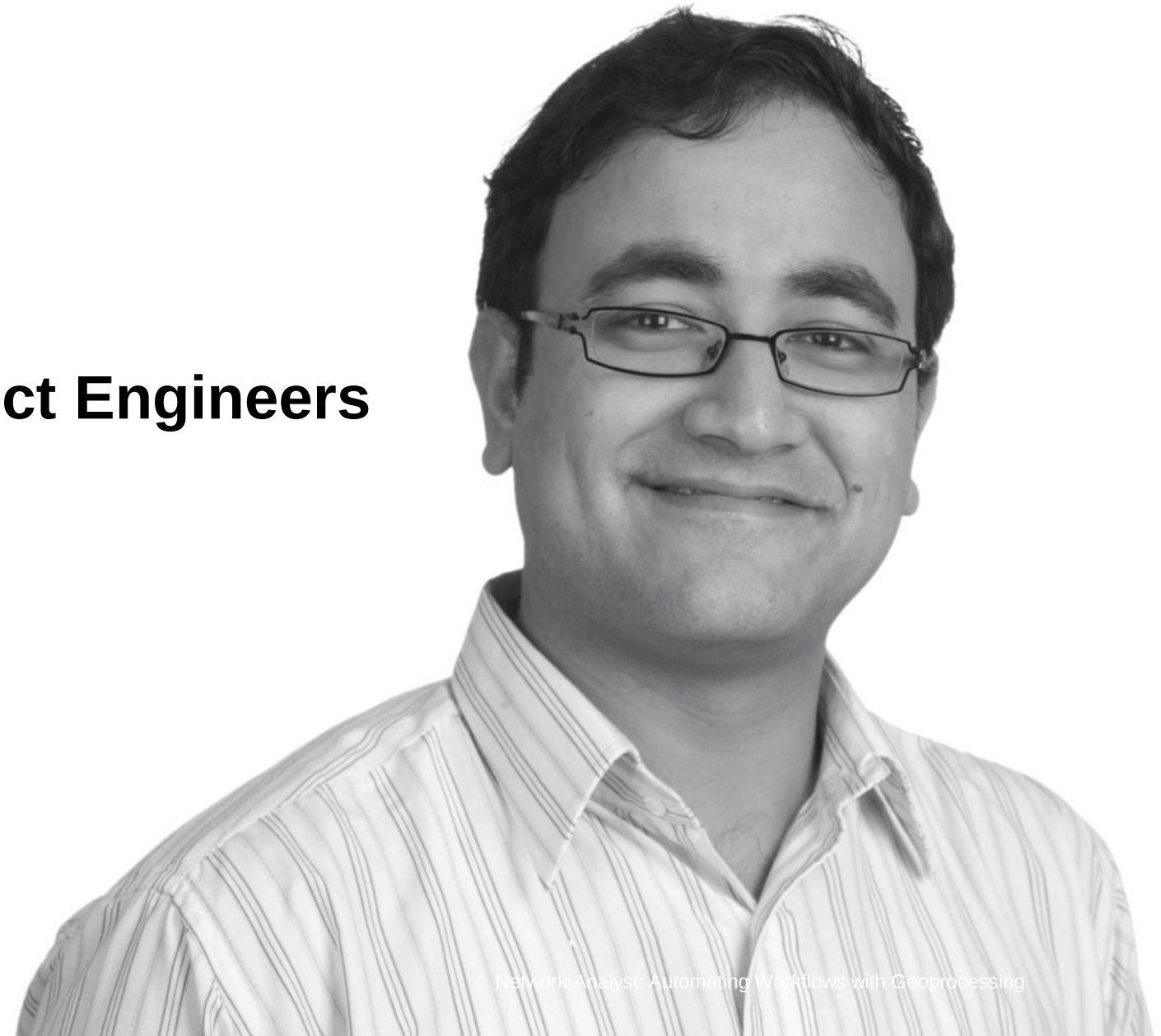
Network Analyst: Automating Workflows with Geoprocessing

Melinda Morang

Patrick Stevens

- **Who are we?**
  - **Network Analyst Product Engineers**



- **Who are you?**

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  - **Have you made geoprocessing models?**

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  - **Are you current geoprocessing users?**
  - **Have you made geoprocessing models?**
  - **Have you made geoprocessing Python scripts?**


Why should you use geoprocessing?

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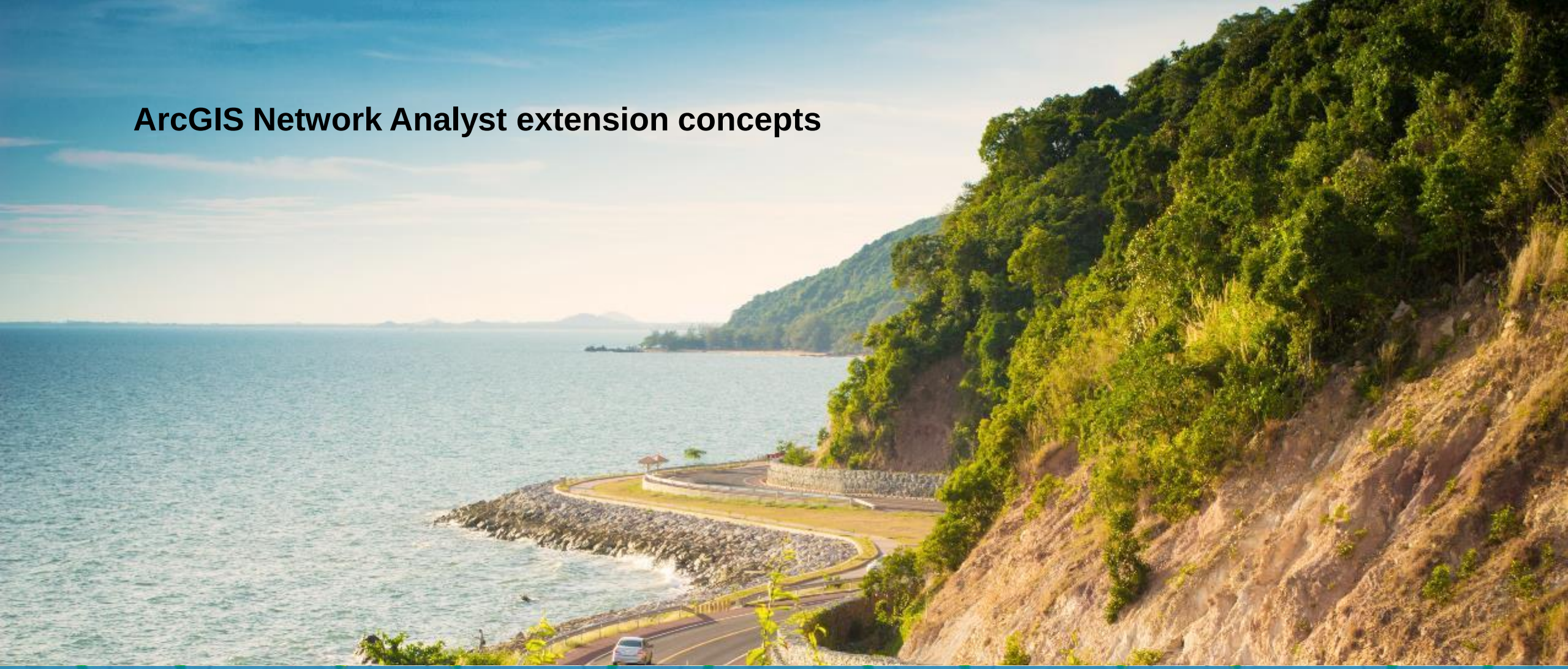
- **Why should you use geoprocessing?**
  - **Automate repetitive tasks**
  - **Reduce mistakes**
  - **Share analysis capabilities**
  - **Increase efficiency**
  - **Expand capabilities of ArcGIS**

Topics to be covered



ArcGIS Network Analyst extension concepts

Topics to be covered

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Geoprocessing and network analysis

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Support and resources

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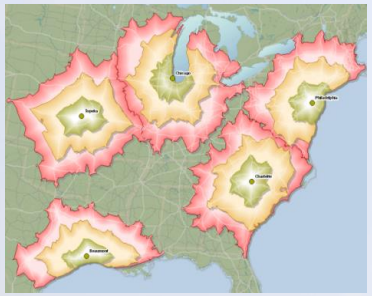
Python: Scripts and script tools

Support and resources

ArcGIS Network Analyst Extension

solvers

Create drive-time areas

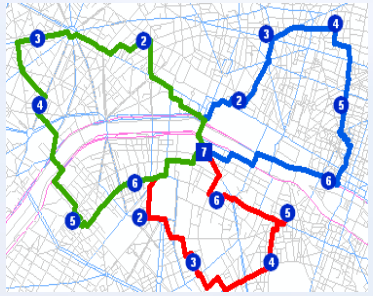


Service Area

Choose best facilities

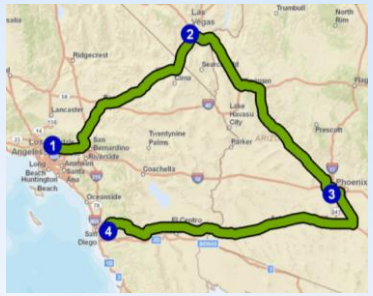
Location-Allocation

Plan routes



Vehicle Routing Problem

Directions

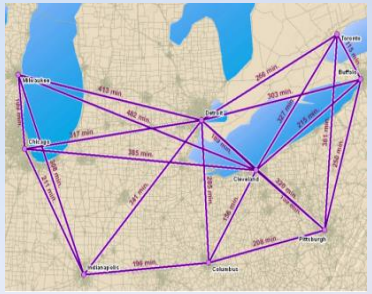


Route

Find nearest

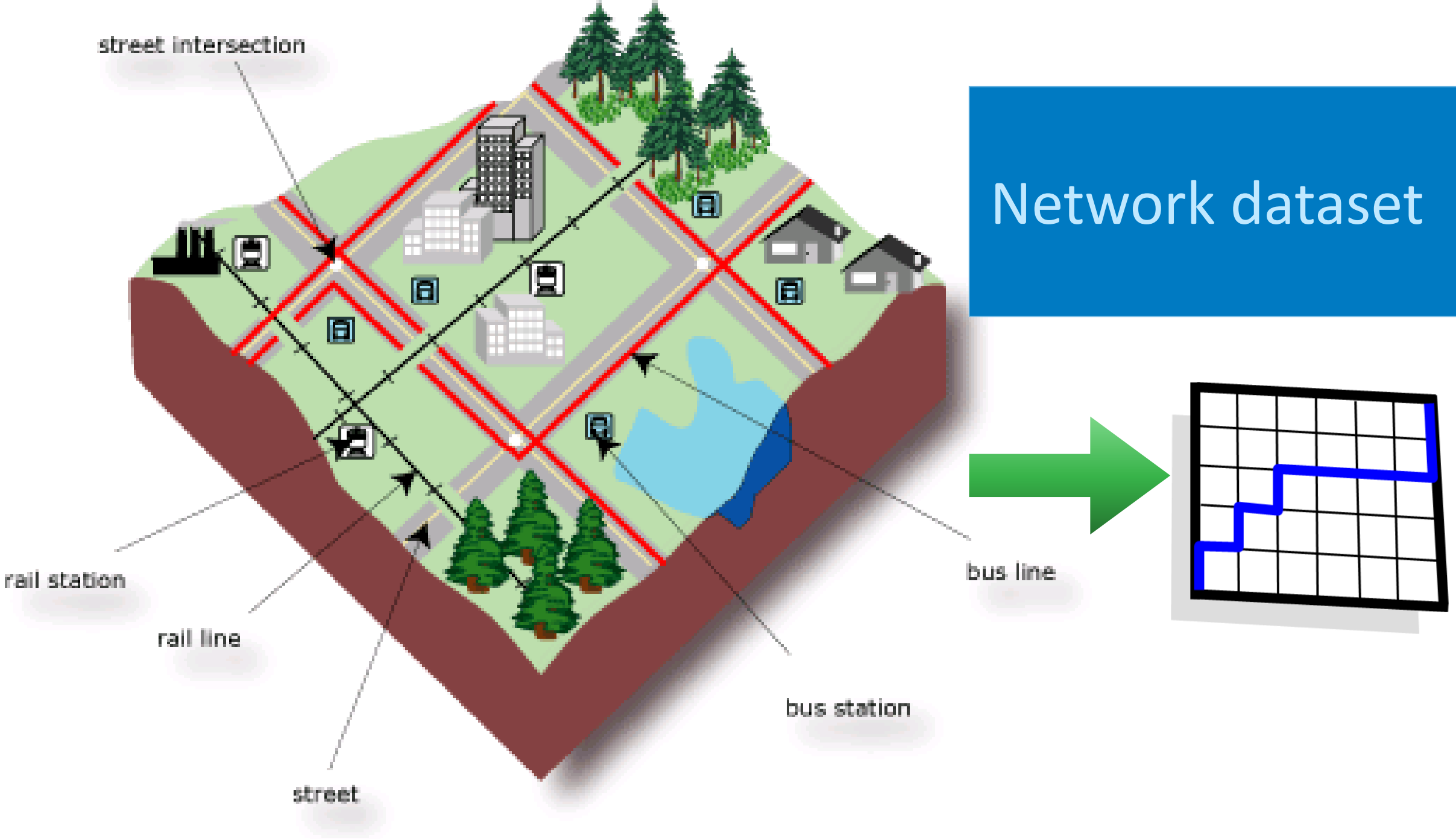
Closest Facility

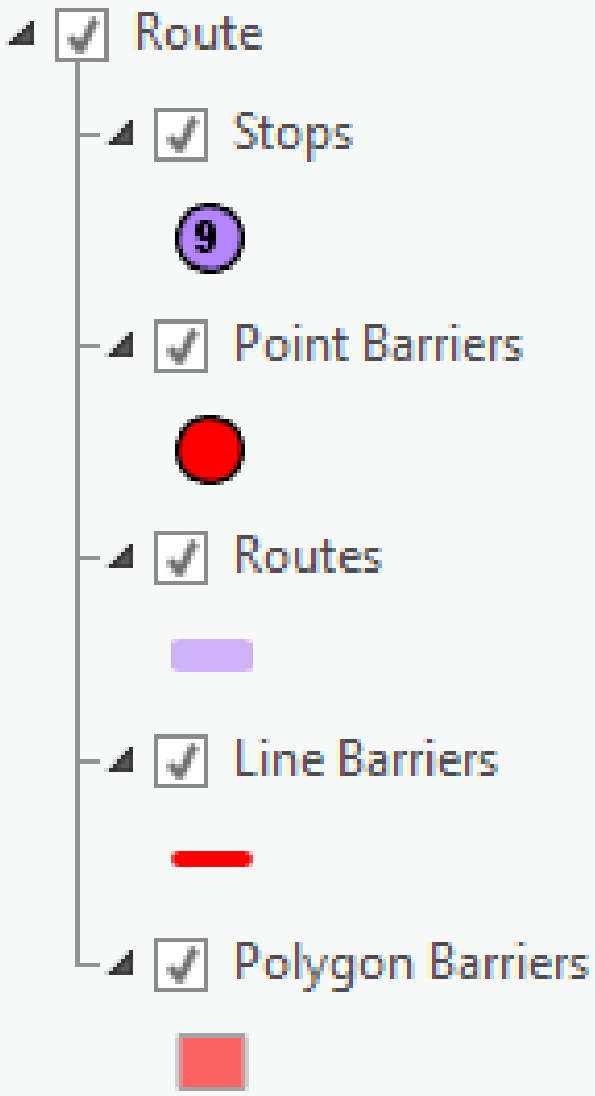
Generate origin destination cost matrix



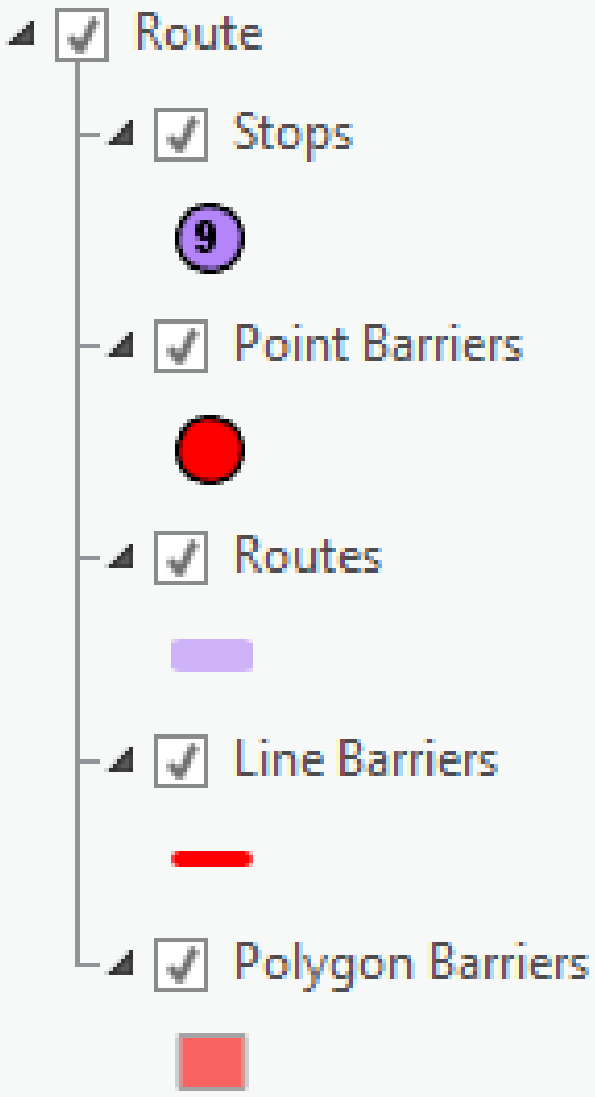
Origin-Destination Cost Matrix

Network dataset



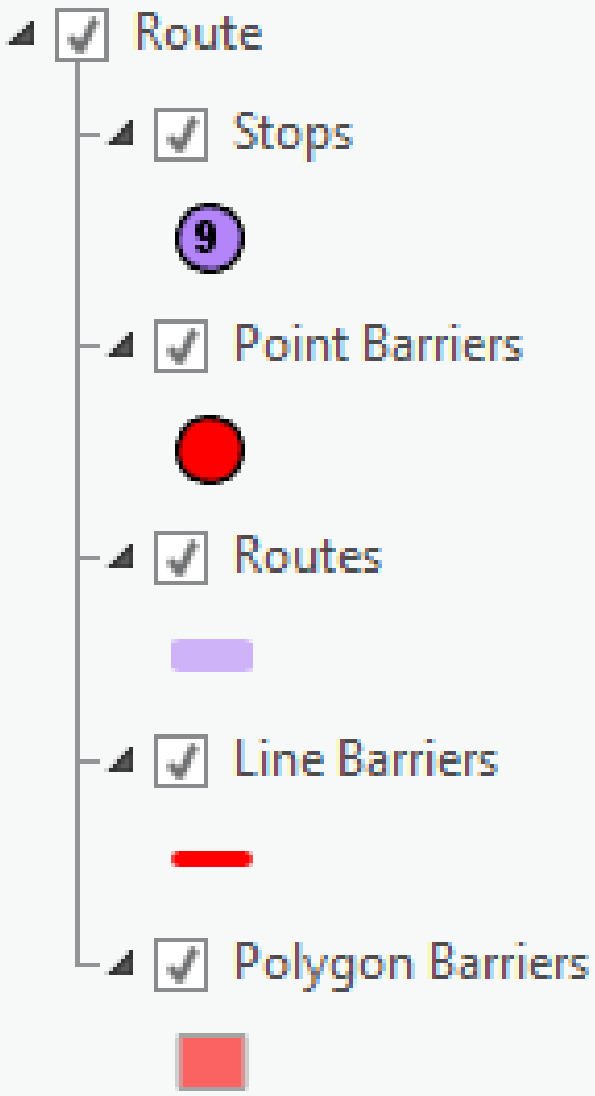


Network Analyst layer



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

Demo

Network Analyst workflow

Performing an analysis manually

Takeaways

Demo: Network Analyst Workflow

- Steps for network analysis:
  - Make an analysis layer
  - Add locations
  - Solve
  - Work with results

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

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Support and resources

What is Geoprocessing?

ArcGIS Help:
The geoprocessing framework

What is Geoprocessing?

Storage & Management

What is Geoprocessing?

Visualization

Storage & Management

What is Geoprocessing?

Computation

Visualization

Storage & Management

What is Geoprocessing?

Computation

=

Geoprocessing

- **Automating workflows**
- **Modeling & Analysis**

Geoprocessing tool types

Geoprocessing tool types

System tools

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

Geoprocessing tool types

System tools

- Network Analyst Tools
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Model tools

- DemoTools.tbx
  - BestRouteModel
  - BestRouteModelwithExtras

Geoprocessing tool types

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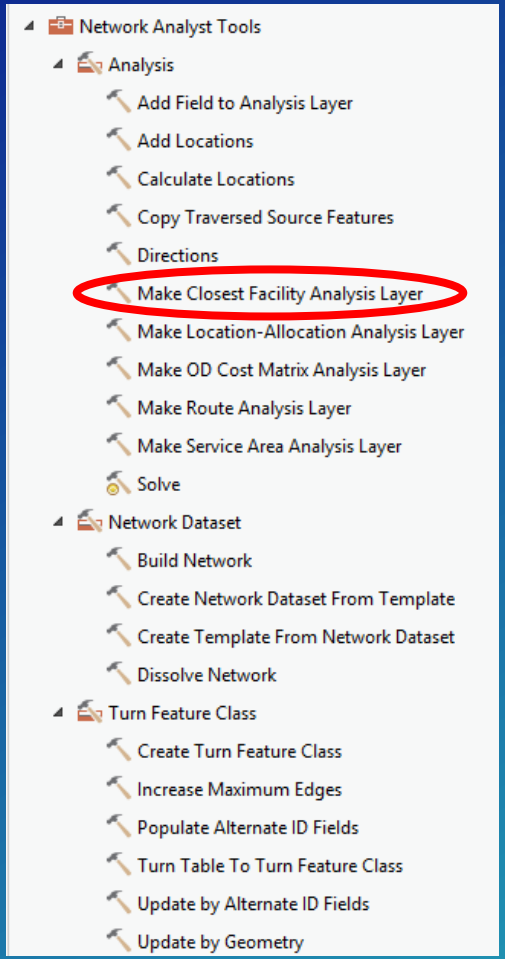
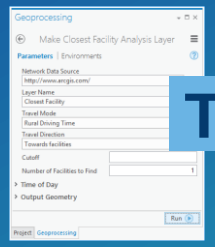
Script tools

- DemoTools.tbx
  - BestRouteScript
  - BestRouteScriptwithExtras

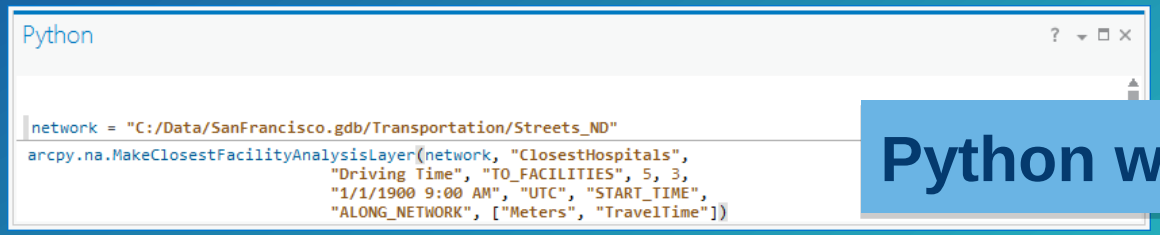
Using Geoprocessing tools



Single tool



Tool dialog



Python window

Chain tools

Model


```
cfLayerObj = arcpy.na.MakeClosestFacilityAnalysisLayer(networkDataset, layerName,
                                                       "Driving Time", "PRESERVE_BOTH").getOutput(0)
```

Script

Network Analyst system tools

- Network Analyst Tools
  - Analysis
    - Add Field to Analysis Layer
    - Add Locations
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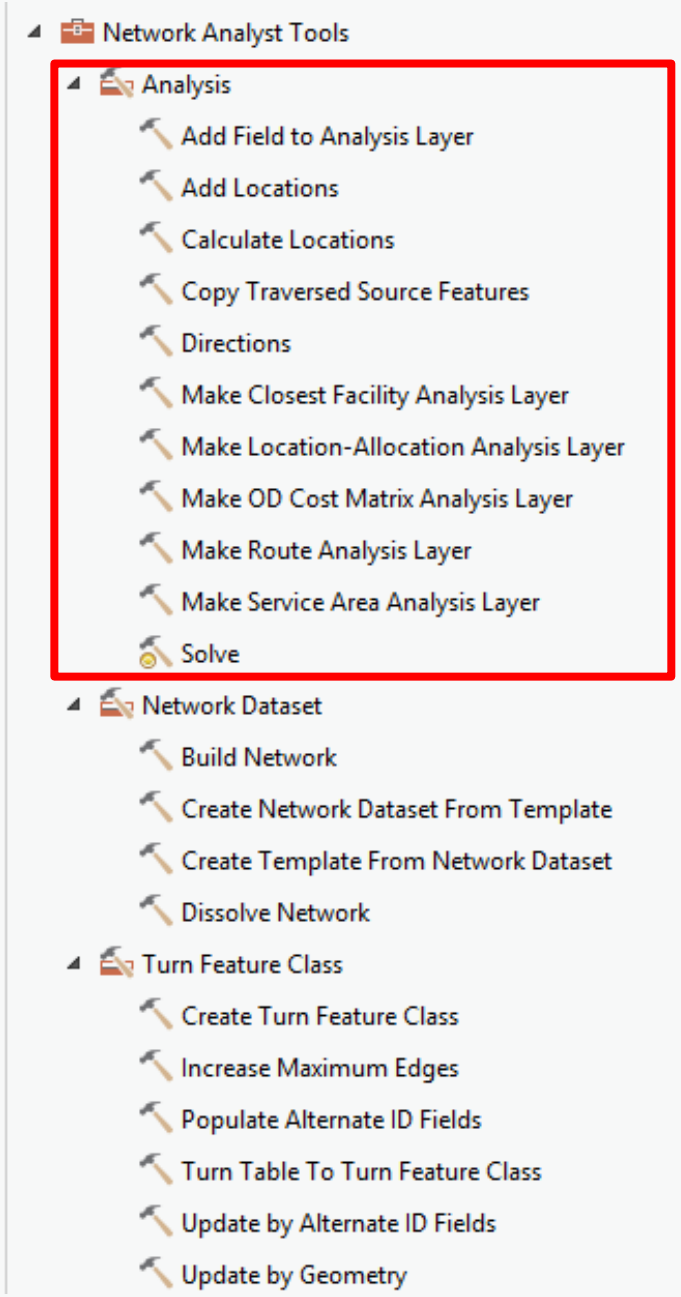

Network Analyst system tools

- **Performing Network Analysis**

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Network Analyst system tools

- **Performing Network Analysis**
- **Building networks**

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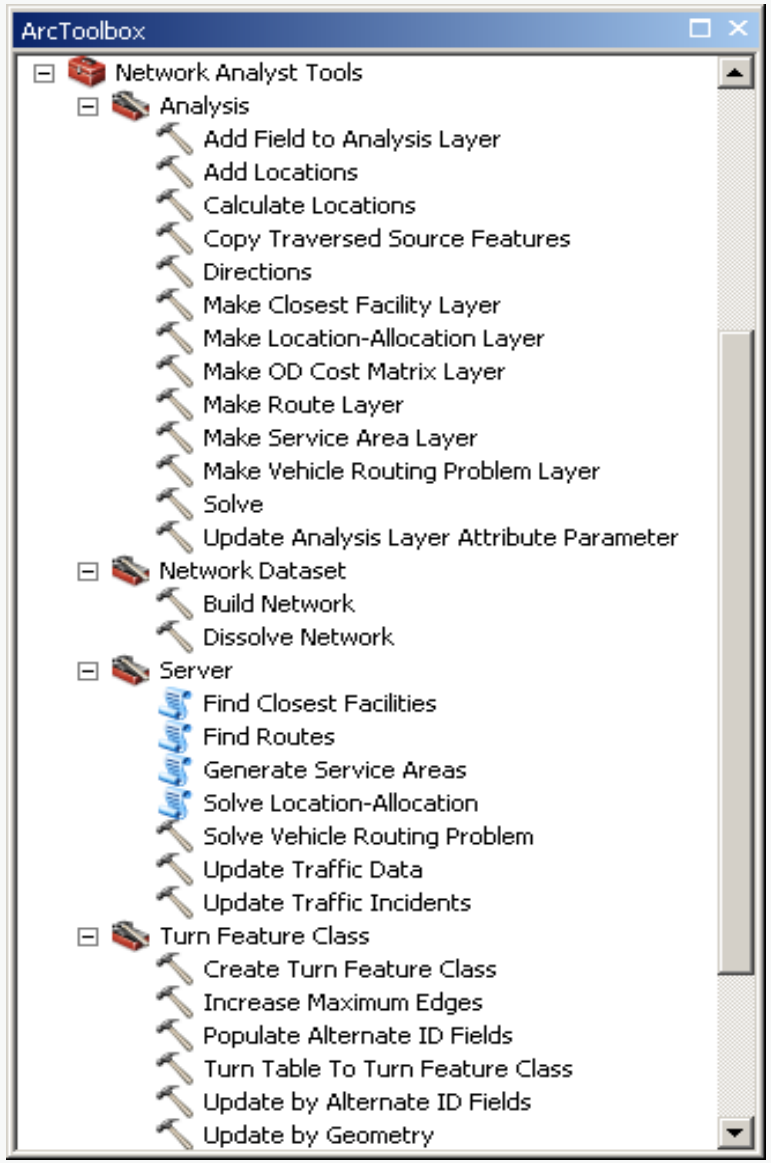
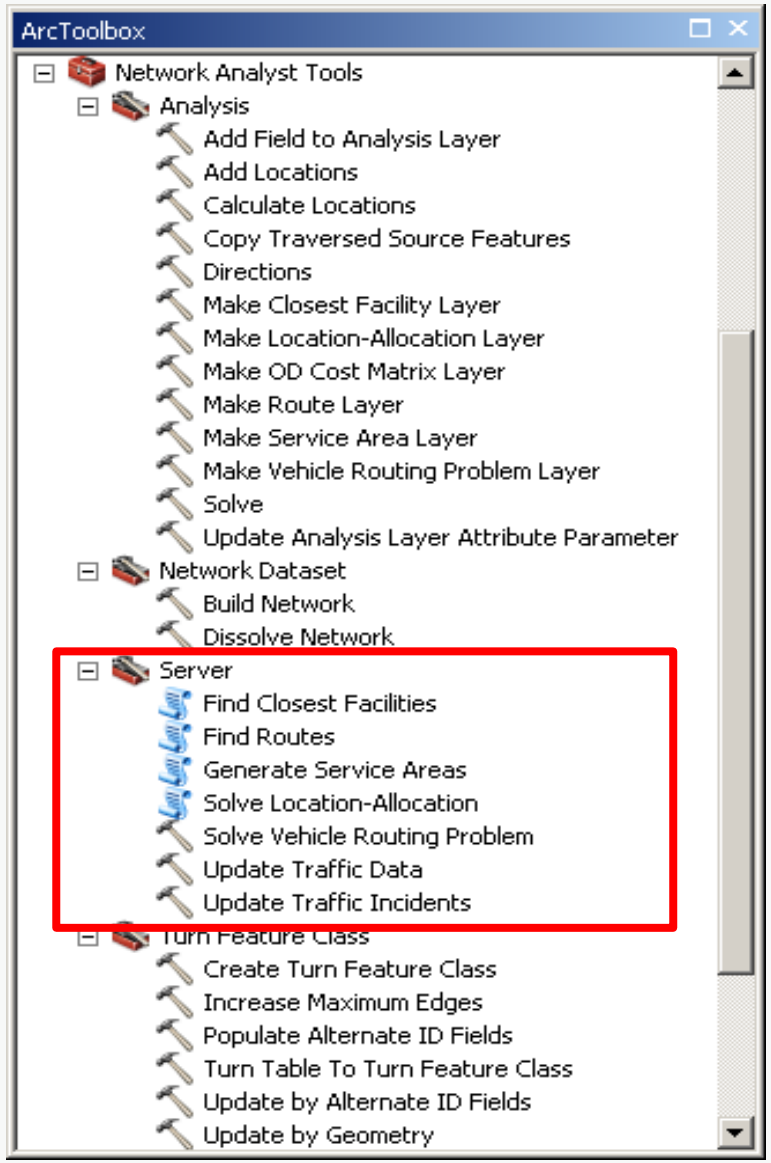
Network Analyst system tools

- 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

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Python: Scripts and script tools

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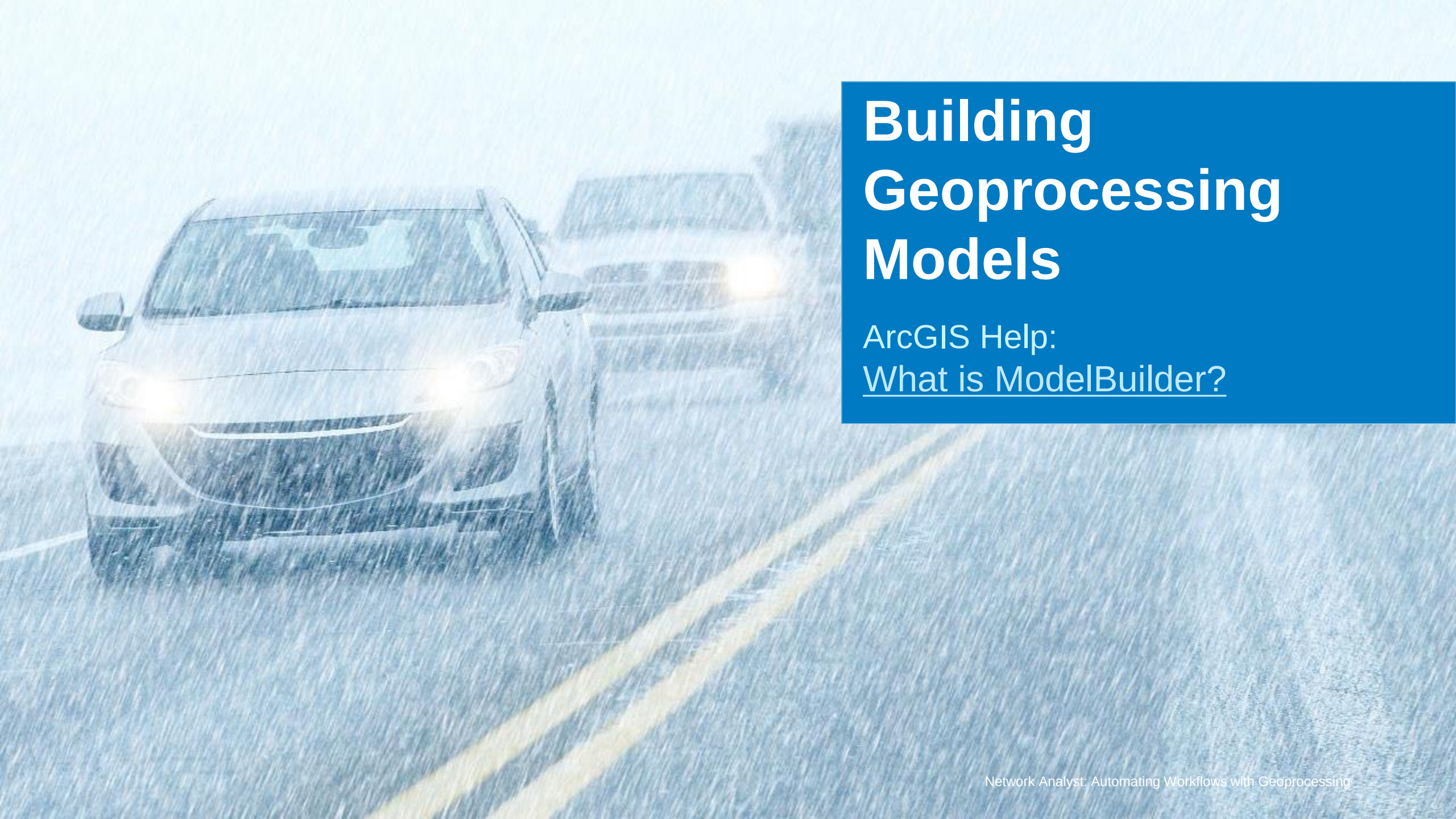
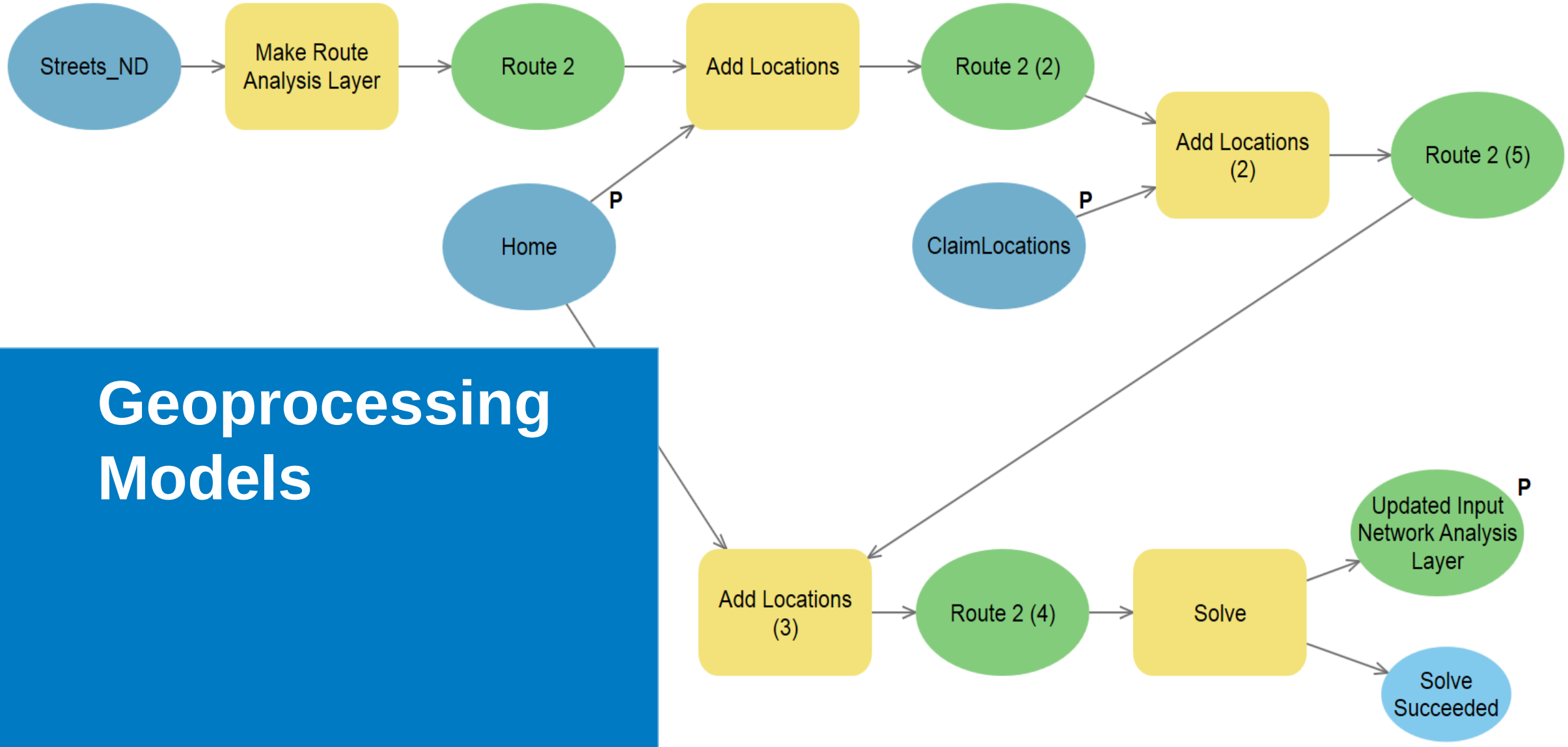


Building Geoprocessing Models

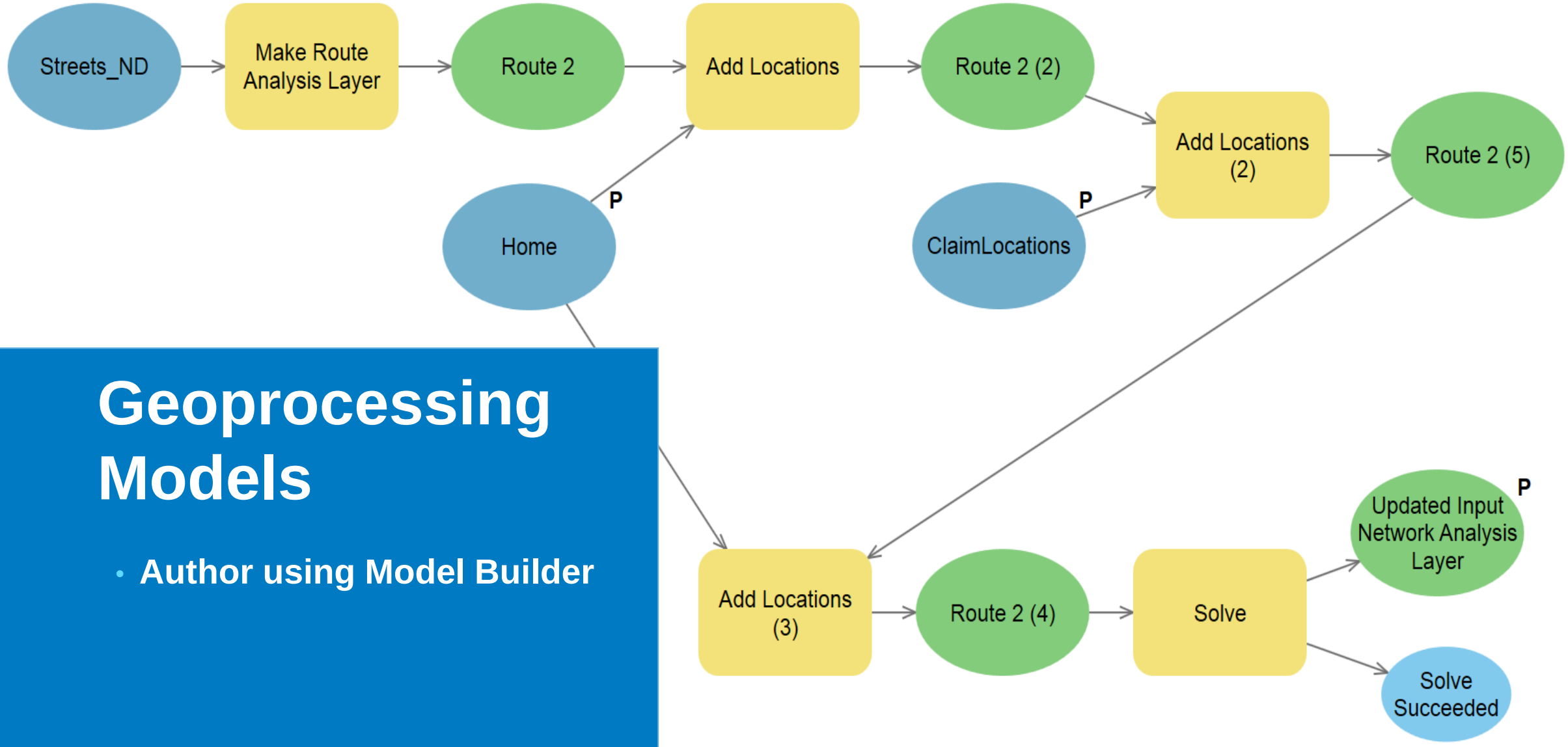
ArcGIS Help:
What is ModelBuilder?

Geoprocessing Models



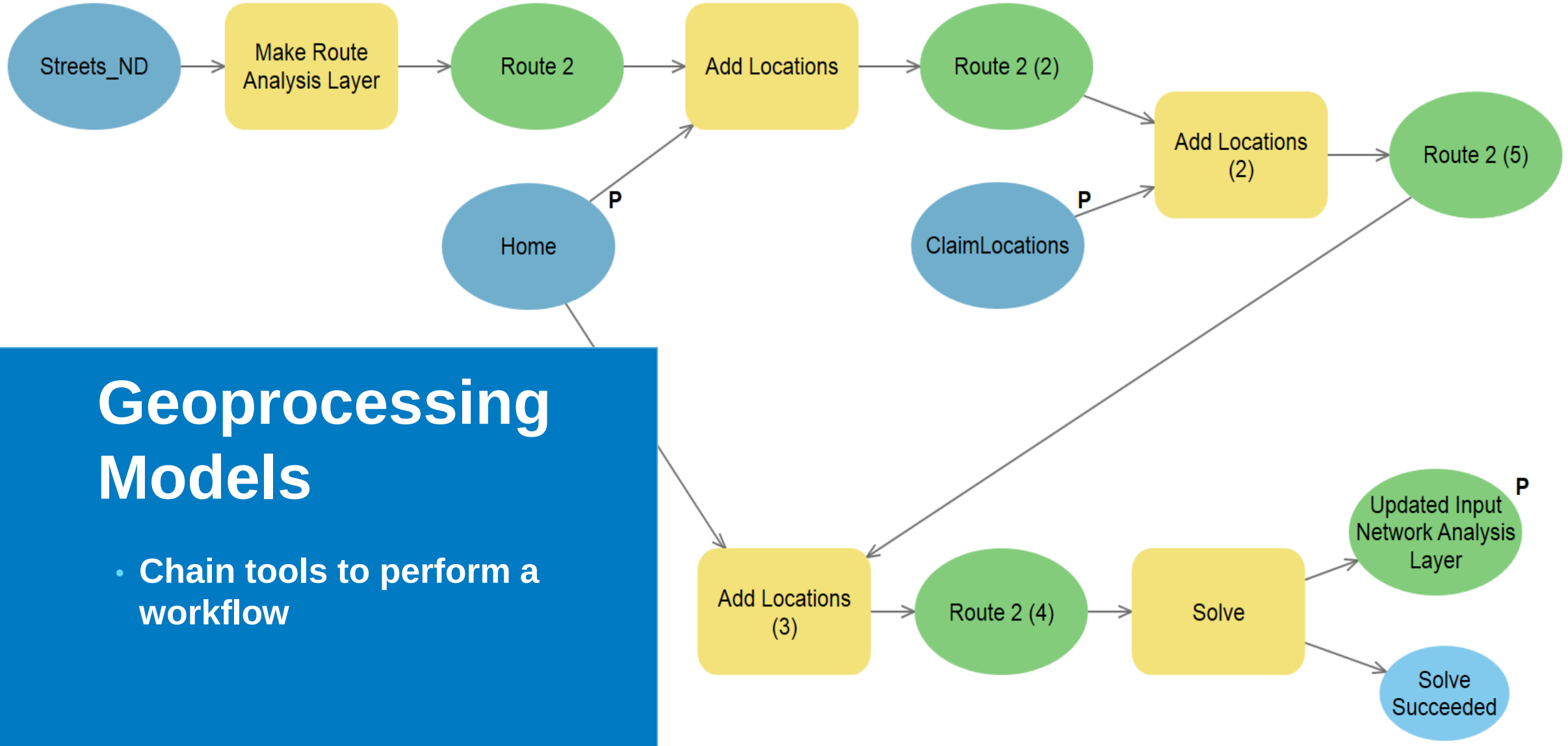
Geoprocessing Models

- Author using Model Builder



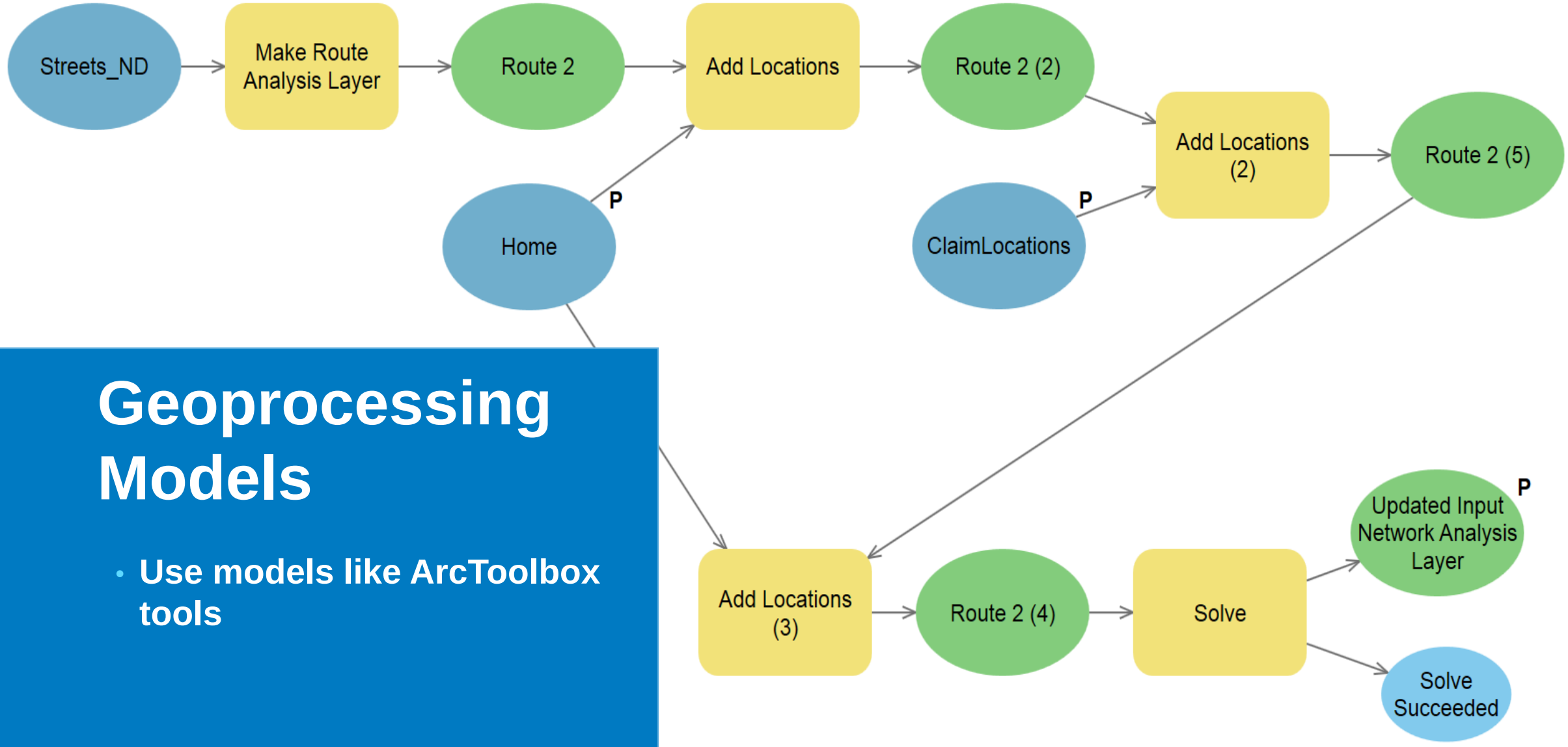
Geoprocessing Models

- Chain tools to perform a workflow



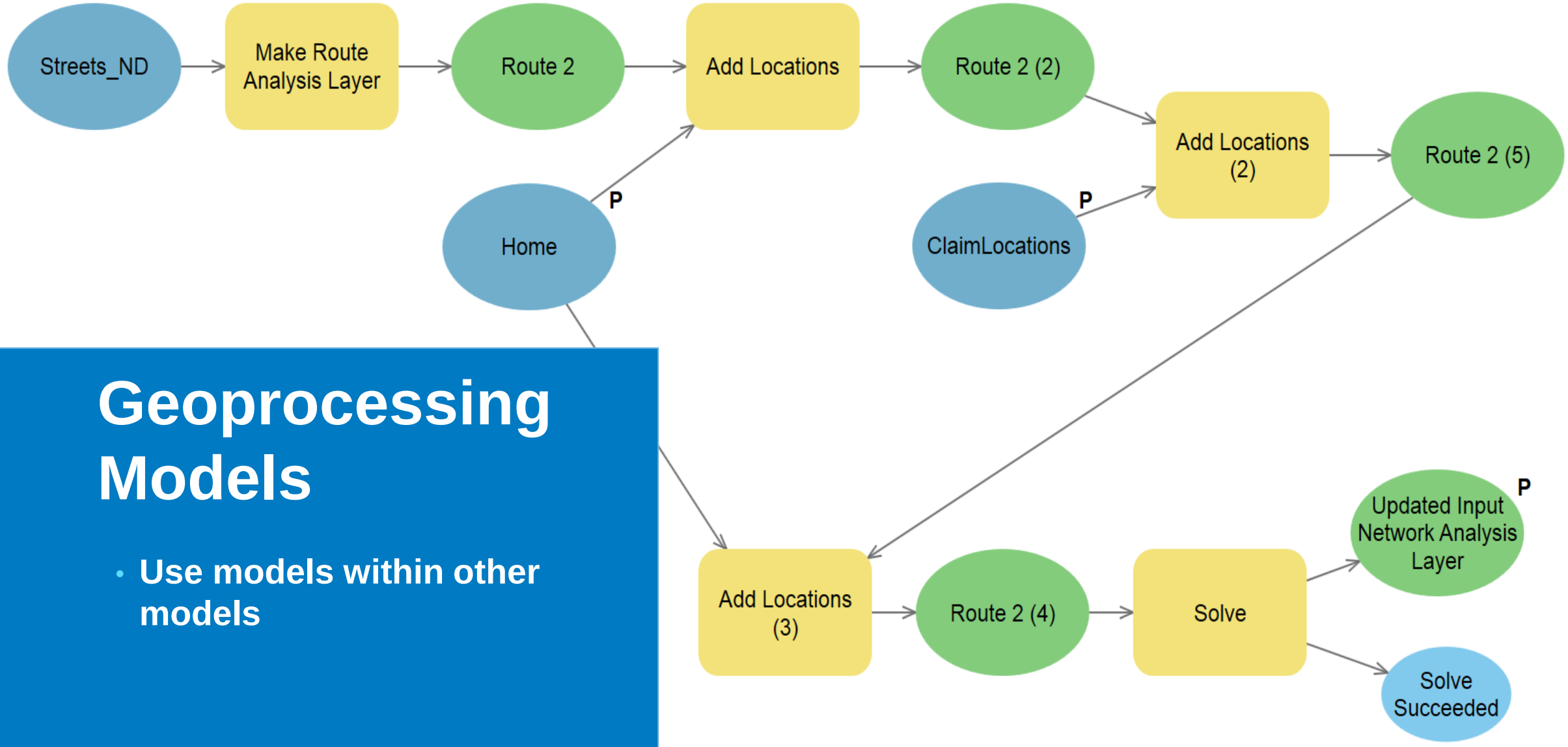
Geoprocessing Models

- Use models like ArcToolbox tools



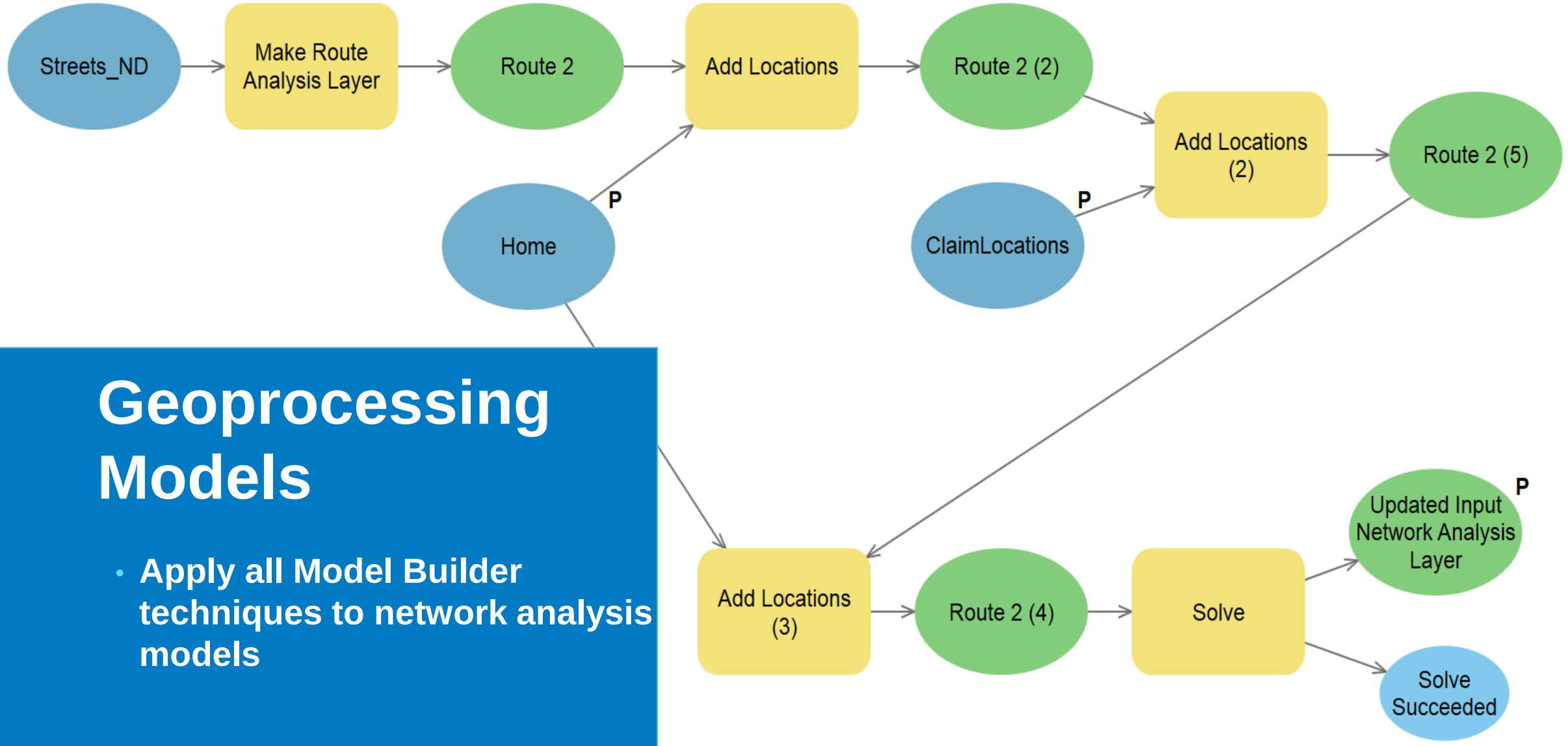
Geoprocessing Models

- Use models within other models



Geoprocessing Models

- Apply all Model Builder techniques to network analysis models



Demo

Automating workflows with geoprocessing models

Performing a network analysis in Model Builder

Sharing a model as a tool

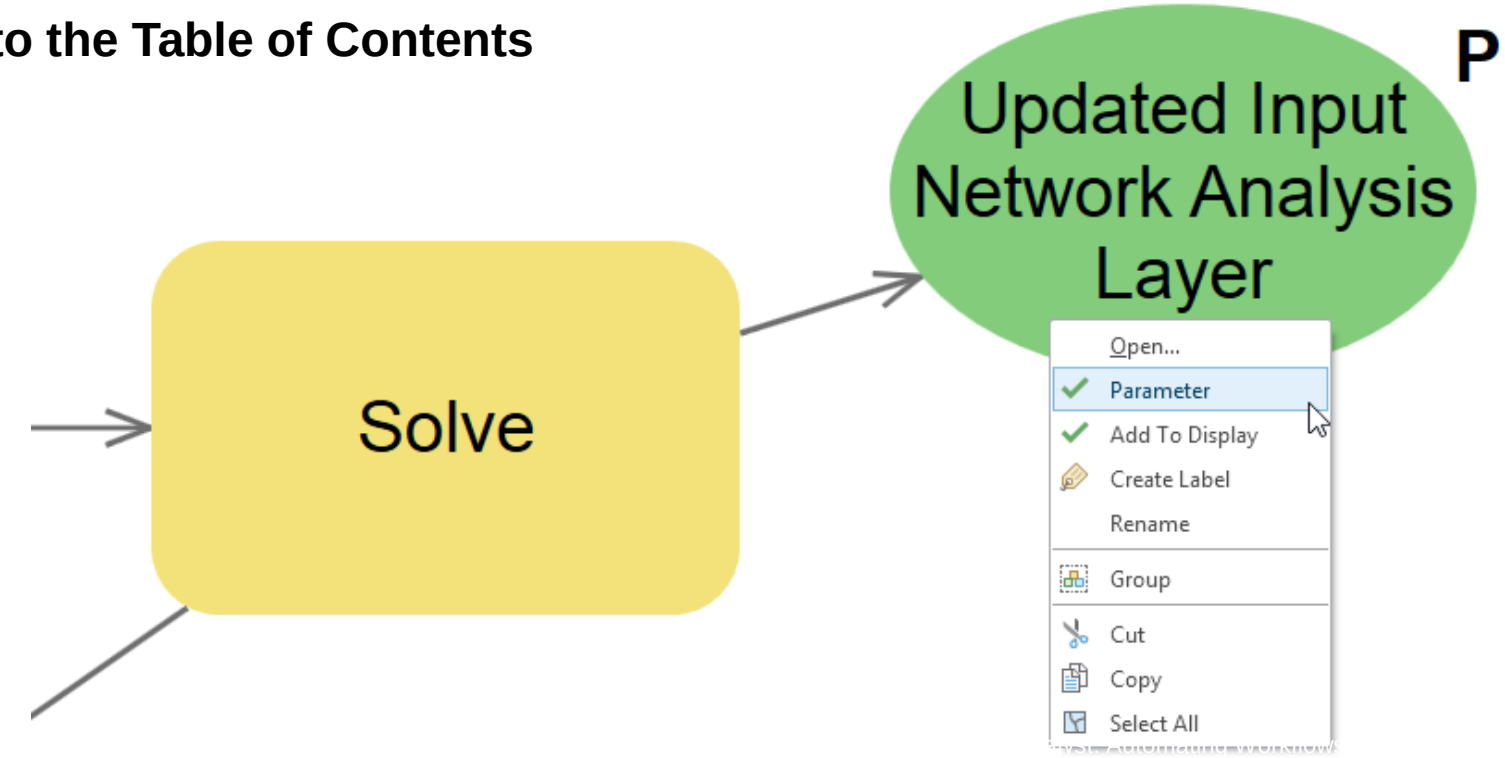
Takeaways

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

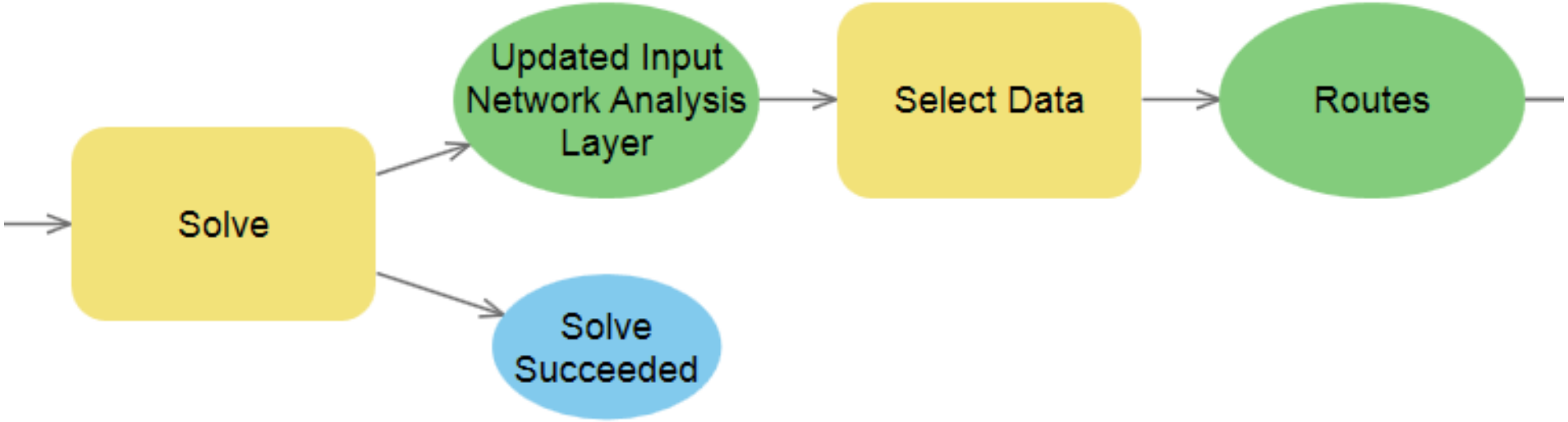
Visualizing analysis results in ArcMap

- **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**



Post-processing your analysis

- Use your analysis result as an input to another tool
  - The **Select Data** tool accesses individual sublayers



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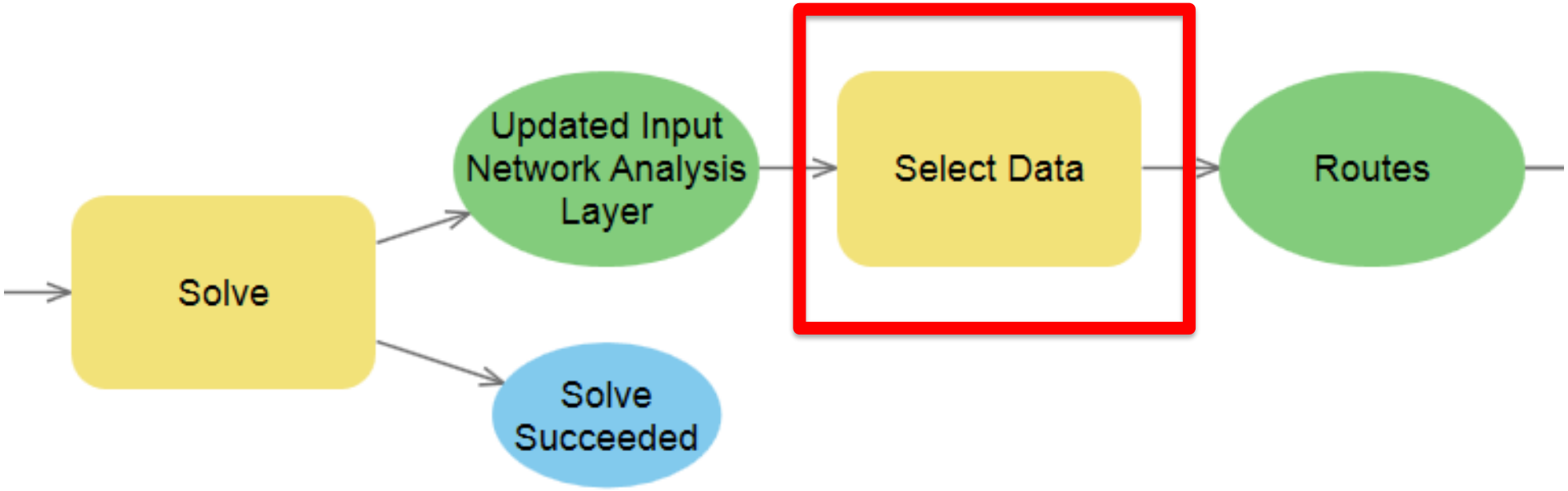

Demo

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

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Python: Scripts and script tools

Support and resources

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Writing Python Scripts

ArcGIS Help:
What is Python?

Python scripts

Python scripts

- Conditional logic

Python scripts

- Conditional logic
- Loops

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- Loops
- Cursors, creating geometry

Python scripts

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

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    - What is the Network Analyst module?
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      - LocationAllocationSolverProperties
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Python scripts

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  - **Other geoprocessing tools**

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Python scripts

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

arcpy.na

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Python scripts

- **Simplify access to Network Analyst functionality from Python**

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Python scripts

- **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**

Python Script: Basic Building Blocks

```
import arcpy
```

Import the arcpy site package

```
arcpy.CheckOutExtension("Network")
```

Check out Network Analyst Extension license

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

Create/edit a Network Analysis layer

```
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Create/edit a Network Analysis layer

```
arcpy.na.AddLocations(layerName, "Stops",
    claimLocations, fieldMappings_claims, "")
```

Add locations to analysis classes

```
# 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:\Transportation"
    env.overwriteOutput = True
    #Input network dataset
    inNetworkDataset = "Transportation/ParisMultimodal_ND"
    outNALayerName = "ClosestWarehouse"
```

```
arcpy.na.Solve(layerName)
```

Run the analysis

```
# 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/Paris.gdb"
    env.overwriteOutput = True
```

```
routeLayerObj.saveACopy(outputLayerFile)
```

Use the results

Edit the properties on an existing layer

```
# 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

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# Get the solver properties object from the service area layer
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```

Access sublayer with ListLayers

```
# 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

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

Access sublayer with ListLayers

```
# 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)
```

- Use sublayers as input to other tools (CopyFeatures, Join, Buffer, etc.).
- Use a SearchCursor to access the rows within a sublayer.

Field mapping

```
# 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, "")
```

Field mapping

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fieldMappings_claims = arcpy.na.NAClassFieldMappings(routeLayerObj, "Stops")
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```

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

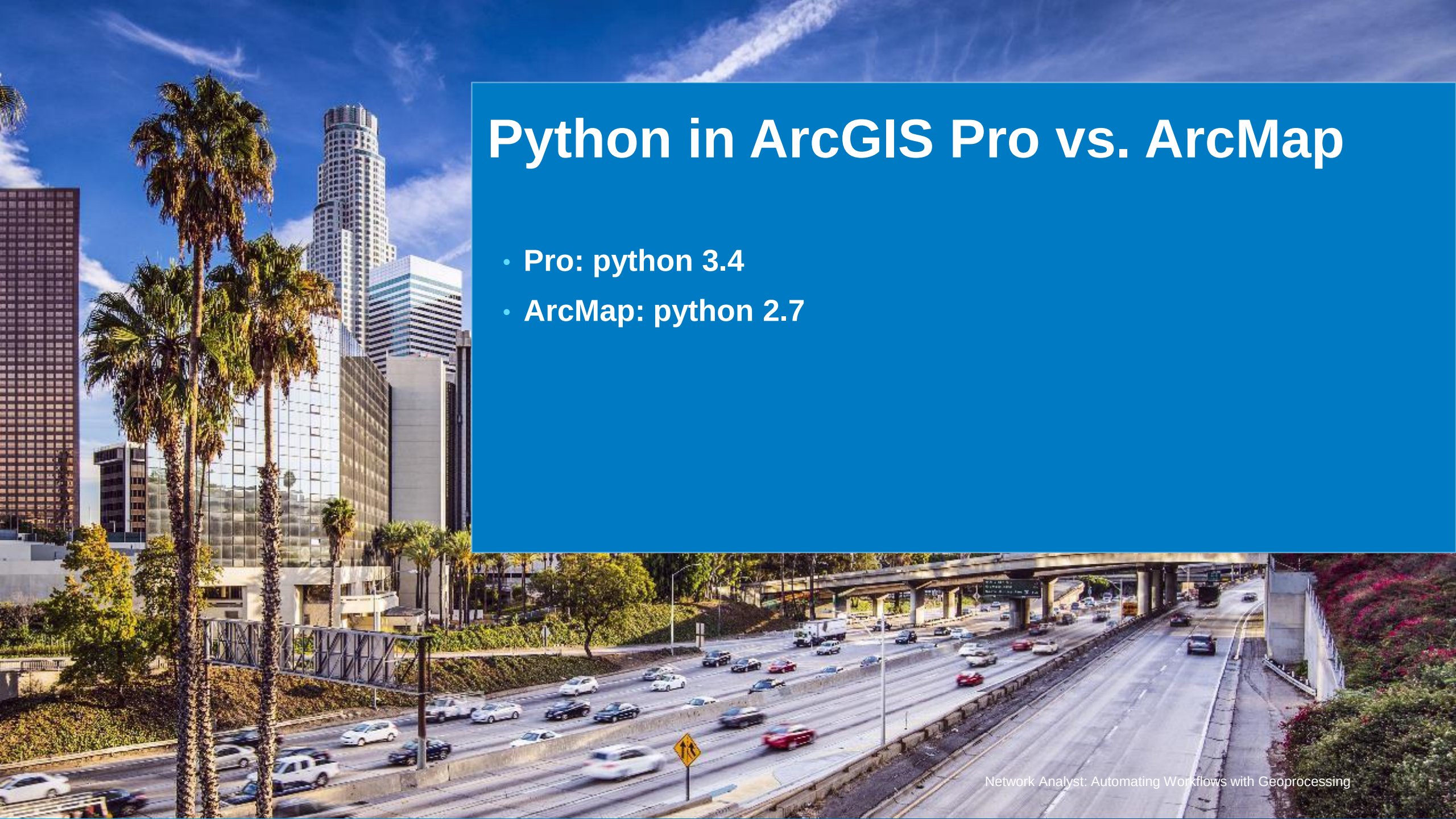
Set the output workspace

```
# 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**
  - http://pro.arcgis.com/en/pro-app/arcpy/get-started/python-migration-for-arcgis-pro.htm

Python in ArcGIS Pro vs. ArcMap

- **Network analysis migration help**
  - http://pro.arcgis.com/en/pro-app/arcpy/network-analyst/migratingfrom10xarcpynetworkanalyst.htm

Python in ArcGIS Pro vs. ArcMap

- **Network analysis migration help**
  - http://pro.arcgis.com/en/pro-app/arcpy/network-analyst/migratingfrom10xarcpynetworkanalyst.htm

- **Unsupported and deprecated tools**
- **Changes for working with layer object**

Python in ArcGIS Pro vs. ArcMap

- **Setting up a development environment (IDE)**
  - http://pro.arcgis.com/en/pro-app/arcpy/get-started/installing-python-for-arcgis-pro.htm

Demo

Automating workflows with python scripts

Performing a network analysis with a python script

Takeaways

Demo: Automating Workflows with Python Scripts

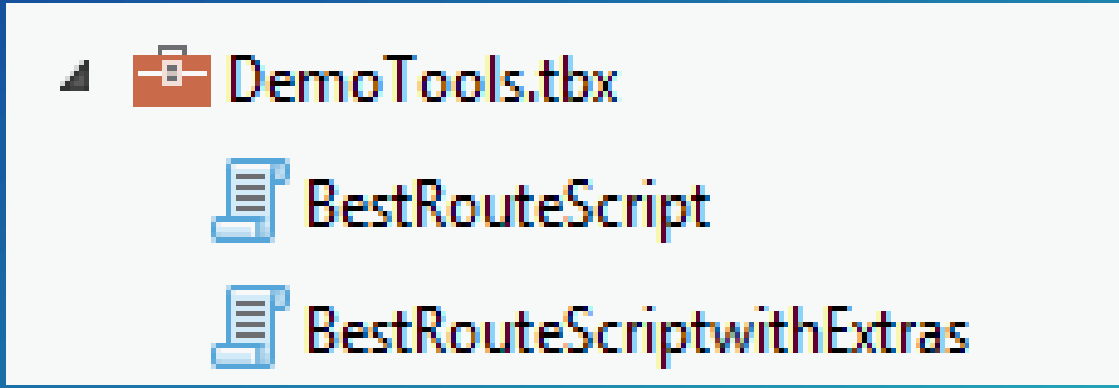
- Run any geoprocessing workflow in **stand-alone python**
- Find **Code samples** in the tool help
- Run simple python commands in the **python window**

Building Script Tools

ArcGIS Help:
What is a script tool?

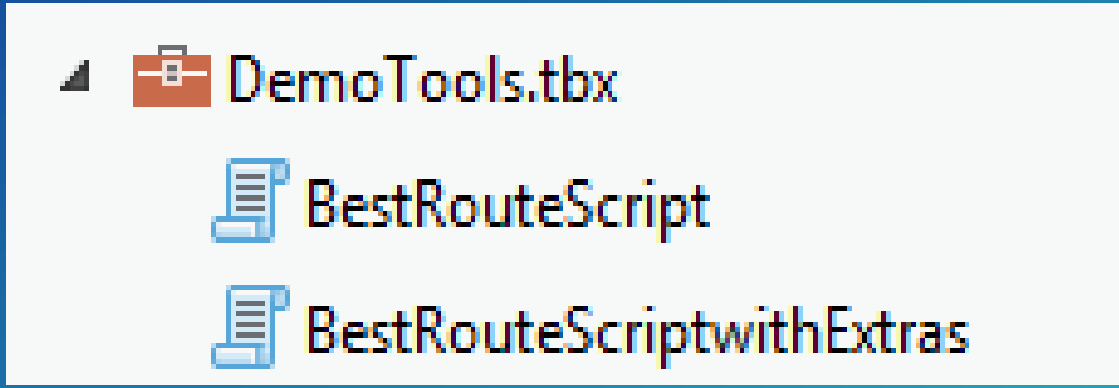
Script tools

- Work with your scripts through a user interface



Script tools

- 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

Add outputs from script tool to ArcMap

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

```
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(…)**

```
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)
```

Demo

Creating a script tool

Create a script tool to provide a UI for a Python script

Use tool validation to customize the UI

Takeaways

Demo: Creating a Script Tool

- 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

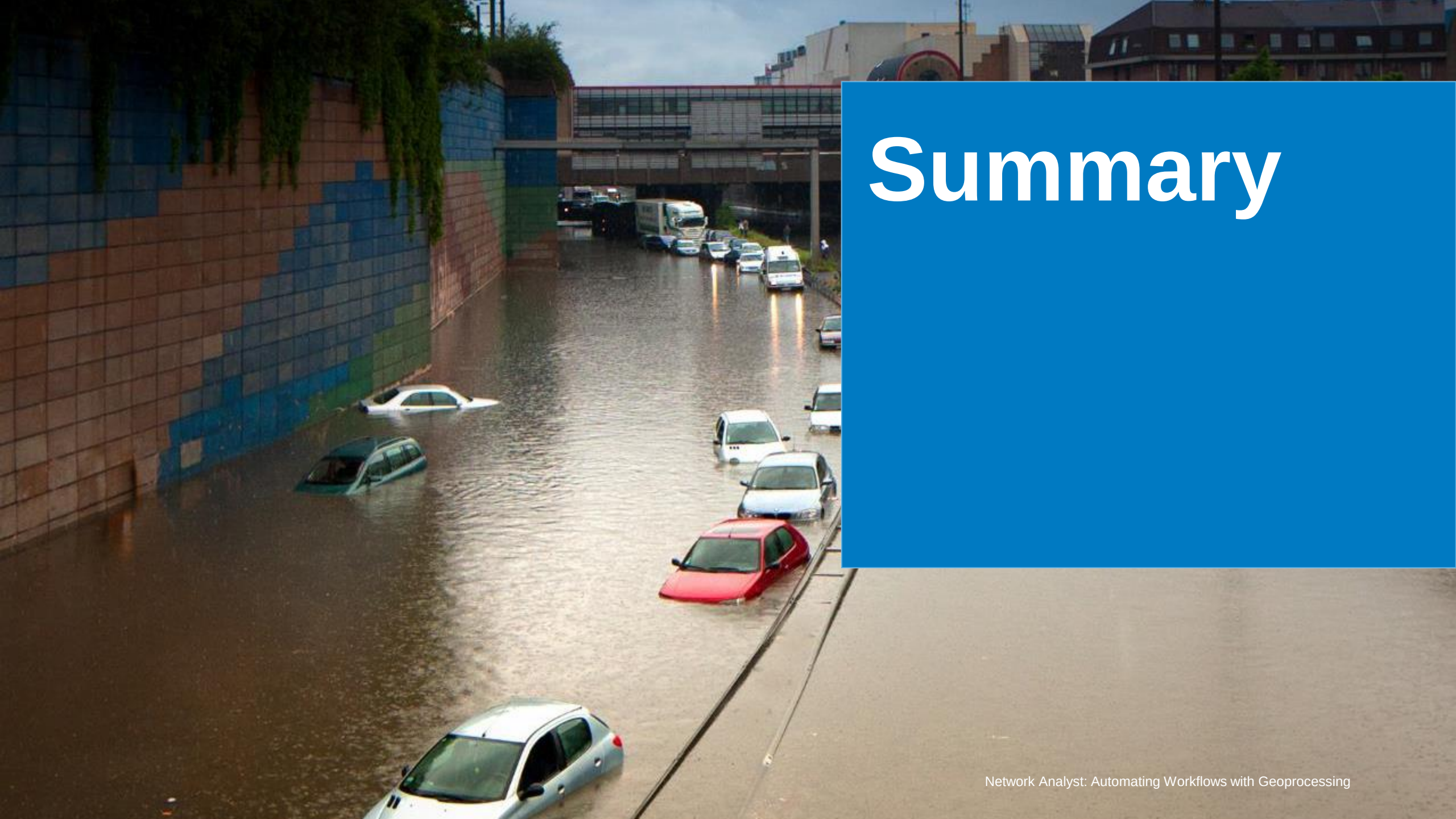
ArcGIS Network Analyst extension concepts

Geoprocessing and network analysis

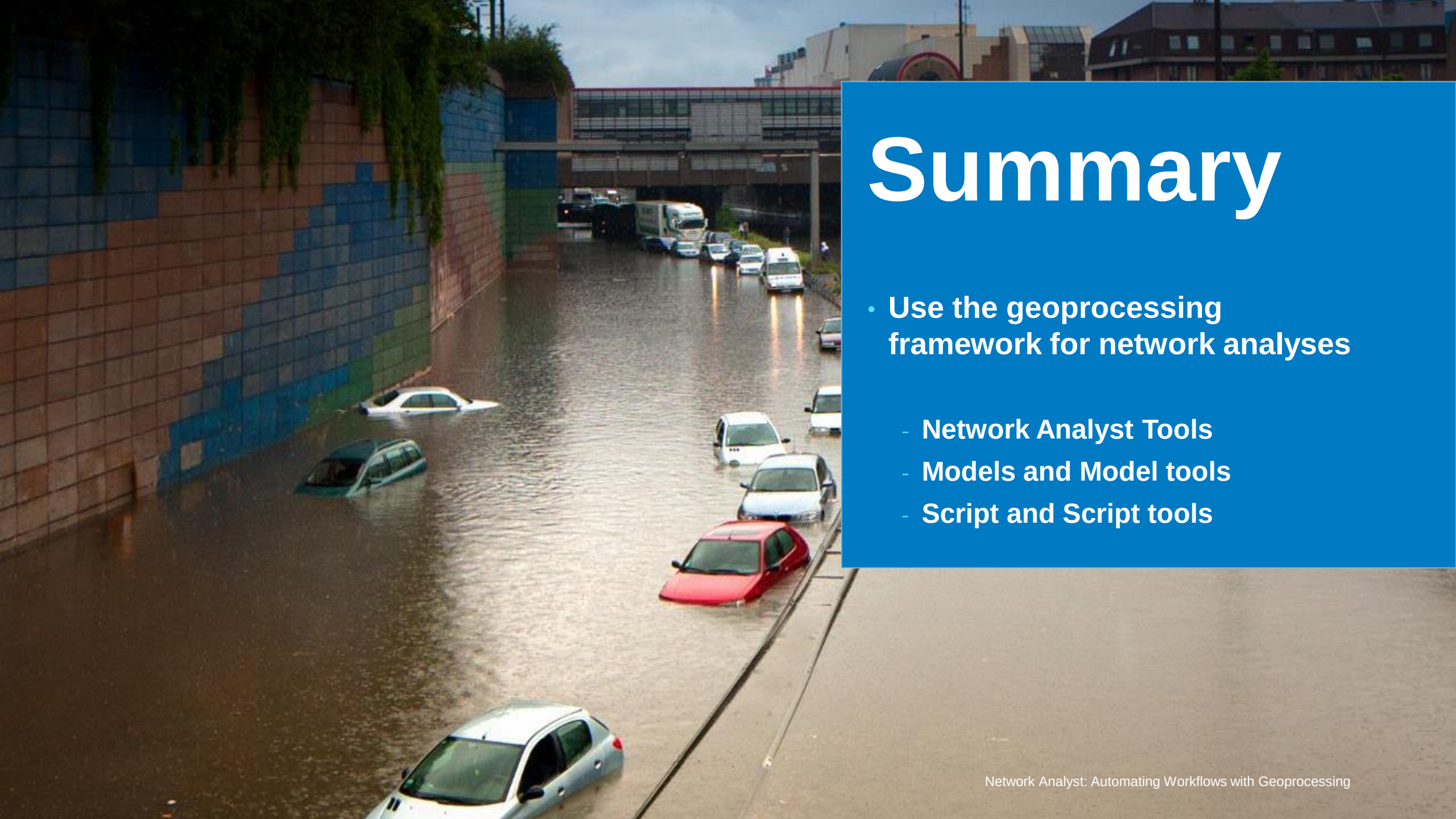
ModelBuilder: Models and model tools

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

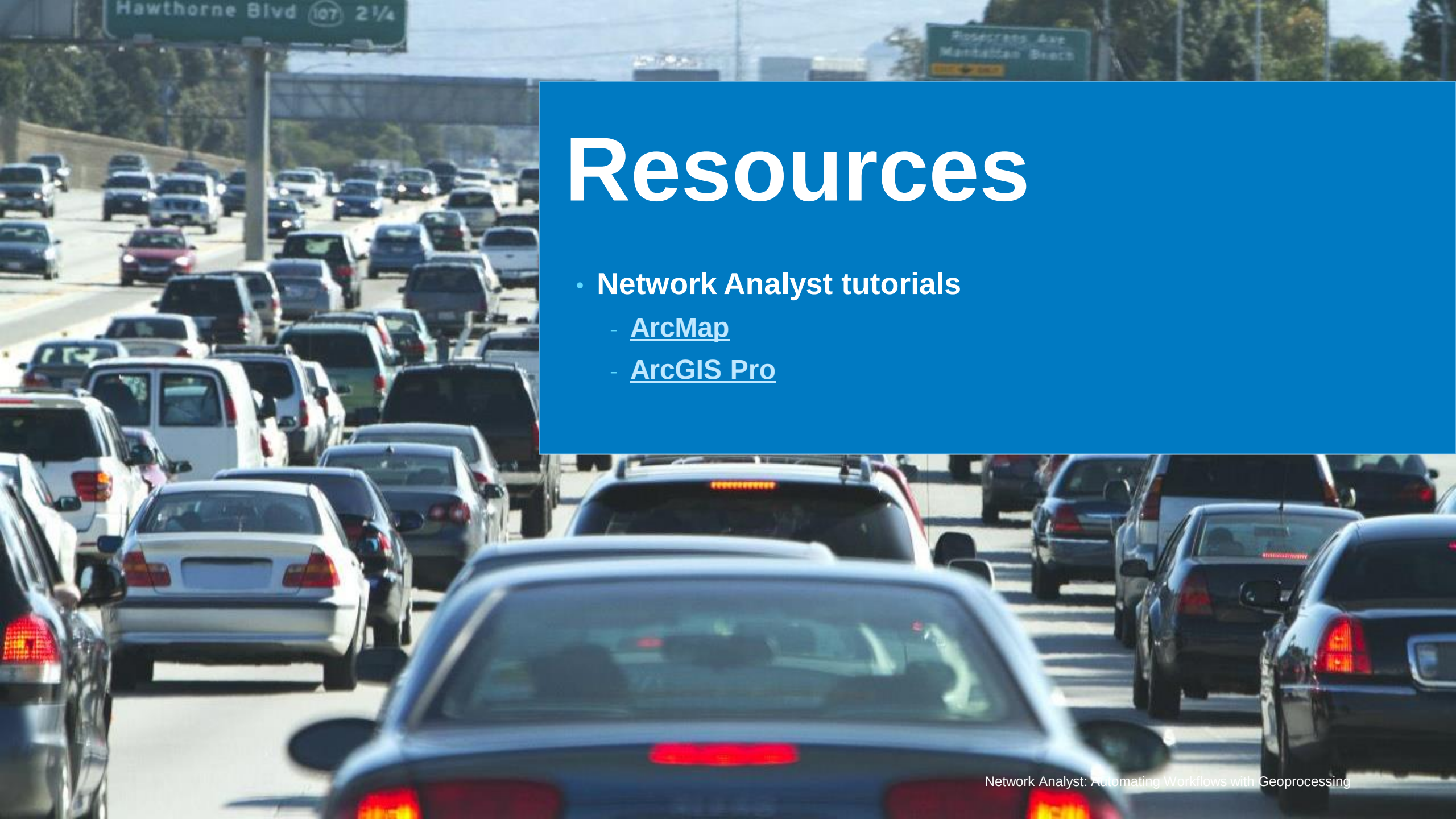
Summary

- Automate workflows

Summary

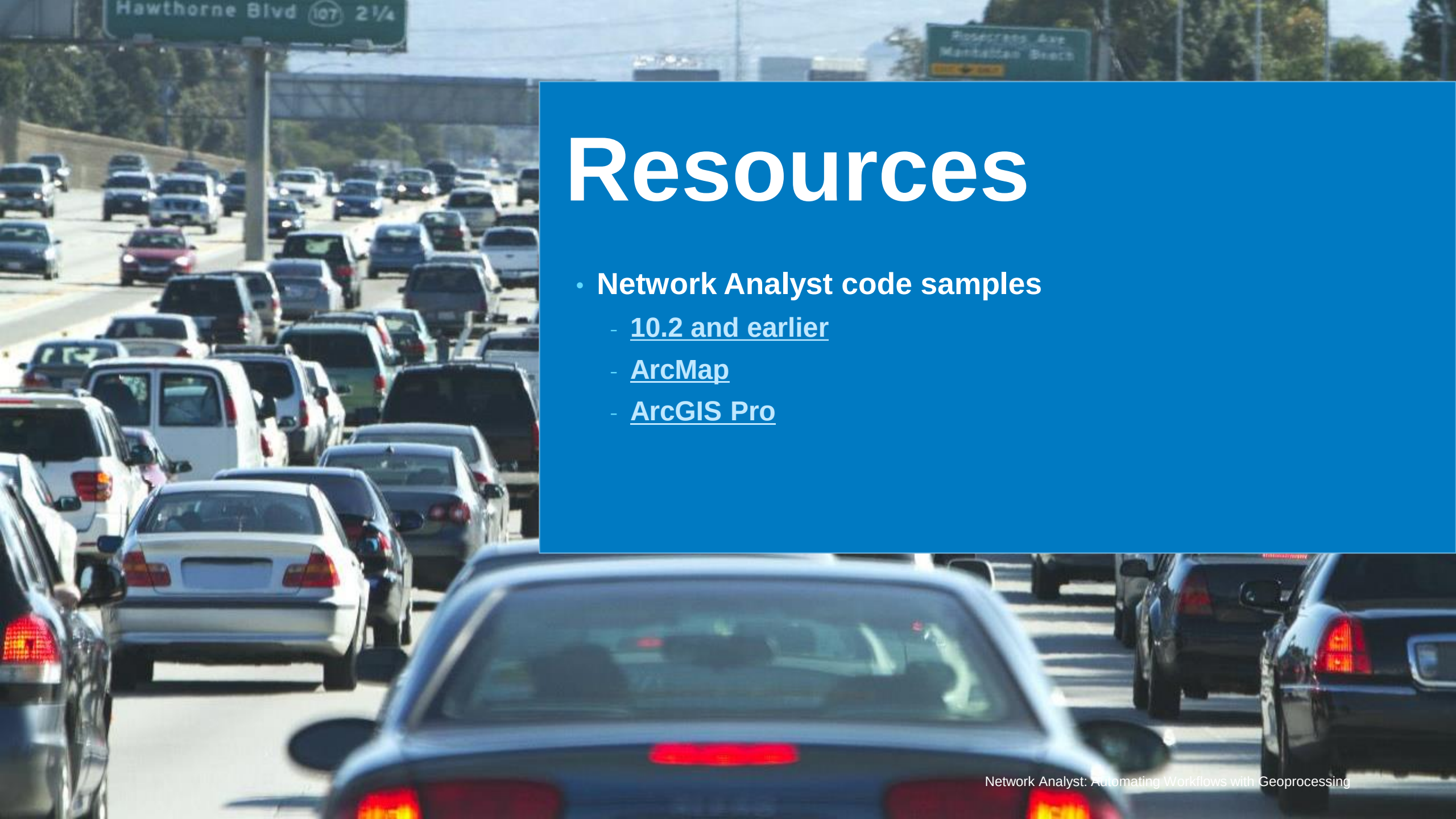
- Incorporate network analysis in larger process

Resources



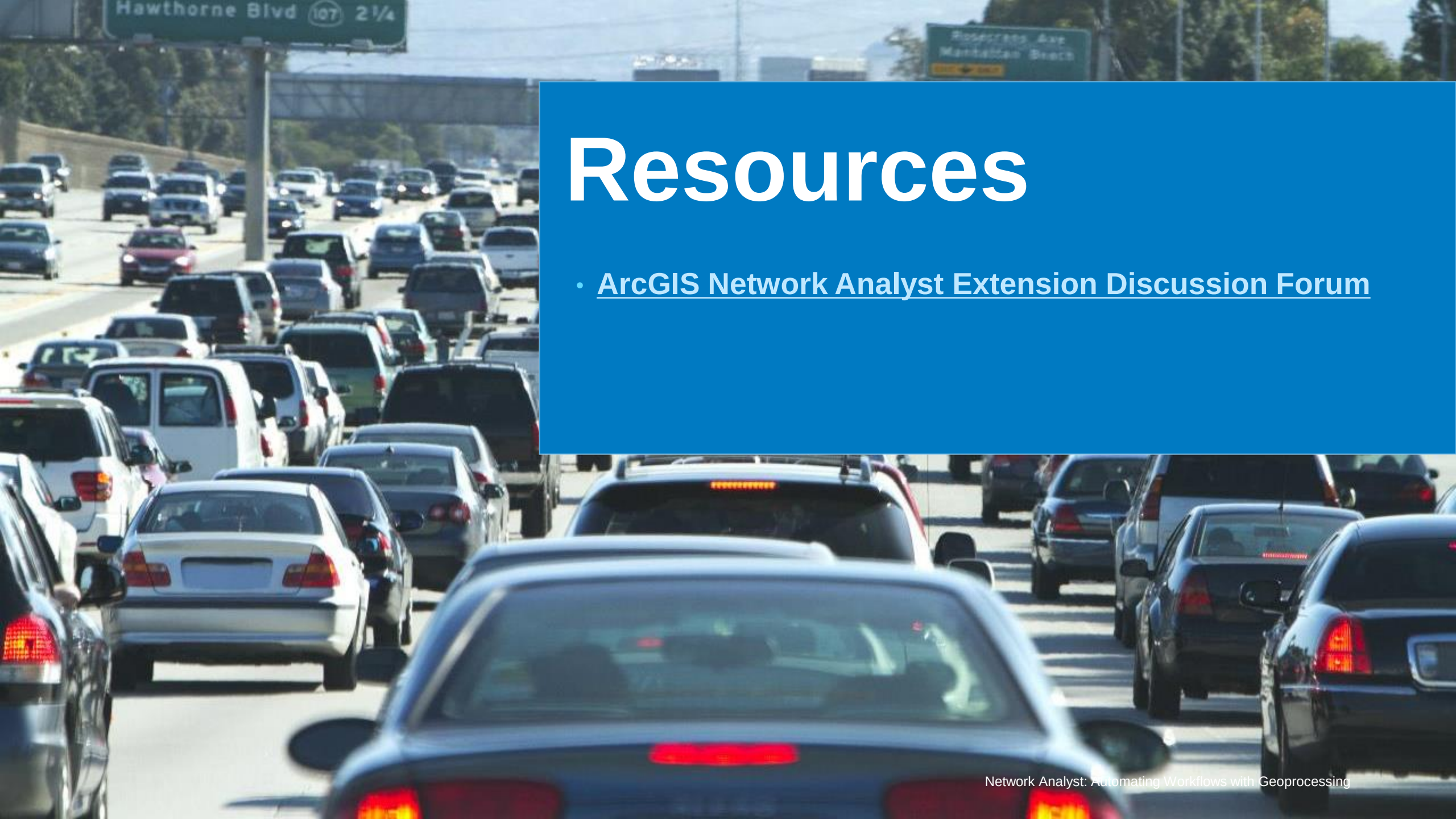
Resources

- **Network Analyst tutorials**
  - ArcMap
  - ArcGIS Pro



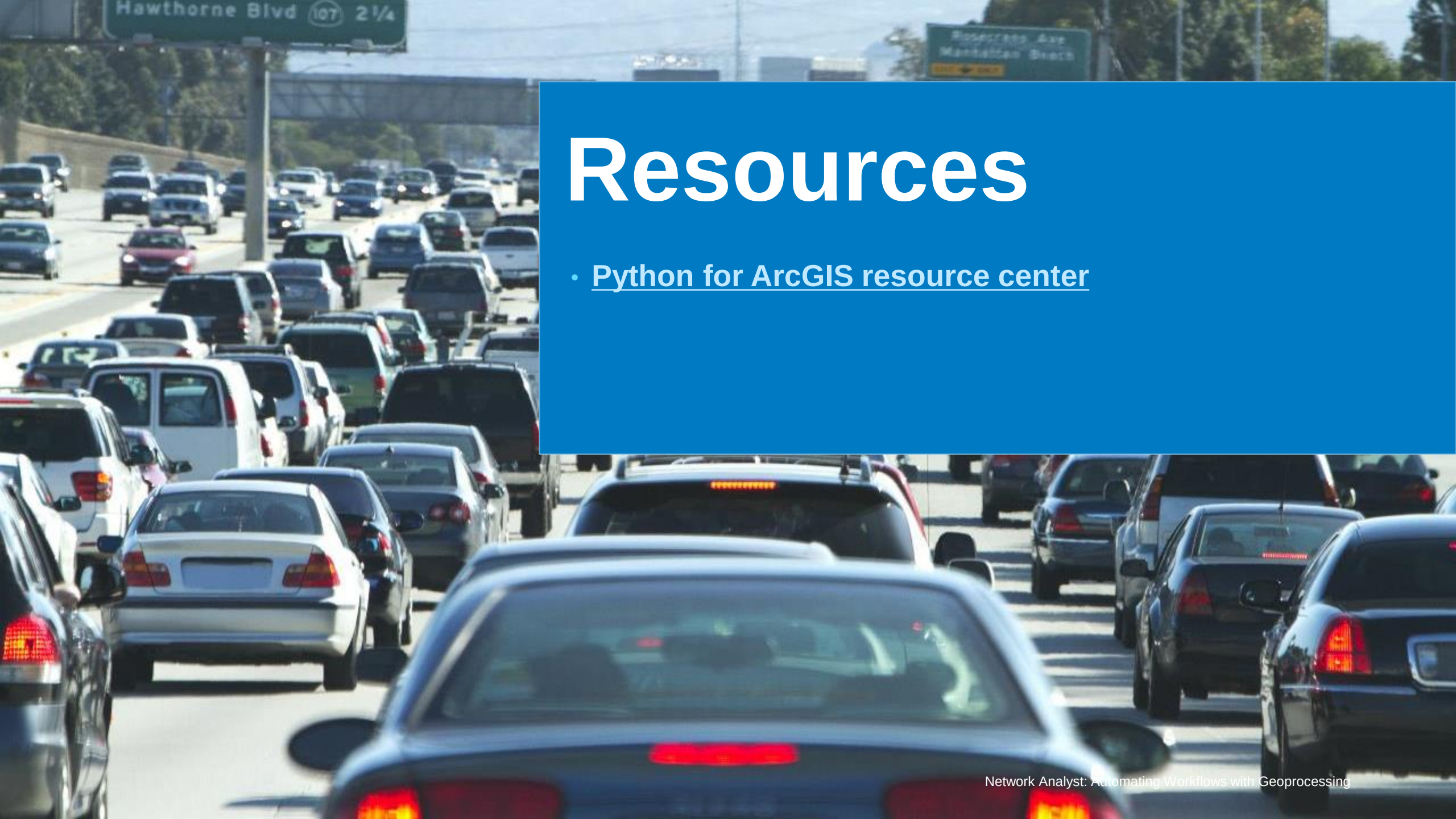
Resources

- **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

to

Melinda Morang

Signature of Manager

Please Take Our Survey on the **Esri Events App!**

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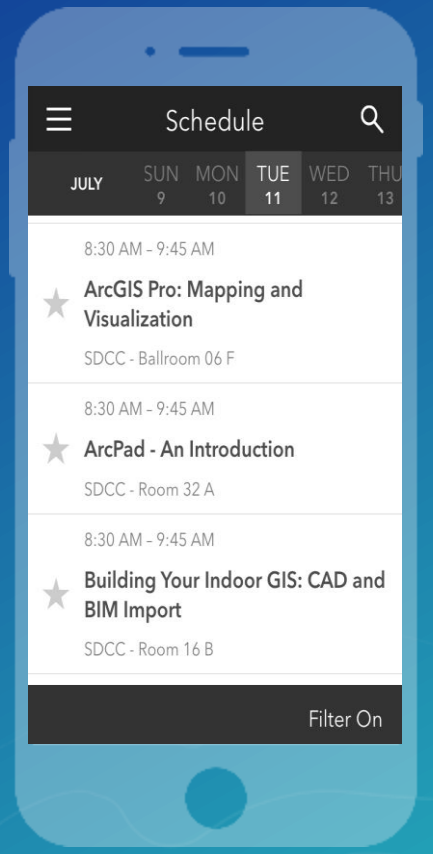
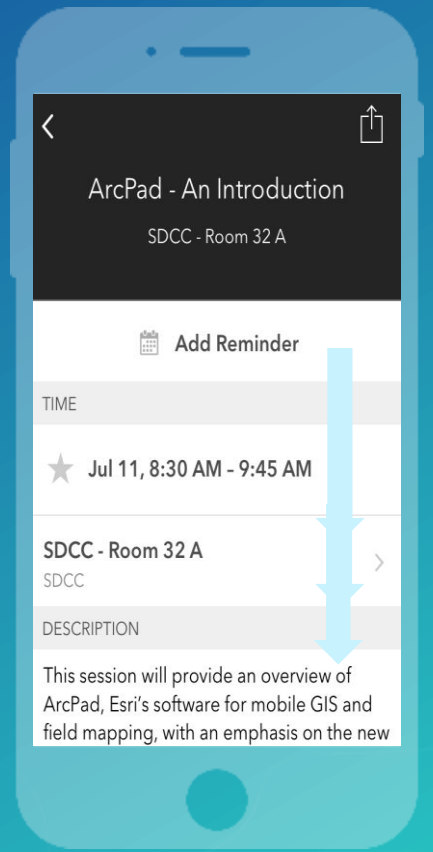
Select the session you attended



Scroll down to find the survey



Complete Answers and Select "Submit"