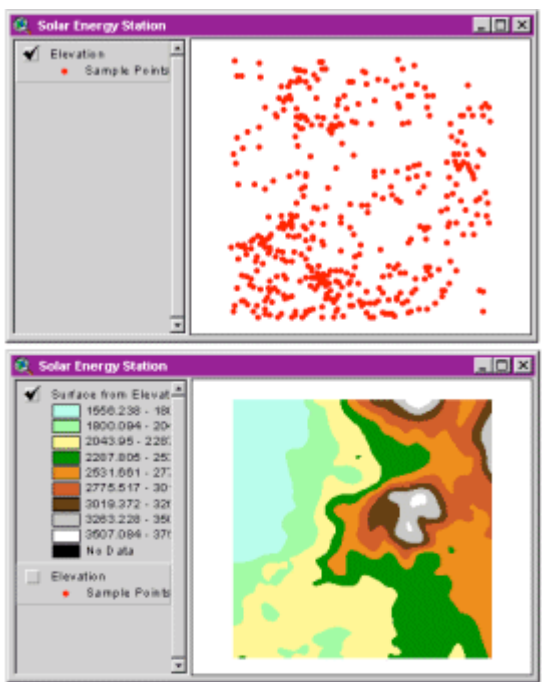
Concept

What is a surface?

A surface is a geographic phenomenon represented as a set of continuous data, such as elevation or air temperature over an area. Usually, the distribution of surface data is not characterized by a sudden change in value (breaklines), although areas of rapid change are common. Examples of sharp variation include steep slopes, the abrupt reduction in precipitation on the lee side of a mountain, or the sharp change in air temperature from the area above a cool body of water to the area above a hot land mass.

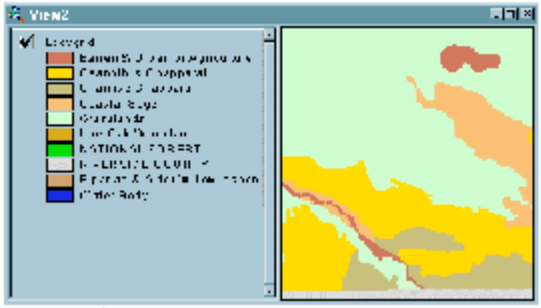
Surfaces can be represented by models built from regularly or irregularly spaced sample points on the surface. Each model contains a formalized data structure, rules, and x,y,z point measurements that can be used to represent a surface.

The top graphic below shows a set of sample elevation points that could be used to generate a surface model for the area enclosed by the box. The bottom graphic shows a spatial model actually created from the points.



Top: A set of sample elevation points. Each point has x,y values and a z value, which defines its elevation. Bottom: A surface model generated from the sample points. [Click to enlarge]

A surface model may represent either discrete features with integer values or spatially continuous data with floating point values.



Discrete grid showing land cover categories. It contains definable boundaries. [Click to enlarge]

Discrete geographic features include points, lines, and polygons. Discrete data most often represents objects. These objects usually belong to a class (e.g., parcels), a category (e.g., land use type) or a group (e.g., political party). Discrete data often have known and definable boundaries.

Spatially continuous data is different from discrete data because a different value can be assigned at each location. Each cell value on the surface is a measure of the concentration or level at that location. Continuous geographic phenomena tend not to have distinct boundaries as discrete geographic features do. Examples of continuous surfaces include elevation, aspect, slope, and noise pollution levels.

Whatever the phenomenon represented, the surface model will be a generalization of reality. It would be difficult, or nearly impossible in some cases, to visit every location in a study area to collect data such as elevation or rainfall accumulation. The alternative is to collect the data at sample locations, and then to interpolate (estimate) values for the rest of the surface.

Surface interpolation methods in ArcView Spatial Analyst include Spline, Inverse Distance Weighting, Kriging, and Trend. These methods will be discussed in greater detail in Module 5, *Introduction to Surface Analysis with ArcView Spatial Analyst*.

A surface can also be represented as a triangulated irregular network, or TIN. A TIN is a vector model that can represent continuous surfaces. It allows the generation of surface models that can analyze and display terrain and other types of surfaces.

The TIN model represents a surface as a series of linked triangles, thus the adjective triangulated. Triangles are made from three points that can occur at any location, thus the adjective irregular. Finally, the TIN model creates a network of triangles by storing the topological relationships of the triangles.

ArcView Spatial Analyst can represent surfaces three ways: with elevation points, contour lines, or surface grids. To create and represent surfaces, ArcView Spatial Analyst makes use of the grid spatial data types that aren't available in the core ArcView GIS software product. ArcView Spatial Analyst does not support TIN datasets, although ArcView 3D Analyst does.

Exercise

Examine data structures

The objective of this exercise is to compare how data is represented in vector and raster themes. You will examine vector representations of point, line, and polygon themes.

Then you will look at how attributes are stored for both vector and raster themes.

If you have not downloaded the exercise data for this module, you should download the data now.

Step 1 **Start ArcView**

Start ArcView and load the Spatial Analyst Extension.

Note: If you are running ArcView GIS 3.1, you see a Welcome to ArcView GIS dialog. Click Cancel to close this dialog.

If ArcView is already running, close any open projects.

Step 2 **Open a project**

From the File menu, choose Open Project. Navigate to your **basicssa\lesson1** folder and open the project **l1_ex01.apr**.

Note: If you are running ArcView GIS 3.1, you see an Update l1_ex01.apr message box. Click No to dismiss this box.

When the project opens, you see a view called Vector and Raster Themes. It contains feature and grid themes representing wells, streams, and soils. The three vector themes wells.shp, streams.shp, and soils.shp are turned on. The other three themes, wells, streams, and soils, are grid themes that represent the same features. They are turned off.

Step 3 **Compare feature representation at smaller scale**

Vector themes and raster themes can represent the same geographic features and make them look the same. Notice the smooth appearance of the point, line, and polygon vector features. Points, lines, and polygons are represented with coordinate locations in the vector theme.

Their location and boundaries are captured in a variety of ways, including digitizing, scanning, and coordinate geometry techniques. The accuracy of the representation depends on a number of factors, including input scale, method of capture, and extent of the theme. In general, the vector data model represents feature shapes very accurately.

Turn off the wells.shp, streams.shp, and soils.shp themes. Turn on the wells, streams, and soils themes.

These raster themes represent the same features, but in a different way. Can you see the difference?

Grid themes represent points, lines, and polygons with a matrix of square cells. The cell size and resolution determine how closely the raster representation of features compares to the vector representation. Notice how closely this raster representation resembles the previous vector theme, especially at this small scale.

Close the Vector and Raster Themes view.

Next, you will examine point, line, and polygon vector and raster themes at a larger scale.

REVIEW TOPIC

Step 4 Examine a vector point theme at a large scale

Open the Point Zoom view.

Here you see the wells.shp vector point theme and the wells grid theme zoomed in. Both themes are turned off. You will compare the two themes.

Turn on the wells.shp theme.

Notice how the well is represented by a point symbol. The point symbol represents an x,y coordinate and accurately represents the location of the well.

Next, you will examine the wells grid theme.

REVIEW CONCEPT

Step 5 Examine a raster point theme at a large scale

Turn on the wells theme.

Point features in a grid theme are represented by the smallest unit of a grid, a cell. You can see that even one cell encompasses an area, unlike a point in a vector theme. The smaller the cell size in a grid theme, the smaller its area will be and thus, the more closely it will resemble a point in a vector theme.

Close the Point Zoom View.

REVIEW CONCEPT

Step 6 Examine a vector line theme at a large scale

Open the Line Zoom view.

Here you see the streams.shp vector line theme and the streams grid theme zoomed in to a larger scale. The streams.shp theme is turned on. Compare how each is represented at this scale.

Notice how the streams are represented by relatively smooth lines. Each stream is represented as series of connected x,y coordinates. Vector themes most accurately represent linear features.

Next, you will examine the streams grid theme.

Step 7 Examine a raster line theme at a large scale

Turn on the streams grid theme.

A line is represented in a grid theme by a series of connected cells. And, as with a point, the accuracy of the representation will vary according to the scale of the data and the resolution of the grid. When both the scale and the resolution are exceedingly fine, with each cell standing for a very small area, the representation will be more accurate.

At this scale, you can see how the streams are represented by a series of cells.

Close the Line Zoom view.

Step 8 Examine a vector polygon theme at a large scale

Open the Polygon Zoom view.

This view shows the soils.shp vector polygon theme and the soils grid theme zoomed in to a larger scale. Both themes are turned off. You will examine how areas are represented in vector and raster themes.

Turn on the soils.shp theme.

Here you see polygons of soil types represented with a series of line segments, each defined by a series of x,y coordinates. Vector data accurately represents geographic features with well-defined boundaries, such as property parcels or zoning. But because soil type is a highly variable surface, these polygon boundaries imply, perhaps inaccurately, that these polygons have well-defined borders and are internally homogeneous.

Turn off the soils.shp theme.

Next, you will examine the soils grid theme.

Step 9 Examine a raster polygon theme at a large scale

Turn on the soils grid theme.

Polygonal, or area, data is represented in a grid by a series of connected cells that define its boundaries. You can see that representing the boundaries of a polygon with a series of square cells does present some problems, the most notable of which is to make a curved boundary look like the steps of a staircase. The finer the cell resolution and the greater the number of cells that represent small areas, the more accurate the representation.

Step 10 Compare vector and raster attribute storage

Make the soils.shp theme active. Click the Open Theme Table button .

Attribute tables for all vector themes contain one record for every feature in the theme. In addition, there may be many attributes associated with each feature. For example, in the attribute table for the soils.shp theme, you see Soil_code and Soil_id among the field names.

Close the table Attributes of soils.shp. Make the soils theme active and click the Open Theme Table button.

Only integer grids have a value attribute table (VAT). Attribute tables for grids contain one record for each category in the grid theme. The VAT always contains at least two items, Value and Count. Value is the value assigned to the cells in the grid. Count is the number of cells in the grid assigned that value. Any number of optional fields can be incorporated into the VAT to represent the other attributes of the categories.

Step 11 Close the project

Close the project without saving any changes.

You have completed this exercise.

Summary

In this lesson, you learned what ArcView Spatial Analyst can do and how it is used to perform spatial analysis on feature or grid themes. You also learned about spatial analysis and saw several examples of typical ArcView Spatial Analyst applications.

Geographic data may be represented either by feature themes or grid themes. Feature themes store data as coordinates. Grid themes represent surfaces as a matrix of identically-sized square cells and that their cell-based structure allows for efficient modeling of locational problems. There are two types of grids: integer and floating point. Only integer grids have a theme table, called a value attribute table (VAT).

A surface is geographic phenomenon represented by a set of continuous data. Surface models can represent either discrete or continuous data. Discrete data have known boundaries and represent categorical data like soils, land use, or parcels. On the other hand, grids modeling continuous data represent changing phenomenon, such as elevation or temperature.

In the exercise, you learned the basic difference between raster and vector representation of line features. You also learned the relationship between cell size, resolution, and scale and how they effect the display of grid themes.

This is the **Basics of ArcView Spatial Analyst - Lesson 1 Self test**.
Please watch your time—you have 2 hours to complete this test.

Use the knowledge you have gained in *Basics of ArcView Spatial Analyst* to answer the following questions. You will need to correctly answer 7 of the following questions to pass.

Netscape Users: Do not resize this browser window. This can cause the page to reload and generate new questions.

GOOD LUCK!

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1. Sự phân tích không gian là một quá trình lysis is a process that always leads to one definitive answer.
   - True
   - False
2. Two geographic features that share a boundary are called:
   - Tagged
   - Adjacent
   - Tangent
   - Connected
3. Có hai loại của dữ liệu dạng Raster: đó là dạng số nguyên và dạng rời rạc.
   - Đúng
   - Sai
4. What is a breakline?
   - Linear features represented with too small a cell size
   - A contiguous group of cells along the perimeter of a grid
   - A sharp and sudden change in the value of surface data
   - None of the above
5. Tất cả các cell trong dữ liệu dạng Raster đều có 8 cell lân cận.
   - Đúng
   - Sai
6. Cái nào dưới dây không phải là phương pháp nội suy trong ArcView?
   - Inverse Distance Weighting (IDW)
   - Kriging
   - Spline
   - Random Point Weighting (RPW)
7. Which of the following is an example of discrete data?
   - Noise pollution levels
   - Land use type
   - Aspect
   - All of the above
8. Which of the following represents a traditional type of spatial analysis?
   - Topological overlay and contiguity analysis
   - Surface analysis

- Linear analysis
- All of the above

9. Surfaces can only be represented by models built from regularly spaced sample points.
    - True
    - False

10. Grid themes represent points, lines, polygons, and surfaces uniformly.
    - True
    - False

Calculate My Grade