



Automate Your GIS Using Python

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What is Python and ArcPy?

- Python is a free, cross-platform, open-source programming language that is both powerful and easy to learn. It is widely used and supported. To learn more about Python, visit python.org.
- Python was introduced to the ArcGIS community with ArcGIS 9.0.
- ArcPy is a Python site package that provides a useful and productive way to perform geographic data analysis, data conversion, data management, and map automation with Python.
- ArcPy includes modules covering other areas of ArcGIS. ArcPy is supported by a series of modules, including a [data access module](#) (arcpy.da), a [mapping module](#) (**arcpy.mapping**), an [ArcGIS Spatial Analyst extension module](#) (**arcpy.sa**), and an [ArcGIS Network Analyst extension module](#) (arcpy.na).

Source

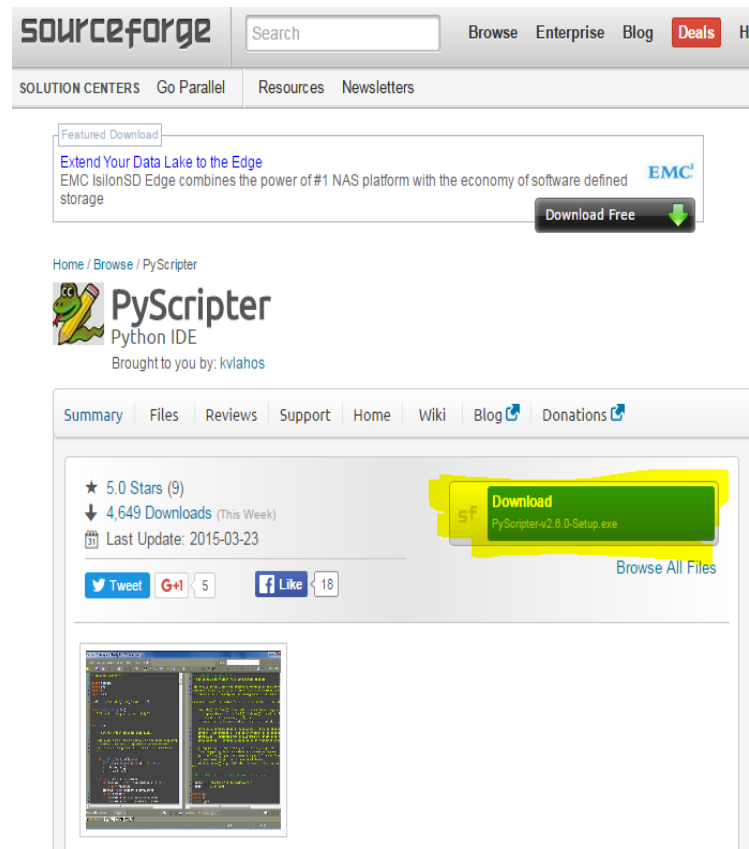
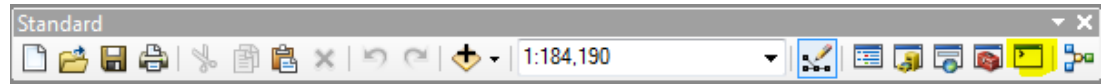
<http://desktop.arcgis.com/en/arcmap/latest/analyze/python/what-is-python-.htm>

<http://pro.arcgis.com/en/pro-app/arcpy/get-started/a-quick-tour-of-arcpy.htm>



How to work with ArcPy?

- ArcGIS's Python Command Window (Available in ArcMap and ArcGIS Pro)
- Develop Python scripts using an integrated development environment (IDE) such as PyScripter



Running a Simple ArcToolbox Tool from the ArcPY Command Window

- To figure out the syntax search for the tool
- Right click on the tool and select Help
- Scroll Down to bottom for sample code for the Python Window and stand alone script
- **Tip:** You can drag datasets and or workspaces from the ArcCatalog to the Python window to get the file paths

Code Sample

Buffer example (Python window)

The following Python window script demonstrates how to use the Buffer tool.

```
import arcpy
arcpy.env.workspace = "C:/data"
arcpy.Buffer_analysis("roads", "C:/output/majorrdsBuffered", "100 Feet", "E
```

Buffer example (stand-alone script)

Find areas of suitable vegetation that exclude areas heavily impacted by major roads:

```
# Name: Buffer.py
# Description: Find areas of suitable vegetation which exclude areas heavil

# import system modules
import arcpy
from arcpy import env

# Set environment settings
env.workspace = "C:/data/Habitat_Analysis.gdb"

# Select suitable vegetation patches from all vegetation
veg = "vegtype"
suitableVeg = "C:/output/Output.gdb/suitable_vegetation"
whereClause = "HABITAT = 1"
arcpy.Select_analysis(veg, suitableVeg, whereClause)

# Buffer areas of impact around major roads
roads = "majorrds"
roadsBuffer = "C:/output/Output.gdb/buffer_output"
distanceField = "Distance"
sideType = "FULL"
endType = "ROUND"
dissolveType = "LIST"
dissolveField = "Distance"
arcpy.Buffer_analysis(roads, roadsBuffer, distanceField, sideType, endType,

# Erase areas of impact around major roads from the suitable vegetation pat
eraseOutput = "C:/output/Output.gdb/suitable_vegetation_minus_roads"
xyTol = "1 Meters"
arcpy.Erase_analysis(suitableVeg, roadsBuffer, eraseOutput, xyTol)
```

ArcPY Syntax and Parameter Tips

Paths

Programming languages, such as Python, treat a backslash (\) as an escape character. For instance, \n represents a line feed, and \t represents a tab. When specifying a path, a forward slash (/) can be used in place of a backslash. Two backslashes can be used instead of one to avoid a syntax error. A string literal can also be used by placing the letter r before a string containing a backslash so it is interpreted correctly.

```
import arcpy

arcpy.GetCount_management("c:/temp/streams.shp")
arcpy.GetCount_management("c:\\temp\\streams.shp")
arcpy.GetCount_management(r"c:\temp\streams.shp")
```

Required versus optional parameters

Tool parameters can be either required or optional. **Optional parameters are surrounded by braces { };** required parameters are not.

Parameter Type	Symbol	Meaning
Required		Required parameter. These parameters are always the first parameters in the command. You must provide a value for required parameters.
Optional	{ }	Optional parameter. These parameters always follow the required parameters. If you don't enter a value for an optional parameter, the default value is calculated and used. A parameter's default value can be found in the tool's help.

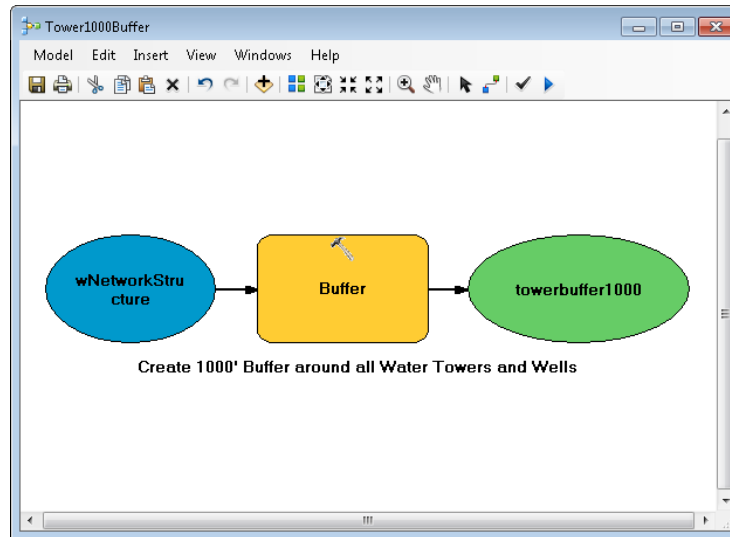
Parameter types

ArcPy Command Window Demo (Buffer Command)



Building an ArcPy script from a model

- Create the model in Model Builder
- Save the Model
- Click the Model – Export – To Python Scrip
- **Tip:** The script won't run "as-is" if you have any variables in the model that were created by dragging layers from the Table of Contents.



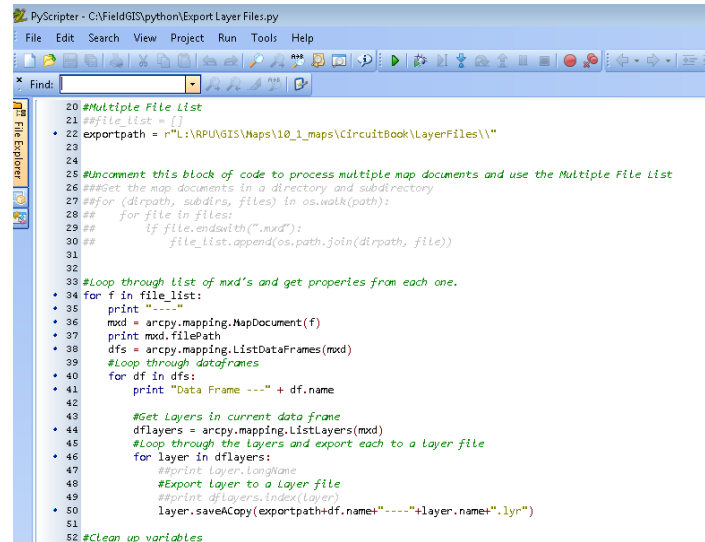
```
1 # -*- coding: utf-8 -*-
2 #
3 # tower1000buffer_fullpath.py
4 # Created on: 2016-02-24 21:42:25.00000
5 # (generated by ArcGIS/ModelBuilder)
6 # Description:
7 # -----
8
9 # Import arcpy module
10 import arcpy
11
12
13 # Local variables:
14 wNetworkStructure = "C:\\FieldGIS\\rpugis_gdb\\rpugis.gdb\\Water_Distribution_Network\\wNetworkStructure"
15 towerbuffer1000 = "C:\\FieldGIS\\python\\pythondemo.gdb\\towerbuffer1000"
16
17 # Process: Buffer
18 arcpy.Buffer_analysis(wNetworkStructure, towerbuffer1000, "1000 Feet", "FULL", "ROUND", "NONE", "")
19
20
```

Model Builder to Python Demo



Building a Script in PyScripter

- Import the ArcPy and other necessary modules
- Keep in mind that Python is case sensitive
- Comments can be made starting a line with a # sign
- Indentation is used to organize blocks of code (Ex. If and For statements)
- Make use of the Debug tools and set breakpoints
- Utilize the IDE windows under the View menu Pulldown
- Be aware of Python Escape Sequences.



```
PyScripter - C:\FieldGIS\python\Export Layer Files.py
File Edit Search View Project Run Tools Help
Find:
20 #Multiple File List
21 ##file_list = []
22 exportpath = r"L:\RPUGIS\Maps\10_1_maps\CircuitBook\LayerFiles\\"
23
24
25 #Uncomment this block of code to process multiple map documents and use the Multiple File List
26 ##Get the map documents in a directory and subdirectory
27 ##for (dirpath, subdirs, files) in os.walk(path):
28 ##     for file in files:
29 ##         if file.endswith(".mxd"):
30 ##             file_list.append(os.path.join(dirpath, file))
31
32
33 #Loop through list of mxd's and get properties from each one.
34 for f in file_list:
35     print "----"
36     mxd = arcpy.mapping.MapDocument(f)
37     print mxd.filePath
38     dfs = arcpy.mapping.ListDataFrames(mxd)
39     #Loop through dataframes
40     for df in dfs:
41         print "Data Frame ----" + df.name
42
43     #Get Layers in current data frame
44     dflayers = arcpy.mapping.ListLayers(mxd)
45     #Loop through the layers and export each to a layer file
46     for layer in dflayers:
47         #Print: Layer, longName
48         #Export Layer to a Layer file
49         #Print dflayers.index(layer)
50         layer.saveACopy(exportpath+df.name+"----"+layer.name+".lyr")
51
52 #Clean up variables
```

Escape Sequences

This all of the escape sequences Python supports. You may not use many of these, but memorize their format and what they do anyway. Try them out in some strings to see if you can make them work.

ESCAPE	WHAT IT DOES.
<code>\</code>	Backslash (\)
<code>'</code>	Single-quote (')
<code>"</code>	Double-quote (")
<code>\a</code>	ASCII bell (BEL)
<code>\b</code>	ASCII backspace (BS)
<code>\f</code>	ASCII formfeed (FF)
<code>\n</code>	ASCII linefeed (LF)
<code>\N(name)</code>	Character named name in the Unicode database (Unicode only)
<code>\r</code>	Carriage Return (CR)
<code>\t</code>	Horizontal Tab (TAB)
<code>\uxxxx</code>	Character with 16-bit hex value xxxx (Unicode only)
<code>\Uxxxxxxxx</code>	Character with 32-bit hex value xxxxxxxx (Unicode only)
<code>\v</code>	ASCII vertical tab (VT)
<code>\ooo</code>	Character with octal value ooo
<code>\xhh</code>	Character with hex value hh

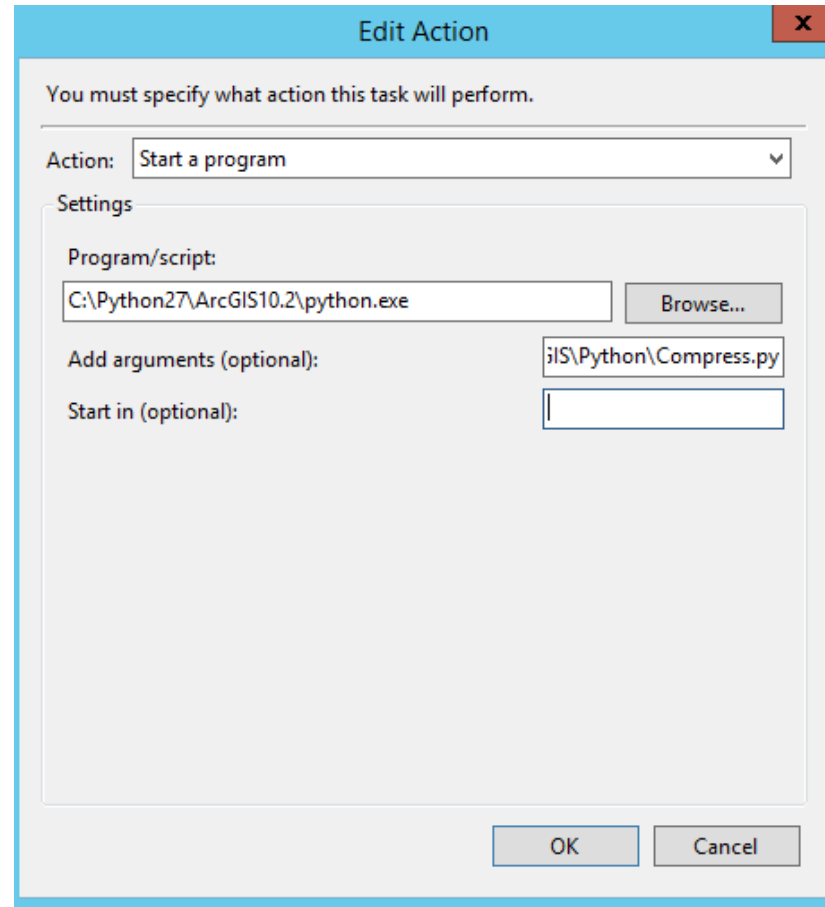
Scripts used at RPU

- Geodatabase Maintenance Scripts
 - Reconcile Versions.py
 - Compress.py (Runs as a scheduled Task)
- Map document changes/exports
 - Export Layers.py
 - Update Definition Queries.py
 - Export map documents to PDF.py



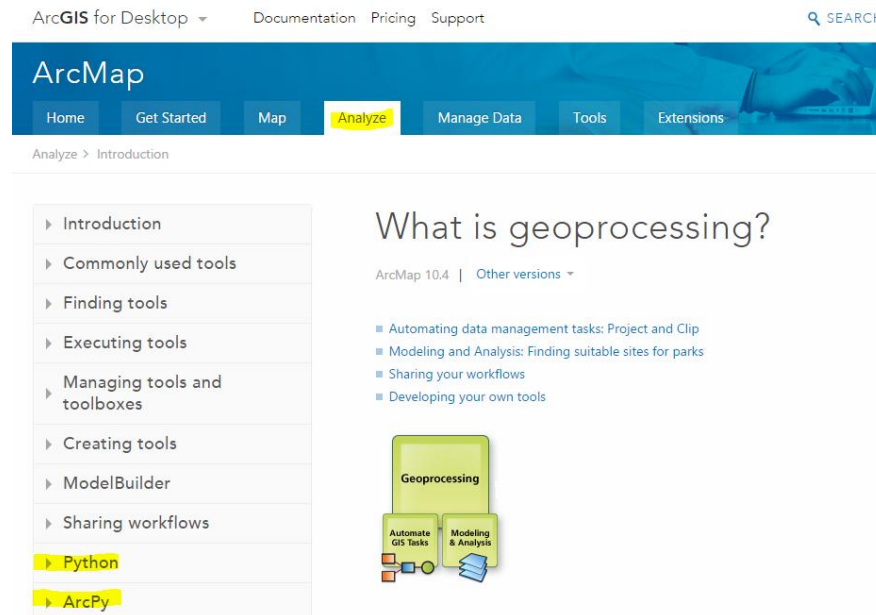
Running a Python Script using Task Scheduler

- Open Task Scheduler and create a new task
- Under the Action Tab create a new action “Start a program”
- Browse for your python.exe
- In the Add arguments text box put the path and filename of the python script you want to run



Where to find ArcPy documentation and examples?

- ArcToolbox Desktop Help – Geoprocessing Tools
- ArcGIS for Desktop online help (Click the Analyze Tab)
- <http://desktop.arcgis.com/en/arcmap/latest/analyze/main/what-is-geoprocessing.htm>



The screenshot shows the ArcGIS for Desktop online help interface. At the top, there are navigation links for 'ArcGIS for Desktop', 'Documentation', 'Pricing', and 'Support', along with a search bar. Below this is the 'ArcMap' header with a navigation menu including 'Home', 'Get Started', 'Map', 'Analyze', 'Manage Data', 'Tools', and 'Extensions'. The 'Analyze' tab is selected. The main content area is titled 'What is geoprocessing?' and includes a list of sub-topics: 'Introduction', 'Commonly used tools', 'Finding tools', 'Executing tools', 'Managing tools and toolboxes', 'Creating tools', 'ModelBuilder', 'Sharing workflows', 'Python', and 'ArcPy'. The 'Python' and 'ArcPy' items are highlighted in yellow. To the right of the list, there is a section titled 'What is geoprocessing?' with a sub-header 'ArcMap 10.4 | Other versions' and a list of four bullet points: 'Automating data management tasks: Project and Clip', 'Modeling and Analysis: Finding suitable sites for parks', 'Sharing your workflows', and 'Developing your own tools'. Below the text is an illustration of a 'Geoprocessing' box containing 'Automate GIS Tasks' and 'Modeling & Analysis' sub-sections.