Watershed Sciences 4930 & 6920
GEOGRAPHIC INFORMATION SYSTEMS

INTRODUCTION TO
GEOPROCESSING

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HOUSEKEEPING

- Lab 3
- Basemaps using WMS
THIS WEEK’S LAB

Lab 3: Reproducing Maps – Geologic Map

• Teach you how to manipulate display properties and symbology to reproduce a map in as close as possible a fashion to the original.

• Teach you how to get out of ArcGIS and into Adobe Illustrator

• Teach you how to extract summary statistics and data from existing data
UTAH AGRC SGID – JUST TO MAKE SURE

- SGID (State Geographic Information Database) Data & Map Servers
- Alternative to ‘Add Basemap’ from ESRI
I. Geoprocessing
II. ModelBuilder
III. Batch Processing
   I. A right-click away
   II. Scripting
WHAT IS GEOPROCESSING?

An ESRI term...

Introduction to Topic

From ESRI's Help:

"Geoprocessing is for everyone that uses ArcGIS. Whether you're a beginning user or a pro, geoprocessing will become an essential part of your day-to-day work with ArcGIS.

The fundamental purposes of geoprocessing are to allow you to automate your GIS tasks and perform spatial analysis and modeling. Almost all uses of GIS involve the repetition of work, and this creates the need for methods to automate, document, and share multiple-step procedures known as workflows. Geoprocessing supports the automation of workflows by providing a rich set of tools and a mechanism to combine a series of tools in a sequence of operations using models and scripts...." - ...READ MORE.

Why we're Covering it

Geoprocessing is what helps make you efficient in your spatial analyses. Whether its combining multiple tools into one using model builder, batch processing a large quantity of data, writing some simple Python scripts, or leveraging the functionality of the Results window, geoprocessing is what can help you move from a novice GIS user, to a highly proficient power user.

Learning Outcomes

This topic supports primary learning outcomes 1, 2, 3 and 4 for the course.

http://gis.joewheaton.org/topics/geoprocessing
TYPES OF GEOPROCESSING IN ARCGIS

- Tools
- Models
- Scripts
- Add-Ins
- Plug-Ins

- These differ from some of the Toolbars you’ve used...
PLACES TO GET GEOPROCESSING TOOLS

- Toolbox
- ArcGIS Resource... Gallery
- From Specific Places...
LOTS OF WAYS TO ACCESS A TOOL

Click the tool name in the Search window

Enter values for the tool’s parameters

Or double-click the tool in the Catalog window

Click OK to execute the tool
WHEN A TOOL RUNS...

• Be patient...
• Two places to track status:
  – Progress bar
  – Results Window!
• Use that results window!
A Plethora of Useful Information…

Keeps track of all past geoprocessing commands!
Also… double click any...
Troubleshoot
There are four levels of environment settings:

1. **Application level** settings are the default settings that will be applied to any tool when it is executed.

2. **Tool level** settings are applied to a single run of a tool and override the application level settings.

3. **Model level** settings are specified and saved with a mode and override tool level and application level settings.

4. **Model process level** settings are specified at the model process level, are saved with the model, and override model level settings.
ENVIRONMENT SETTINGS

Tool environment settings

Tool environment settings inherit from application environment settings: when you open a tool's dialog box and click the **Environments** button, the application environment settings are used as the initial values for the tool's environment settings.

**Note:** Tool environment settings only apply to the current run of the tool and do not update the application environment settings.
EVERY TOOL HAS ENVIRONMENT SETTINGS

- Tools validate parameter values as you enter them...
- They also can override environment settings

[Diagram showing error and warning icons for more information]

- Error: tool will not execute
- Parameter value required
- Warning: tool may have undesired results
- No icon: optional parameter

[Diagram showing how to click the icon to open the information dialog and how to click to close the information dialog]
BRING THEM UP... & EXPAND TO USE

Environment settings specified in this dialog box are values that will be applied to appropriate results from running tools. They can be set hierarchically, meaning that they can be set for the application you are working in, so they apply to all tools; for a model, so they apply to all processes within the model; or for a particular process within a model. Environments set for a process within a model will override all other setting, and environments set for all processes in a model will override those set in the application.

Changing the default settings that will be used is a prerequisite to performing geoprocessing tasks. You may only be interested in analyzing a small piece of a geographic area, such as changing the extent for results, or you may want to write all results to a specific location (for example, changing the current workspace or the scratch workspace).
OUTPUT COORDINATE SYSTEM

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This is how you force grid concurrency

Extent -> Limits

Snap... aligns
RECALL MASKED EXTENTS

- Rasters that have the same masked extents, simply have the same nodata cells
- The mask can be derived from a polygon or a raster
- A concurrent raster mask is the most accurate!

From: help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/001w0000001t000000

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WHERE TO LEARN MORE ABOUT GEOPROCESSING

Additional Resources

Geoprocessing in ArcGIS

- Geoprocessing ArcGIS Resource Center - This is the main hub of information on Geoprocessing and getting yourself up to speed.
- The Geoprocessing Forum - Trying to do something with Geoprocessing and having trouble? Try posting a thread or searching this forum.
- Geoprocessing Help - An overview of Geoprocessing in ArcGIS
- Using the Results Window - An essential new feature of Geoprocessing in ArcGIS

Batch Processing

- A quick Tour of Batch Processing - ArcGIS 10 Help topic

Finding Existing Tools and Scripts

- Geoprocessing Model and Script Tool Gallery - A hub of tools you can download and install in ArcGIS that other users have made. Very useful!
- See also this week’s lab Tutorial Topic 1

Geoprocessing with Model Builder

- Designing and Building Geoprocessing Tools - This video walks you through the basics of building Geoprocessing Tools using Model Builder in ArcGIS 10.
- A quick tour of creating tools with ModelBuilder - ArcGIS 10 Help Tutorial

Add-Ins

- Add-Ins for ArcGIS 10 - Add-Ins are a new feature in ArcGIS. This video describes them.
- Add-Ins Blog

Plug-Ins

Plug-Ins are typically tool-bars that are installed externally and produced by someone other than ESRI, to work

- <- Links on our website
- Plus,
  - Other Classes
  - ESRI Courses
  - ESRI Tutorials

http://gis.joewheaton.org/topics/geoprocessing#TOC-Additional-Resources
TODAY’S PLAN...

I. Geoprocessing

II. ModelBuilder

III. Batch Processing
   I. A right-click away
   II. Scripting
THE MODELBUilder INTERFACE

- ModelBuilder window: where you edit, test and run models

MODEL ELEMENTS:

- **Variables**: Variables are elements in a model that hold a value or a reference to data stored on disk. There are two types of variables:
  - **Data**: Data variables are model elements that contain descriptive information about data stored on disk. Properties of data that are described in a data variable include field information, spatial reference, and path.
  - **Values**: Value variables are values such as strings, numbers, Booleans (true/false values), spatial references, linear units, or extents. Value variables contain anything but references to data stored on disk.

- **Connectors**: Connectors connect data and values to tools. The connector arrows show the direction of processing. There are four types of connectors:
  - **Data**: Data connectors connect data and value variables to tools.
  - **Environment**: Environment connectors connect a variable containing an environment setting (data or value) to a tool. When the tool is executed, it will use the environment setting.
  - **Precondition**: Precondition connectors connect a variable to a tool. The tool will execute only after the contents of the precondition variable are created.
  - **Feedback**: Feedback connectors connect the output of a tool back into the same tool as input.
THE MODELBUILDER INTERFACE, CONT.

- Model elements have 3 states
- Not ready to run (parameters aren’t defined)
  
  ![Input → tool → output](http://www.utdallas.edu/~briggs/poec6382/custom.ppt)  
  
  Usually referred to as Derived Data
- Ready to run (all elements are colored)
  
  ![Input → tool → output](http://www.utdallas.edu/~briggs/poec6382/custom.ppt)
- Already run (elements are colored and shaded)
  
  ![Input → tool → output](http://www.utdallas.edu/~briggs/poec6382/custom.ppt)
TODAY’S PLAN...

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IV. Python Scripting
V. Efficiency
BRUTE FORCE...

• If you do something once or twice, brute force may suffice...

• If you start doing it more than that, make yourself a tool
  – Limits opportunity for sloppy mistakes
  – Makes
  – If good enough, share it with others...
BATCH PROCESSING

- I got to do this same thing 100 times
- AGHHH
- Brute force or Batch Process?
- Use right-click in Arc Toolbox and click ‘batch’
- Write a script that loops through same thing (input varies)
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ANY GEOPROCESSING TASK:

• That you think you want to do more then once...
• Just right click...
THEN.... FILL OUT BATCH GRID

- Add as many rows as you want (batch)...
- Double click on each cell to fill out...
- Copy and Paste from above.
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SCRIPTING IN GIS

• Sequences of GIS operations that can be stored and shared
  • Native languages: Arc Macro Language, Avenue
  • Software independent languages such as Visual Basic for Applications, Perl, or Python
  • a model can be written and executed as a script

• Scripts can be manipulated visually
  • e.g., through ESRI's ModelBuilder
PROGRAMMING?

- Lots of languages (syntax is critical to speak)
- Loops (for or do)
- Conditional (if, then, else)
Simple Loops

```
LOOP
    EXIT [WHEN <condition>] ;
END LOOP;
```

```
SQL> declare
    2    counter number := 0;
    3    begin
    4       LOOP
    5           counter := counter + 1;
    6           dbms_output.put_line(counter);
    7           EXIT WHEN counter = 5;
    8       END LOOP;
    9    end;
   10 /
```

PL/SQL procedure successfully completed.

Initialize counter!

Use the EXIT statement to exit loop
BUT I DON’T KNOW HOW TO CODE?

- Three simple tricks to learning:
  1. Build a model (visually) and then ‘Export -> To Python Script…’
  2. Try Geoprocessing Results -> ‘Copy as Python Snippet…’
  3. Python scripting window and help!
1. OPEN IT UP... AND READ IT...

- Try and run it at command prompt!
2. COPY AS PYTHON SNIPPET

• The snippet shows the syntax for any geoprocessing command you just ran...

```python
# Replace a layer/table view name with a path to a dataset (which can be a layer file) or create the layer/table view within the script
# The following inputs are layers or table views: "ShearZones", "Velocity_All"
arcpy.gp.zonalStatistics_sa("ShearZones","OBJECTID","Velocity_All","C:/Users/Joe Wheaton/Documents/ArcGIS/Default.gdb/ZonalSt_Shear","MEAN","DATA")
```
3. PYTHON WINDOW

• Start typing... & let auto-complete help

• Then tab select then tab... Type dot `.`
3. PYTHON WINDOW

- Start typing first few letters of command...

- Then tab select then tab... Type `,` & fill out:
3. PYTHON WINDOW

• Then run it...

```python
>>> arcpy.Clip_analysis
("Points","ShearZones","dummy.shp")
<Result 'C:Users\Joe Wheaton\Documents\ArcGIS \dummy.shp'>

>>> 
```
JUST PLAY....

• If you really want to learn this stuff:
  – Find a problem you need to solve, have a play, try to bolt pieces together, try to get it to work
  – Lots of help and forums and examples to draw off of

• OR:
  – Take Python Class in Fall (WILD 6900) – 5 week espresso course
  – Take Ethan White’s BIOL 4040/6040 – ‘Python Programming for Biologists’ in Fall
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