Python: Automating Network Analysis Workflows

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Agenda

- About ArcGIS Network Analyst
- Network analysis using ArcGIS Online
  - Accessing services
  - Passing credentials
- Network analysis using ArcGIS Desktop
  - Network Analyst Python Module (arcpy.na)
  - Network analysis workflow
  - Tips and tricks

Slides and code samples from this demo theater

http://esriurl.com/ds17napy

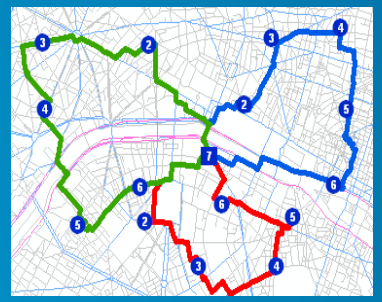
ArcGIS Network Analyst

ArcGIS Network Analyst Extension

Solving transportation problems

Service Area

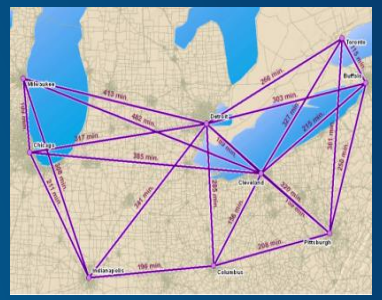
Location-Allocation



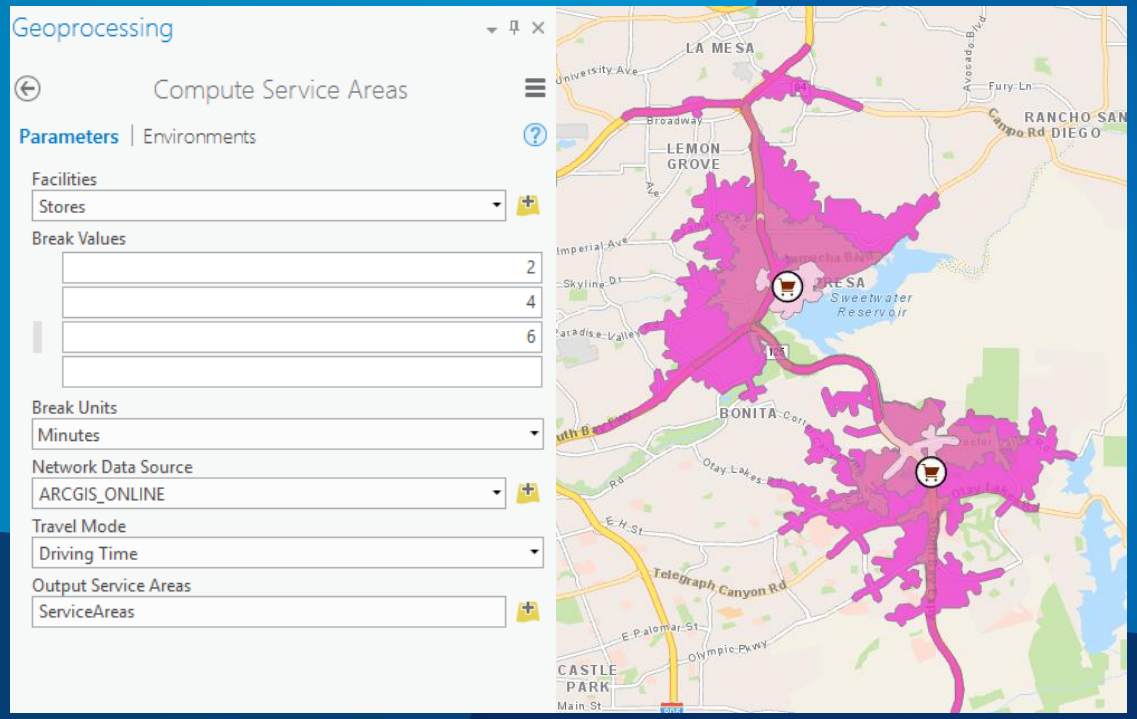
Vehicle Routing Problem

Route

Closest Facility



Origin-Destination Cost Matrix



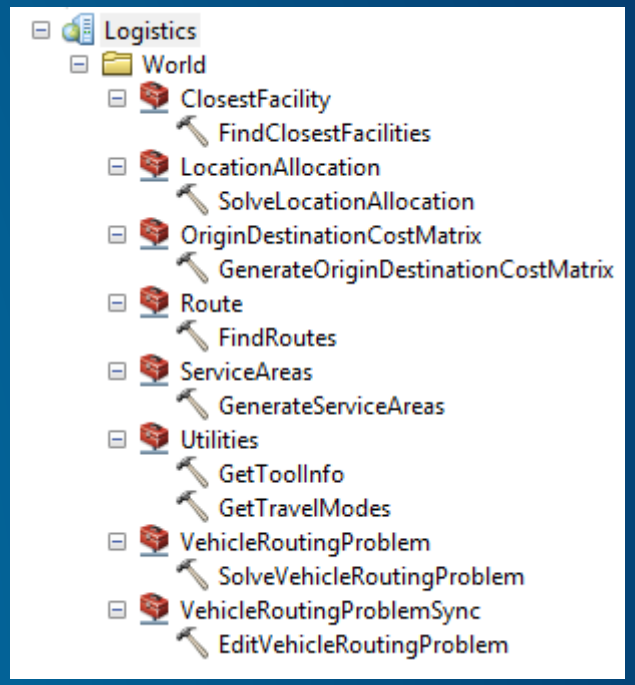
Demo:
Network Analysis using script tools

Network analysis using ArcGIS Online

Network Analysis using ArcGIS Online Services

- Ready to use
- Managed by Esri
- High quality street data
- Worldwide coverage

ArcGIS Online



- Requires ArcGIS Online subscription with service credits
- No need for Network Analyst Extension license
- No need for your own network dataset

Using Online Services from Python

- Import the appropriate toolbox
- Gather credentials (3 options)
  1. Include credentials in the script
  2. Store credentials in an ArcGIS Server connection file
  3. Use the token of the user signed into ArcGIS Desktop

```
# Construct the connection string to import the service toolbox
if username and password:
    tbx = "https://logistics.arcgis.com/arcgis/services;{0};{1};{2}".format(service_name, username, password)
elif ags_connection_file:
    tbx = "{0};{1}".format(ags_connection_file, service_name)
elif token and referer:
    tbx = "https://logistics.arcgis.com/arcgis/services;{0};token={1};{2}".format(service_name, token, referer)
else:
    raise arcpy.ExecuteError("No valid option specified to connect to the {0} service".format(service_name))

# Import the service toolbox
try:
    arcpy.ImportToolbox(tbx)
```

Using Online Services from Python (continued…)

- **Call the geoprocessing tool from the imported toolbox**

```
# Call the service
arcpy.AddMessage("Executing the service tool.")
result = service.GenerateServiceAreas(self.facilities, self.breaks, self.break_units,
                                      Travel_Mode=self.travel_mode)
```

- **Get the output**

```
# Save the service areas to the output feature class.
arcpy.AddMessage("Saving the results from the service tool.")
result.getOutput(0).save(self.service_areas)
```

```
# Construct the connection string to import the service to
if username and password:
    tbx = "https://logistics.arcgis.com/arcgis/services;{0
elif ags_connection_file:
    tbx = "{0};{1}".format(ags_connection_file, service_na
elif token and referer:
    tbx = "https://logistics.arcgis.com/arcgis/services;{0
else:
    raise arcpy.ExecuteError("No valid option specified to

# Import the service toolbox
try:
    arcpy.ImportToolbox(tbx)
```

Demo:
Service Areas using
ArcGIS Online

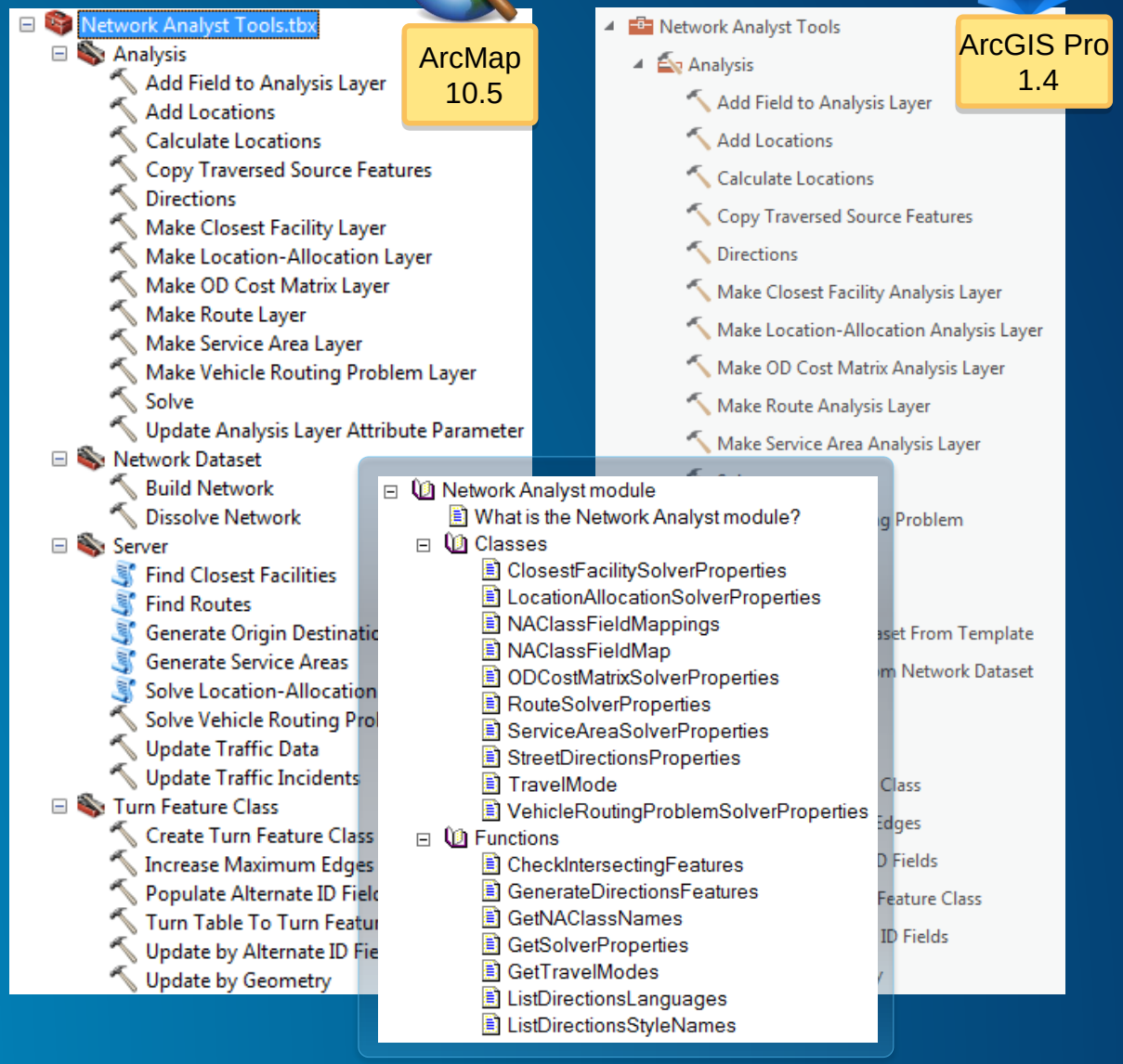
Network analysis using ArcGIS Desktop

Network Analysis using ArcGIS Desktop

arcpy.na python module

- Geoprocessing tools
- Helper methods

- Requires ArcGIS Network Analyst Extension license
- Use your own street data in a network dataset
- Customize ArcGIS and extend functionality



Where do I get a network dataset?

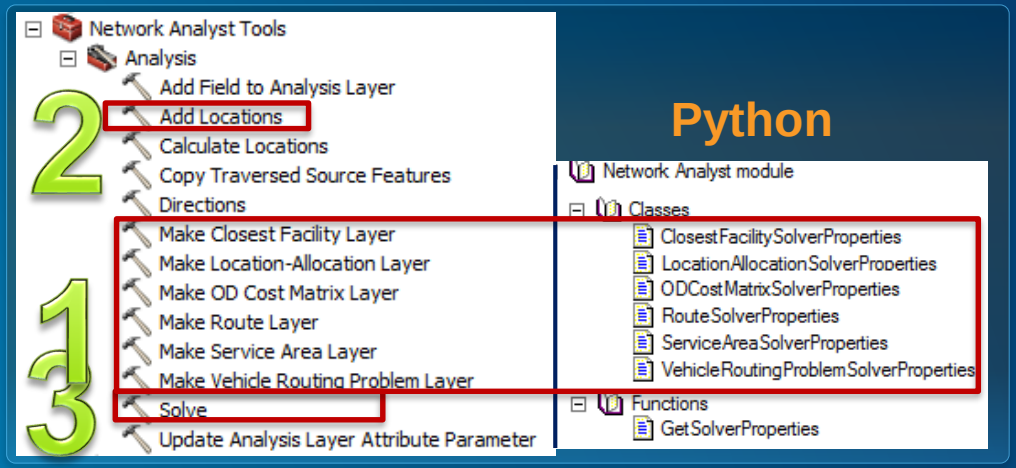
- Purchase StreetMap Premium for ArcGIS
  - High quality ready-to-use network dataset
  - Can add your own street data as well

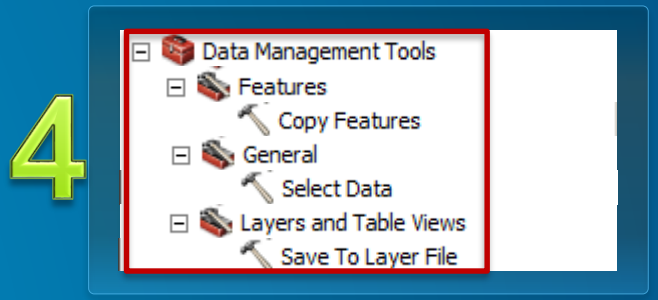
OR

- Build your own network dataset from:
  - Your organization's data
  - TIGER
  - OpenStreetMap (try ArcGIS Editor for OpenStreetMap)

Network Analysis Workflow

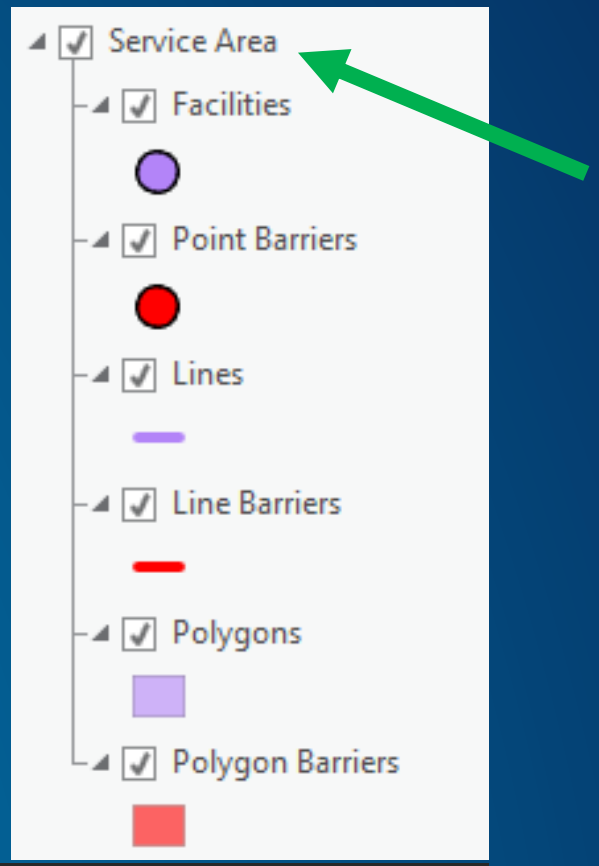
1. Create analysis layer
2. Add locations
3. Solve
4. Use the results





1. Create analysis layer

- Composite layer configured for a specific solver type (Route, Service Area, etc.)
- Contains analysis settings
- Contains input and output data (in sublayers)
- References a network dataset

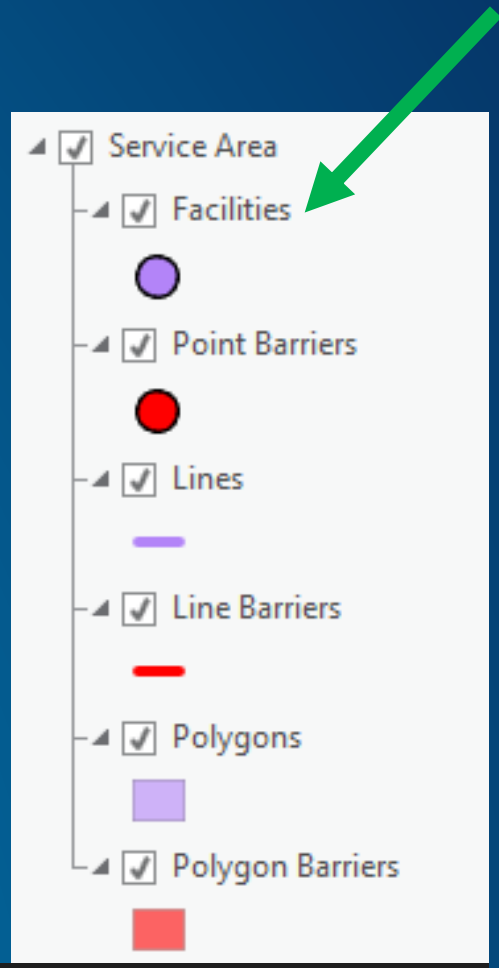


arcpy.na.MakeServiceAreaLayer()

```
# Create a new service area layer
arcpy.AddMessage("Creating service area analysis layer")
result = arcpy.na.MakeServiceAreaLayer(self.network_source, service_area_layer_name, impedance_attribute,
                                       "TRAVEL_FROM", self.breaks)
# Get the layer object from the result object. The service area layer can now be referenced using the layer
# object.
service_area_layer = result.getOutput(0)
```

2. Add locations

- Add input data
- Add barriers if desired



arcpy.na.AddLocations()

arcpy.na.NAClassFieldMappings() to map fields

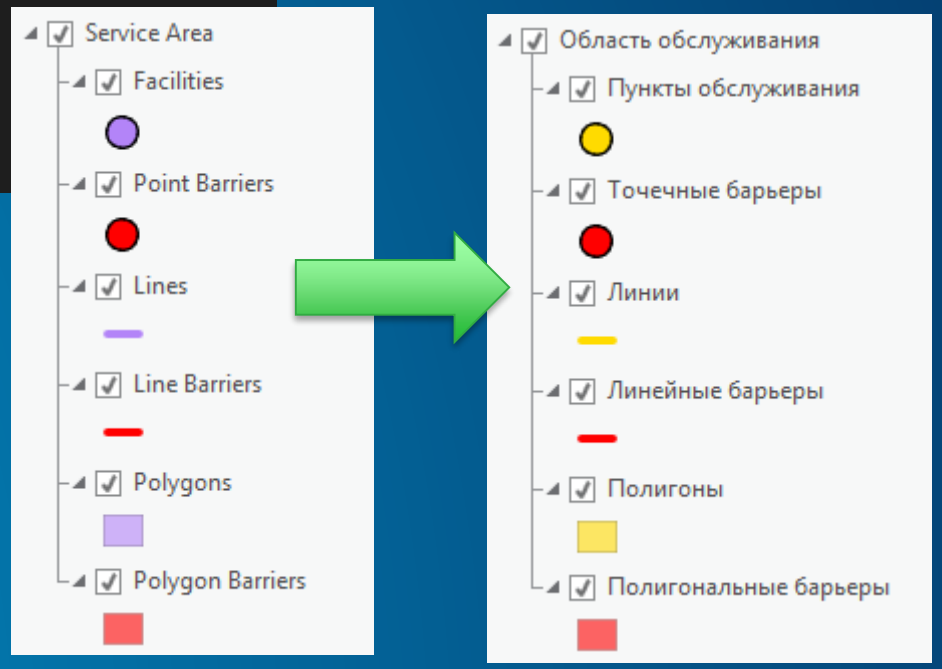
```
# Map the StoreName field from stores as Name field using field mappings
field_mappings = arcpy.na.NAClassFieldMappings(service_area_layer, facilities_layer_name)
field_mappings["Name"].mappedFieldName = "StoreName"
# Load the stores as facilities using the field mappings.
arcpy.AddMessage("Loading facilities")
arcpy.na.AddLocations(service_area_layer, facilities_layer_name, self.facilities, field_mappings,
                      search_tolerance)
```

Tip: Make localization-friendly scripts

- NA layer sublayer names are different across ArcGIS language versions
- Use arcpy.na.GetNAClassNames() to get localized sublayer names.

```
# Get the names of all the sublayers within the service area layer.
sub_layer_names = arcpy.na.GetNAClassNames(service_area_layer)

# Stores the layer names that we will use later
facilities_layer_name = sub_layer_names["Facilities"]
polygons_layer_name = sub_layer_names["SAPolygons"]
```

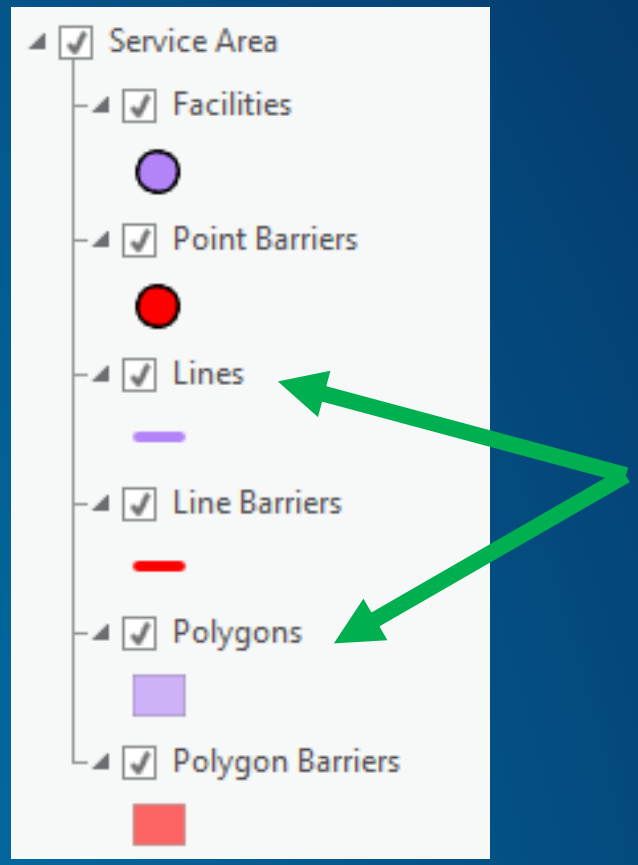


3. Solve

- Run the analysis
- Output is in the network analysis layer

arcpy.na.Solve()

```
arcpy.AddMessage("Performing service area analysis")
arcpy.na.Solve(service_area_layer)
```



Tip: Reuse existing network analysis layers

- Instead of creating a new network analysis layer
- Example: Solving the same analysis at different times of day in a loop
- Steps:
  1. Get reference to a network analysis layer object
  2. Get the solver properties object with arcpy.na.GetSolverProperties()
  3. Update the properties

```
#Get the Service Area Layer's solver properties. This can be used to
#set individual properties later without re-creating the layer.
solver_properties = arcpy.na.GetSolverProperties(layer_object)

#Solve the Service Area for each time of day in the time list
for t in times_of_day:
    #Use the solver properties to set the time of day for the solve
    solver_properties.timeOfDay = t

    #Solve the service area layer
    arcpy.na.Solve(layer_object)
```

4. Work with the results

- Save NA layer to disk using:
  - arcpy.management.SaveToLayerFile() (ArcMap)
  - <NA layer object>.saveACopy() (ArcGIS Pro)
- Access output sublayers using:
  - arcpy.mapping.ListLayers() (ArcMap)
    <NA layer object>.listLayers() (ArcGIS Pro)

```
# Get the layer object for the output polygons.
if nast.NATool.is_arcgis_pro():
    # When using ArcGIS Pro, get the polygons sub layer using the listLayers method on the service area layer
    # object
    polygons_layer = service_area_layer.listLayers(polygons_layer_name)[0]
else:
    # When using ArcMap, get the polygons sub layer using the ListLayers function in the mapping module
    polygons_layer = arcpy.mapping.ListLayers(service_area_layer, polygons_layer_name)[0]
```

Tip: Watch out for differences between ArcMap and ArcGIS Pro

- **Python version syntax changes**
  - **ArcGIS Pro uses Python 3.5**
  - **ArcMap uses Python 2.7**
- **arcpy.na module changes**

- **You *can* write single script that works in both!**

```
# Get the layer object for the output polygons.
if nast.NATool.is_arcgis_pro():
    # When using ArcGIS Pro, get the polygons sub layer using the listLayers method on the service area layer
    # object
    polygons_layer = service_area_layer.listLayers(polygons_layer_name)[0]
else:
    # When using ArcMap, get the polygons sub layer using the ListLayers function in the mapping module
    polygons_layer = arcpy.mapping.ListLayers(service_area_layer, polygons_layer_name)[0]
```

```
# Create a new service area layer
arcpy.AddMessage("Creating service area analysis layer")
result = arcpy.na.MakeServiceAreaLayer(self.network_source, serv
                                       "TRAVEL_FROM", self.break
# Get the layer object from the result object. The service area
# object.
service_area_layer = result.getOutput(0)  # pylint: disable=no-m
```

Demo:
Service Areas using
ArcGIS Desktop

Resources

- ArcGIS Online services in the Network Analyst help
- Network Analyst tutorial
- Code samples in Network Analyst tools toolbox

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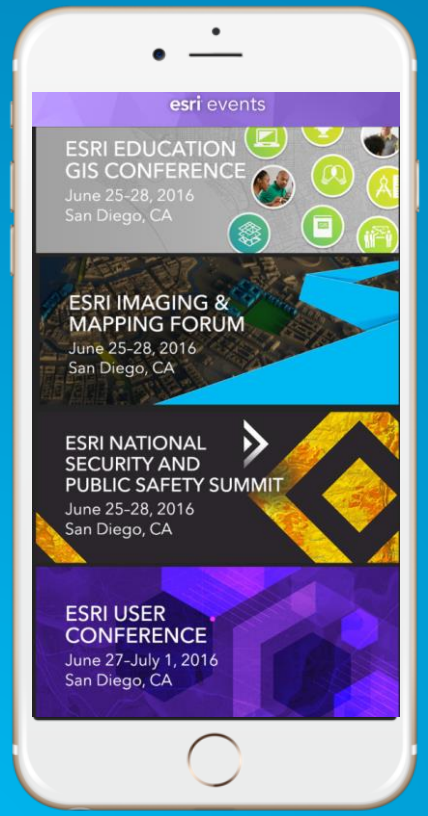

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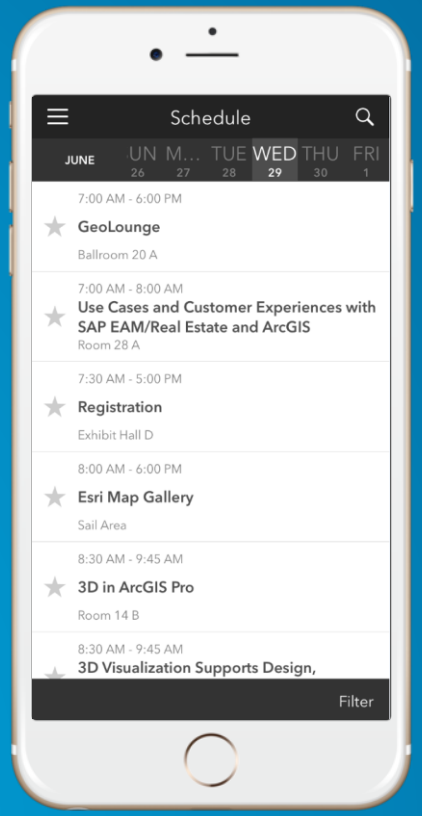

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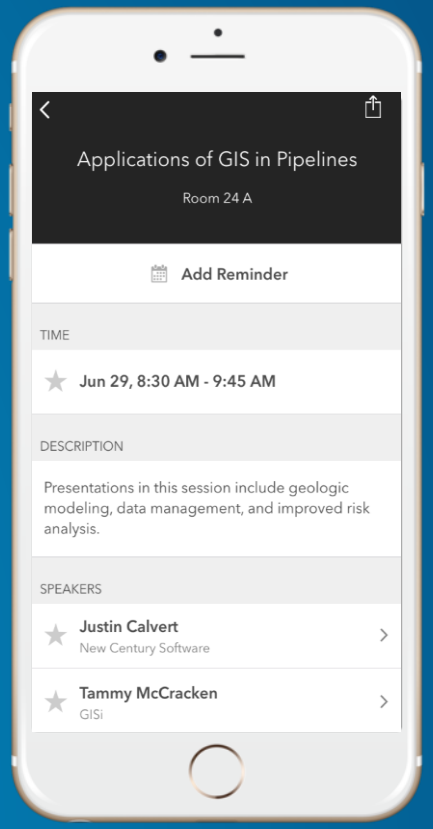
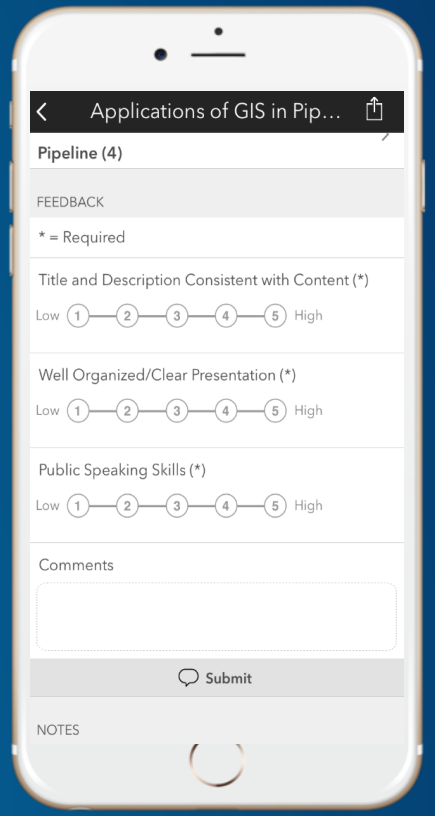


Answer survey questions and submit



Questions?

Slides and code samples from this demo theater:

http://esriurl.com/ds17napy

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