The Value of Coding for GIS

King County GIS User Group
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Python Scripting

```python
>>> # Import the arcpy and os modules.
... import arcpy
... import os
... # Input feature classes to buffer.
... inFCs = "C:/temp/VirtualCampus/PythonDesktop10/Data/Shapefiles/Schools.shp"
... # Output workspace.
... outWS = "C:/temp/VirtualCampus/PythonDesktop10/Data/Westerville.gdb"
... # Buffer distance.
... dist = 1000
... # Split input feature classes into separate feature classes.
... inFCs = inFCs.split(";")
... # Loop through each feature class and create buffers.
... for inFC in inFCs:
...     # Figure out the name of the output feature class.
...     (filePath, fileName) = os.path.split(inFC)
...     dotInd = fileName.find("."")
...     if dotInd <> -1:
...         newFC = fileName[0:dotInd]
...         outFC = newFC + "_buffer"
...     else:
...         outFC = fileName + "_buffer"
...     # Create the buffer feature class.
...     arcpy.Buffer_analysis(inFC, outWS + "\" + outFC, str(dist) + " Feet")
... ```
Analyze your property!

Instructions:

1. Find your property:
   - Zoom in to find your parcel, or
   - Type in your address (If you type in your address, you still have to zoom until you can click on the red border/outline of your property)
   - Click on the property and select "Analyze this Property"

2. Take the Forest Health Assessment for more property specific guidance, or get General Guidance about climate change impacts and King County forests and resources to take action.

http://gismaps.kingcounty.gov/ForestryCPR/
.NET - Beyond Data-Driven Pages
What is “Coding”?  

• See *How Coding Works*, codeconquest.com  

  • Simple - instructions that tell a computer what to do  
  • Complex - binary sequences of 1s and 0s that turn transistors on and off  

• Language types:  
  • Low level languages - operate close to binary code (e.g., C++)  
  • High level languages - operate far away from binary code (e.g., Python)  
  • In between - e.g., C#, Visual Basic
Why Code?

“Coding is the hottest skill on the job market, the modern-day language of creativity, and a powerful force in the economy”

“coding is ... an innovative and artistic process”

Madeline McSherry, New America Foundation - *Why Everyone Should Learn to Code: An Event Recap*

[http://www.slate.com/blogs/future_tense/2013/03/29/codecademy_hacker_school_why_everyone_should_learn_to_code.html](http://www.slate.com/blogs/future_tense/2013/03/29/codecademy_hacker_school_why_everyone_should_learn_to_code.html)
Why Should Coding Be Important?

• Personal development perspective
  Why should coding be important to you?
  • Professional growth
  • Expanded toolbox
  • Streamline workflows

• Policy perspective
  Why should coding be important to your employer?
  • Return on investment
  • Standard operating procedures
  • Leveraging/freeing up resources
Do You Need to Code?

• Not necessarily, but it can really help

• It depends on your job
  • Very valuable for analysts
  • Helpful for managers (increasing need to understand role of coding)
Levels of Coding

• Scripting and tool development
  • GIS analyst
  • E.g., data manipulation, map-making, glue code

• Application development
  • GIS developer
  • E.g., add-in, plugin

• Software engineering
  • Computer scientists/IT professionals
  • E.g., Microsoft Office
Industry Needs

See *Yes, You Need to Code* - Bill Dollins, geoMusings.com

“I am very publicly on the record that I think some form of coding skill is essential for any GIS analyst entering the workforce today”

[http://blog.geomusings.com/2013/01/30/yes-you-need-to-code/](http://blog.geomusings.com/2013/01/30/yes-you-need-to-code/)
Technology Trend

- Coding has always been valuable for GIS

- Increasing emphasis on coding

- Local example: MapTime Seattle (Meetup group)
  - Making a web page and a web map (HTML5, CSS, JavaScript, Leaflet.js)
  - Git & GeoJSON
  - Mapping with D3.js
Being able to take advantage of extensibility options can really set you apart as a GIS professional.

“Software tools expose less than 10% of their full capability through their default interfaces”

Bill Dollins, geoMusings - Yes, You Need to Code
Coding Types

• Programming
  • Creating an executable formulation of a computing problem
    (http://en.wikipedia.org/wiki/Computer_programming)
  • Scripts, programs, add-ins/plugins

• Configuration
  Setting values to adjust base functionality

• Customization
  • Either
  • Hybrid
Importance of Coding

“If you choose to get by with just using the GUI tools, you are doing yourself two disservices:

1. You are placing yourself at the mercy of others who can code to get around to building the customizations you need.
2. You are allowing your skills to erode by not using a significant amount of capability.”

Bill Dollins, geoMusings - Yes, You Need to Code

“If you don’t code you risk settling for what you’re given, which may not be the best solution for the task at hand”

Ralph Straumann, in response to Yes, You Need to Code
Benefits of Coding

1. Satisfaction
2. Efficiency
3. Repeatability & validation
4. Freedom
5. Enablement
6. Creativity
7. Clarity & logic
8. Documentation & organization
9. Integration & interoperability
10. Employability
Benefits of Coding - Efficiency

- Tasks can be quantified
  - Level of effort
  - Cost
  - Value

- Justifies creation of streamlining tools and processes
Copy Map Point Tool (Python Add-In)

class CopyMapPoint(object):
    """ Documentation for CopyMapPoint.addin.copy_map_point (Tool) """
    def __init__(self):
        self.enabled = True
        self.cursor = ""
    def on�MouseDown(self, x, y, button, shift):
        """ Copies map k,j to the clip board in degrees, minutes, seconds. """
        # Get the spatial reference from the data frame.
        sr = arcpy.mapping.ListDataFrames(self.activeDataFrame)..spatialReference
        # Get the clicked point and reproject it.
        ref_point = arcpy.PointClass(x, y, self.map_sr)
        ref_point = arcpy.Point(ref_point.x, ref_point.y, sr)
        # Set the hemisphere indicators.
        if ref_point.X > 0:
            west_or_west = "N"
        else:
            west_or_west = "W"
        if ref_point.Y > 0:
            south_or_north = "E"
        else:
            south_or_north = "S"
        # Get the lat/long values in the required format.
        x_lat = (ref_point.X) / (1000)
        y_lat = (ref_point.Y) / (1000)
        add_to_clipboard("(N) (W) (S) (E), format(x, f, x, y)",
        west_or_west, y_west[0], y_west[1], y_west[2],
        south_or_north, y_south[0], y_south[1], y_south[2])
# Our new wrapped versions of os.startfile and webbrowser.open startfile = run_in_other_threads(os.startfile)
open_browser = run_in_other_threads(webbrowser.open)
## Resources

### Presentations

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Presenter(s)</th>
<th>Title</th>
<th>Type/Venue</th>
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### Code Samples

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Item</th>
<th>Type</th>
<th>Description</th>
<th>Download Link</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>10/20/14</td>
<td>Get Map Point Tool</td>
<td>.NET</td>
<td>ArcMap 10.2 .NET (C#) add-in tool to allow the user to click on the map and obtain a lat/long string representing the clicked location. Based on a code snippet created for a client project and used with permission.</td>
<td>GetMapPoint</td>
</tr>
<tr>
<td>2</td>
<td>10/20/14</td>
<td>Copy Map Point Tool</td>
<td>Python</td>
<td>ArcMap 10.2 Python add-in tool to allow the user to click on the map and obtain a lat/long string representing the clicked location.</td>
<td>CopyMapPoint</td>
</tr>
</tbody>
</table>
ArcMap Field Update & Feature Navigation Tools (.NET Add-Ins)


http://gispd.com/training
Benefits of Coding - Repeatability & Validation

- Allow for re-running processes and custom validation procedures
- Increases confidence in methods and results
- Crash-resistant processing

E.g., Species Protection Area tools
Species Protection Area Tools

.NET add-in & external code
Species Protection Area Tools - Operation

Setup file

Log file

Setup file location file

GIS Professional Development
Benefits of Coding - Freedom

• Work with command line

• Build sequences of instructions using libraries of functions, e.g., GDAL

• Build your own...
Benefits of Coding - Enablement

- Learning to code
  - Opens new doors
  - Advance your professional capabilities
  - Increases your standing

- Access (more) open source options

- Open source experience makes you a better proprietary software user

See
- *Opening the Door to Open Source GIS*
- *Explorations into Open Source GIS*
- *Treading Into Open Source GIS*

Benefits of Coding - Creativity

- Required functionality may not exist

- Develop new processes, & procedures

E.g., extended flow accumulation computation

See *The Value of Automation: Geoprocessing with .NET and ArcObjects*, 2008 Washington GIS Conference

http://dhowes.com/presentations
Benefits of Coding - Clarity & Logic

- Coding helps you think clearly and logically about problems
- Understand what’s really happening under the hood

E.g., Whitebox

http://www.uoguelph.ca/~hydrogeo/Whitebox/index.html
Benefits of Coding - Documentation & Organization

• Create a record of actions

• Allow for reproduction of results at any time

• Build a repository of methods

See


http://dhowes.com/presentations
Benefits of Coding - Integration & Interoperability

• Don’t come to a halt if a few core programs won’t do everything you need them to do

• Bring together the best of all worlds

E.g., using data from R in ArcMap
Benefits of Coding - Employability

• Look at most GIS analyst job openings?

• Ability to code demonstrates interest in
  • Your career
  • Advancing yourself
  • Investing in your capabilities

• Demonstrates appreciation for GIS investment
Coding Recommendations - 1

• Start small

• Be realistic & don’t overdo it

• Resist the temptation to start coding too soon

Help others and learn from them
Coding Recommendations - 2

- Be persistent
- Keep plenty of backups
- Use code storage systems (repositories)
  E.g., Subversion, GitHub
Coding Recommendations - 3

• Consider re-use and readability
  • By yourself
  • By others

• Keep code neat, simple, clean

• Use plenty of comments
  //This comment will save me a lot of grief later
Coding Recommendations - 4

Follow style standards

- Python PEP 8 Style Guide
  https://www.python.org/dev/peps/pep-0008/

- C# Coding Conventions

- Conventions for your language of choice
Coding Recommendations - 5

*Think in terms of objects*

Object-oriented code

- Professional
- Re-usable
- Clean
Coding Recommendations - 6

- Adopt a cookbook approach - create code “recipes”

- Get each piece working in turn

- Think of all the ways something can fail and cover for them as required
Coding Recommendations - 7

- Think about how your tools could be misused
- Handle errors cleanly
- Develop strong testing methodologies
  E.g., unit tests
Path for Growth - ArcGIS for Desktop

- Python command line in ArcMap
- Standalone Python scripts
- Create a geoprocessing tool
- Create a Python toolbox
- Create a Python add-in
- Create a .NET Windows form application
- Create a .NET ArcGIS for Desktop add-in
Path for Growth - Open Source GIS

- Write a spatial SQL query
  [http://postgis.net/](http://postgis.net/)

- Write a Python script that uses the GDAL library

- Create a Leaflet.js (JavaScript) webmap

- In QGIS
  - Write a Python script
  - Create a Python plugin
    - [http://plugins.qgis.org/](http://plugins.qgis.org/)
Resources

- Interactive Development Environments (IDEs)
  - PyScripter
  - Microsoft Visual Studio 2012 Express
  - Eclipse
- Esri ArcGIS Resource Centers
- Open source GIS help pages
- Blogs (e.g., geoMusings, GISPD.com)
- FOSS4G
- GISPD.com
- MapTime Seattle (Meetup group)
- CUGOS.org
Education

• King County GIS Center
  http://www.kingcounty.gov/operations/GIS.aspx

• Coursera
  https://www.coursera.org/

• edX
  https://www.edx.org/

• Penn State
  http://open.ems.psu.edu/courseware
  • GEOG485 GIS Programming and Automation
  • GEOG585 Open Web Mapping

• GISPD.com
  http://gispd.com
  • Extending ArcGIS for Desktop Using Python and .NET Add-Ins
  • Extending ArcGIS for Desktop with Python and .NET: Geoprocessing Tools and Add-Ins
Questions?
Thanks for Coming
Image Credits

- https://watergis.files.wordpress.com/2012/03/python.jpg
- http://www.udel.edu/johnmack/frec480/arcmap_intro2.png
- https://me4bruno.files.wordpress.com/2012/02/qgis-osm-admin4-border.png
- http://blogs.yis.ac.jp/18heminke/files/2013/01/freedom-jumping_00376259-1s2s8xq.jpg
- http://www.uoguelph.ca/~hydrogeo/Whitebox/img/FSP.png
- http://www.derekyu.com/tigs/forums/tutorials/gmtut/gmtut-008.png
- http://img.scoop.it/PCbXE8EdKoLX-urHpRfsrjl72eJkfbmt4t8yenImKBVvK0kTmF0xjctABnaLJIm9
- http://1.bp.blogspot.com/_R3IQEFF9yoE/TLn9MlEsiiI/AAAAAAAAA3s/01K9nCWfphE/s1600/WindowsFormsApplication.jpg
- http://upload.wikimedia.org/wikipedia/commons/7/7b/Logo_square_postgis.png
- http://wiki.openstreetmap.org/wiki/Leaflet
- http://upload.wikimedia.org/wikipedia/commons/7/71/QGis_Logo.png