

Working with ArcGIS Spatial Analyst (Three days)

Overview

Explore how the ArcGIS Spatial Analyst software extension uses raster and vector data in an integrated environment. This course teaches basic raster concepts and shows how to use ArcGIS Spatial Analyst tools to create, run, and edit spatial models. It focuses on problems that are best solved in a raster environment such as surface analysis and distance measurement. Participants are shown how to use the raster tools in ArcGIS Spatial Analyst and learn how to build grid-based datasets.

Audience

This course is for those who want to learn how to use ArcGIS Desktop applications to conduct raster-based analysis, conversion, and editing.

Prerequisites and recommendations

Completion of *Introduction to ArcGIS 1 (for ArcView 8, ArcEditor 8, and ArcInfo 8)* or equivalent experience is required. Programming knowledge is not necessary. Participants in this course should know the following:

- Basic operating system skills (copying, deleting, and moving files and directories)
- Adding, renaming, and deleting themes
- Setting data frame properties (map and distance units, projection)
- Displaying layers in ArcMap
- Using ArcGIS menus, buttons, and tools
- Performing queries
- Selecting records in layers tables
- Using ArcGIS online help

Goals

- Understand the raster data models
- Learn the ArcGIS Spatial Analyst interface
- Convert data to raster format and build raster databases
- Learn many of the map algebra functions
- Use ArcGIS Spatial Analyst for distance modeling
- Interpolate surfaces from sample points
- Perform surface hydrology functions
- Apply basic modeling concepts
- Implement models

Topics covered

- ArcGIS Spatial Analyst Basics: Overview of the extension; Understanding raster concepts; ArcGIS Spatial Analyst interface; Comparing raster and feature themes; Querying raster themes
- Structure of raster themes: How to create raster datasets; Raster storage and management
- Aligning themes: Raster registration and georeferencing; How projection affects analysis; Importing and exporting raster datasets
- Conducting surface analyses: Calculating density; Choosing an interpolation method; Interpolating a continuous raster from sample points; Contours and hillshading; Visibility analysis
- Map algebra functions: Writing expressions; Expression syntax
- Calculating distance measurements: Euclidean distance; Cost–distance; Finding least-cost path
- Surface hydrology: Identifying watershed basins; Determining surface runoff characteristics
- Designing and implementing GIS models: Spatial modeling concepts and issues

Course Outline:

Getting started with ArcGIS

Spatial Analyst

- Benefits of raster GIS
- ArcGIS raster support
- Spatial Analyst tools
- Seven interfaces for Spatial Analyst

Analyst

- Spatial Analyst toolbar
- Spatial Analyst and ArcToolbox
- Spatial Analyst and Command Line

- Spatial Analyst and ModelBuilder
- Spatial Analyst and scripts
- Spatial Analyst and ArcObjects
- Spatial Analyst and Map Algebra
- Managing the extension
- Resources for self-study

Raster concepts

- Geography as raster
- Features as raster
- Raster coordinate systems
- Raster resolution
- Raster cell coincidence
- Raster resampling
- Raster registration
- Raster cell values
- Raster attribute tables
- Raster zones and regions
- Raster formats
- Raster format essentials
- Image formats
- ESRI grid format
- Analysis environments
- Setting output cell size
- Setting output extent
- Setting snap raster
- Setting analysis mask
- Setting output projection
- Setting geoprocessing environments
- Setting toolbar environments

Building a raster database

- Roadmap 4A: Building a raster database
- ESRI Data Models
- Data sources
- Rasters in ArcCatalog
- Geoprocessing: Raster management tools
- Raster spatial reference
- Raster compression
- Merging rasters
- Rasters in an ArcSDE geodatabase
- Rasters in a personal geodatabase
- Geodatabase raster datasets
- Geodatabase raster catalogs
- Image formats
- General properties: Pyramids
- General properties: Statistics
- Raster rendering
- Resampling and color ramp stretching
- Raster conversion tools
- Conversion on the fly
- Converting features to raster
- Converting raster to features
- Projecting rasters with ArcMap
- Projecting rasters with geoprocessing tools
- Geometric transformation tools
- Georeferencing a raster
- Georeferencing steps
- Georeferencing toolbar
- Adding links
- Assessing link accuracy
- Transforming the raster
- Rectification process
- Rectification must resample

Map Algebra

- Map Algebra: The language of raster
- Expression syntax rules
- Expression evaluation
- Map Algebra objects
- User attributes in expressions
- Special cell values in Map Algebra
- Map Algebra operators
- Examples of operators
- Multi Output Map Algebra tool
- Single Output Map Algebra tool
- Map Algebra versus ModelBuilder
- Spatial Analyst commands
- Map Algebra functions
- Function syntax rules
- Local functions
- Focal functions
- Focal neighborhoods
- Neighborhood notation
- Zonal functions
- Global functions
- CON function
- Working with NoData

Raster processing tools

- Why raster processing
- Tool locations
- Extract and Sample
- Resample
- Aggregate
- BlockStatistics
- Expand
- Shrink
- BoundaryClean
- Thin
- MajorityFilter
- Nibble
- Regiongroup
- Multivariate Statistics

Interpolation tools

- Creating surfaces
- Functional surface
- What is interpolation?
- Linear interpolation
- Sampling a surface
- Controlling sample points
- Barriers to interpolation
- ArcGIS interpolation tools
- Inverse Distance Weighted (IDW)
- IDW parameters
- Natural Neighbors
- Spline
- Choosing a spline type
- Trend
- Kriging
- Kriging models
- Topo To Raster
- Visual comparisons of Interpolators
- Feature density estimation
- Testing your surface

Surface analysis tools

- Road map: Surface analysis tools
- Sources of topographic data
- Surface conversion
- Using surfaces in ArcGIS Spatial Analyst
- Contour tool
- Slope tool
- Aspect tool
- Curvature
- Hillshade tool
- Visibility analysis
- Visibility tools
- Controlling visibility in a viewshed

Hydrologic tools

- ArcHydro Data Model
- Surface hydrology tools
- Roadmap: Surface hydrology
- Topographic surfaces
- Topo to Raster tool
- Identifying and filling sinks
- Flow Direction tool
- Flow Accumulation tool
- Creating streams
- Stream Order tool
- Stream Link tool
- Creating basin IDs for streams
- Stream to Feature tool
- Roadmap: Basins and watersheds
- Defining watersheds and basins
- Snap Pour Point tool
- Roadmap: Other operations
- Flow Length tool
- Performing a raindrop trace
- Groundwater hydrology tools
- Roadmap: Groundwater hydrology
- Groundwater tool limitations
- Darcy Flow tool
- Particle Track tool
- Porous Puff tool

Distance tools

- Distance tools
- Roadmap: Euclidean distance
- Euclidean tools output
- Calculating Euclidean distance
- Euclidean direction and allocation
- Weighted distance measurement
- Roadmap: Weighted distance process
- Creating the cost surface
- Calculating travel costs
- Accumulated travel cost output
- Backlink output
- Allocation output
- Roadmap: Path Distance tools
- Path Distance tool
- Roadmap : Cost Path tool
- Finding paths
- Roadmap: Corridor tool

Building models

- Modeling spatial problems
- Types of models
- Binary suitability models
- Weighted suitability models
- Weighted suitability methodology
- Define the model
- Break big models into submodels
- Decide how to measure the issues
- Data types and math in modeling
- Define a scale of suitability
- Determine suitability and weights
- Convert measures into suitability
- Reclassify tool
- Reclassify with equations
- Weight and combine the layers
- Weighted Overlay tool
- Find the best locations
- Building models with ModelBuilder
- Model elements
- Running a model
- Setting tool parameters
- Setting model parameters
- Setting derived data properties
- Setting diagram properties
- Setting model properties
- Saving, exporting, and printing a model