01b. Intro to Network Data Model

GE3238 GIS Design and Practices
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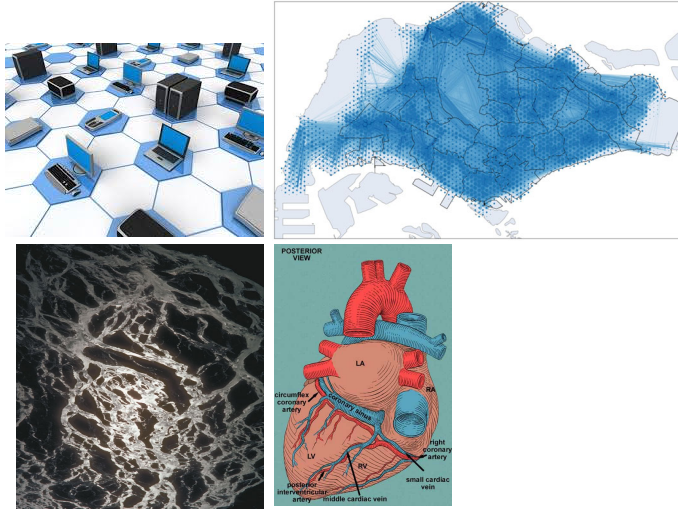
Learning Objective

- What is the underlying structure that enables finding, e.g. shortest path, and give directions?

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1

Examples of Network

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Data Model

- Everyone has a mental model of a problem, be it sophisticated or basic

- Data models help <u>make explicit</u> and scaffold our mental models as we use information technology to solve complex problems

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Spatial Data Model

- A collective term for the process of identifying all the design elements used in the construction of a GIS
- What are the primitive entities?
  - What are the permitted relations between entities?
  - What are the properties of an entity?
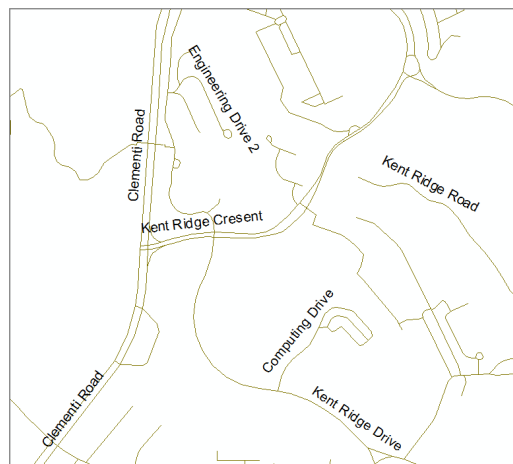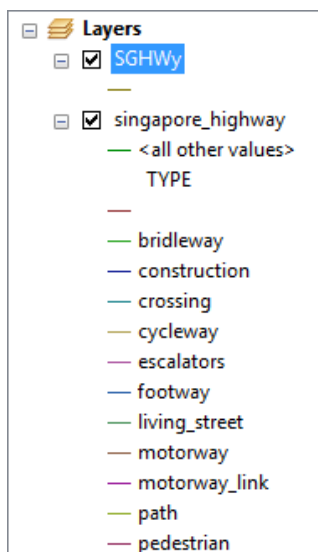 - How do we enforce constraints to avoid problems in the database?

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Spatial Data Model?

Layers
- ☑ SGHWy
- ☑ singapore_highway
  - <all other values>
    TYPE
  - bridleway
  - construction
  - crossing
  - cycleway
  - escalators
  - footway
  - living_street
  - motorway
  - motorway_link
  - path
  - pedestrian

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Spatial Data Model? (cont.)

Table

singapore_highway

FID	Shape	TYPE	NAME	ONEWAY	LANES
0	Polyline	secondary	Jalan Tanjung Kupang		0
1	Polyline	secondary			0
2	Polyline	trunk	Lebuhraya Tanjung Pelapas		0
3	Polyline	residential			0
4	Polyline	secondary			0
5	Polyline	secondary			0
6	Polyline	motorway	Lebuhraya Hubungan Linkedua Malaysia-Singapura	yes	2
7	Polyline	motorway	Lebuhraya Hubungan Linkedua Malaysia-Singapura	yes	2
8	Polyline	motorway_link		yes	0
9	Polyline	residential			0
10	Polyline	primary			0
11	Polyline	primary	Jalan Gelang Patah		0
12	Polyline	motorway		yes	0
13	Polyline	motorway_link			0
14	Polyline	primary			0
15	Polyline	motorway		yes	0
16	Polyline	primary	Lebuhraya Persiaran Pantai Johor Bahru-Nusajaya		0
17	Polyline	trunk_link		-1	1

|◄ ◄   1   ► ►| (0 out of 13140 Selected)   7
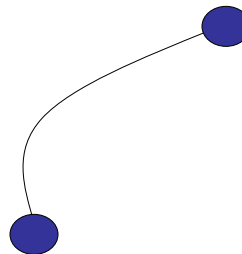
singapore_highway

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Basic Elements 0: Primitive Entities

- Node
  - A node refers to the end point of a link

- Link (or edge)
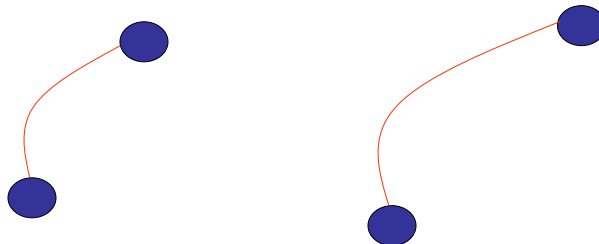 - A link refers to a road segment defined by two end points

Key terms

Primitive

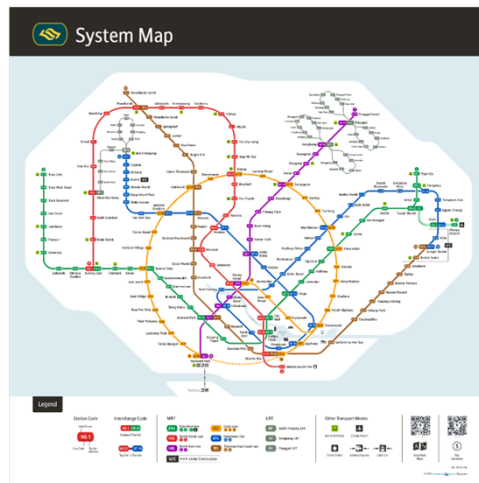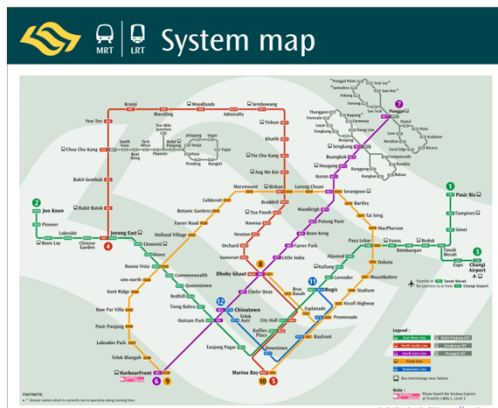Node

Link

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Basic Element 1

Topology

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Think about this intuitive example
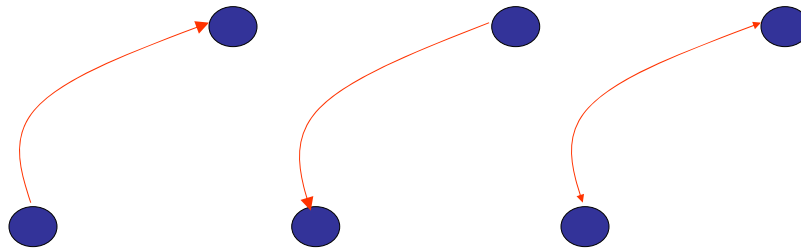
Key terms

Topology
Connectivity

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Basic Element 2

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Basic Element 3a: Link Impedance

- The cost of traversing a link
  - Length of a link?

  - Traveling speed?

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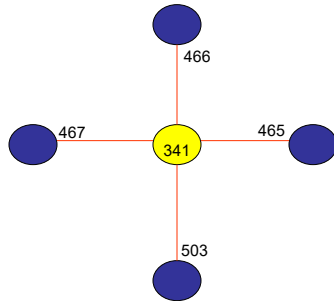# Basic Element 3b: Junction Impedance

466 **467** **341** **465** **503**

Node#	Arc1#	Arc2#	Angle	Minutes
341	503	467	90	0.500
341	503	466	0	0.250
341	503	465	−90	0.250
341	467	503	−90	0.250
341	467	466	90	0.500
341	467	465	0	0.250
341	466	503	0	0.250
341	466	467	−90	0.250
341	466	465	90	0.500
341	465	503	90	0.500
341	465	467	0	0.250
341	465	466	−90	0.250

Key terms

Cost

Junction

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Basic Element 4
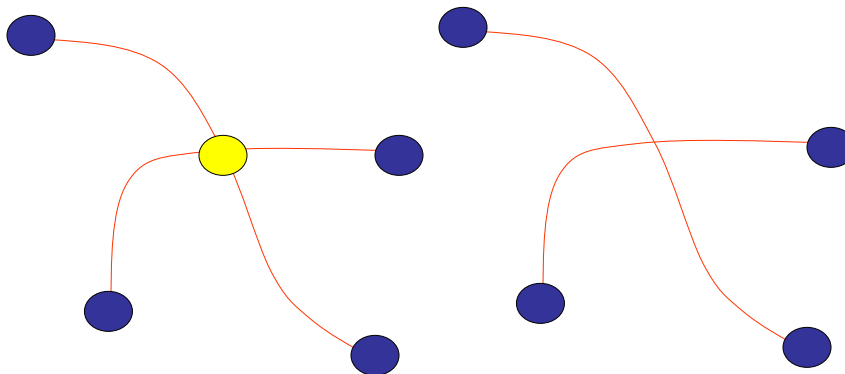
Key terms

Connectedness

Junction

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First Ave.

E. Oak St.

W. Oak St.
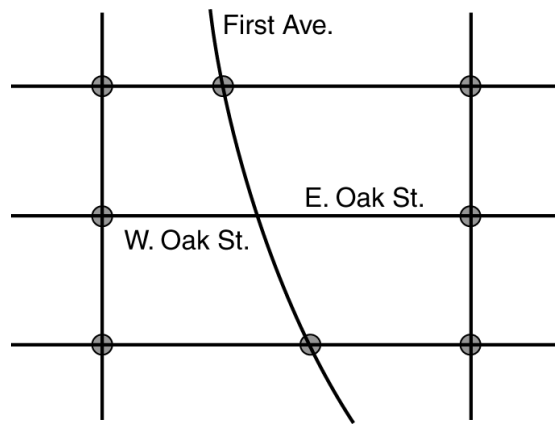
First Ave. crosses Oak St. with an overpass. A nonplanar representation with no nodes is used at the intersection of Oak St. and First Ave.
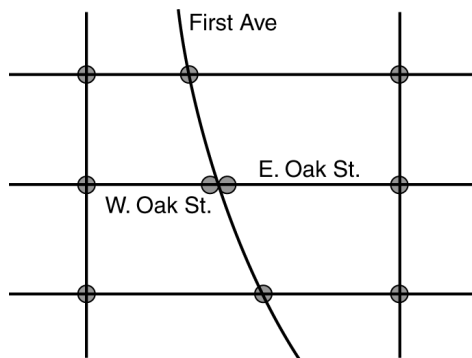
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First Ave

E. Oak St.

W. Oak St.

First Ave. crosses Oak St. with an overpass. A planar representation with two nodes is used at the intersection: one for First Ave., and the other for Oak St. First Ave has 1 for the T-elev and F-elev values, indicating that the overpass is on First Ave.

Street name	F-elev	T-elev
First Ave	0	1
First Ave	1	0
W. Oak St.	0	0
E. Oak St.	0	0

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Basic Element 5

461

462   467

339

501

17

17

466   385

467   465   340   342

341   **265**

503   339

Node#	Arc1#	Arc2#	Angle	Minutes
341	503	467	90	0.500
341	503	466	0	0.250
341	503	465	−90	0.250
341	467	503	−90	0.250
341	467	466	90	0.500
341	467	465	0	0.250
341	466	503	0	0.250
341	466	467	−90	0.250
341	466	465	90	0.500
341	465	503	90	0.500
341	465	467	0	0.250
341	465	466	−90	0.250

Node#	Arc1#	Arc2#	Angle	Minutes
265	339	342	−87.412	0.000
265	339	340	92.065	0.000
265	339	385	7.899	0.000
265	342	339	87.412	0.500
265	342	340	−0.523	0.250
265	342	385	−84.689	0.250
265	340	339	−92.065	0.250
265	340	342	0.523	0.250
265	340	385	95.834	0.500
265	385	339	−7.899	0.000
265	385	342	84.689	0.000
265	385	340	−95.834	0.000

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18

461

462   467

339

501

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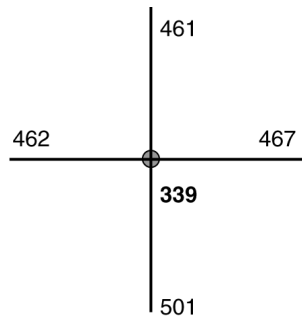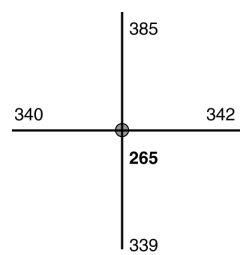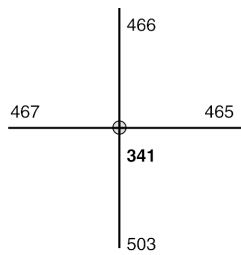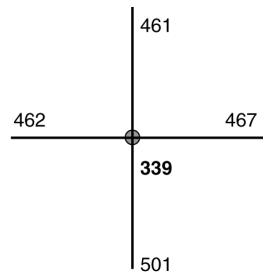
Key terms

Turn table

Node#	Arc1#	Arc2#	Angle	Minutes
339	467	501	90.190	0.500
339	467	462	1.152	0.250
339	467	461	−92.197	−1.000
339	462	501	−90.962	0.250
339	462	467	−1.152	0.250
339	462	461	86.651	−1.000
339	461	501	2.386	0.250
339	461	467	92.197	0.500
339	461	462	−86.651	0.250

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Summary (conceptual)

- What is the underlying structure that enables finding, e.g. shortest path, and give directions?
  - A network data model based on edges and junctions. Edges and junctions are (atomic or primitive) entities that cannot be further divided
  - These entities hold multiple relations, with the most important one being *connectivity*
  - These entities also hold properties to capture *impedance* (or cost)

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