Geoprocessing Models – Multiple Routes

First Scenario:

You are an insurance agent who works from your home office. You have to perform some client visits to validate their claims. The clients are available only during certain time durations. So you need to visit them during the time windows that they are available. You wish to find the best route that starts at your home, visits the claim locations in the best possible order without violating time windows and return to your home at the end of the day.

Demo steps:

1) Start MultipleRoutes.mxd
2) Mention that you are using the free street map data and a ArcGIS Online topographic basemap.
3) Explain the scenario
4) Open the attribute table for Claim Locations and show the time windows and service time
5) Explain that you will use the Network Analyst Toolbar to solve this route problem.
6) Create a new route layer.
7) Show these analysis settings
    a. Impedance
    b. Use Time windows
    c. Reorder stops, preserve both
    d. Oneway restrictions
    e. True shape.
8) Load Home as Stop
9) Load Claim Locations as Stops. Show the TimeWindowfields and Attr_time field mappings.
10) Load the Home as end stop
11) Solve and show the route.
12) Explain that we had done a lot of steps and so we will automate this using geoprocessing
13) Create a new toolbox called My Tools and create a new model
14) Set the model name as BestRouteModel and use relative paths
15) Show the tools in the Analysis toolset.
16) Start Creating the GP model. Make sure the model builder canvas is big enough
    a. Drag the Make Route Layer tool and fill in the network dataset and other settings
    b. Mention that the tool is now colored meaning that it has the necessary parameters to run
    c. Connect the AddLocations tool and add the Home as stop
    d. Connect another AddLocations and Add ClaimLocations as Stops.
        i. Show field mappings and append to existing locations option

   e. Connect third AddLocations to add the home as end stop. Mention append to existing locations.
   f. Connect Solve.
   g. Right click the output NA Layer and Click Add To Display.
   h. Run the Model and show the output.
17) Say that your colleague wants to use it for his home and ClaimLocations. But this model is static
18) Make the Home and Claim locations as model parameters
19) Tell that now your colleague is running it as model tool and run it as model tool
20) Mention that the output route layer is not added to the TOC.
21) Open the model make the output as Model parameter and run the model tool again.

Second Scenario:

You work as a GIS Analyst for a taxi company. Each day you get a CSV file containing Start and End Addresses of the routes used by the fleet of taxis. You need to find the best route between each stop pair and then store the routes as a feature class in a geodatabase. The feature class is used ot determine the statistics such as total mileage for the day. This has to be done everyday as you get a CSV file. Your boss had this idea that there should be a button on the toolbar which when clicked brings up a form to specify the input CSV file and the geodatabase and on execution writes the routes for the day to a feature class in the geodatabase.

Demo Steps:

1) Show the CSV file and explain it has the start and end address.
2) Mention that button on a toolbar and you are thinking of VBA and ArcObjects. But you are really not a VBA expert and you need to do this quickly.
3) Geoprocessing and Model Builder provides a non-programmatic solution. Show the model tool and tell that we will look at the model in a moment.
4) Go to customize mode and tell that you have already created the My Tools toolbar.
5) On the Commands tab, click the Geoprocessing Tools category
6) Click Add Tools and Select the Find Daily route model.
7) Drag the Find Daily Routes model to the My tools toolbar.
8) Click the button and show that you are specifying the CSV file and the file gdb as parameter.
9) Run the model
10) Open the attribute table for output routes
11) Select a route, zoom to it and show the fields ID, Start Address, End Address from CSV file and Total Time and Total Length that you calculated.
12) Open the model and show the following
    a. Make Route Layer
        i. Imepedance Time
        ii. Accumulate Length
    b. Geocode Start Address using the locator and store results in a temp inmemory feature class
    c. Add Locations
        i. Field Mappings
            1. Name: is the geocoded address
            2. RouteName: Mention that if you don;’t do this then we will get a single route. Also that this achieves Multiple routes without looping
            3. Search query: Not locate on Freeways.
            4. Exclude restricted portions
    d. Add End Locations using the ID and Append option. Other settings are also same.
    e. Mention that output of a solve is a composite layer with stops and routes. You just need the routes so use SELECT DATA.
    f. You also want each route to have the Start Address and End Address.

g. Mention that the FirstStopID in Routes and ObjectID in Routes are related and so you can use Join Field tool to transfer the Name field from Stops to Routes.
h. Similarly for EndAddress.
i. You need the feature class name to be same as CSV file name. So use Parse Path
j. Feature Class to Feature to Store the feature class and keep only the fields you need.
k. Delete the in-memory layer after you have copied the feature class as a good practice.

13) Leave the MultipleRoutes.mxd Open.

Python Scripts – Multiple Routes

Scenario:

Let's see how we can perform the same scenario of finding the best sequenced route to visit the claim locations as a python script.

Demo Steps:

1) Tell that there are multiple ways in which you can write a python script. If you are familiar with writing python scripts, you can open the tool help and look at the script examples.
2) Open Python window and type "arcpy.Solve_na("Route")" and show that you can copy the python code to a file or save the session history as script.
3) Easiest way when getting started and especially when you have or know some steps in a model, then just export the model as script
4) Edit the Model and say that model is using layers from the mxd. Since we want to run the script at the Os prompt the ArcMap layers are not present. So we specify the full paths for NDS, Home and ClaimLocations.
5) Remove the output NA Layer as model parameter.
6) Export the model as python script BestRouteScript.py in MultipleRoutes Folder.
7) In Explorer right-click the script and "Edit in IDLE"
    a. In IDLE show how the script has the basic building blocks such as import arcpy
    b. Checkout extension
8) Mention that exported code has cyclic references to same variable and so delete them
9) Store the route layer name in a variable so that the layer can be used else where using this name.
10) Change the layer name to Route variable in all other tools.
11) You also want to Save the output layer file using the SaveToLayerFile tool.
12) Execute the tool from tool dialog.
13) Go to the results window and "Copy as Python snippet"
14) Paste the code and edit the route variable and the layer name.
15) Save the script and Run at OS prompt
16) Add the route layer to the display
17) Leave the MXD open.

Script Tools – Allocation Tools

First Scenario:

Let's see how we can provide a UI for our script that we wrote earlier using a script tool. Script tools convert Python scripts to a geoprocessing tool so they can behave like just another GP tool. In the script we harcoded the paths to inputs. We want to make them a variables.

Demo Steps:

1) Right click the My Tools.tbx and Select Add
2) Provide BestRouteScriptTool as name and use relative path
3) Specify BestRouteScript as source
4) Create two input feature layer parameter, Home and Claim Locations
5) Finish and create the script tool.
6) Run the script tool. Mention that tool succeeds but no output gets added to TOC.
7) Tell that this is because our script tool has no output parameter and only outputs from gp tools get added to the TOC.
8) Create a new derived output parameter of type NA Layer.
9) Edit the script
10) Comment out Save ToLayer File (Joke: "I want to pass on a coding tip. Never Delete a working line of code. Always comment it out You may never know when you need that line back)
11) Use SetParameterAsText(2,Route)
12) Run the script tool and the tool the layer gets added to the display.

Second Scenario:

ArcPy module provides the ArcGIS functionality for python. Python scripts can take advantage of any other python module. This allows you to use other scientific analysis python module with ArcGIS. A frequent network analysis problem is to allocate students to the nearest schools such that school capacity is not exceeded. We will see how we can leverage the python language to write a script tool that performs this allocation scenario.

Demo Steps:

1) Open SchoolAllocation.mxd
2) Explain the scenario
3) Open the attribute table for Schools and show the capacity field.
4) Mention that the out of the box CF solver does not honor capacity.
5) Such optimization problems are solved using a technique called LP.
6) Using a open source LP solver called COIN that has a python interface using the PuLP module.
7) Open the script tool and fill in the parameters
8) Show how filling in the network dataset automatically fills in the other parameters
9) Show that incorrect network dataset name blanks out the related parameters
10) Run the tool and explain that the tool first builds the OD and then formulates the LP, solves it and draws the results back. show the results
11) Show the results and mention about the custom symbology used to draw the results
12) Open the tool parameters and show the layer file attached to the output NA Layer
13) Go to validation tab and mention that the custom tool validation behavior was done using the tool validator class by describing the network dataset.
14) Mention that source code and the entire tool along with documentation can be downloaded from arcgis.com. Show the web page.