



Introduction to Spatial Analysis and Spatial Modeling

1

Benefits of raster GIS

- ❑ **ArcGIS raster support**
- ❑ **The ArcGIS Spatial Analysis extension**
 - **The seven interfaces**
 - **Installation and licensing**
- ❑ **Exercise 1**
 - **Introduction to the spatial analyst interfaces**

Benefits of raster GIS

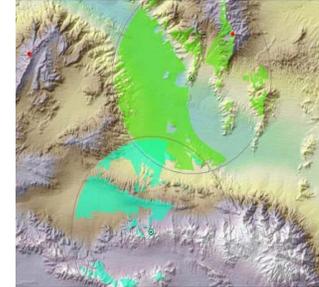
□ Location-based data model (cells)

- Better than features for many types of analyses

□ Especially suited for

- Surface creation and analysis
 - Elevation, rainfall, population
- Location models
 - Best site for business, hospital
- Distance measurement
 - Proximity, mobility, best path
- Modeling movement
 - Flood inundation, fire spread

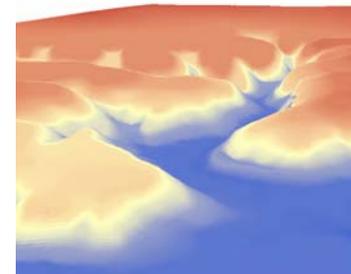
Modeling



Distances

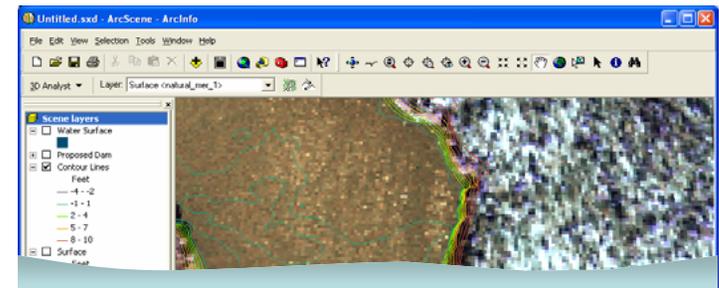


Surfaces



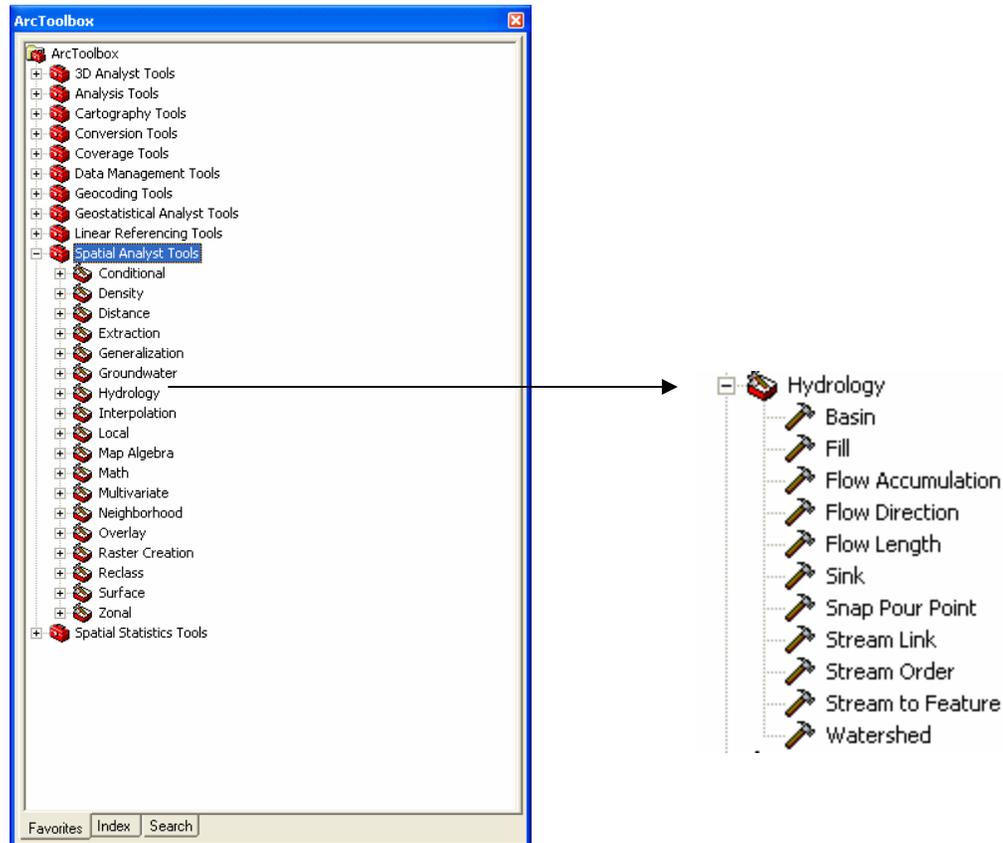
ArcGIS raster support

- ❑ ArcGIS has out-of-the-box raster support
 - Use with ArcMap
 - Draw, query, georeference
 - Manage with ArcCatalog
 - Copy, rename, delete,
 - Manipulate with ArcToolbox
 - Convert, project, merge, clip,
 - Store with a geodatabase
 - Raster datasets and catalogs
- ❑ Add Spatial Analyst for analysis

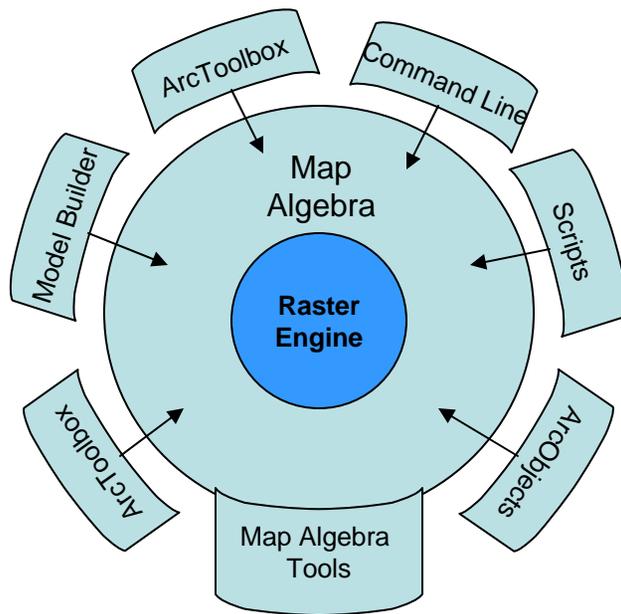


Spatial Analysis tools

- ❑ Over 100 tools organized into toolsets



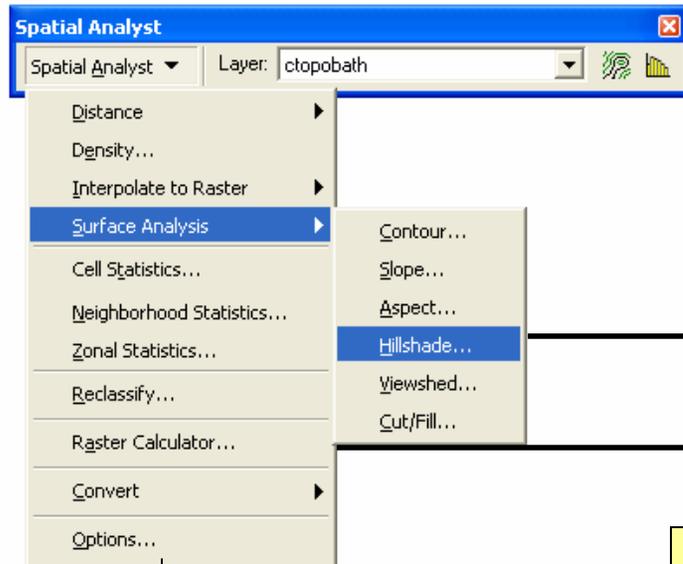
Seven interfaces for Spatial Analyst



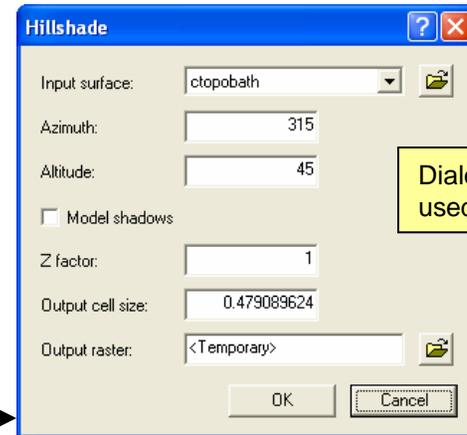
- ❑ 1. ArcToolbox
Dialogs for all tools
 - ❑ 2. Command Line
Type commands
 - ❑ 3. Model Builder
Visual modeling
 - ❑ 4. Scripts
Write easy programs
 - ❑ 5. Spatial Analyst Toolbar
Dialogs for common tools
 - ❑ 6. ArcObjects
More programming power
 - ❑ 7. Map Algebra Tools
For all interfaces
-
- ◆ Most become Map Algebra
 - ◆ Evaluated by Raster Engine

•These are all part of the geoprocessing framework

The Spatial Analyst toolbar

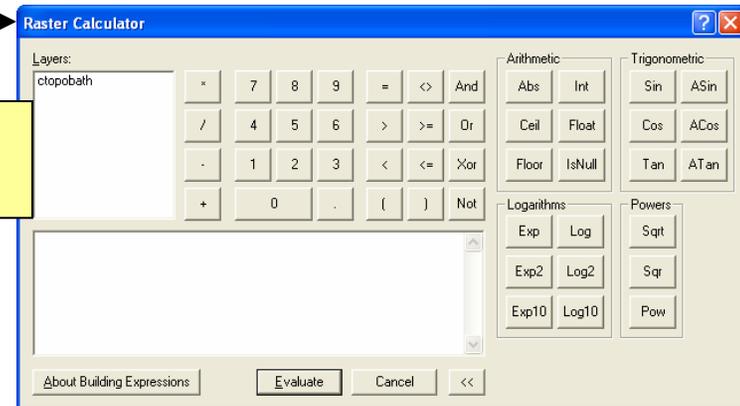


Has its own environment
(not part of the geoprocessing)



Dialogs for commonly
used tools

Can compose
Map Algebra
expressions



Spatial Analyst and ArcToolbox

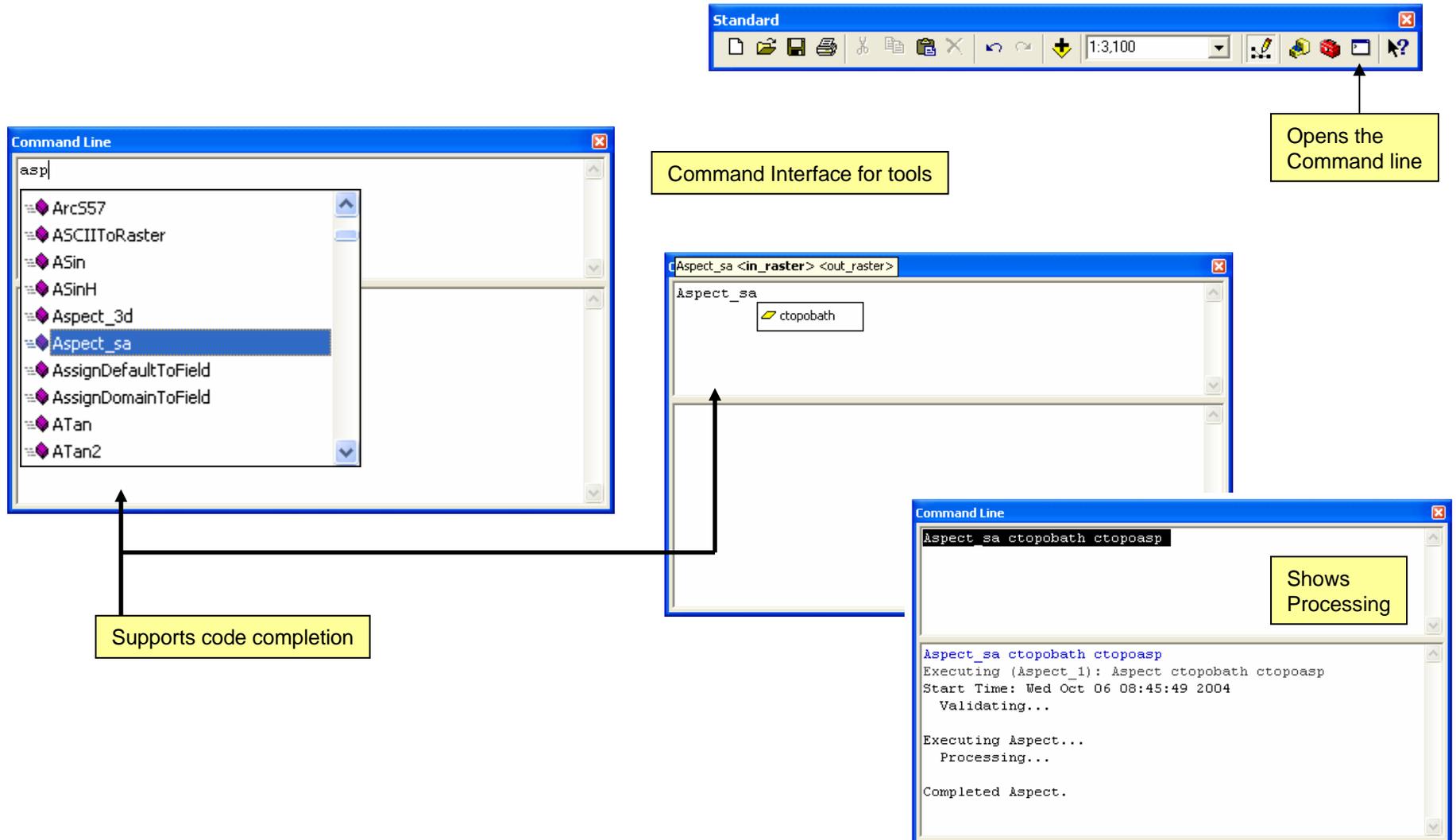
The image displays the ArcGIS interface with three main components:

- Standard toolbar:** Located at the top, it contains various icons for file operations and navigation. A yellow callout box labeled "Opens ArcToolbox" points to the Spatial Analyst icon (a red cube) in the toolbar.
- ArcToolbox:** A vertical panel on the left side of the screen. It lists various tool categories such as Conditional, Density, Distance, Extraction, Generalization, Groundwater, Hydrology, Interpolation, Local, Map Algebra, Math, Multivariate, Neighborhood, Overlay, Raster Creation, Reclass, Surface, and Zonal. The "Aspect" tool is highlighted under the "Surface" category. A yellow callout box labeled "Hints and links to help" points to the help icon in the top right corner of the Aspect dialog box.
- Aspect dialog box:** A central window titled "Aspect" with a light beige background. It features two input fields: "Input raster" and "Output raster", each with a browse button (a folder icon). The dialog box also includes a "Help" tab, a "OK" button, a "Cancel" button, an "Environments..." button, and a "<< Hide Help" button. A yellow callout box labeled "Hints and links to help" points to the help icon in the top right corner of the dialog box.

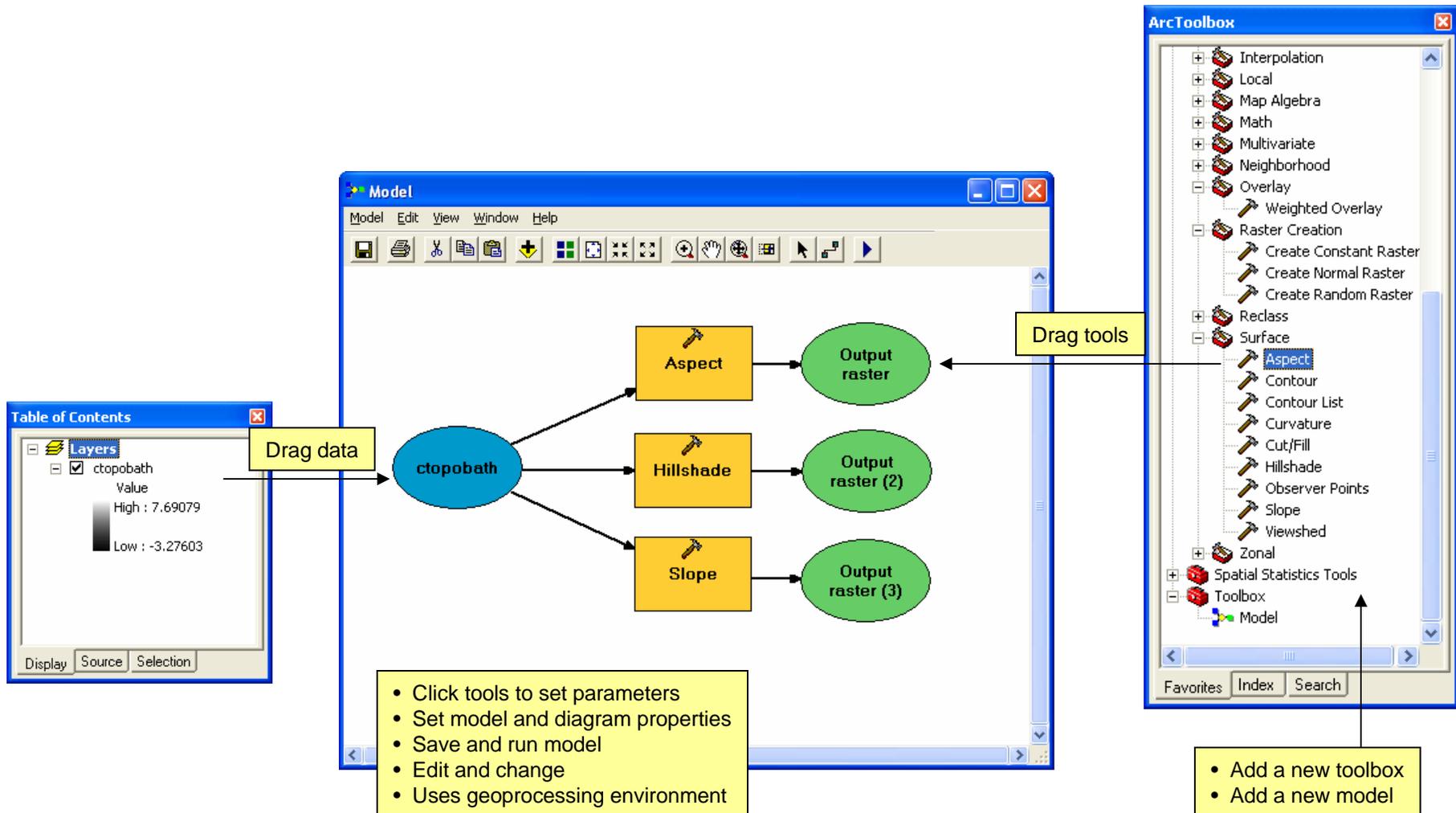
Additional annotations include:

- An arrow pointing from the "Aspect" tool in the ArcToolbox to the Aspect dialog box.
- A yellow callout box at the bottom right containing the following text:
 - Uses geoprocessing environments (right-click to set)
 - Has Map Algebra tools

Spatial Analyst and Command Line

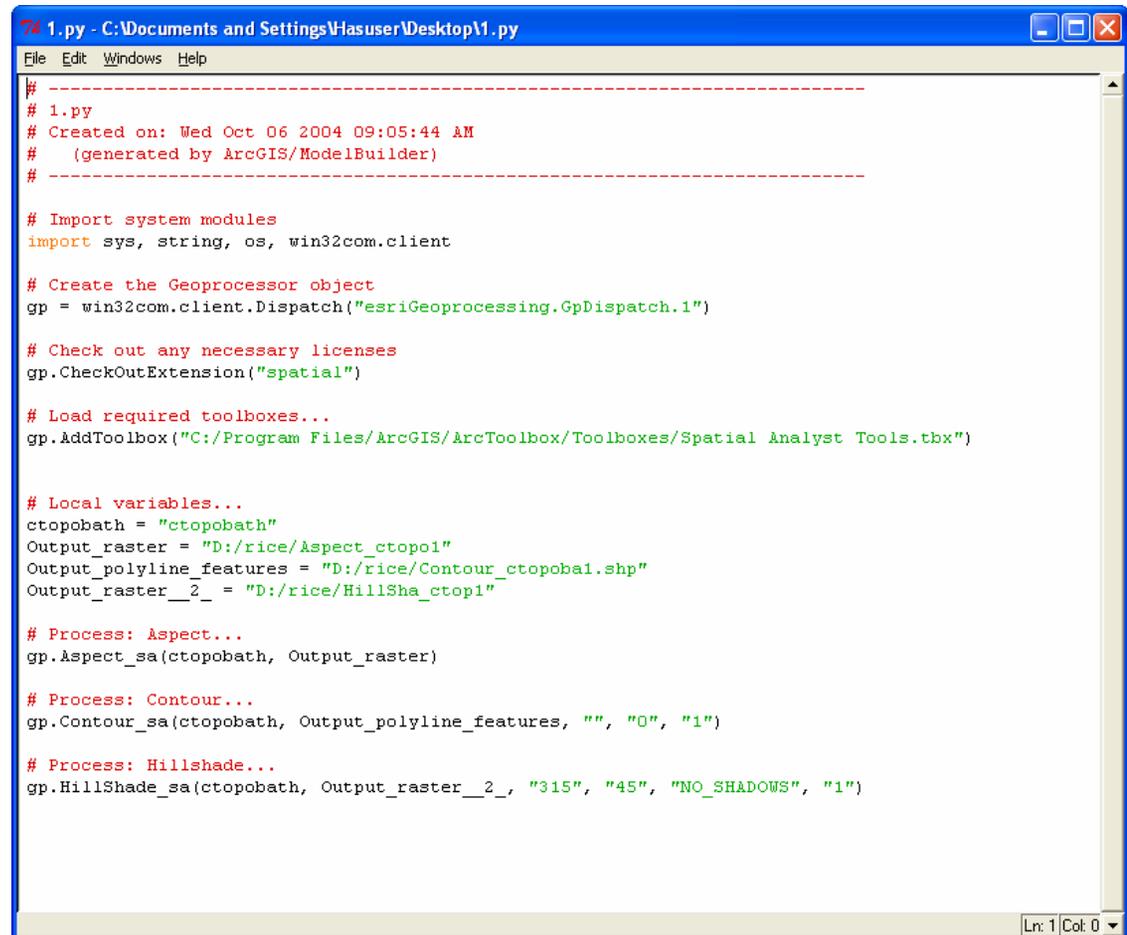


Spatial Analyst and Model Builder



Spatial Analyst and scripts

- Many languages are supported (Python shown)
- Is object-oriented (But easy!)
- Uses geoprocessor tools, environments
- May add scripts to ArcToolbox
- May use scripts in models
- Has a Map Algebra tool



```
1.py - C:\Documents and Settings\Huser\Desktop\1.py
File Edit Windows Help
# -----
# 1.py
# Created on: Wed Oct 06 2004 09:05:44 AM
# (generated by ArcGIS/ModelBuilder)
# -----

# Import system modules
import sys, string, os, win32com.client

# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")

# Check out any necessary licenses
gp.CheckOutExtension("spatial")

# Load required toolboxes...
gp.AddToolbox("C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial Analyst Tools.tbx")

# Local variables...
ctopobath = "ctopobath"
Output_raster = "D:/rice/Aspect_ctop1"
Output_polyline_features = "D:/rice/Contour_ctopobath1.shp"
Output_raster__2_ = "D:/rice/HillSha_ctop1"

# Process: Aspect...
gp.Aspect_sa(ctopobath, Output_raster)

# Process: Contour...
gp.Contour_sa(ctopobath, Output_polyline_features, "", "0", "1")

# Process: Hillshade...
gp.HillShade_sa(ctopobath, Output_raster__2_, "315", "45", "NO_SHADOWS", "1")

Ln: 1 Col: 0
```

Spatial Analyst and ArcObjects

- ❑ Many languages are supported (VBA shown)
- ❑ Is object-oriented (Powerful, but a lot of classes to learn)
- ❑ Must set your environments
- ❑ Build stand-alone applications, or build tools, or ...?
- ❑ Has classes for Map Algebra

```
Command Line
ctopobath = "ctopobath"
Output_raster = "D:/rice/Aspect_ctopobath"
Output_polyline_features = "D:/rice/Contour_ctopobath.shp"
Output_raster_2_ = "D:/rice/HillShade_ctopobath"

' Process: Aspect...
gp.Aspect_sa ctopobath, Output_raster

' Process: Contour...
gp.Contour_sa ctopobath, Output_polyline_features, "", "0", "1"

' Process: Hillshade...
gp.HillShade_sa ctopobath, Output_raster_2_, "315", "45",
"NO_SHADOWS", "1"
.
```

Supports code completion

14 2004 (Elapsed Time: 5.00 secs)

Spatial Analyst and Map Algebra

□ An analysis language for raster data

- Uses math-like expressions with operators and functions:

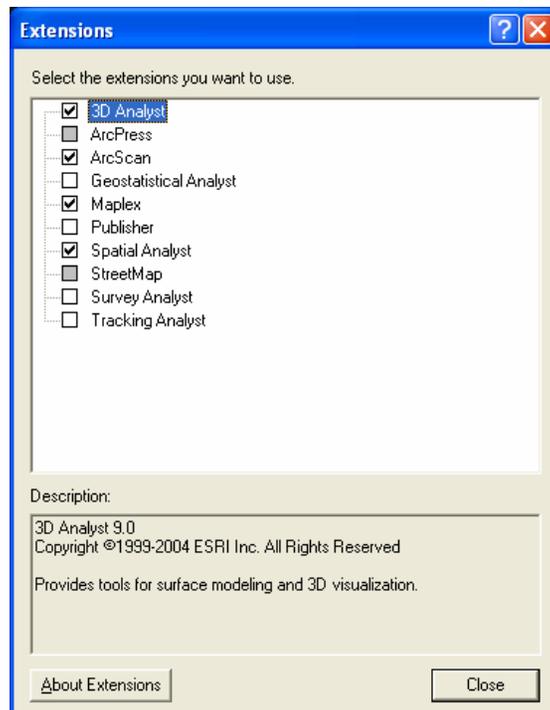
```
SmoothHill = Hillshade(FocalMean([Elevation] * 0.3048))
```

- Can be more efficient than Spatial Analyst tools (one expression may use many functions and operators)

□ Spatial Analyst tools and Map Algebra

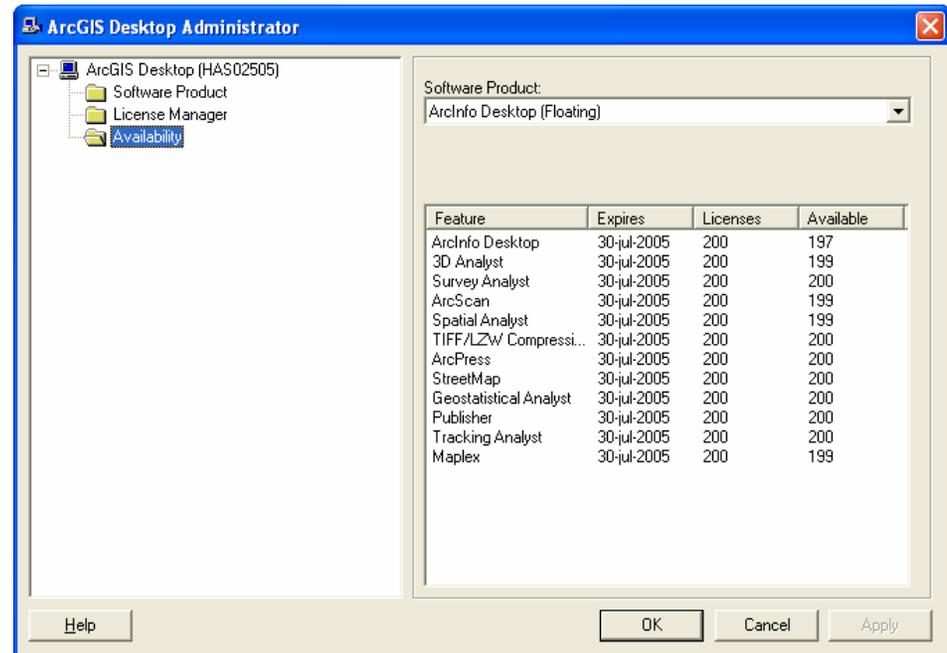
- Most tools implement Map Algebra functions and operators
 - Tools provide dialog and command line interfaces
 - Most tools implement a single function or operator (some implement many functions)
- Tools exist for writing Map Algebra expressions

Managing the extension



Tools > Extensions

- Enable or disable extensions



Start> Programs > ArcGIS> Desktop Administrator

- Select software product
- Select license manager
- Check license availability

Resources for self study

- ❑ **Online Help**
 - For ArcGIS Desktop users and for developers
- ❑ **Documentation**
- ❑ **ESRI Support Center**
 - Software information
 - Knowledge Base
 - Downloads
 - User forums
 - Developer support and tools
- ❑ **Virtual Campus courses**
 - Self-learning modules

Exercise 1 overview

- Check the license in the Desktop Administrator
- Enable the extension in ArcMap
- Run a tool with the Spatial Analyst toolbar
- Run a tool with the ArcToolbox
- Run a tool with the Command Line window
- Build and run a model with the Model Builder
- Create and run a script and view its code
- Run and view a VBA program that uses ArcObjects
- Write and run a Map Algebra expression
- Install several ArcObjects-based utilities (you will use them in future exercises)