please turn off mobile phones and pagers.

Raster Data Management
Introduction to ArcGIS Raster

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Outline of Presentation

- Raster Fundamentals
- Raster functionality in ArcGIS
- What’s new in ArcGIS 9.0?
- What’s next?

Question / Comments
Raster Fundamentals

“Raster” = “Image” = “Grid”
&
“Cell” = “Pixel”

- Raster format
- Resolution
- Bit depth / Color depth
- Lossless and Lossy compression
- Discrete vs. Continuous
- Rendering
  - Classified
  - Stretch
  - Pseudocolor / colormap
  - RGB composite
- Pyramids for display speed
Demonstration of Raster Fundamentals
Pyramids

- Reduced resolution copies of original
  - Pixel size doubles at each reduced level
- Improves display performance
  - Client requests appropriate level
- Pyramids are not used in raster analysis
- Pyramids are used for printing when necessary
Pyramid Resampling Methods

- **Nearest Neighbor**
  - Value of nearest pixel
  - Does not create new values
  - Quickest overall

- **Bilinear Interpolation**
  - Weighted average of 4 nearest pixels
  - Smoothes continuous imagery

- **Cubic Convolution**
  - Smooth curve fitted to 16 nearest pixels
  - Sharpens continuous imagery

For discrete data

For continuous data
Raster Formats in ArcGIS

**READ and WRITE**
- GRID and GRID Stacks
- ERDAS 8.x Imagine (IMG)
- TIFF/GeoTIFF
- Rasters in the Geodatabase
  - ArcSDE and personal GDB Rasters

**READ ONLY**
- ESRI BIL, BIP, BSQ
- MrSID (MG2 and MG3)
- JFIF (JPEG)
- DTED (Level 1 and 2)
- ADRG
- CDRG
- CIB
- NITF (2.0 & 2.1)
- BMP, GIF, PNG
- ERDAS 7.4 LAN, GIS, RAW
- ER-Mapper ERS
- JPEG2000 (read)
- DIGEST (ASRP/USRP)
- Intergraph CIT/COT
Raster Formats in ArcGIS

Downloadable formats

• ECW (from ERMapper)
• ENVI (from ENVI)
• PIX (from PCI)
• Etc…
• “Creating a Customized Raster Format DLL”
  – Download new 9.0 version from http://ArcGISDeveloperOnline.esri.com

COMING SOON

• JPEG2000 writer
• HDF
• PDS/ISIS
• netCDF
Raster Data in ArcGIS 9.0

- Geodatabase:
  - Raster column
  - Rasters as attributes of feature classes
  - Personal geodatabase raster data storage

- ArcSDE:
  - Raster Dataset pyramid update enhancement
  - Improved loading speeds

- ArcGIS:
  - Enhanced Raster Catalog functionality
  - Enhanced Rendering of Raster Catalogs
  - New Raster Transformation Engine
    - Accurate raster reprojection
    - Cube projection (ArcGlobe)
Geodatabase Rasters

• Enterprise Level
  – ArcSDE provides the gateway
  – Leverages professional RDBMS
    • SQL Server, DB2, Oracle, Informix
  – Raster data is stored within the database
  – Multiple terabyte capabilities

• Personal Level (new at 9.0)
  – Leverages Microsoft’s Access database
  – Raster Data is stored in referenced files
    • Geodatabase can manage or not manage
  – Multiple gigabyte capabilities
    • More than 2GB because of IMG file capabilities
Personal Geodatabase
Rasters

• **Raster data is not** stored inside Access

• **Raster Data is stored as referenced files**
  
  – **Managed**
    • Raster Data is copied as IMGs to a special folder
    • Note: Raster Datasets are always managed
  
  – **Unmanaged**
    • Raster Data is simply referenced by a pathname
    • Note: Raster Catalogs and Raster Attributes can be managed or unmanaged
Geodatabase Rasters

• Designed for…
  – Central sharing/management
  – Fast access to data repositories
  – Leverage geodatabase strengths

• Features
  – Pyramids
  – ArcSDE
    • Tiling, spatial indexing, and compression
  – Wide variety of storage options
Geodatabase Rasters: Storage Options

- **Raster Dataset**
  - Single row table
  - One continuous raster dataset
  - Fast display at any scale

- **Raster Catalog**
  - Multi-row table
  - Collection of raster datasets
  - Separate datasets, any overlap is OK

- **Feature Attributes**
  - Raster Datasets are associated with features
GDB Raster Datasets

- One continuous raster dataset via mosaicking
- Choices for overlapping pixels
  - Overwrite, ignore new pixels, blend, min, max

Input files:
- 3712a.tif
- 3712b.tif
- 3712c.tif
- 3712d.tif

New Raster Dataset:
- UC2004:IMAGE_3712
GDB Raster Catalogs

- Collection of raster datasets stored in one business table
  - Each input is stored separately and completely
  - Maintains overlap
    - Time series, stereo pairs, TM scenes, etc
  - Metadata is preserved
  - Use entire catalog, or a subset

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>NAME</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WC_4724</td>
<td>05/26/98</td>
</tr>
<tr>
<td>2</td>
<td>WC_4725</td>
<td>07/05/01</td>
</tr>
<tr>
<td>3</td>
<td>WC_4726</td>
<td>10/04/01</td>
</tr>
<tr>
<td>4</td>
<td>WC_4727</td>
<td>02/26/02</td>
</tr>
</tbody>
</table>
Raster Attributes

• Geodatabase raster data is associated with geodatabase features
Rasters in the Enterprise Geodatabase

Client Application

... are just like other ArcSDE feature classes
... are just like other file-based rasters
Rasters in the Personal Geodatabase

Client Application

Network

Microsoft Access
Loading Raster Data into the Enterprise Geodatabase

1. Build reduced resolution pyramids
2. Tile each level
3. Store in single database table record

<table>
<thead>
<tr>
<th>ID</th>
<th>RASTER DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9786765443332278</td>
</tr>
</tbody>
</table>
Retrieving Raster Data from the Geodatabase

Image name, desired extent, and screen resolution are passed to database

Smallest number of pixels are returned to the client

Client Database
Raster Customization in ArcGIS

• **ArcObjects**
  – A platform on which ArcGIS products and applications rely on
  – COM based components you can use for customization

• **Raster Data Objects**
  – A portion of ArcObjects that deals with raster data
  – Support all raster functionality from ArcGIS user interface
  – Plus more functionality not exposed through UI
Use of Raster Data Objects

• Add new raster functionality to ArcGIS
  – i.e. Leica’s Image Analyst Extension

• Build standalone/embedded applications

• Build web applications using ArcGIS Server and raster objects
Developer Help for Raster Objects

- http://arcgisdeveloperonline.esri.com
  - Library Reference/DataSourcesRaster
    - DataSourcesRaster library overview
  - Samples/Raster
    - All raster samples
    - VB, VB.NET, C#, C++ and Java
Unified Raster Data Access

Workspace

IRasterWorkspaceEx (optional)

ServletResponseFactory

IRasterWorkspace2 (optional)

AccessWorkspaceFactory

SdeWorkspaceFactory

IRasterWorkspace2 : IUnknown

- CreateRasterCatalog
- CreateRasterDataset
- DeleteRasterCatalog
- DeleteRasterDataset
- OpenRasterCatalog
- OpenRasterDataset
- SaveAsRasterDataset

IRasterWorkspaceEx : IUnknown

- CreateRasterCatalog
- CreateRasterDataset
- DeleteRasterCatalog
- DeleteRasterDataset
- OpenRasterCatalog
- OpenRasterDataset
- SaveAsRasterDataset
Raster Loading Experience using ArcObjects

• ArcGIS 8.3 loading code will still work
  – Load to 8.3 schema
  – Register with geodatabase to add a geometry column
Raster Loading Experience using ArcObjects (Cont…)

• Load raster dataset
  – IRasterWorkspaceEx::CreateRasterDataset
  – IRasterLoader or IRasterDatasetEdit::Mosaic

• Load raster catalog
  – IRasterWorkspaceEx::CreateRasterCatalog
  – Add a row
  – Populate the raster field with a raster dataset
Raster Catalog Display

- **GdbRasterCatalogLayer** is for geodatabase raster catalogs
  - Associated with a list of renderers
  - System provides RasterCatalogRendererPicker to set rendering rules
- **RasterCatalogLayer** is for table based raster catalogs
  - Continues to work in 9.0
Mosaicking Raster Data

- MosaicRaster object
  - Colormap, multiband, mosaic from raster catalog
  - Control raster property
  - SaveAs to a new raster dataset
    - IMG, TIFF, GRID, and geodatabase

- RasterLoader object
  - IRasterDatasetEdit::Mosaic (RasterDataset)
  - Load raster to an existing dataset
Raster Data Objects in the New Libraries (Assemblies)

- Raster objects reside in 4 assemblies:
  - esriDataSourcesRaster.olb
  - esriGeoDatabase.olb
  - esriCarto.olb
  - esriDataSourcesRasterUI.olb
Demonstration of ArcGIS 9.0 Raster Functionality
What’s Next?

• Prior to our next big release
  – Build a patch for users with Leica’s LPS 8.7
  – Release HDF reader
  – Find and fix bugs

• Future releases of ArcGIS
  – Work on our Raster Data Services
    • Part of ArcGIS Server
  – Finish our Raster Transformation Pipeline
  – Build support for associated GDB raster tables
  – Build support for more raster formats
What is an Oracle 10g GeoRaster?

• New Oracle Data type
  – Storing pixels in relational database
• Complement to ESRI
  – Rasters and the database go well together
  – We’ve been doing this since ArcGIS 8.0 (5+ years)
• We are working to support Oracle 10g
  – Includes their raster implementation
More Raster Related Sessions

Please pick up a

“Raster Data Management: Conference 2004 Daily Planner”
Evaluations

Please fill them out.

Your comments help ESRI become better at meeting your needs.

Thank-you.
End of Presentation
Thank-you for attending!!
Open to Questions