. . . please turn off mobile phones and pagers. . . .

Raster Data Management
Introduction to ArcGIS Raster

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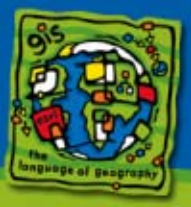


Outline of Presentation

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

Question / Comments

Raster Fundamentals

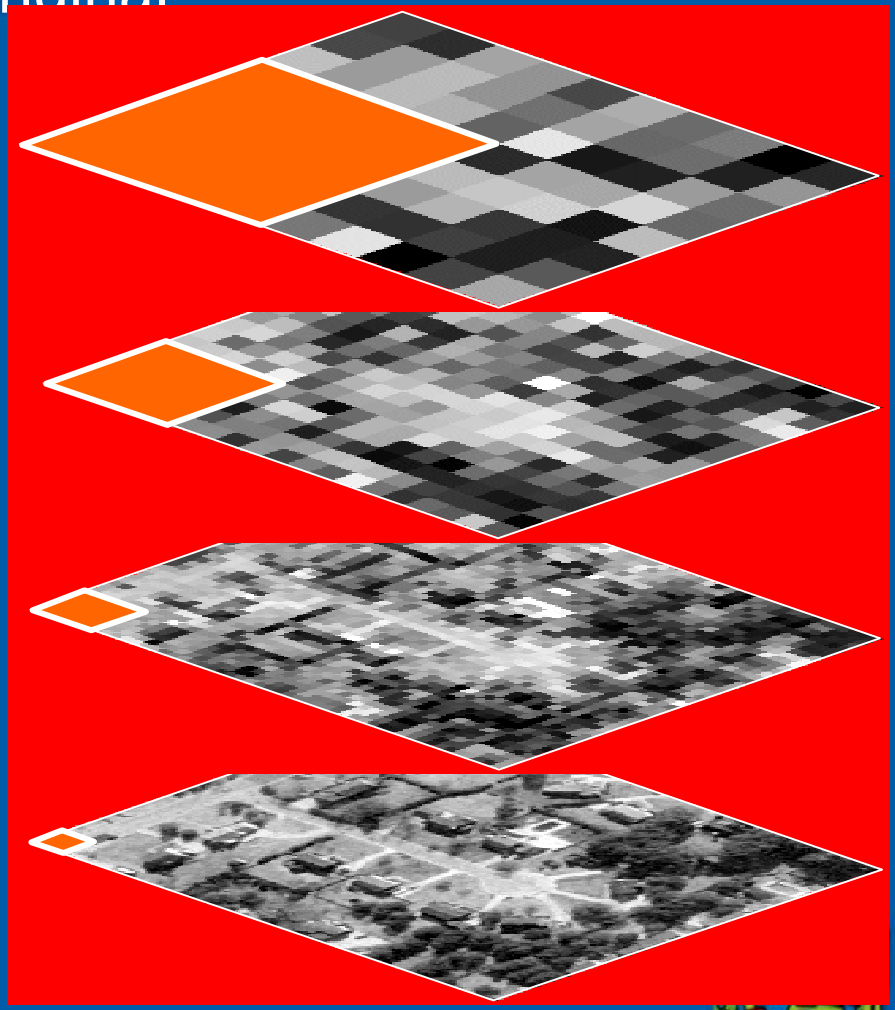
"Raster" = "Image" = "Grid"
&
"Cell" = "Pixel"

- 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

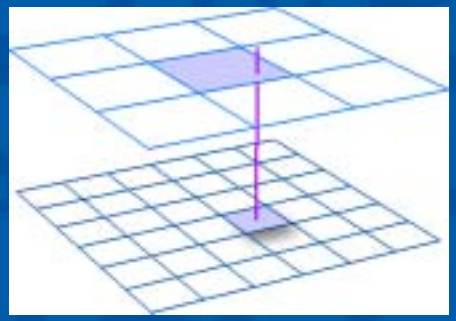
Pyramids

- 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

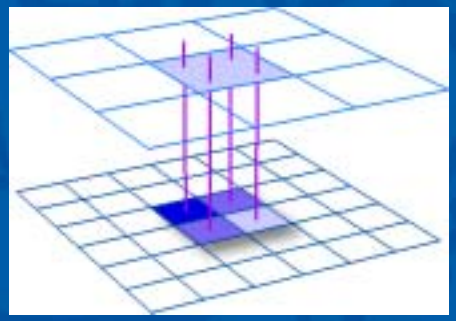


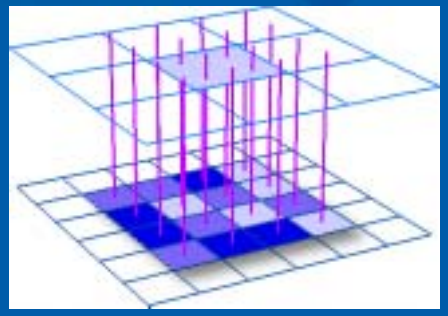
Pyramid Resampling Methods

For discrete data



For continuous data





- **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

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
- CADRG
- 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

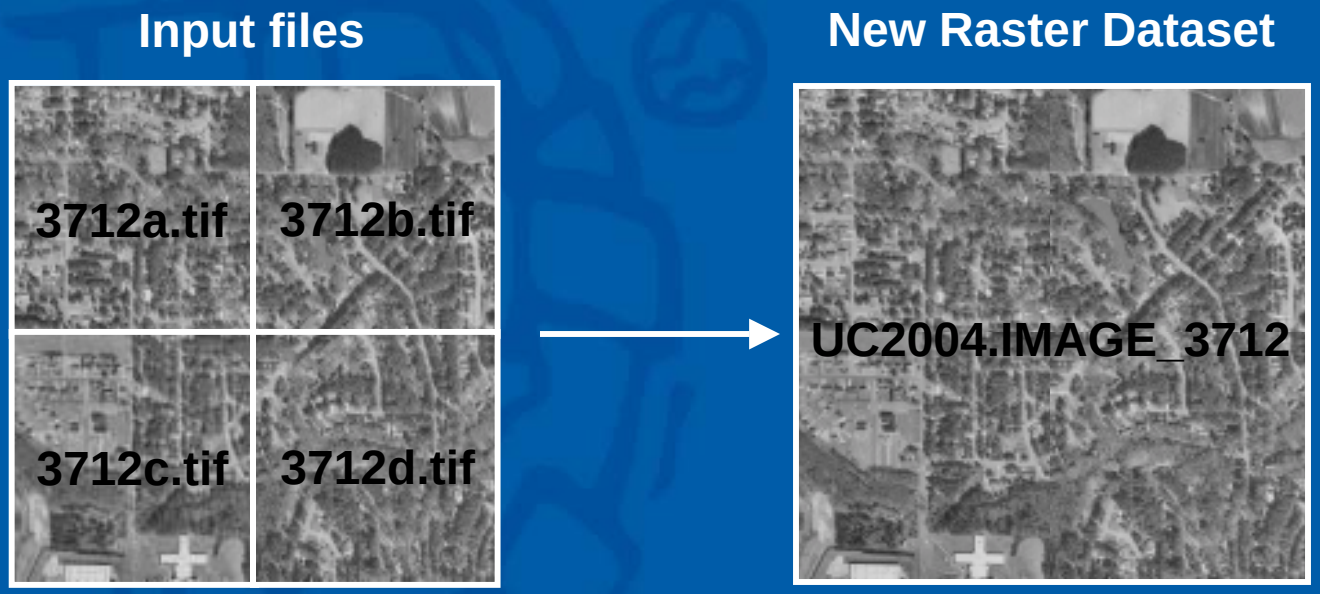
Geodatabase Rasters

- 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

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

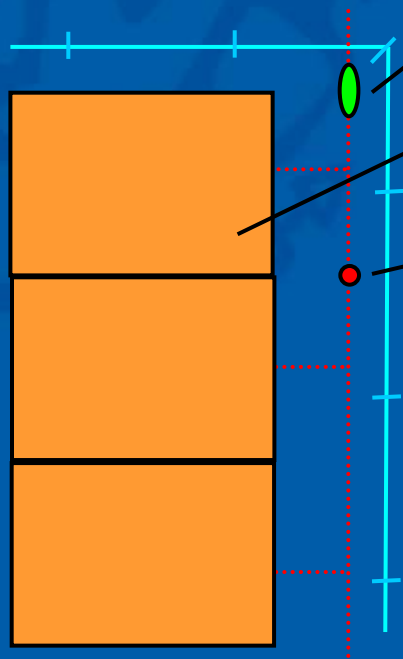
Raster column →

UC2004.AERIAL_CATALOG

IMAGE	NAME	DATE
1	WC_4724	05/26/98
2	WC_4725	07/05/01
3	WC_4726	10/04/01
4	WC_4727	02/26/02

Raster Attributes

- Geodatabase raster data is associated with geodatabase features



Rasters in the Enterprise Geodatabase

Client Application

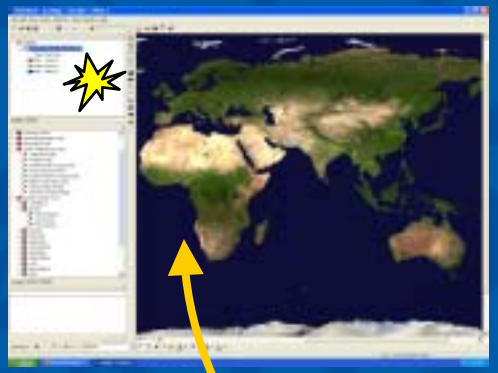
Network

ArcSDE

RDBMS

… are just like other ArcSDE feature classes
… are just like other file-based rasters

Rasters in the Personal Geodatabase



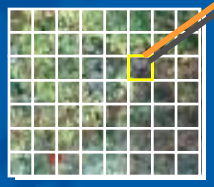
Client Application

Network

Microsoft Access

Loading Raster Data into the Enterprise Geodatabase

Build reduced resolution pyramids

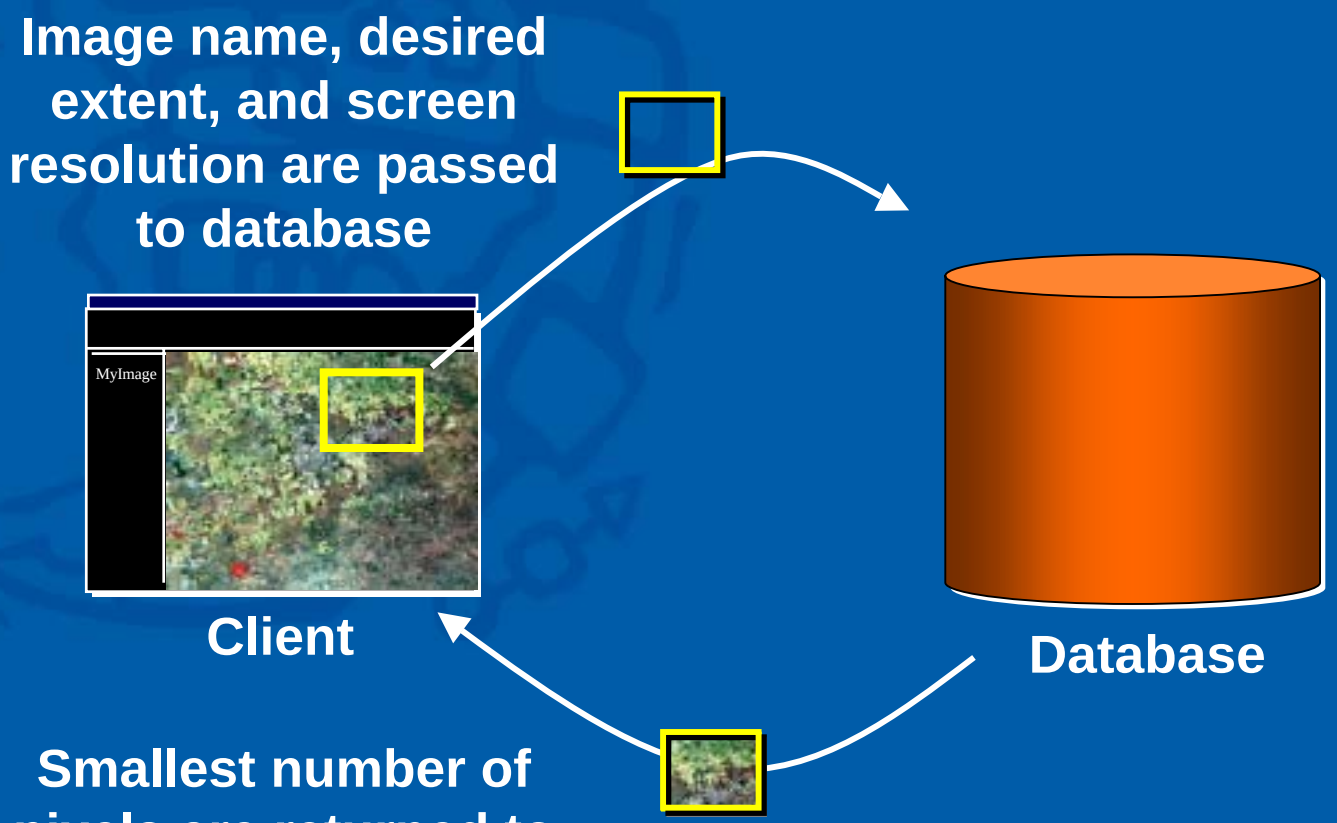


Tile each level

ID	…	RASTER DATA
1		9786765443332278

Store in single database table record

Retrieving Raster Data from the Geodatabase



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

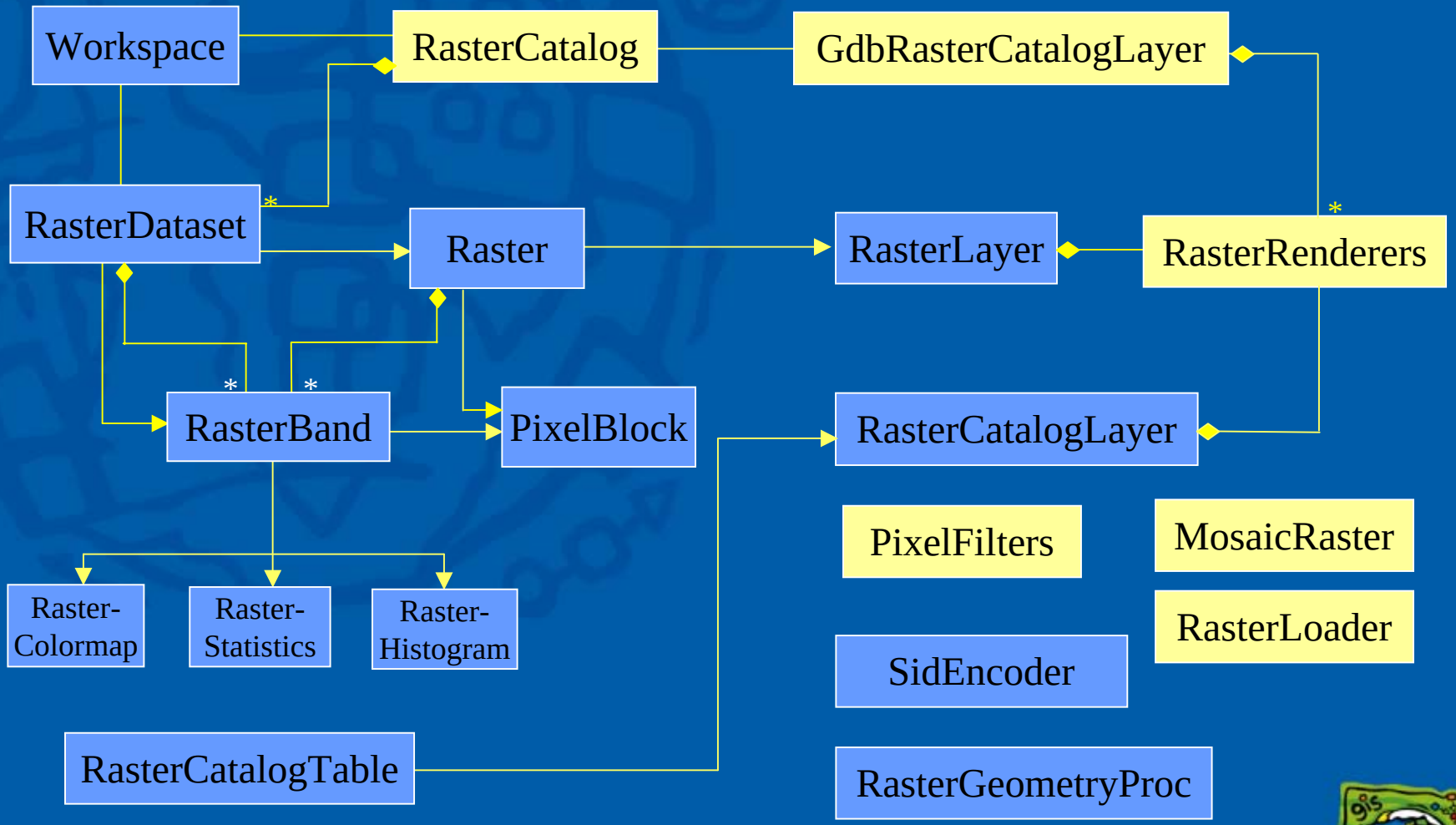
Use of Raster Data Objects

- 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

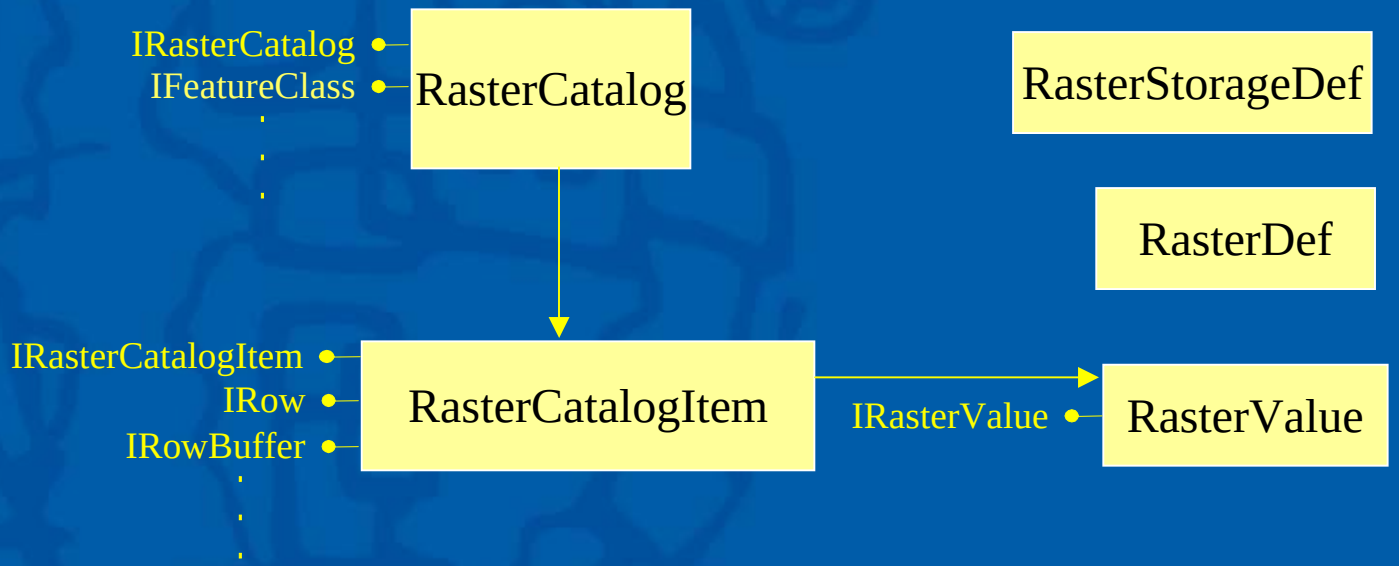
Developer Help for Raster Objects

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

Raster Data Objects Overview

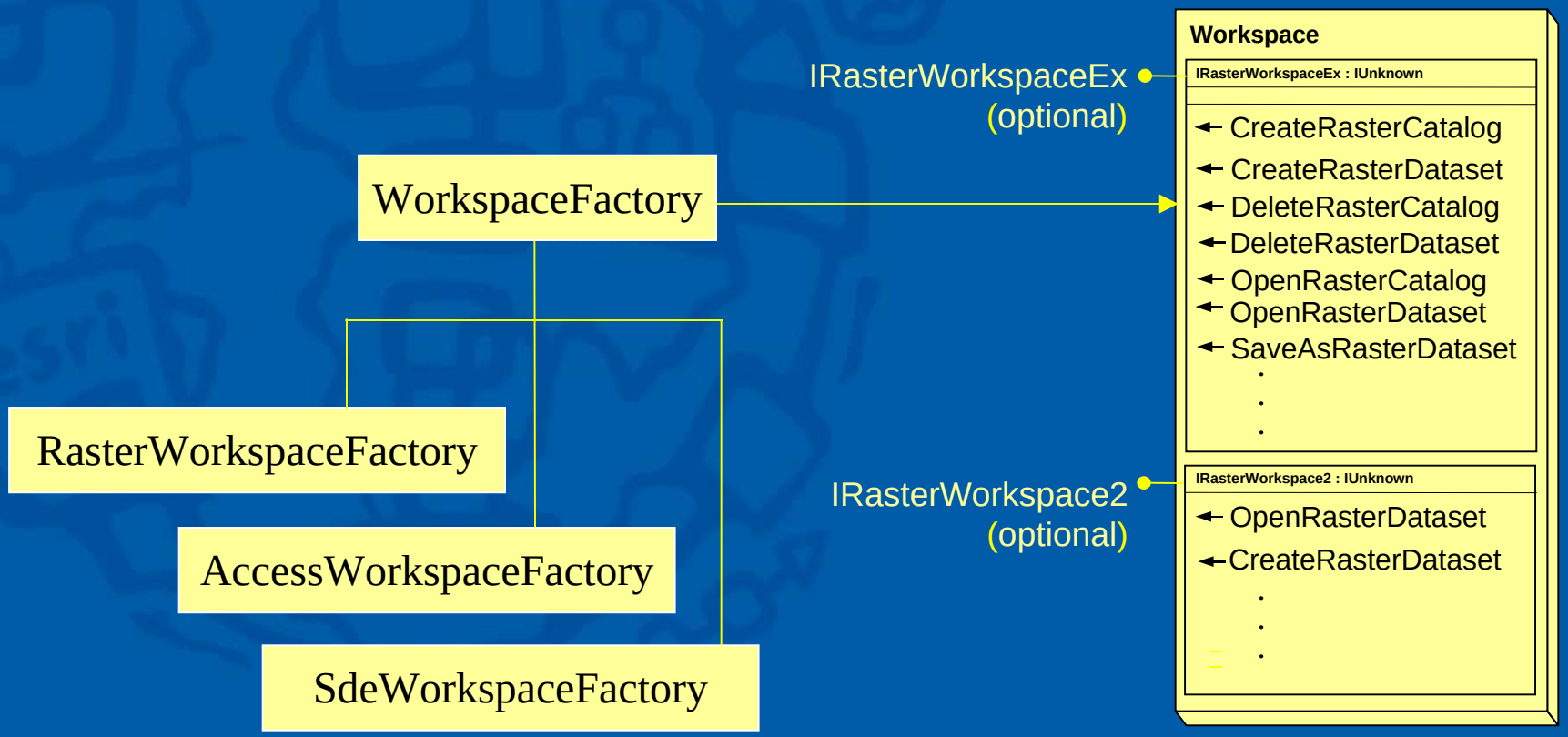


RasterCatalog



OBJECTID*	Shape*	Raster	Name	Shape_Length	Shape_Area
1	Polygon	Raster	dem_ll.tif	27180.0000253133	39281400.0731673
2	Polygon	Raster	dem_lr.tif	41219.9999743892	105409799.894901
3	Polygon	Raster	dem_ul.tif	20219.9999548309	24769799.9126963
4	Polygon	Raster	dem_ur.tif	34259.9999039067	66468599.5756448

Unified Raster Data Access

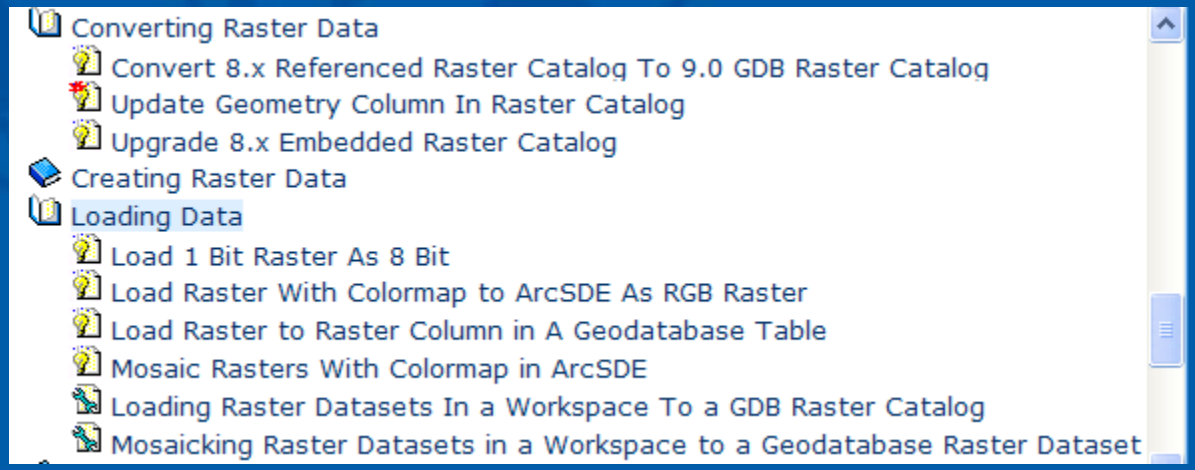


Raster Loading Experience using ArcObjects

- ArcGIS 8.3 loading code will still work
  - Load to 8.3 schema
  - Register with geodatabase to add a geometry column

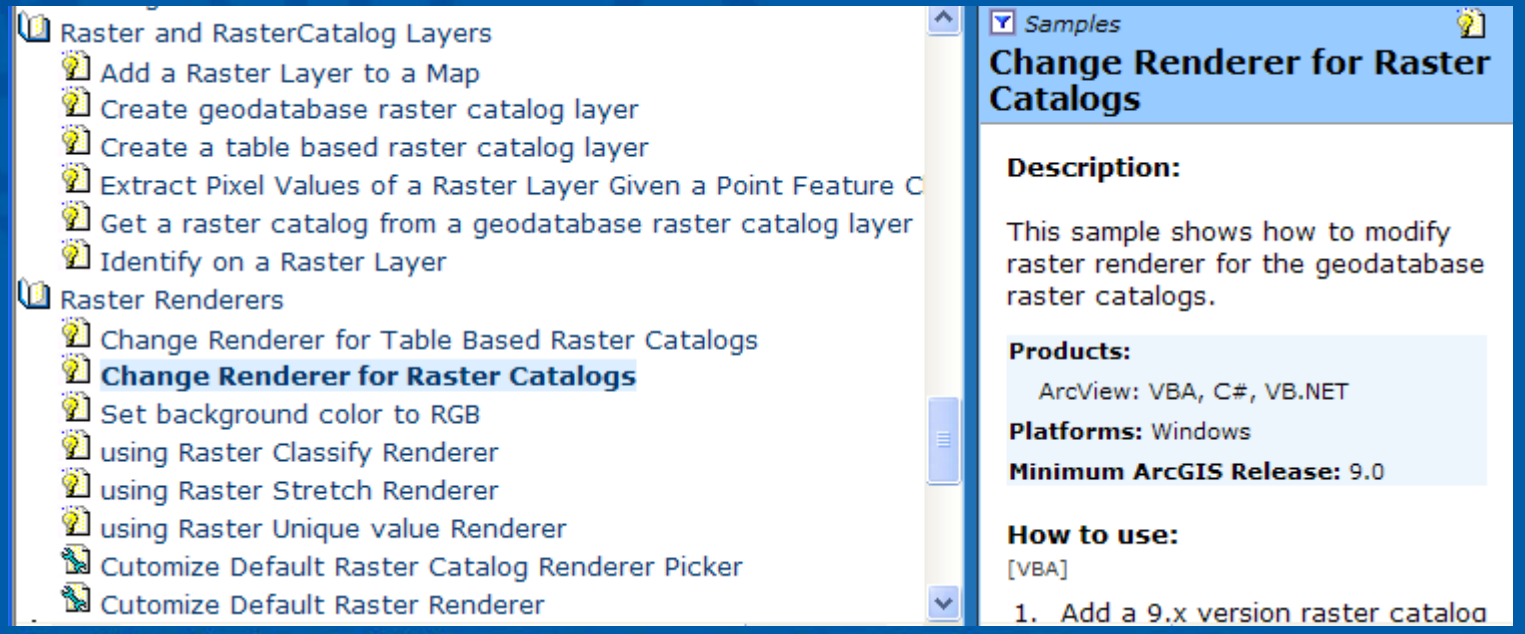
Raster Loading Experience using ArcObjects (Cont…)

- 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



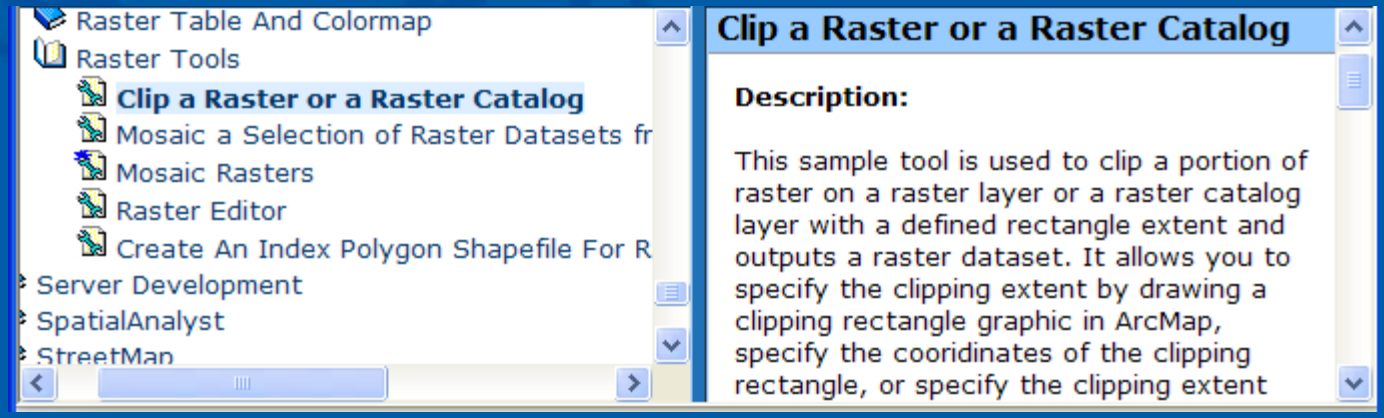
Raster Catalog Display

- 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