

04a. Network dataset as a specific example of spatial data model

GE3238 GIS Design and Practices
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Learning Objectives

- Is network dataset sufficiently general?
 - Entity, property, and relation
 - Relation between [entities | an entity and its property]
 - **Current network (as in Lab01) to multi-modal network**
- Spatial data models
 - Vector and raster: What do they offer?
 - **The model to support network analysis?**
 - Conceptual-logical-physical

Key terms

Spatial data model

Multimodal network

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Current capabilities of the network (data) model in Lab01?

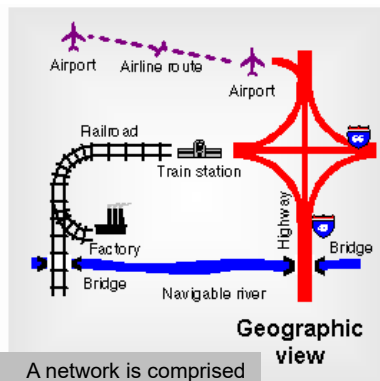
- Support applications that require optimizing distance travelled on restricted paths
- However, does it _____?
 - **support** accurate modelling of one-way
 - **implement** accurate modelling of one-way
 - **support** pedestrian movement as a model of travel
 - **Implement** pedestrian movement as a mode of travel
 - ...

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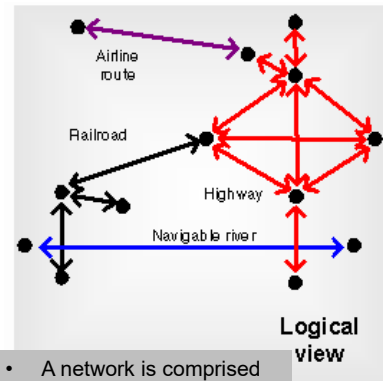
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Multi-modal network?

- What do you observe from the logical network in terms of **connectivity**?



- A network is comprised of linear features through which commodities flow.
- A network contains point features where a transfer of commodities occur, such as from roads to railroad stations, or from one road to another.

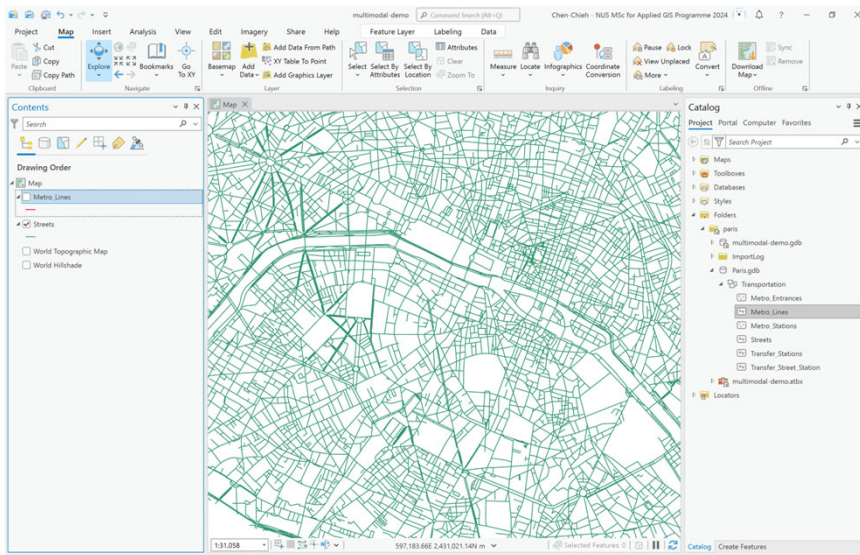


- A network is comprised of edges and junctions.
- Commodities flow through edges, and edges connect together junctions, where flow from one edge to another.
- In a network, geometry is not important, only the connectivity of edges and junctions.

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Street



Key terms

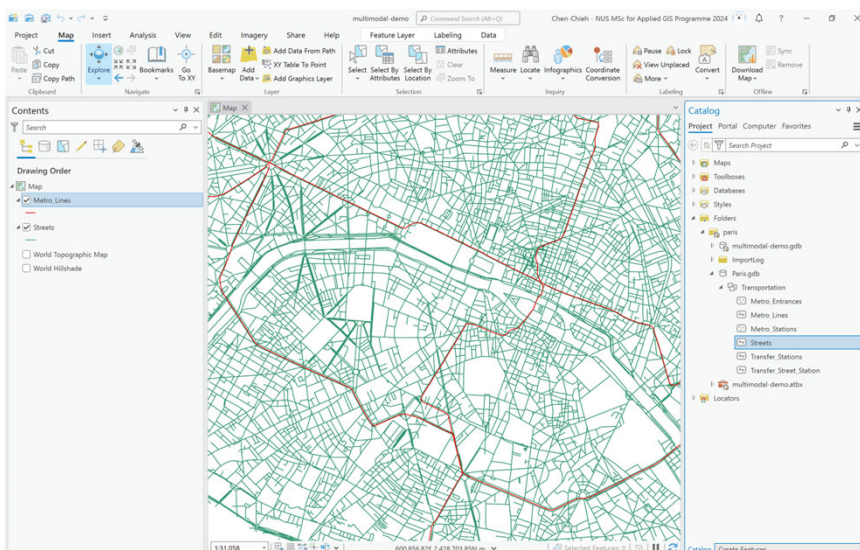
Logical & physical data model

Geometry

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Street + Metro line



Key terms

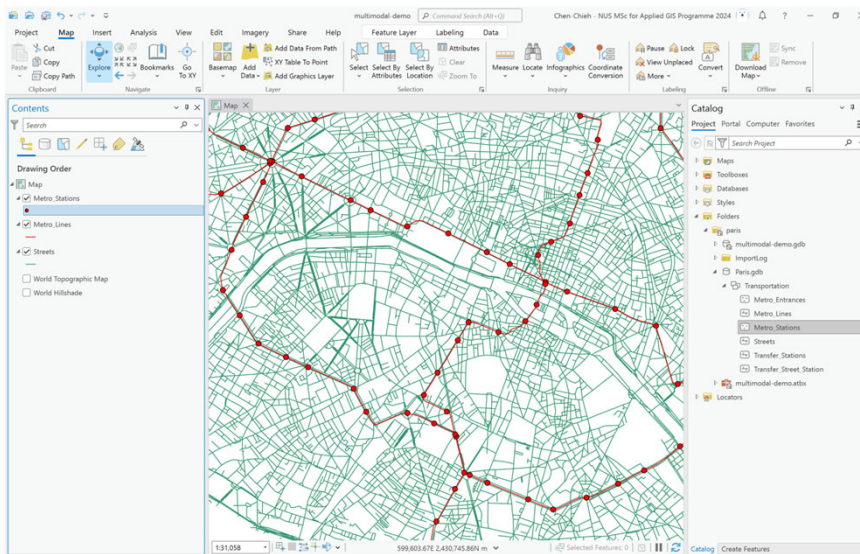
Logical & physical data model

Geometry

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Street + Metro Line + Metro Station



Key terms

Logical & physical data model

Geometry

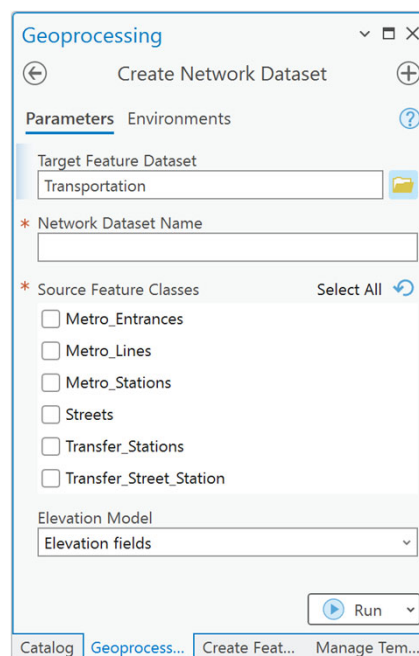
Junction

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Multi-modal?

- “Multi-modal” in this lecture == multiple modes of transportation
- What data layers are needed for a multi-modal (transportation) network model?



Key terms

Multimodal

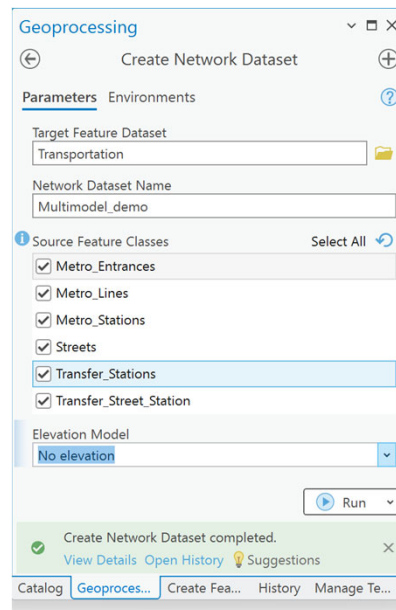
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Multi-modal?

- By checking all six layers, what relations are implied?

(Implication – some of these relations must be specified to enable modelling of multimodal transportation network)



Key terms

Relation

Spatial relation

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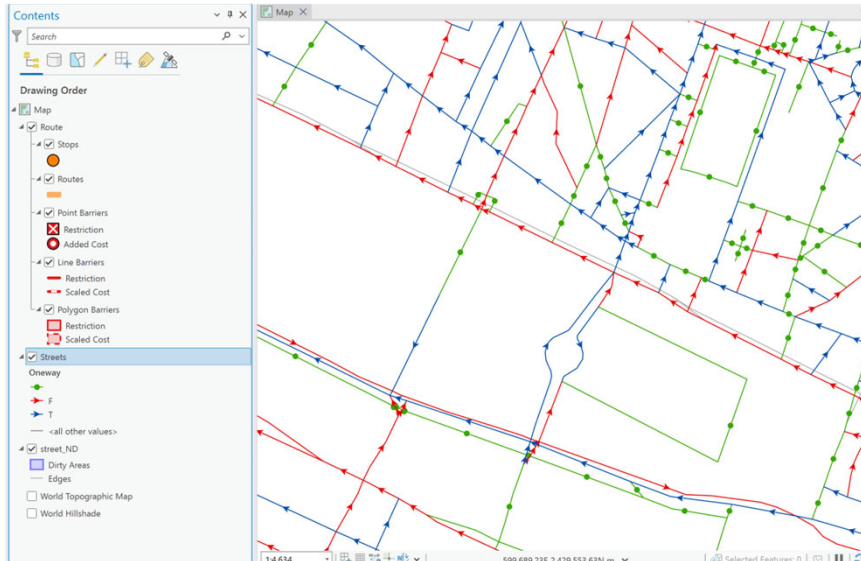
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Visualizing Oneway field



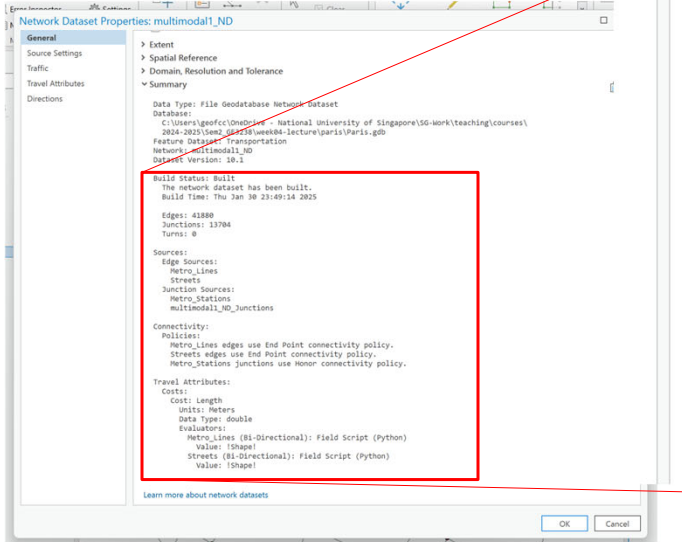
Key terms

Symbology layer

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What about the connectivity (up to this slide)?



Build Status: Built
The network dataset has been built.
Build Time: Thu Jan 30 23:49:14 2025

Edges: 41880
Junctions: 13704
Turns: 0

Sources:
Edge Sources:
Metro_Lines
Streets
Junction Sources:
Metro_Stations
multimodal1_ND_Junctions

Connectivity:
Policies:
Metro_Lines edges use End Point connectivity policy.
Streets edges use End Point connectivity policy.
Metro_Stations junctions use Honor connectivity policy.

Travel Attributes:
Costs:
Cost: Length
Units: Meters
Data Type: double
Evaluators:
Metro_Lines (Bi-Directional): Field Script (Python)
Value: !Shape!
Streets (Bi-Directional): Field Script (Python)
Value: !Shape!

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Group Connectivity

Network Dataset Properties: Multimodel_demo

General Source Settings Traffic Travel Attributes Directions

Network Dataset is used by network layers in opened maps.

Group Count: 2

Name	Policy	Groups
Edges		
Metro_Lines	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Streets	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Transfer_Stations	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Transfer_Street_Station	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Junctions		
Metro_Entrances	Honor	<input checked="" type="checkbox"/> <input type="checkbox"/>
Metro_Stations	Honor	<input checked="" type="checkbox"/> <input type="checkbox"/>

Endpoint

Endpoint

Any Vertex

Honor

Honor

Override

OK Cancel

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Group Connectivity

Connectivity

Network Dataset Properties: Multimodel_demo

General | **Source Settings** | Traffic | Travel Attributes | Directions

Network Dataset is used by network layers in opened maps.

Group Count: 2

Name	Policy	Groups
Edges		
Metro_Lines	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Streets	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Transfer_Stations	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Transfer_Street_Station	Endpoint	<input checked="" type="radio"/> <input type="radio"/>
Junctions		
Metro_Entrances	Honor	<input checked="" type="checkbox"/> <input type="checkbox"/>
Metro_Stations	Honor	<input checked="" type="checkbox"/> <input type="checkbox"/>

Learn more about group connectivity

OK Cancel

Endpoint

Endpoint

Any Vertex

Honor

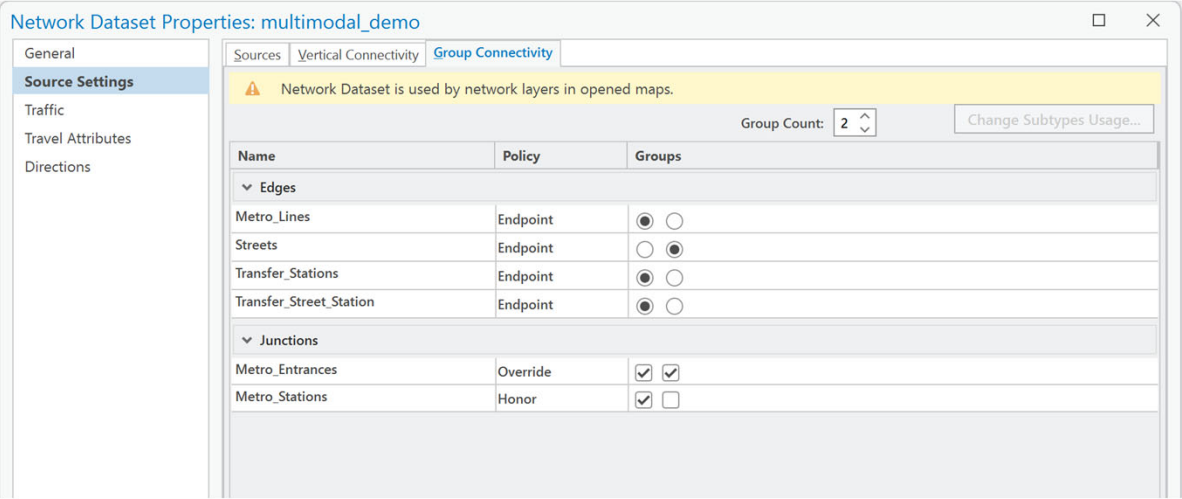
Honor

Override

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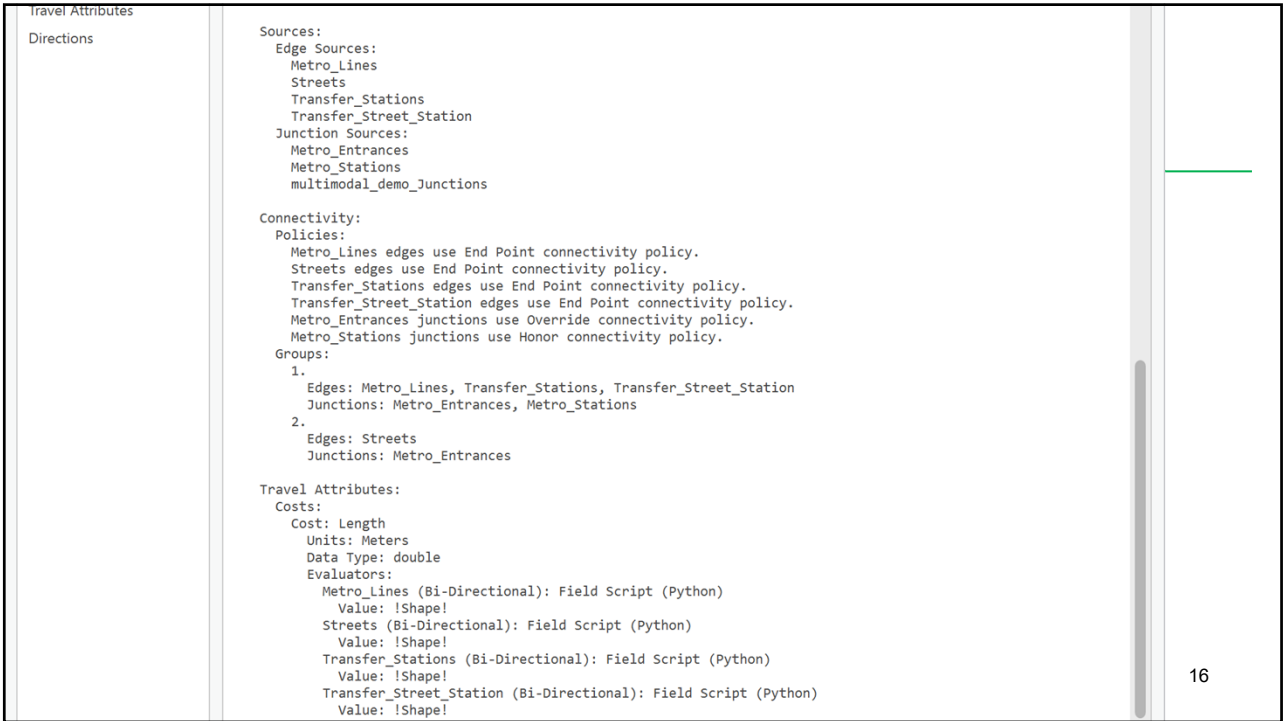
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Group Connectivity



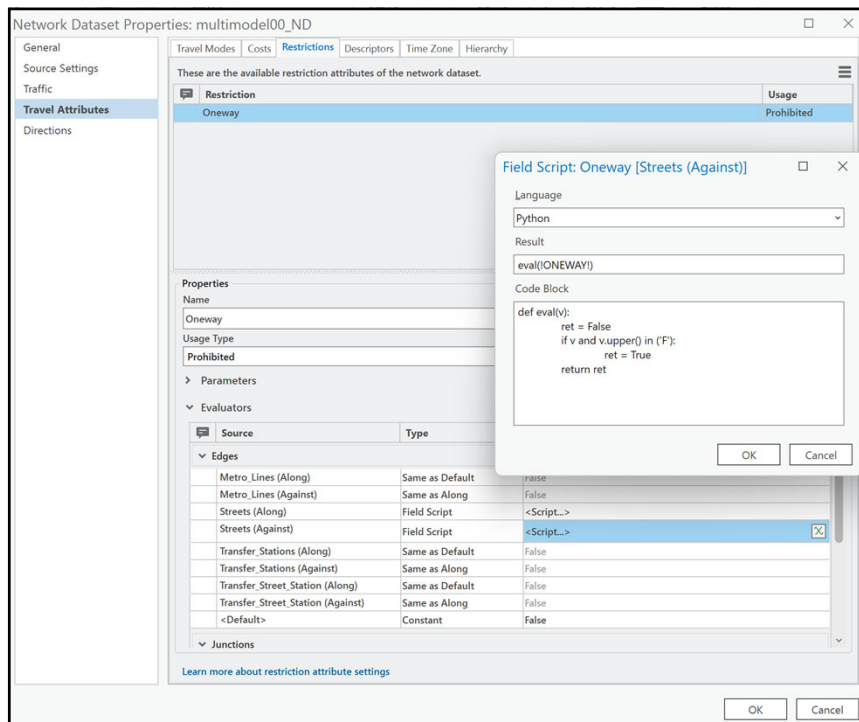
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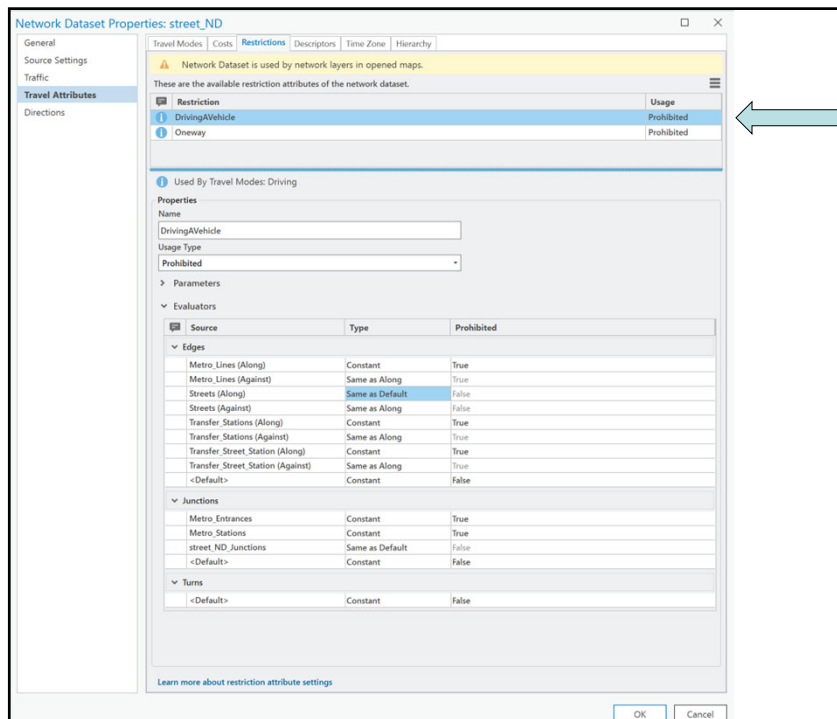


Key terms

Oneway

T & F

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Key terms

Oneway

T & F

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Dataset Version: 10.1

Build Status: Built
The network dataset has been built.
Build Time: Fri Jan 31 17:43:18 2025

Edges: 396
Junctions: 192
Turns: 0

Sources:
Edge Sources:
Metro_Lines
Streets
Transfer_Stations
Transfer_Street_Station
Junction Sources:
Metro_Entrances
Metro_Stations
multimodal_demo_Junctions

Connectivity:
Policies:
Metro_Lines edges use End Point connectivity policy.
Streets edges use End Point connectivity policy.
Transfer_Stations edges use End Point connectivity policy.
Transfer_Street_Station edges use End Point connectivity policy.
Metro_Entrances junctions use Override connectivity policy.
Metro_Stations junctions use Honor connectivity policy.

Groups:
1.
Edges: Metro_Lines, Transfer_Stations, Transfer_Street_Station
Junctions: Metro_Entrances, Metro_Stations
2.
Edges: Streets
Junctions: Metro_Entrances

Travel Attributes:
Travel Modes:
Default Travel Mode: Pedestrian_Time
Travel Mode: Pedestrian_Time
Description:
Collection of network dataset settings that define actions that network and how the actions can be performed.
Type: Walk
Uses Costs:
Impedance: PedestrianTime
Distance Cost: Meters
AT1 Travel H. Time: A11

[Learn more about network datasets](#)

Connectivity:

Policies:

Metro_Lines edges use End Point connectivity policy.

Streets edges use End Point connectivity policy.

Transfer_Stations edges use End Point connectivity policy.

Transfer_Street_Station edges use End Point connectivity policy.

Metro_Entrances junctions use Override connectivity policy.

Metro_Stations junctions use Honor connectivity policy.

Groups:

1.

Edges: Metro_Lines, Transfer_Stations, Transfer_Street_Station
Junctions: Metro_Entrances, Metro_Stations

2.

Edges: Streets
Junctions: Metro_Entrances

OK Cancel

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Travel Mode – Driving (in a multi-modal network)

Network Dataset Properties: street_ND

General
Source Settings
Traffic
Travel Attributes
Directions

Travel Modes | Costs | Restrictions | Descriptors | Time Zone | Hierarchy

These are the available travel modes of the network dataset.

Driving

Description
Collection of network dataset settings that define actions that are allowed on the network and how the actions can be performed.

Type
Driving

Costs
Impedance
DriveTime: minutes
Time Cost
DriveTime: minutes
Distance Cost
Meters: meters

Restrictions
These are the available restrictions of the network dataset. Choose the restrictions to apply to this travel mode.

Attribute	Parameters
<input checked="" type="checkbox"/> DrivingVehicle	Prohibited
<input checked="" type="checkbox"/> Oneway	Prohibited

U-Turns
Choose the types of street junctions where u-turns are allowed when traveling between locations.

All

Advanced

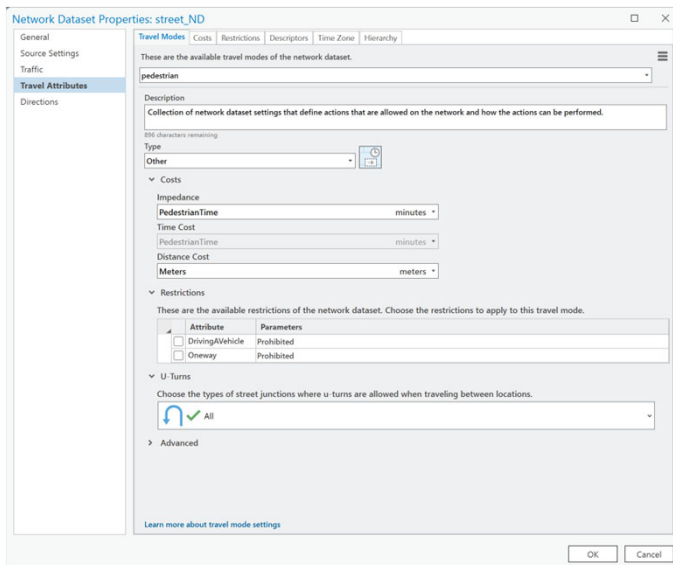
[Learn more about travel mode settings](#)

OK Cancel

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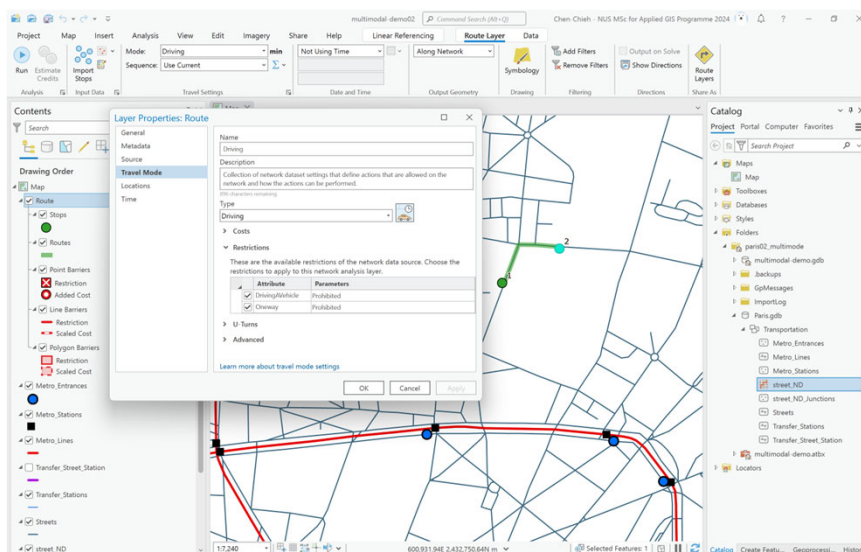
Travel Mode - Pedestrian



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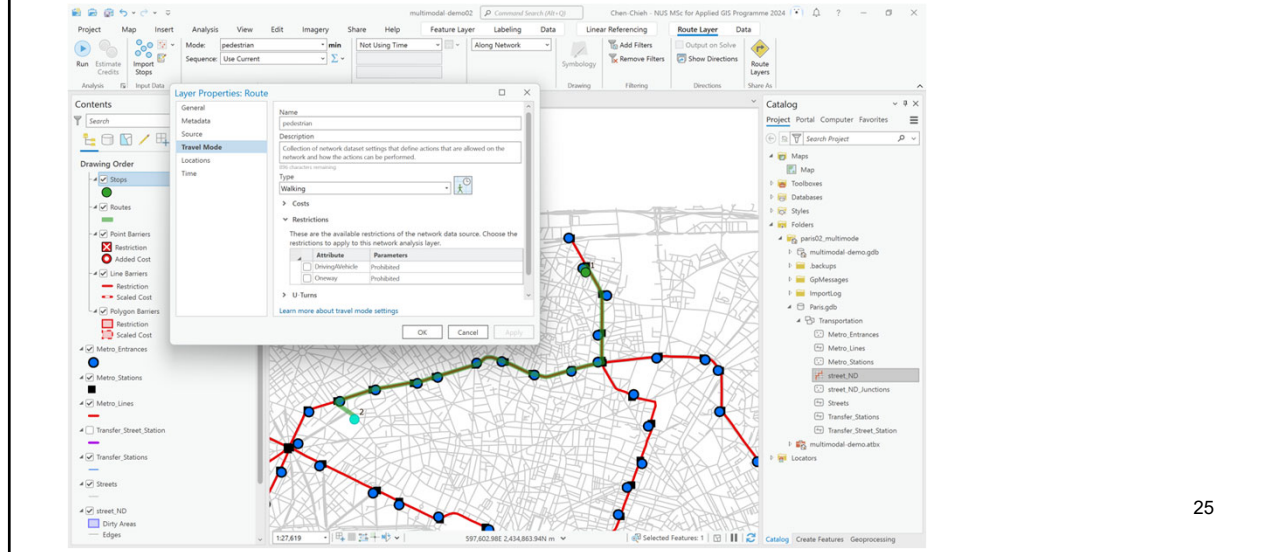
Verification - Driving



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Verification - Pedestrian



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All is good...

- The Network dataset UI presents you the network data model for transportation
 - At the conceptual/logical level, it is a network
 - At the physical level, it uses a relational model
- It is sufficiently general
 - Versatility: supporting multi-modal transportation
 - Flexibility: allowing restrictions to be specified within multi-modal transportation

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All is good, but...

- Your data need to be clean with an appropriate topology
 - Mostly at end point
- We assume that data values are available in the attribute table
 - This is not always true
 - Values may carry different meanings
- Evaluator/restriction must be handled with care

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