How and Why to use the ArcPy module instead of ArcMap

Clay Barrett

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GIS

OKSCAUG 2015

Ignite The Possibilities

Overview

- Who am I?
- What is Python?
- What is ArcPy?
- Why use it?
- How to use it

Clay Barrett

- OSU Cartography Services
  - GIS Technician
    - AAPG Mapping Projects
- Master of Science
  - Geography May 2015
    - Remote Sensing of Water Quality in Eastern Oklahoma

Apparent Reflectance Tool

- Success?!
  - Elapsed Time: 0 seconds
  - No output generated

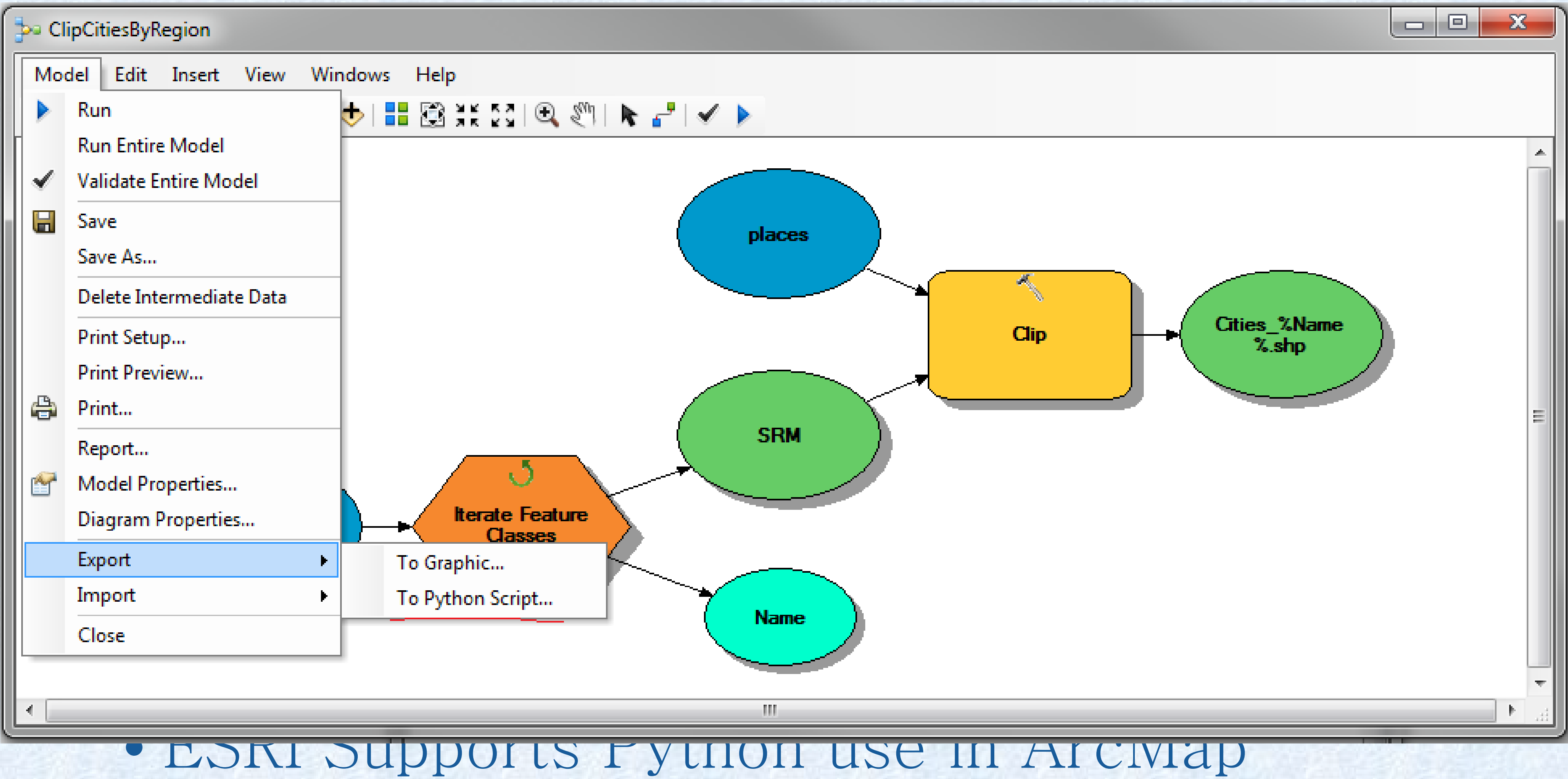
Thesis Data Processing

- 10 years of Landsat Images
  - 1,000 files
- 7 images per file (at least)
  - 7,000 images
- Clipped, Masked for water and cloud, and then converted
  - 28,000 images
- Sample 9 pixels per sample site (4-9)
  - 1,750,000 pixels to sample

There’s got to be a better way!

- 28,000 image manipulations
  - Not feasible to do by hand
  - ModelBuilder can help with a single operation, but not manage file manipulations between operations
- Decided to use Python
  - Process images
  - File operations
  - Summarize data across file types (dbf, csv, xcl, tif)
- How hard could it be?
  - $P_\lambda = \dfrac{\pi(L_\lambda - L_{haze})d^2}{ESUN_\lambda \cos(\pi \,/\, 180\ \theta_s)}$

Python



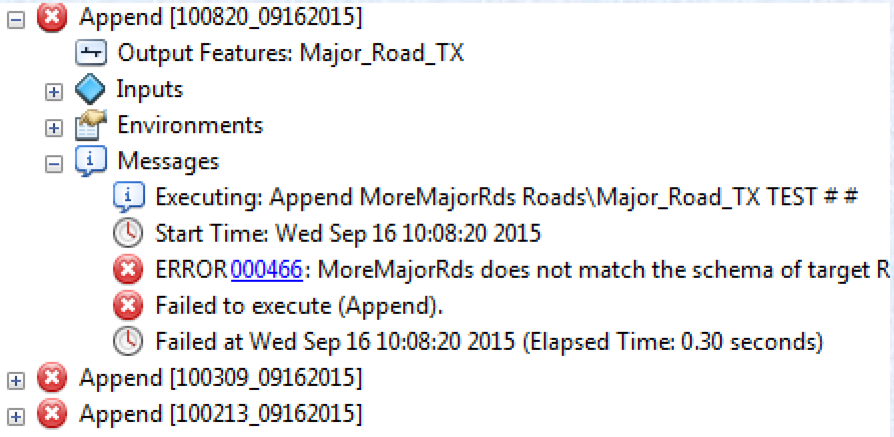
- ESRI Supports Python use in ArcMap
  - Since 9
  - Default from 10.0

ArcPy

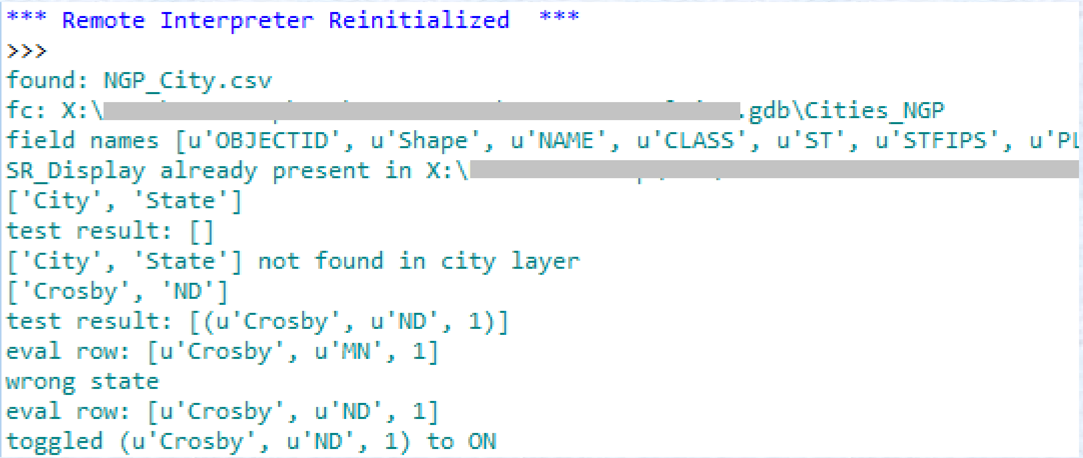
- A Custom Python Build with access to all ArcMap's functions
  - (Almost) Everything you can do in ArcMap can be called from a script
  - Arrived with 10.0
- Benefits
  - Better user control
  - Code is reusable
  - Faster than operations in ArcMap

ArcPy: User Control

- Success?!
  - Sometimes the Results information
- Error 99999
  - No useful information
- Good error codes
  - Sometimes you c
- Python
  - Print is your frie
  - Analyze every st

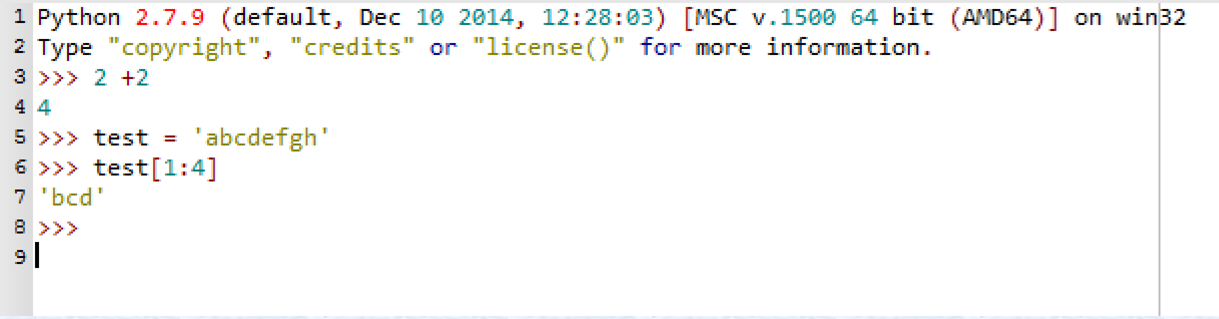


```
⊟ ☒ Append [100820_09162015]
      Output Features: Major_Road_TX
    ⊞ Inputs
    ⊞ Environments
    ⊟ Messages
         Executing: Append MoreMajorRds Roads\Major_Road_TX TEST # #
         Start Time: Wed Sep 16 10:08:20 2015
       ☒ ERROR 000466: MoreMajorRds does not match the schema of target R
       ☒ Failed to execute (Append).
         Failed at Wed Sep 16 10:08:20 2015 (Elapsed Time: 0.30 seconds)
⊞ ☒ Append [100309_09162015]
⊞ ☒ Append [100213_09162015]
```



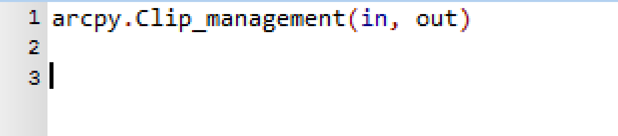
```
*** Remote Interpreter Reinitialized  ***
>>>
found: NGP_City.csv
fc: X:\[redacted].gdb\Cities_NGP
field names [u'OBJECTID', u'Shape', u'NAME', u'CLASS', u'ST', u'STFIPS', u'PL
SR_Display already present in X:\[redacted]
['City', 'State']
test result: []
['City', 'State'] not found in city layer
['Crosby', 'ND']
test result: [(u'Crosby', u'ND', 1)]
eval row: [u'Crosby', u'MN', 1]
wrong state
eval row: [u'Crosby', u'ND', 1]
toggled (u'Crosby', u'ND', 1) to ON
```

ArcPy: Code Reuse



```
Python 2.7.9 (default, Dec 10 2014, 12:28:03) [MSC v.1500 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> 2 +2
4
>>> test = 'abcdefgh'
>>> test[1:4]
'bcd'
>>>
```

- Not IDLE
  - Does not connect to Arcpy
  - Not suited to exporting code blocks
- Not the Python window
  - Copy/Paste not suited to expor
  - Save As instead



```
arcpy.Clip_management(in, out)
```

- Use an IDE
  - Integrated Development Environment
  - Designed to make coding easier
  - Like PyScripter (better coding tool)
  - Or PythonWin (arcpy autocomplete built-in)

ArcPy: Faster

- Non Graphical Interface
  - No GUI
  - No graphics
  - No load time
- No linked resources
- Still does require accessing the license manager

ArcPy: Drawbacks

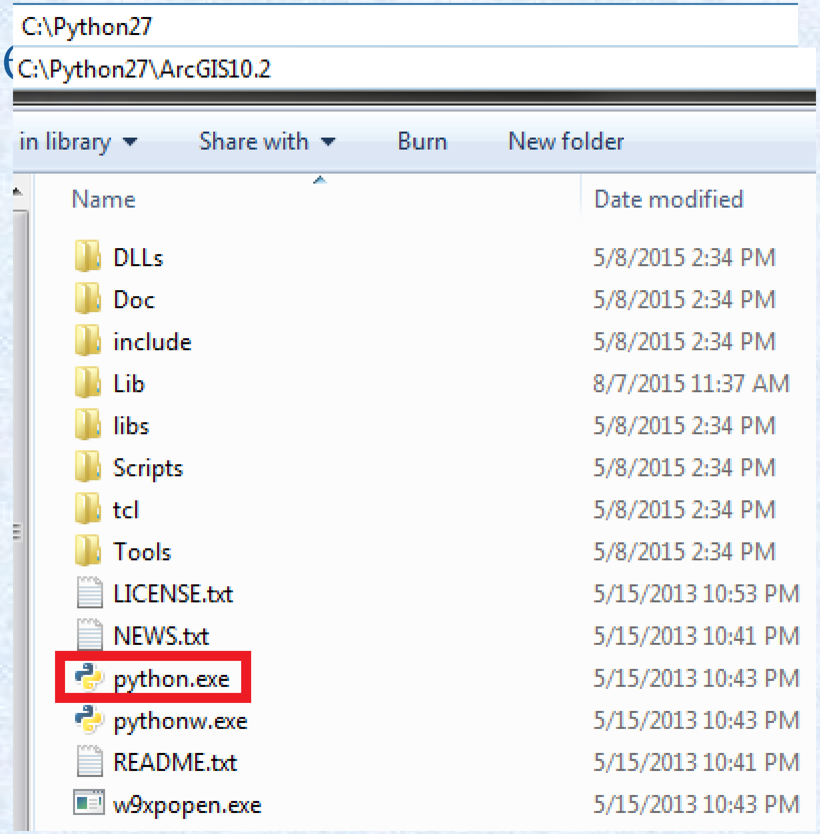
- DIY
  - Can’t be afraid to code, make mistakes, and learn new things
- Requires a bit of setting up to be efficient
- Still tied to ArcMap license
- Loss of autocomplete?
  - Direct use of layers is not reusable
  - ESRI docs contain the same information
  - Other online resources provide more help

Suitable Tasks

- Every Repetitive Task
  - Iterating through features
  - Clipping features to a Region of Interest
  - Creating new fields in attribute tables
  - Evaluating values in an attribute table
  - Moving/unpacking files
- The more you use it
  - The more you want to use it

How to ArcPy

- Python install not require
  - but if you do, pick 2.7
- ArcMap already installs ArcPy in the default Python directory

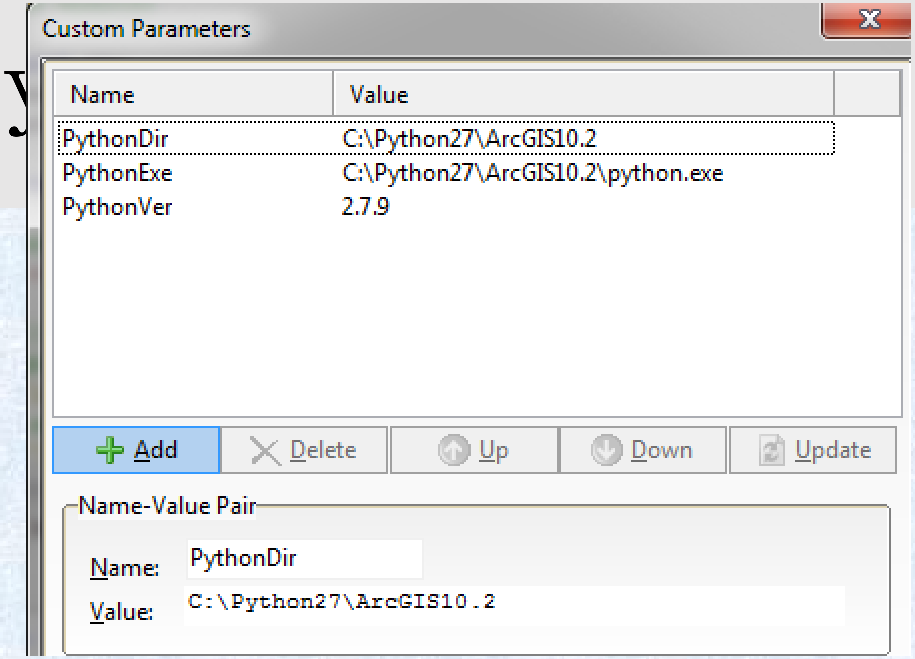


C:\Python27
C:\Python27\ArcGIS10.2

Name	Date modified
DLLs	5/8/2015 2:34 PM
Doc	5/8/2015 2:34 PM
include	5/8/2015 2:34 PM
Lib	8/7/2015 11:37 AM
libs	5/8/2015 2:34 PM
Scripts	5/8/2015 2:34 PM
tcl	5/8/2015 2:34 PM
Tools	5/8/2015 2:34 PM
LICENSE.txt	5/15/2013 10:53 PM
NEWS.txt	5/15/2013 10:41 PM
python.exe	5/15/2013 10:43 PM
pythonw.exe	5/15/2013 10:43 PM
README.txt	5/15/2013 10:41 PM
w9xpopen.exe	5/15/2013 10:43 PM

  - C:₩Python27₩ArcGIS10.2₩python.exe

How to ArcPy



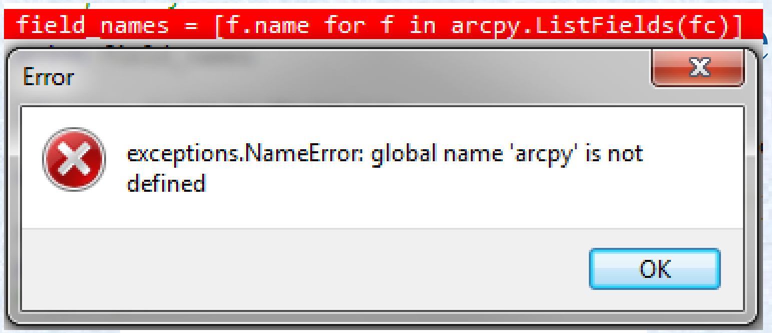
Name	Value
PythonDir	C:\Python27\ArcGIS10.2
PythonExe	C:\Python27\ArcGIS10.2\python.exe
PythonVer	2.7.9

Name-Value Pair

Name: PythonDir

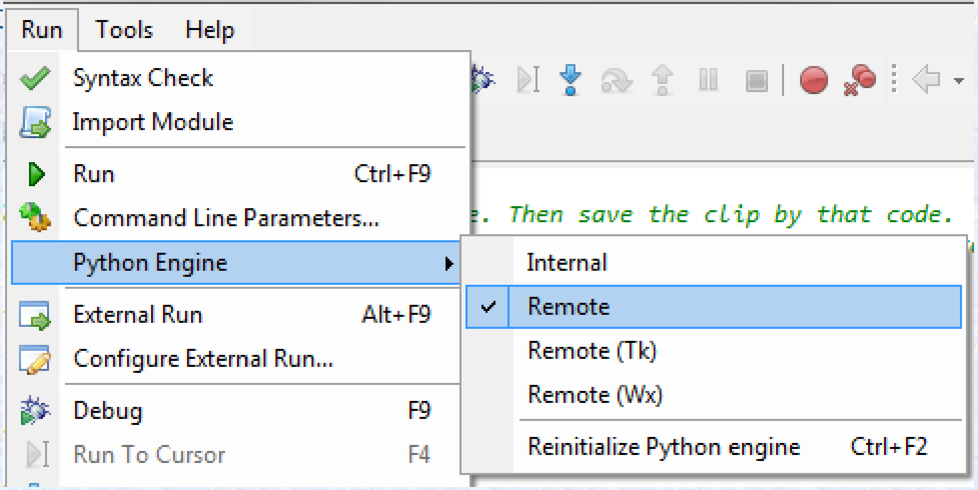
Value: C:\Python27\ArcGIS10.2

- Get an IDE
  - Install PyScripter
  - Run PyScripter 2.7
  - Set parameters
    - Tools/Options/Custom Parameters
  - Set to remote engine



```
field_names = [f.name for f in arcpy.ListFields(fc)]
```

exceptions.NameError: global name 'arcpy' is not defined



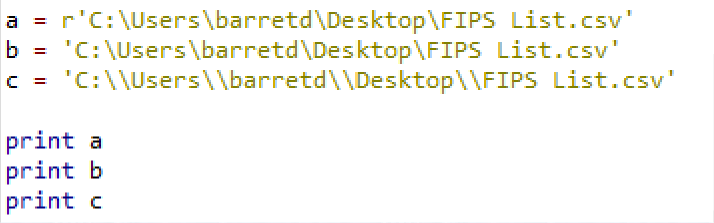
Python Engine: ✓ Remote

```
e. Then save the clip by that code.
```

- Run the code

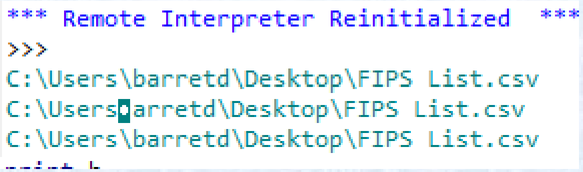
Pitfalls

- Syntax syntax syntax
- Software and human readable paths are not the same



```
a = r'C:\Users\barretd\Desktop\FIPS List.csv'
b = 'C:\Users\barretd\Desktop\FIPS List.csv'
c = 'C:\\Users\\barretd\\Desktop\\FIPS List.csv'

print a
print b
print c
```

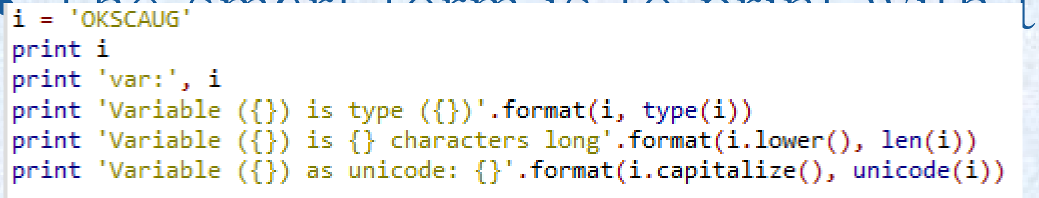


```
*** Remote Interpreter Reinitialized  ***
>>>
C:\Users\barretd\Desktop\FIPS List.csv
C:\Users□arretd\Desktop\FIPS List.csv
C:\Users\barretd\Desktop\FIPS List.csv
print b
```

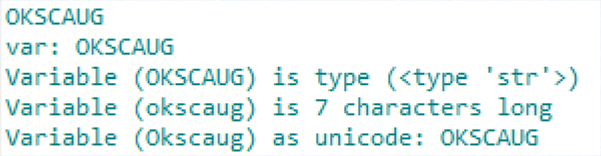
- Locks on GDB still matter
  - Cannot work in ArcMap on GDB while running scripts on it
  - You can have Catalog open to get file names, paths easily

Tips

- Print statements are your friend
  - The most basic form is <print i> where i is your variable
  - The smart form is to print with the format



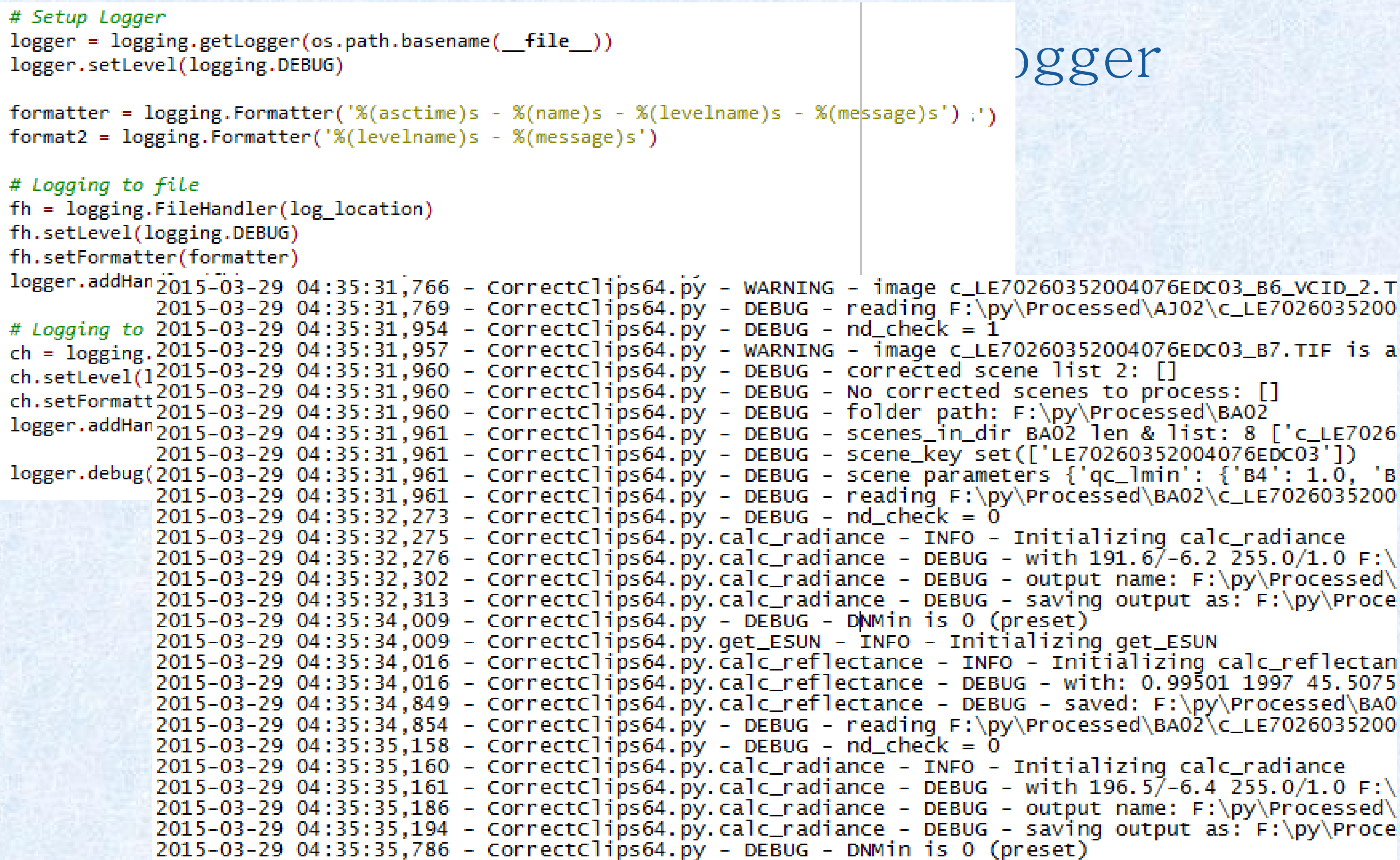
```
i = 'OKSCAUG'
print i
print 'var:', i
print 'Variable ({}) is type ({})'.format(i, type(i))
print 'Variable ({}) is {} characters long'.format(i.lower(), len(i))
print 'Variable ({}) as unicode: {}'.format(i.capitalize(), unicode(i))
```



```
OKSCAUG
var: OKSCAUG
Variable (OKSCAUG) is type (<type 'str'>)
Variable (okscaug) is 7 characters long
Variable (Okscaug) as unicode: OKSCAUG
```

Tips

ogger



```
# Setup Logger
logger = logging.getLogger(os.path.basename(__file__))
logger.setLevel(logging.DEBUG)

formatter = logging.Formatter('%(asctime)s - %(name)s - %(levelname)s - %(message)s') ;')
format2 = logging.Formatter('%(levelname)s - %(message)s')

# Logging to file
fh = logging.FileHandler(log_location)
fh.setLevel(logging.DEBUG)
fh.setFormatter(formatter)
logger.addHan

# Logging to
ch = logging.
ch.setLevel(l
ch.setFormatt
logger.addHan

logger.debug(
```

```
2015-03-29 04:35:31,766 - CorrectClips64.py - WARNING - image c_LE70260352004076EDC03_B6_VCID_2.T
2015-03-29 04:35:31,769 - CorrectClips64.py - DEBUG - reading F:\py\Processed\AJ02\c_LE7026035200
2015-03-29 04:35:31,954 - CorrectClips64.py - DEBUG - nd_check = 1
2015-03-29 04:35:31,957 - CorrectClips64.py - WARNING - image c_LE70260352004076EDC03_B7.TIF is a
2015-03-29 04:35:31,960 - CorrectClips64.py - DEBUG - corrected scene list 2: []
2015-03-29 04:35:31,960 - CorrectClips64.py - DEBUG - No corrected scenes to process: []
2015-03-29 04:35:31,960 - CorrectClips64.py - DEBUG - folder path: F:\py\Processed\BA02
2015-03-29 04:35:31,961 - CorrectClips64.py - DEBUG - scenes_in_dir BA02 len & list: 8 ['c_LE7026
2015-03-29 04:35:31,961 - CorrectClips64.py - DEBUG - scene_key set(['LE70260352004076EDC03'])
2015-03-29 04:35:31,961 - CorrectClips64.py - DEBUG - scene parameters {'qc_lmin': {'B4': 1.0, 'B
2015-03-29 04:35:31,961 - CorrectClips64.py - DEBUG - reading F:\py\Processed\BA02\c_LE7026035200
2015-03-29 04:35:32,273 - CorrectClips64.py - DEBUG - nd_check = 0
2015-03-29 04:35:32,275 - CorrectClips64.py.calc_radiance - INFO - Initializing calc_radiance
2015-03-29 04:35:32,276 - CorrectClips64.py.calc_radiance - DEBUG - with 191.6/-6.2 255.0/1.0 F:\
2015-03-29 04:35:32,302 - CorrectClips64.py.calc_radiance - DEBUG - output name: F:\py\Processed\
2015-03-29 04:35:32,313 - CorrectClips64.py.calc_radiance - DEBUG - saving output as: F:\py\Proce
2015-03-29 04:35:34,009 - CorrectClips64.py - DEBUG - DNMin is 0 (preset)
2015-03-29 04:35:34,009 - CorrectClips64.py.get_ESUN - INFO - Initializing get_ESUN
2015-03-29 04:35:34,016 - CorrectClips64.py.calc_reflectance - INFO - Initializing calc_reflectan
2015-03-29 04:35:34,016 - CorrectClips64.py.calc_reflectance - DEBUG - with: 0.99501 1997 45.5075
2015-03-29 04:35:34,849 - CorrectClips64.py.calc_reflectance - DEBUG - saved: F:\py\Processed\BA0
2015-03-29 04:35:34,854 - CorrectClips64.py - DEBUG - reading F:\py\Processed\BA02\c_LE7026035200
2015-03-29 04:35:35,158 - CorrectClips64.py - DEBUG - nd_check = 0
2015-03-29 04:35:35,160 - CorrectClips64.py.calc_radiance - INFO - Initializing calc_radiance
2015-03-29 04:35:35,161 - CorrectClips64.py.calc_radiance - DEBUG - with 196.5/-6.4 255.0/1.0 F:\
2015-03-29 04:35:35,186 - CorrectClips64.py.calc_radiance - DEBUG - output name: F:\py\Processed\
2015-03-29 04:35:35,194 - CorrectClips64.py.calc_radiance - DEBUG - saving output as: F:\py\Proce
2015-03-29 04:35:35,786 - CorrectClips64.py - DEBUG - DNMin is 0 (preset)
```

Resources

- Learning Python/Coding
  - CodeAcademy.com
  - LearnPython.org
  - TutorialsPoint.com/python/
- Books
  - Grab them all
  - Find an author you enjoy
  - Use to understand the concepts, not get code from

Resources

- Model Builder
  - Watch out for export issues
- ArcGIS help pages
  - Explains it more thoroughly
  - In another, resizable window
  - Contains code sample you can use to jumpstart
- StackOverflow.com and GIS.StackExchange.com
  - Real answers to real questions
  - Provide the context that the help pages often lack
- OKGIS listserv

Conclusion

- Python is fun
- ArcPy is handy
- Learn a bit now
- Save a lot of time and effort later

Questions?

GIS

OKSCAUG 2015

Ignite The Possibilities