



POLITECNICO
MILANO 1863

ArcGIS Network Analyst

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GIS Course

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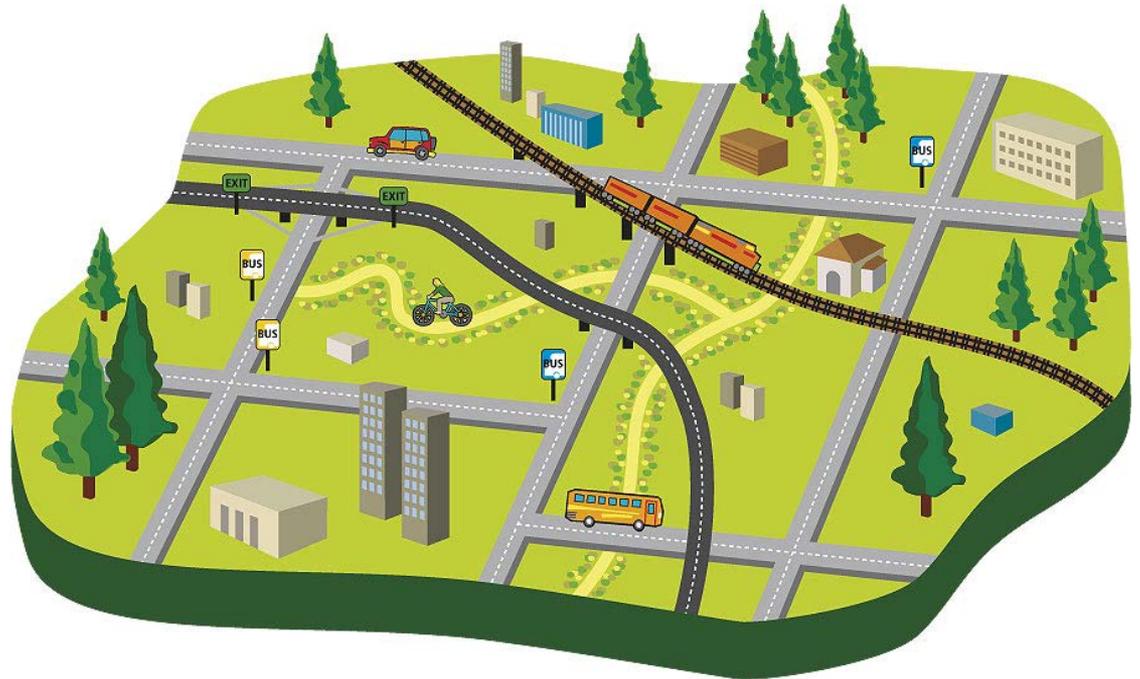
Politecnico di Milano, Lecco Campus



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Network Analyst: why?

- To manage networks, such as road networks or utility networks
- To manage what can take advantage of the connection through a network, such as individual vehicles or fleets, or commercial activities



Network Analyst – What is a network?

- In a Network you can set
 - Connectivity among the network sections



- Attributes defining e.g. travel time, travel cost, flow direction, ...



Network Analyst – Which are the possible analyses?

- To find an area within a certain travel time (Service Area)



- To find the closest facility



- To find the optimal path
 - Based on the shortest path
 - With respect to a specific cost attribute
 - With respect to an Origin-Destination (OD) Cost Matrix
 - For a fleet of vehicles (Vehicle Routing Problem)



- To find the best set of facilities to serve the most demand (Location-Allocation)

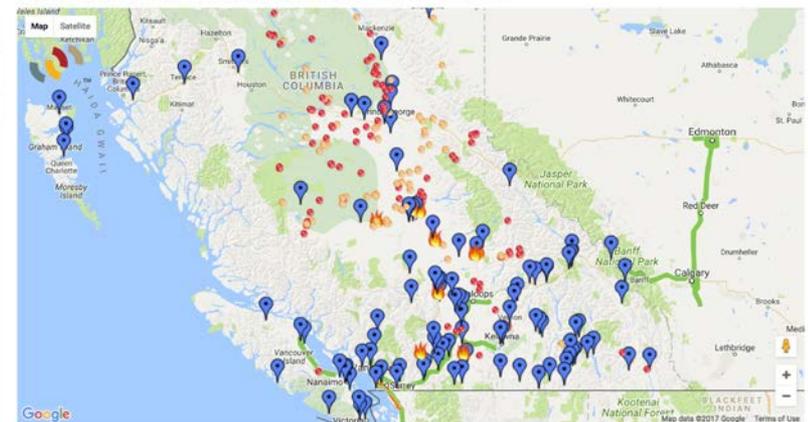


Network Analyst – Which are the possible analyses?

- It is possible to model critical situations, for example when a road section must be closed (or a pipeline must be replaced) to evaluate which is the affected population and which are the alternative paths
- In case of emergency, such as flood, fire or earthquake
 - It is possible to allocate the vehicles, e.g. of firemen, red cross and civil protection
 - It is possible to locate the road blocks and model the available paths



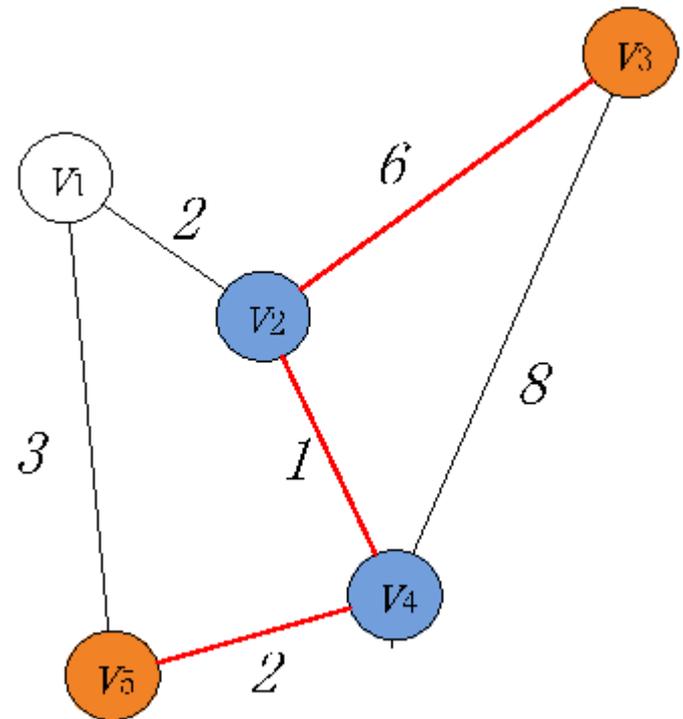
BC Wildfires and Road Closures



Network Analysis – Shortest path analysis

There are various algorithms to find the shortest path on a weighted network, based on a specific cost, e.g. distance, time, economic cost (e.g. for toll roads).

E.g. Dijkstra's algorithm starts from a single source node, then, building a set of nodes that have minimum distance from the source, it finds the shortest path



Network Analyst – How to build a network

- A network dataset stores much more information with respect to a regular vector layer representing linear features.
- In a network dataset the following elements are modelled:
 - Connectivity among vector segments



- Directions (One way/two ways)
- Turn restrictions



- Overpasses and Tunnels



Every network element must be modelled to allow the software to interpret it

Network Analyst – How to build a network

Every network element must be modelled to allow the software to interpret it

- You can start from a vector layer of street
- Appropriate attributes must be filled to mark tunnels, bridges, the flow direction
- It is possible also to take into account very detailed information, such as historical traffic data, to allow modelling the traffic jam at different times of the day and during the week and to modify the travel time accordingly
- The exercise slides are dedicated to the building of a road network and to how to exploit it to make network analyses.

Examples of cost attributes

Assigning values to cost attributes

The DriveTime network attribute in the graphic below uses a field evaluator for the Streets source feature class. This is indicated under the **Type** column. The **Value** column shows that the FT_Minutes field supplies the network attribute values for the from-to direction of the Streets source. Similarly, values for the to-from direction of the streets source are drawn from the field TF_Minutes.

In this example, the other edge sources in this network are transit edges and do not have a drive time. Hence, they can be assigned a constant value of -1, or better, a constant value of zero and given restriction attributes that prohibit automobiles and other street vehicles.

 Dive-in: Restrictions, rather than negative costs, are preferred because negative costs are subtracted when accumulating cost attributes.

Source	Direction	Element	Type	Value
Metro_Lines	From-To	Edge	Constant	-1
Metro_Lines	To-From	Edge	Constant	-1
Streets	From-To	Edge	Field	FT_Minutes
Streets	To-From	Edge	Field	TF_Minutes
Transfer_Stations	From-To	Edge	Constant	-1
Transfer_Stations	To-From	Edge	Constant	-1
Transfer_Street_Station	From-To	Edge	Constant	-1
Transfer_Street_Station	To-From	Edge	Constant	-1
Metro_Entrances		Junction		
Metro_Stations		Junction		
ParisNet_Junctions		Junction		

Examples of cost attributes

Oneway: Field to set the direction flow on the network

"B" bidirectional flow;

- "F" one directional flow, «From – to», with respect to the arc direction;

- "T" " one directional flow, «To – From» with respect to the arc direction

The major cost for Network analysis is the network set up.