Applications of Python Scripting: Creating Custom Map Books in ArcGIS 10

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Outline

- Identify Key Changes in Map Book Production
- VBA vs. Python – Why it's Easier
- Introduce the Arcpy Mapping Module
- Introduce Data Driven Pages
- Breakdown of Custom Scripts and their Map Components
- Examples of the Finished Product
- Resources
- Contact Information
Changes in Mapbook Production

- For previous years we used lengthy VBA Code
- 246 Lines Total...
- Code was harder to customize and manipulate
Why Python Makes Things Easier....

- Less code to write
- Large well rounded module library that simplifies and shortens the amount of code written
- Dynamically typed
- Scripts can be published as geoprocessing tools and used again for future projects
- The ArcPy module builds on and is the successor to the arcgisscripting module which could be used in previous versions of Arc
The ArcPy Mapping Module

- **ArcPy provides access to:**
  - Geoprocessing Tools
  - Functions
  - Classes
  - Other Modules

- This access allows the user to create simple or complex workflows quickly.

- Each python script used for producing a map or map book will begin with by importing the arcpy module in line 1.

  ex: `import arcpy`
How ArcPy is Organized

Modules, Functions, Tools, & Classes

- **Module**
  - Python file that includes functions and classes
  - Can be shared with others working on similar projects
  - `arcpy.mapping` is the module we will focus on

- **Function**
  - Performs a specific task
  - Incorporated into a larger programs with other functions to create custom scripts
  - All **geoprocessing tools** are **functions**
  - Examples of functions within this presentation:
    - `arcpy.RefreshActiveView`
    - `arcpy.mapping.ExportToPDF()`
    - `arcpy.mapping.ListLayerElements`

- **Class**
  - Blueprints or framework of how something is created
  - Can be used to create objects (instances)
  - `dataFrame.extent` is a property of the **dataFrame class** in this presentation
A Few Key Elements within a Map Book Script

- **Map:**
  - MapDocument

- **dataframe:**
  - ListDataFrames, dataFrame.extent

- **Cursor:**
  - arcpy.SearchCursor("Layer")

- **Extent:**
  - row.shape.extent

- **textElement:**
  - Many, many options to create custom layouts

- **outDir:**
  - Output directory used when creating multipage pdf's

- **finalPdf:**
  - arcpy.mapping.PDFDocumentCreate(finalPDF_filename)
    - use when creating multipage pdf's

- **mxdPath**
  - mxdPath = r"C:\MapbookName\Mapbook.mxd"
Data Driven Pages

How it works:

- A feature layer or index layer divides the map into sections and generates a map page per index feature.

- A single layout defines the map composition and it consistent for all map pages.

- Dynamic elements of the layout will change with each page.

- Maps can be exported as individual pages or multipage PDFs.

- Title pages, indices, and any other supplemental information can be appended with a few simple lines of code.
Choose Your Best Fit...

Can be Created from:
- A grid (grid index features)
  - Uses a set scale for each map page based on the size of each grid cell.
- A route (strip map index features)
  - The rotation setting can be used to center the each strip (linear feature) from bottom to top in the center of the page.
- Map features
  - The scale will change depending on the map feature.
  - Ex: county, state, lake, city etc.

Additional Settings:
- Spatial Reference – The map will use the spatial reference of the main data frame unless otherwise state by the user in the DDP setup.
  - For More information on setting the spatial reference visit the ERSI Arc 10 Help desktop ‘Creating Data Driven Pages’
- Inset maps can also be included using extent rectangles within the DDP map set that will change dynamically for each map page
How to set up Data Driven Pages

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How to Setup Data Driven Pages

- The tools are part of the data driven pages toolset.
  - The ‘page name’, ‘page number’ and a given ‘page count’ can be added and controlled from the Data Driven Pages Toolbar.

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- Two dynamic text elements are set with the Data Driven Pages in this example
  - The name “Austin – 1” is derived from the CITY_NAME field of the Index Grid
  - The Page number is derived from the PAGE_NUM field of the index grid.
  - Both elements are added to the page through the Data Driven Pages toolbar below:
Setup: Definition

- **Data Frame:**
  - Choose the data frame being displayed by the map

- **Layer:**
  - Grid, Strip, or Feature Layer for which each record and extent will produce a single map page

- **Name Field:**
  - Will define the dynamic text included as the ‘Page Text’ → ‘Data Driven Page Name’ element

- **Sort Field:**
  - Field used by the DDP toolset to loop through the layer (grid, strip or feature)

- **Rotation:**
  - Can be set when the feature layer used to create each map has different orientations for different map pages

- **Spatial Reference:**
  - Automatically takes the spatial reference of the main data frame unless otherwise noted.

- **Page Number:**
  - Can be set by a field from the layer used to create each map page; Will define the dynamic text included as the ‘Page Text’ → ‘Data Driven Page Number’ element

- **Starting page Number:**
  - Map pages can be set to begin printing as a specific number; this will leave space for titles, indices, and supplementary graphs or other information
Setup: Extent

- **Best Fit**
  - Use this setting for Strip or Feature Maps using a feature layer with different scales and orientations
  - Gives you the option to set your margins

- **Center and Maintain Current Scale**
  - Use this option when using symmetrical grids or similarly sized features with the same scale for all map pages

- **Data Driven Scale**
  - Can be derived from scale values within the index layer. Valid fields will be either short integer, long integer, float, or double
How to Create Your Pages...

Two options:

1. Run from the export map option
   - Must choose all pages from the ‘Options’ → ‘Pages’ Tab from File → Export Map menu
   - This will give you a separate PDF page for each map in your map book

2. Run a custom data driven pages script through the python window with customizations and appended pages
   - This will create a single map book with appended pages such as title, index, and supplemental information and maps.
<table>
<thead>
<tr>
<th>Option (1)</th>
<th>Option (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports Individual PDFs based on settings from 'Page and Print Setup'</td>
<td>Exports a Single Multi-page PDF with appended pages</td>
</tr>
<tr>
<td></td>
<td>Images Removed to reduce file size; will be shown in presentation</td>
</tr>
</tbody>
</table>
Data Driven Pages Script

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Custom Data Driven Pages Script:

Exports Pages and Appends Additional Information...

Example of the Final Data Driven Pages Custom Script Output Map

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Custom Scripts Based on Map Elements

Custom Maps

- For map books with many variable text elements and customizations a simple python script will suffice.

- For the TxDOT County Mapbook a python script is used to export and update various map text elements across the page.

- This option works best if you want complete control over your customizations and style.
- What appear to be simple static text elements will be defined and updated based upon the index table and the python script
- Arrows at edges define the adjacent map page numbers
- “Page –”
  - Will be filled with the page number from the STATE_ID field
- “Counties:”
  - Will be filled in with Counties included on each map page and populated from the counties field of the index
Setup: Dynamic Text Elements

- Adjacent page numbers are set by the North, South, East and West fields.
- Page Number is set by a static text element + the STATE_ID field.
- The Counties shown per page is set a static text element “Counties:” + the ‘Counties’ field.

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Custom Map Layouts: Setting Up Your Map

1) Fixed extents do not work, you will get an extent error when running your code.
2) Center your text elements so they do not move.
   - Page numbers will be left aligned and padded with spaces

3) Remember your anchor points
   - Can use the `str.center(textelement)` function to pad your page numbers to get even spacing for each page number whether it is 1, 2, 3 or more characters
     - **Example:** ‘Page- 1’ ‘Page- 11’ ‘Page-111’
       - All page numbers have the same text length independent of their own length by using the `str.center(textelement)` code

4) If your data frame is the same size as your grid then you will not have to set a scale in your python code, if it is not an exact fit you will add a scale reference in the script before the refresh active view and before the pdf is exported.
Text Elements

Examples from the TxDOT County Map Book:

North (adjacent page element)
- Text Element determined by the ‘North’ Field of the index grid.
- The same theory applies to South, East and West adjacent page elements

Counties
- Fixed Text “Counties:” + Variable Text Element determined by the ‘Counties’ Field of the index grid.

Page
- Fixed Text “Page –” + variable text element from ‘State_ID’ field of the index grid.

For Pages with no adjacent map
- Text element is set to “-” by a line of code in the script.
County Map Book Code

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Custom Script for the 2010 County Map Book

Creates a set of numbered map pages with custom text and layout elements.

Sample County Mapbook Example

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Some Basic Syntax

- Python code is very sensitive to its indentation, in fact it will not work if even one indentation error exists.

- You cannot concatenate string variables to numeric variables. Must set numeric variables as strings in your code.
  
  ```python
  textElement.text = "Page-" + (str(row.STATE_ID))
  ```

- `=` signs set your variables
  - Use `=` when setting your location variables (Directories/Paths)
    ```python
    outDir = r"C:\NewMap"
    ```
  - Directories/Paths can also be written as:
    ```python
    outDir = "C:\\NewMap"
    ```

- `==` is equivalent to ‘is equal to’ and Semicolons are equal to ‘then’
  ```python
  if textElement.name == "West":
      textElement.text = row.West
  if row.West == 0:
      textElement.text = "-"
  ```
Resources

- How to Create Custom Tools and Toolbars in Arc 10
- How to Add/Run Python Scripts in Arc 10
- ESRI Arc 10 Desktop Help
  - Data Driven Pages
  - Create Grid Index Features
  - What is ArcPy?
  - Importing ArcPy
  - Essential ArcPy Vocabulary
  - A quick Tour of ArcPy
- Python Resources
  - http://www.python.org/about/gettingstarted/
  - http://www.effbot.org/zone/librarybook-index.htm
  - http://diveintopython.org/

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For further information and to view the data we maintain visit:

Transportation, Planning and Programming Division
http://www.txdot.gov/about_us/administration/divisions/tpp.htm

The Online County Map Book

The Statewide Planning Map