Network Analyst: Automating Workflows with Geoprocessing

Melinda Morang
Patrick Stevens
• Who are we?
  - Network Analyst Product Engineers
• Who are you?
• Who are you?
  - Are you current Network Analyst users?
• Who are you?
  - Are you current Network Analyst users?
  - Are you current geoprocessing users?
• Who are you?
  - Are you current Network Analyst users?
  - Are you current geoprocessing users?
  - Have you made geoprocessing models?
• Who are you?
  - Are you current Network Analyst users?
  - Are you current geoprocessing users?
  - Have you made geoprocessing models?
  - Have you made geoprocessing Python scripts?
• Why should you use geoprocessing?
• Why should you use geoprocessing?
  - Automate repetitive tasks
Why should you use geoprocessing?
- Automate repetitive tasks
- Reduce mistakes
Why should you use geoprocessing?
- Automate repetitive tasks
- Reduce mistakes
- Share analysis capabilities
Why should you use geoprocessing?
- Automate repetitive tasks
- Reduce mistakes
- Share analysis capabilities
- Increase efficiency
Why should you use geoprocessing?
- Automate repetitive tasks
- Reduce mistakes
- Share analysis capabilities
- Increase efficiency
- Expand capabilities of ArcGIS
Network Analyst: Automating Workflows with Geoprocessing

Topics to be covered
ArcGIS Network Analyst extension concepts

Topics to be covered
ArcGIS Network Analyst extension concepts
Geoprocessing and network analysis

Topics to be covered
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

ModelBuilder: Models and model tools
Topics to be covered

ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

ModelBuilder: Models and model tools

Python: Scripts and script tools
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

ModelBuilder: Models and model tools

Python: Scripts and script tools

Support and resources

Topics to be covered
ArcGIS Network Analyst extension concepts
Geoprocessing and network analysis
ModelBuilder: Models and model tools
Python: Scripts and script tools
Support and resources

Topics to be covered
ArcGIS Network Analyst Extension

- **Create drive-time areas**
- **Choose best facilities**
- **Location-Allocation**
- **Plan routes**
- **Vehicle Routing Problem**
- **Directions**
- **Find nearest**
- **Route**
- **Closest Facility**
- **Generate origin destination cost matrix**
- **Origin-Destination Cost Matrix**

Network Analyst: Automating Workflows with Geoprocessing
Network dataset

Network Analyst: Automating Workflows with Geoprocessing
Network Analyst layer

- Route
  - Stops
    - 9
  - Point Barriers
    - 
  - Routes
  - Line Barriers
  - Polygon Barriers
Network Analyst layer

- One layer type for each solver
Network Analyst layer

- One layer type for each solver

- Holds the analysis
  - Analysis properties
  - Inputs
  - Outputs
Network Analyst workflow
Performing an analysis manually
Steps for network analysis:
- Make an analysis layer
- Add locations
- Solve
- Work with results
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

ModelBuilder: Models and model tools

Python: Scripts and script tools

Support and resources
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

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Python: Scripts and script tools

Support and resources

Topics to be covered
What is Geoprocessing?

ArcGIS Help:
The geoprocessing framework
What is Geoprocessing?

Storage & Management
What is Geoprocessing?

Visualization  ---  Storage & Management

Network Analyst: Automating Workflows with Geoprocessing
What is Geoprocessing?

Computation

Visualization

Storage & Management
What is Geoprocessing?

Computation = Geoprocessing

- Automating workflows
- Modeling & Analysis
Geoprocessing tool types
System tools

- Network Analyst Tools
  - Analysis
    - Make Service Area Analysis Layer
    - Solve
System tools

- Network Analyst Tools
  - Analysis
    - Make Service Area Analysis Layer
  - Solve

Geoprocessing tool types

Model tools

- DemoTools.tbx
  - BestRouteModel
  - BestRouteModelwithExtras
Network Analyst: Automating Workflows with Geoprocessing

Geoprocessing tool types

System tools
- Network Analyst Tools
  - Analysis
    - Make Service Area Analysis Layer
  - Solve

Model tools
- DemoTools.tbx
  - BestRouteModel
  - BestRouteModelwithExtras

Script tools
- DemoTools.tbx
  - BestRouteScript
  - BestRouteScriptwithExtras
Using Geoprocessing tools

- **Single tool**
- **Tool dialog**
- **Python window**
- **Chain tools**
- **Model**
- **Script**

Network Analyst: Automating Workflows with Geoprocessing
Performing Network Analysis

Network Analyst system tools

• Network Analyst Tools
  • Analysis
    • Add Field to Analysis Layer
    • Add Locations
    • Calculate Locations
    • Copy Traversed Source Features
    • Directions
    • Make Closest Facility Analysis Layer
    • Make Location-Allocation Analysis Layer
    • Make OD Cost Matrix Analysis Layer
    • Make Route Analysis Layer
    • Make Service Area Analysis Layer
    • Solve
  • Network Dataset
    • Build Network
    • Create Network Dataset From Template
    • Create Template From Network Dataset
    • Dissolve Network
  • Turn Feature Class
    • Create Turn Feature Class
    • Increase Maximum Edges
    • Populate Alternate ID Fields
    • Turn Table To Turn Feature Class
    • Update by Alternate ID Fields
    • Update by Geometry
Network Analyst tools

- Performing Network Analysis
- Building networks
Network Analyst

- Performing Network Analysis
- Building networks
- Managing turns
Using Geoprocessing

- Performing Network Analysis
- Building networks
- Managing turns
Using Geoprocessing

- Performing Network Analysis
- Building networks
- Managing turns
- Publishing services
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

ModelBuilder: Models and model tools

Python: Scripts and script tools

Support and resources

Topics to be covered
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**ModelBuilder: Models and model tools**
Python: Scripts and script tools
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Topics to be covered
Building Geoprocessing Models

ArcGIS Help: What is ModelBuilder?
Geoprocessing Models

- Author using Model Builder
Geoprocessing Models

- Chain tools to perform a workflow
Geoprocessing Models

- Use models like ArcToolbox tools
Geoprocessing Models

- Use models within other models
Network Analyst: Automating Workflows with Geoprocessing

Geoprocessing Models

- Apply all Model Builder techniques to network analysis models
Automating workflows with geoprocessing models

Performing a network analysis in Model Builder

Sharing a model as a tool
Takeaways

Demo: Automating Workflows with Geoprocessing Models

- Automate workflows with Model Builder
- Make inputs and outputs model parameters
- Run your model as a tool
- Share models and projects
When running models as tools...
- The output network analysis layer should be a model parameter
- This will add the layer to the Table of Contents
• Use your analysis result as an input to another tool
  - The Select Data tool accesses individual sublayers
Post-processing your analysis

- Use your analysis result as an input to another tool
  - The **Select Data** tool accesses individual sublayers
Automating workflows with geoprocessing models

Working with inputs and outputs
Takeaways

Demo: Automating Workflows with Geoprocessing Models

- Include the network analysis workflow as part of a larger workflow
- Use the **Select Data** tool to access sublayers
- Work with **external data** like CSV files
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

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Support and resources

Topics to be covered
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Topics to be covered
Writing Python Scripts

ArcGIS Help: What is Python?
Python scripts
Python scripts

- Conditional logic
Python scripts

- Conditional logic
- Loops
Python scripts

- Conditional logic
- Loops
- Cursors, creating geometry
Python scripts

- Conditional logic
- Loops
- Cursors, creating geometry
- Built-in and third party modules
Python scripts

• ArcPy site package
Python scripts

- ArcPy site package
  - Network Analyst module
Python scripts

- ArcPy site package
  - Network Analyst module
  - Other geoprocessing tools

ArcPy
- Introduction
- ArcPy functions
- ArcPy classes
- Data Access module
- Mapping module
- Network Analyst module
  - What is the Network Analyst module?
    - Classes
      - ClosestFacilitySolverProperties
      - LocationAllocationSolverProperties
      - NAClassFieldMappings
      - NAClassFieldMap
      - ODCostMatrixSolverProperties
      - RouteSolverProperties
      - ServiceAreaSolverProperties
      - StreetDirectionsProperties
      - VehicleRoutingProblemSolverProperties
    - Functions
      - CheckIntersectingFeatures
      - GenerateDirectionsFeatures
      - GetNAClassNames
      - GetSolverProperties
      - ListDirectionsLanguages
      - ListDirectionsStyleNames
Network Analyst: Automating Workflows with Geoprocessing

Python scripts

- ArcPy site package
  - Network Analyst module
  - Other geoprocessing tools
  - Other useful functions and classes
    - Describe

ArcPy
- Introduction
- ArcPy functions
- ArcPy classes
- Data Access module
- Mapping module
- Network Analyst module
  - What is the Network Analyst module?
  - Classes
    - ClosestFacilitySolverProperties
    - LocationAllocationSolverProperties
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  - Functions
    - CheckIntersectingFeatures
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    - GetNAClassNames
    - GetSolverProperties
    - ListDirectionsLanguages
    - ListDirectionsStyleNames
Python scripts

- Simplify access to Network Analyst functionality from Python
Python scripts

- Simplify access to Network Analyst functionality from Python
  - No need to re-create layers
  - Speed up execution
  - Simplify script logic

- Edit the analysis properties of network analysis layers

Network Analyst: Automating Workflows with Geoprocessing

- Simplify access to Network Analyst functionality from Python
- Edit the analysis properties of network analysis layers
  - No need to re-create layers
  - Speed up execution
  - Simplify script logic
# Name: Solve_Workflow.py
# Description: Solve a closest facility analysis to find the closest warehouse from the store locations and save the results to a layer file on disk.
# Requirements: Network Analyst Extension

# Import system modules
import arcpy
from arcpy import env

try:
    # Check out the Network Analyst extension license
    arcpy.CheckOutExtension("Network")

    # Set environment settings
    env.workspace = "C:\data\Frias.gdb"
    env.overwriteOutput = True

    # Set local variables
    inNetworkDataset = "Transportation/FriasMultimodal_ND"
   [outSHALayerName] = "ClosestWarehouse"
import arcpy

#Check out the Network Analyst extension license
arcpy.CheckOutExtension("Network")

#Set environment settings
env.workspace = "C:/data/Paria.gdb"
env.overwriteOutput = True

#Set local variables
inNetworkDataset = "Transportation/PariaMultimodal_ND"
outNHLayerName = "ClosestWarehouse"
arcpy.CheckOutExtension("Network")

Check out Network Analyst Extension license
Create/edit a Network Analysis layer

```python
routingLayerObj = arcpy.na.MakeRouteAnalysisLayer(networkDataset, 
layerName, "Driving Time", 
"PRESERVE_BOTH").getOutput(0)
```
Create/edit a Network Analysis layer

```python
routeLayerObj = arcpy.na.MakeRouteAnalysisLayer(networkDataset, 
layerName, "Driving Time", 
"PREERVE_BOTH").getOutput(0)
```
arcpy.na.AddLocations(layerName, "Stops", claimLocations, fieldMappings_claims, "]")

Add locations to analysis classes
Run the analysis

```python
import arcpy
from arcpy import nsr

try:
    arcpy.CheckOutExtension("Network")

arcpy.na.Solve(layerName)
```
routeLayerObj.saveACopy(outputLayerFile)

Use the results
Edit the properties on an existing layer

```python
# Get the solver properties object from the service area layer
solverProps = arcpy.na.GetSolverProperties(saLayer)

# Update the properties for the service area layer using the solver properties
solverProps.defaultBreaks = [5, 10, 15]
```
Edit the properties on an existing layer

```python
# Get the solver properties object from the service area layer
solverProps = arcpy.na.GetSolverProperties(salayer)

# Update the properties for the service area layer using the solver properties
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Edit the properties on an existing layer

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# Update the properties for the service area layer using the solver properties
solverProps.defaultBreaks = [5, 10, 15]
```
Access sublayer with ListLayers

```python
# Get the output Routes sublayer and save it to a feature class
routesSubLayer = arcpy.mapping.ListLayers(outNALayer, subLayerNames["Routes"])[0]
arcpy.management.CopyFeatures(routesSubLayer, outRoutesFC)
```
Access sublayer with ListLayers

```python
# Get the output Routes sublayer and save it to a feature class
routesSubLayer = arcpy.mapping.ListLayers(outNALayer, subLayerNames["Routes"])[0]

arcpy.management.CopyFeatures(routesSubLayer, outRoutesFC)
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arcpy.management.CopyFeatures(routesSubLayer, outRoutesFC)
```
Access sublayer with ListLayers

- Use sublayers as input to other tools (CopyFeatures, Join, Buffer, etc.).
Access sublayer with ListLayers

- Use sublayers as input to other tools (CopyFeatures, Join, Buffer, etc.).

- Use a SearchCursor to access the rows within a sublayer.

```python
# Get the output Routes sublayer and save it to a feature class
routesSubLayer = arcpy.mapping.ListLayers(outNALayer, sublayerNames['"Routes"'])[0]

arcpy.management.CopyFeatures(routesSubLayer, outRoutesFC)
```
# Set up field mappings for claim locations
fieldMappings_claims = arcpy.na.NAClassFieldMappings(routeLayerObj, "Stops")
fieldMappings_claims["Name"].mappedFieldName = "Name"

# Add claim locations
arcpy.na.AddLocations(layerName, "Stops", claimLocations, fieldMappings_claims, "")
# Set up field mappings for claim locations
fieldMappings_claims = arcpy.na.NAClassFieldMappings(routeLayerObj, "Stops")
fieldMappings_claims["Name"][0].mappedFieldName = "Name"

# Add claim locations
arcpy.na.AddLocations(layerName, "Stops", claimLocations, fieldMappings_claims, "")
Field mapping

```python
# Set up field mappings for claim locations
fieldMappings_claims = arcpy.na.NAClassFieldMappings(routeLayerObj, "Stops")
fieldMappings_claims["Name"]["mappedFieldName"] = "Name"

# Add claim locations
arcpy.na.AddLocations(layerName, "Stops", claimLocations, fieldMappings_claims, ")"
Set the output workspace

```python
# Set the output workspace
arcpy.env.workspace = r'D:\Data\ScriptOutput.gdb'
```
Python in ArcGIS Pro vs. ArcMap
Python in ArcGIS Pro vs. ArcMap

- Pro: python 3.4
- ArcMap: python 2.7
Python in ArcGIS Pro vs. ArcMap

- Pro: python 3.4
- ArcMap: python 2.7

General migration help
Python in ArcGIS Pro vs. ArcMap

- Network analysis migration help
Python in ArcGIS Pro vs. ArcMap

- Network analysis migration help

- Unsupported and deprecated tools
- Changes for working with layer object
Python in ArcGIS Pro vs. ArcMap

- Setting up a development environment (IDE)
Automating workflows with python scripts

Performing a network analysis with a python script
Takeaways

Demo: Automating Workflows with Python Scripts

- Run any geoprocessing workflow in **stand-alone python**
- Find **Code samples** in the tool help
- Run simple python commands in the **python window**
Building Script Tools

ArcGIS Help: What is a script tool?
• Work with your scripts through a user interface
• Work with your scripts through a user interface

• Use Script tools like any other tool within ArcToolbox
  - Use script tools in models and vice versa
• If a network analysis layer is the output use `arcpy.SetParameterAsText(...)`

```python
layerName = "DailyRoute"
routeLayerObj = arcpy.na.MakeRouteAnalysisLayer(networkDataset, layerName, "Driving Time", "PRESERVE_BOTH").getOutput(0)

# Add the output layer to the map
arcpy.SetParameterAsText(2, layerName)
```
Add outputs from script tool to ArcMap

- If a network analysis layer is the output use `arcpy.SetParameterAsText(...)`

```python
layerName = "DailyRoute"
routeLayerObj = arcpy.na.MakeRouteAnalysisLayer(networkDataset, layerName, "Driving Time", "PRESERVE_BOTH").getOutput(0)

# Add the output layer to the map
arcpy.SetParameterAsText(2, layerName)
```
Create a script tool to provide a UI for a Python script.

Use tool validation to customize the UI.
• Provide a user interface for python scripts by making a **script tool**

• Use derived output and `arcpy.SetParameterAsText()` to add results to the map

• Use **tool validation** to customize your script tool’s user interface
Topics to be covered

- ArcGIS Network Analyst extension concepts
- Geoprocessing and network analysis
- ModelBuilder: Models and model tools
- Python: Scripts and script tools
- Support and resources
Topics to be covered

ArcGIS Network Analyst extension concepts
Geoprocessing and network analysis
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Python: Scripts and script tools
Support and resources
Summary
Summary

- Use the geoprocessing framework for network analyses
  - Network Analyst Tools
  - Models and Model tools
  - Script and Script tools
Summary

- Automate workflows
Summary

- Incorporate network analysis in larger process
Resources

- Network Analyst tutorials
  - ArcMap
  - ArcGIS Pro
Resources

• Network Analyst code samples
  - 10.2 and earlier
  - ArcMap
  - ArcGIS Pro
Resources

• ArcGIS Network Analyst Extension Discussion Forum
Resources

• Python for ArcGIS resource center
Esri presents the

Employee of the Year Award

Melinda Morang

Signature of Manager
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**Network Analyst: Automating Workflows with Geoprocessing**

- **Title and Description Consistent with Content**
  - Low: 1, High: 5

- **Well Organized/Clear Presentation**
  - Low: 1, High: 5

- **Public Speaking Skills**
  - Low: 1, High: 5

- **The content of the workshop was relevant to my work**
  - No, Yes