

The Road Processing Goes on Forever

Transportation Corridor Grading Automation with Python

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Introductions



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Agenda

1

Background

2

Previous Workflow

3

Generating Actionable
Data

4

Automating with
Python

5

Using
ArcGIS Online

BGE, Inc.

- Civil Engineering Firm
- Office Locations
- Clients

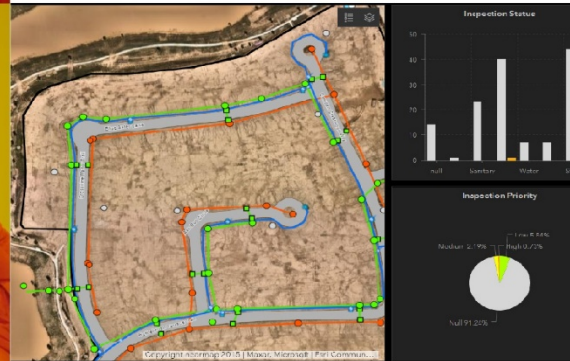
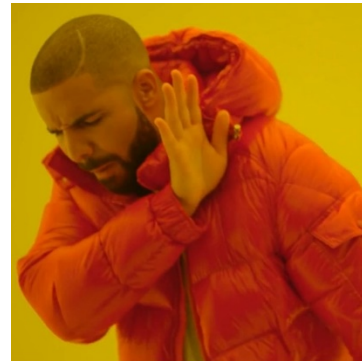
Technology Solutions

- GIS Analysts
- Solution Architects
- Embedded Program

Project Information



Serving. Leading. Solving.™

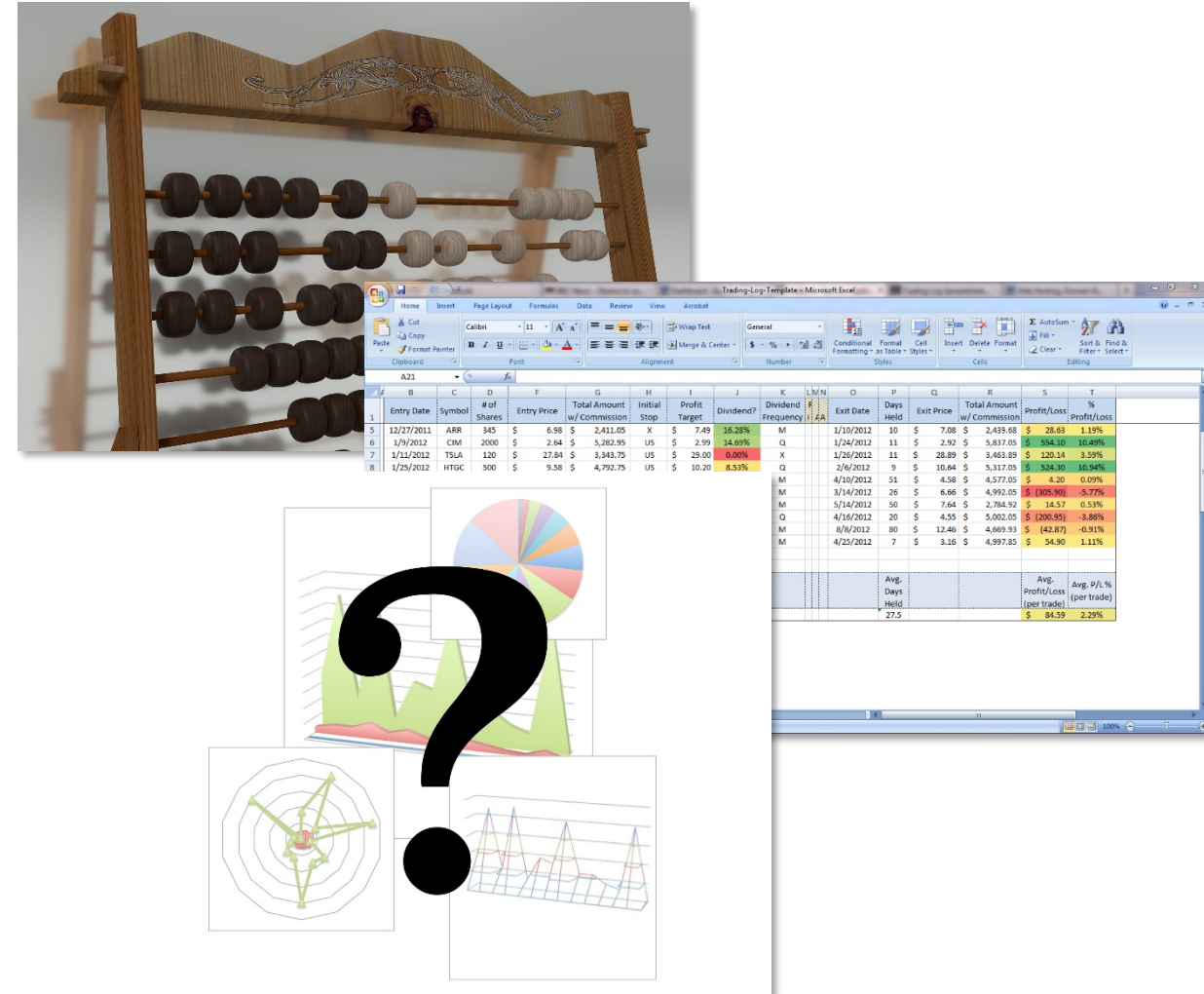


Workflow

- Overlay proposed ROWs on top of data sets and count, measure, and estimate
- Enter the data into a spreadsheet with formulas
- Relay results to clients and stakeholders

Issues:

- Very tedious and error-prone
- SPREADSHEETS
 - Fragile data storage
 - No real visuals or analytics to explain results
 - Easy to get multiple versions
- All data and results are basically thrown away when new possibilities come up or data changes



- **Understand the needs**

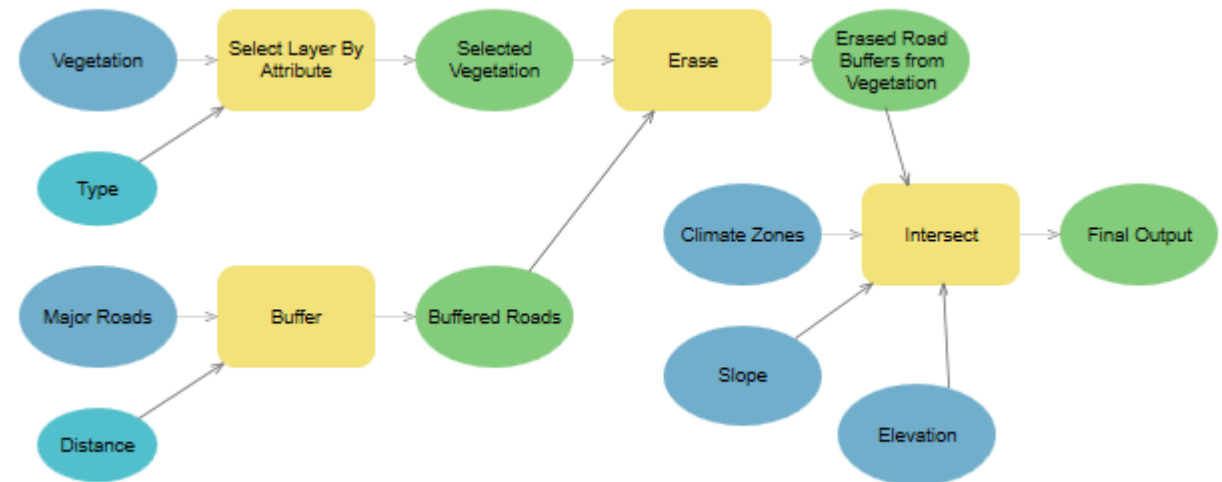
- What is required to generate the final grading matrix?

- **Source the data**

- Acquire the relevant datasets
 - FEMA Floodplains, Parcel Data, Building Footprints, etc

- **Manipulate the Information**

- Determine which geoprocessing tools will be used



- **Benefits of Python**

- Allows for iterative logic tools (for/while loops, if statements)
- Allows for inclusion of functions available in other Python Libraries (os, numpy, re, etc)
- Easily Repeatable once script is written

- **ArcGIS Notebooks**

- Built off Jupyter Notebooks
- Able to run Python Code within ArcGIS Pro Project
- Easily Shareable

The screenshot shows an ArcGIS Pro Notebook interface. The notebook title is 'CAMPO Matrix'. The main content is a table titled 'Evaluation Criteria' with three columns: 'Criteria', 'Weight', and 'Data'. Below the table, there are two code cells. The first cell contains import statements for 'arcpy', 're', and 'numpy as np'. The second cell contains project workspace and output settings.

| Criteria | Weight | Data |
|---|--------|---|
| Mobility/Engineering | 1 | |
| Meets Desirable Design Criteria | 3 | |
| Route Length (mi) | 3 | Alignment |
| Anticipated 2045 Daily Traffic Use | 3 | |
| Estimated Construction Cost | 2 | Alignment |
| Safety Improvements to Existing Facilities | 2 | |
| Land Use | 1 | |
| Residential Displacements | 3 | Route_Buildings |
| Commercial Displacements | 3 | Route_Buildings |
| Public Input | 3 | |
| Public Parks Impacted | 3 | Park |
| Number of Railroad Crossings | 2 | Railroad |
| Prime Farmland Impacted | 2 | Farmland |
| Impacts to Public Facilities | 2 | Post_Office, Fire_Department, Road |
| Impacts to Planned Development | 2 | Proposed_Developments |
| Proposed ROW | 2 | 150 ft |
| Parcels Impacted | 2 | ParcelsClip |
| Parcels Bisected | 2 | ParcelsClip |
| Environmental | | |
| Archaeological & Historic Resource Properties | 3 | |
| Known TCEQ Hazardous Materials Sites | 3 | IHWCA, PetroleumStorageTank |
| Cemeteries (#) | 3 | Cemetery |
| Stream Crossings (#) | 2 | Streams |
| Wetlands/Waterbodies (acres) | 2 | Wetlands, Water_Bodies |
| Floodplains/Floodways (acres) | 2 | FEMA_Flood_Zone |
| Known USFWS Critical Habitat (acres) | 2 | CriticalHabitat |
| Utilities | | |
| Oil/Gas Pipeline Crossings | 2 | GasLines |
| Transmission Towers | 2 | Transmission_Tower, Transmission_Power_Line |
| Water Towers | 2 | Water_Tower |

```
In [1]: import arcpy
import re
import numpy as np

In [2]: #Project Workspace
arcpy.env.workspace = r'D:/CAMPO Matrix/CAMPO Matrix/CAMPO Matrix.gdb'

arcpy.env.overwriteOutput = True

CAMPO_Matrix = 'CAMPO_Matrix_Data_A11'
```

Geoprocessing Examples

Need

Acres of ROW Acquisition Required

Number of Streams or Waterbodies
intersected

Residential Displacements

Solution

Sum the acreage of parcels that fall within
Route ROW
`arcpy.analysis.summarizeWithin`

Create intersections between Route and
Streams
`arcpy.analysis.TabulateIntersection`

Classify Building Footprints based off
parcel classification
`arcpy.analysis.TabulateIntersection`
Calculate number of buildings that fall
within Route ROW
`arcpy.analysis.Statistics`

• Creating the Suitability Matrix

- Worked with engineering team to create grading ranges for each dataset that was manipulated
 - 50 homes displaced was a 1, while 5 homes displaced or less was a 5
- Summarized and weighed scores
- Final Values were both assigned to Route feature and Excel output

| Western Caldwell County Transportation Study | | | | | | | | | | | |
|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|
| Alternatives Evaluation Criteria Data | | | | | | | | | | | |
| | Weight | Yellow | Red | Purple | Blue | Green | Light Blue | Gray | Maroon | Pink | Orange |
| Mobility/Engineering | | | | | | | | | | | |
| Route Length (mi) | 3 | 9.49 | 9.96 | 10.16 | 8.39 | 11.10 | 10.19 | 10.22 | 9.59 | 9.79 | 7.95 |
| Western Terminal | 5 | 4 | 5 | 5 | 2 | 4 | 5 | 5 | 4 | 4 | 1 |
| Eastern Terminal | 5 | 2 | 5 | 5 | 1 | 5 | 5 | 5 | 4 | 5 | 2 |
| Land Use | | | | | | | | | | | |
| Parcels Impacted | 3 | 90 | 119 | 107 | 38 | 156 | 121 | 95 | 99 | 117 | 28 |
| Residential Displacements | 5 | 5 | 32 | 2 | 6 | 56 | 6 | 2 | 1 | 16 | 4 |
| Commercial Displacements | 5 | 0 | 1 | 0 | 0 | 20 | 0 | 0 | 0 | 2 | 0 |
| Other Displacements | 4 | 2 | 4 | 1 | 3 | 3 | 2 | 1 | 1 | 6 | 0 |
| Number of railroad crossings | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| Prime Farmland Impacted | 3 | 190.40 | 230.85 | 238.35 | 114.57 | 247.42 | 239.25 | 244.93 | 174.92 | 219.20 | 170.53 |
| Impacts to Fire Departments | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Number of Roadway Crossings | 2 | 9 | 13 | 14 | 9 | 28 | 13 | 11 | 18 | 17 | 7 |
| Environmental | | | | | | | | | | | |
| Archaeological & Historic Resource P | 3 | 3 | 4 | 6 | 1 | 7 | 5 | 4 | 5 | 3 | 0 |
| Impacts to Petroleum Storage | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Stream Crossings (#) | 3 | 8 | 10 | 11 | 13 | 10 | 10 | 12 | 9 | 11 | 9 |
| Wetlands impacted (acres) | 4 | 2.95 | 1.35 | 1.67 | 6.00 | 1.60 | 4.46 | 2.14 | 3.52 | 4.47 | 3.24 |
| Waterbodies impacted | 4 | 1.72 | 0.00 | 0.26 | 3.28 | 0.17 | 0.41 | 0.32 | 2.22 | 0.26 | 0.93 |
| Floodplains/Floodways (acres) | 4 | 21.41 | 30.21 | 29.28 | 42.07 | 42.09 | 44.42 | 31.64 | 23.59 | 44.17 | 49.53 |
| Utilities | | | | | | | | | | | |
| Oil/Gas Pipeline crossings | 2 | 6 | 6 | 6 | 2 | 6 | 6 | 6 | 6 | 6 | 3 |
| Transmission power line crossings | 3 | 2 | 3 | 4 | 3 | 5 | 6 | 3 | 4 | 2 | 2 |

- **Pushing to AGOL**

- Encountered issue with trying to automatically publish results to AGOL
 - Dashboards and other applications would break if we overwrote the published feature
- Used Delete and Append functions to keep Dashboards online
 - Written into the script – no manual effort needed



ArcGIS Online

Mapping and analysis: location intelligence for everyone

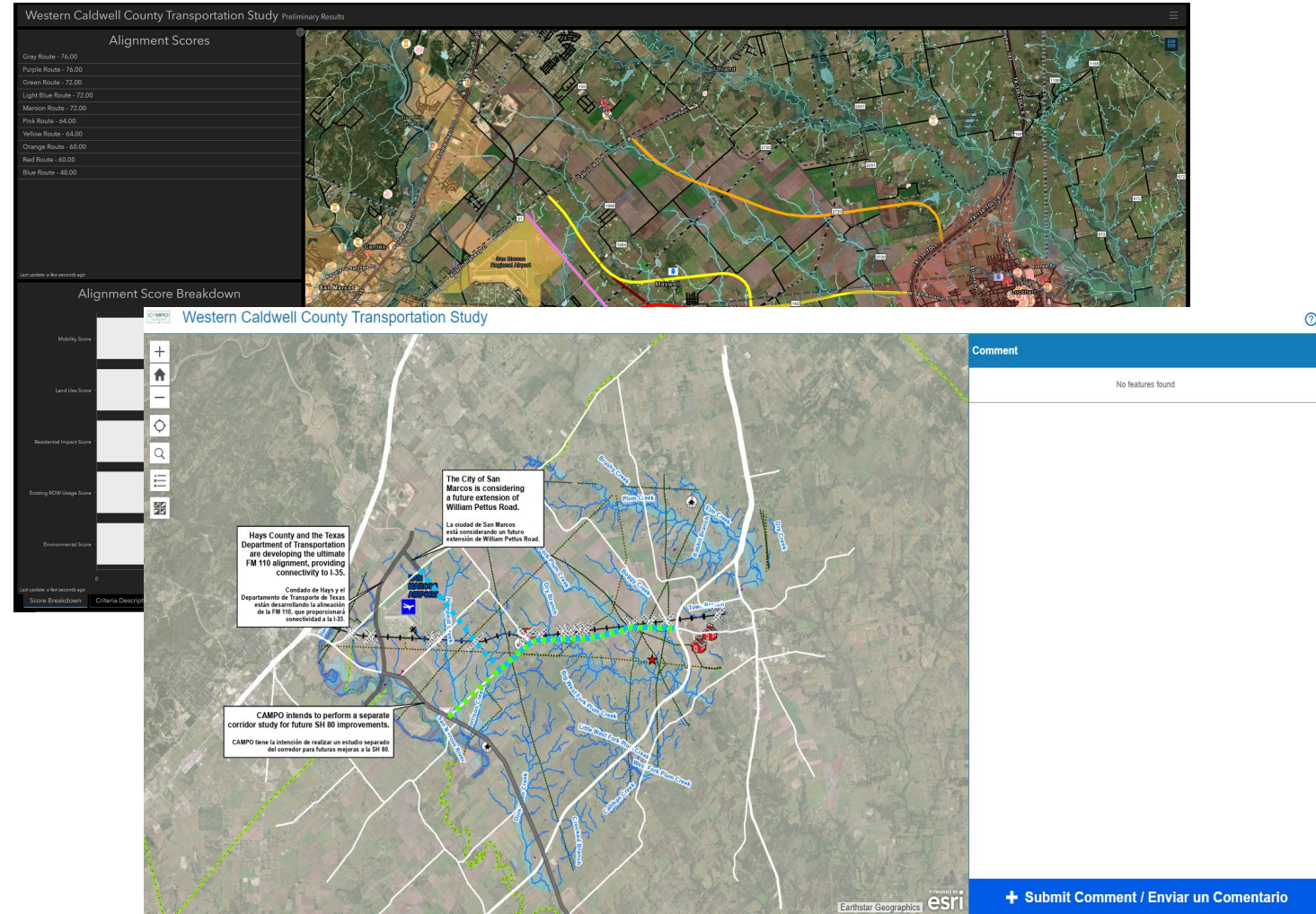
• Viewing our Results

– Dashboard

- Provided way to visualize both routes, data used, and results all in one page

– Public Engagement App

- Built off Crowdsour Reporter tool
- Provided opportunity from public to provide feedback on possible routes and view grading



Conclusion

Results and Benefits

- Increased efficiency and accuracy of data
- Repeatable solution that provides an easier way to consume the results
- Utilize our skills and introduce new ideas to our organization
- Collaborate with our partners and clients to better understand their needs



QUESTIONS?

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