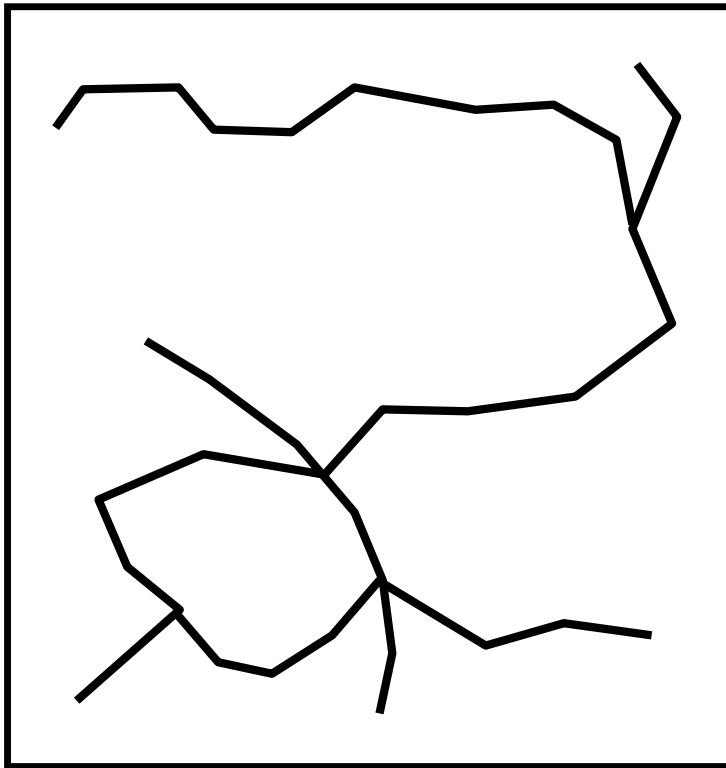
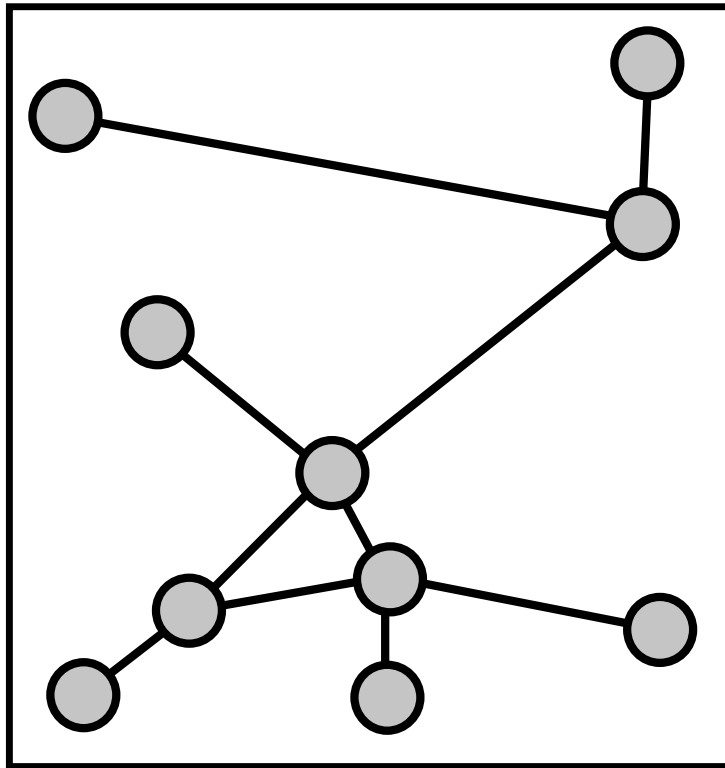


Graph Representation of a Real Network

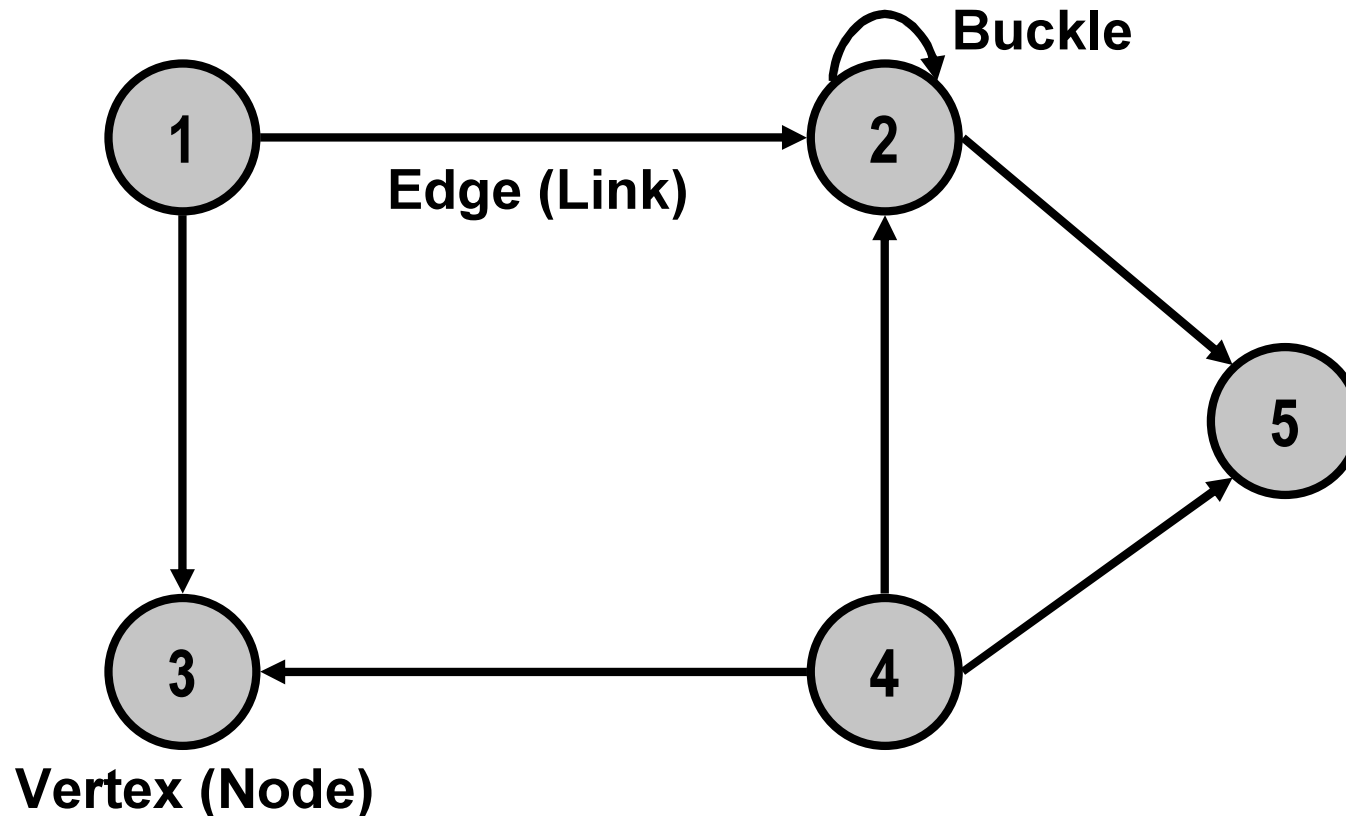


Real Network

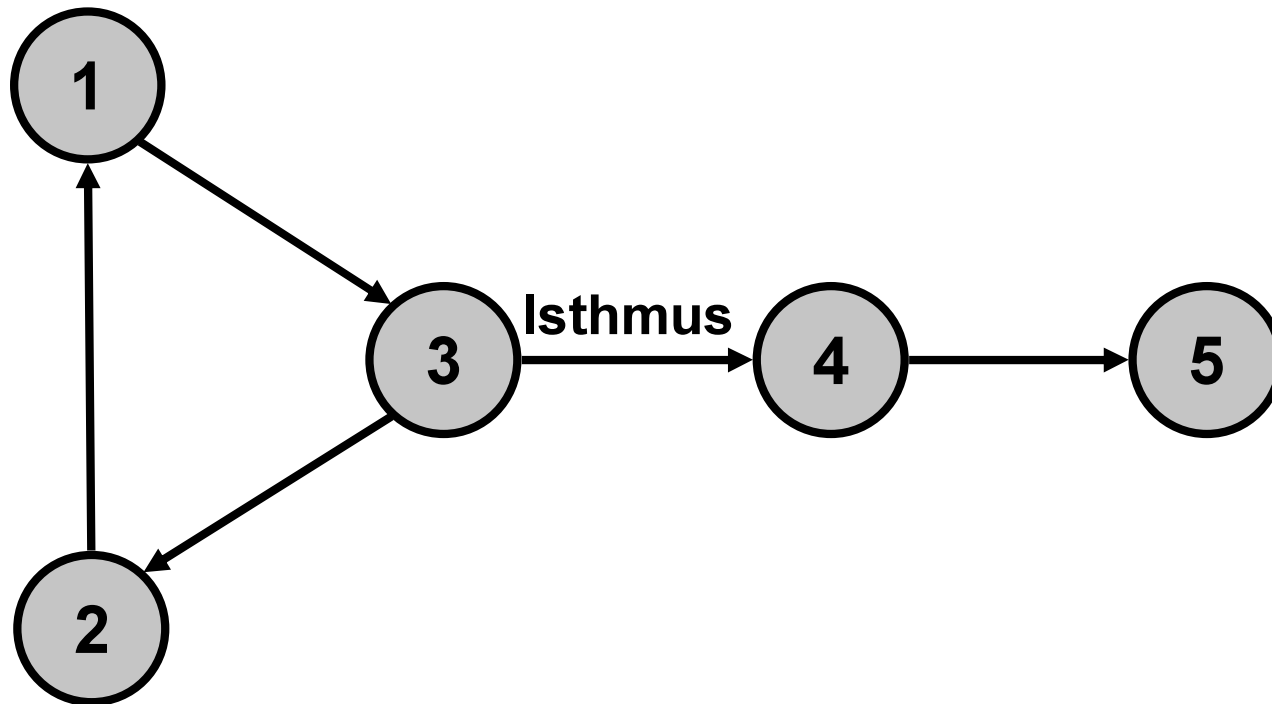


Graph Representation

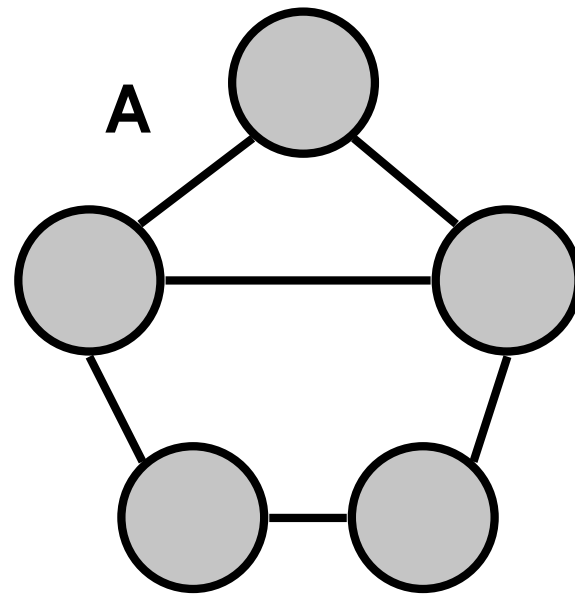
Basic Graph Representation of a Transport Network



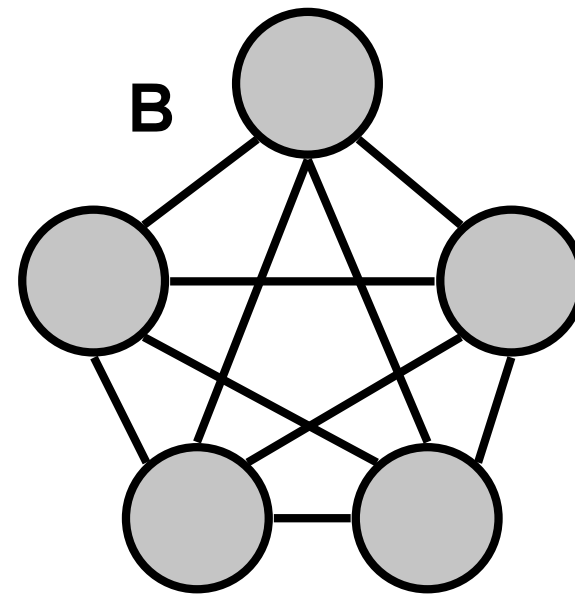
Isthmus Connection



Planar and Non-Planar Graphs

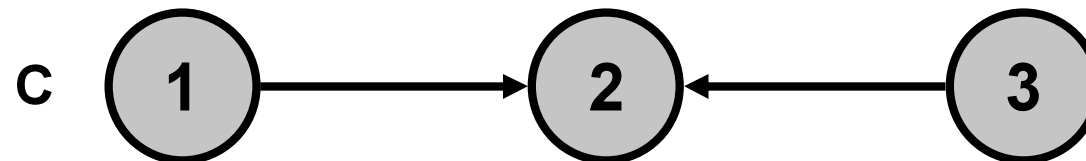
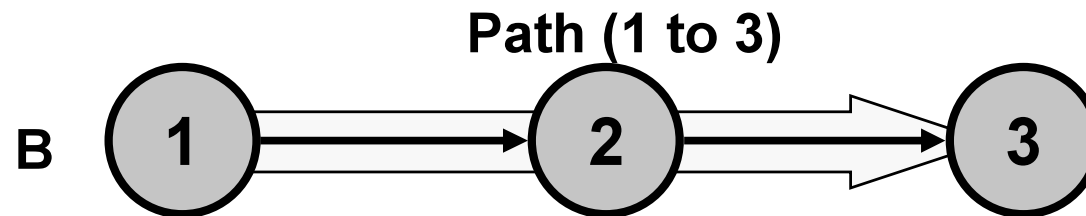
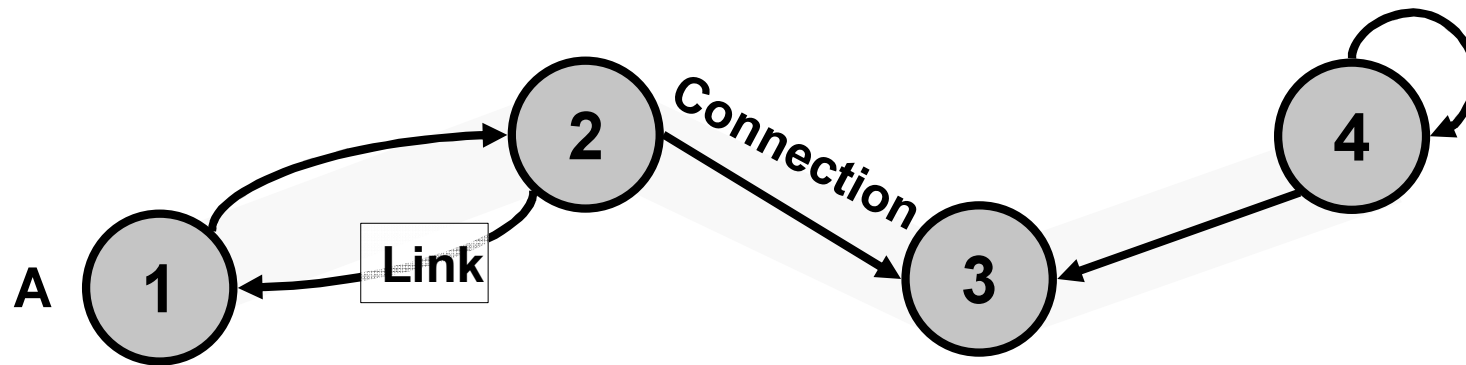


Planar

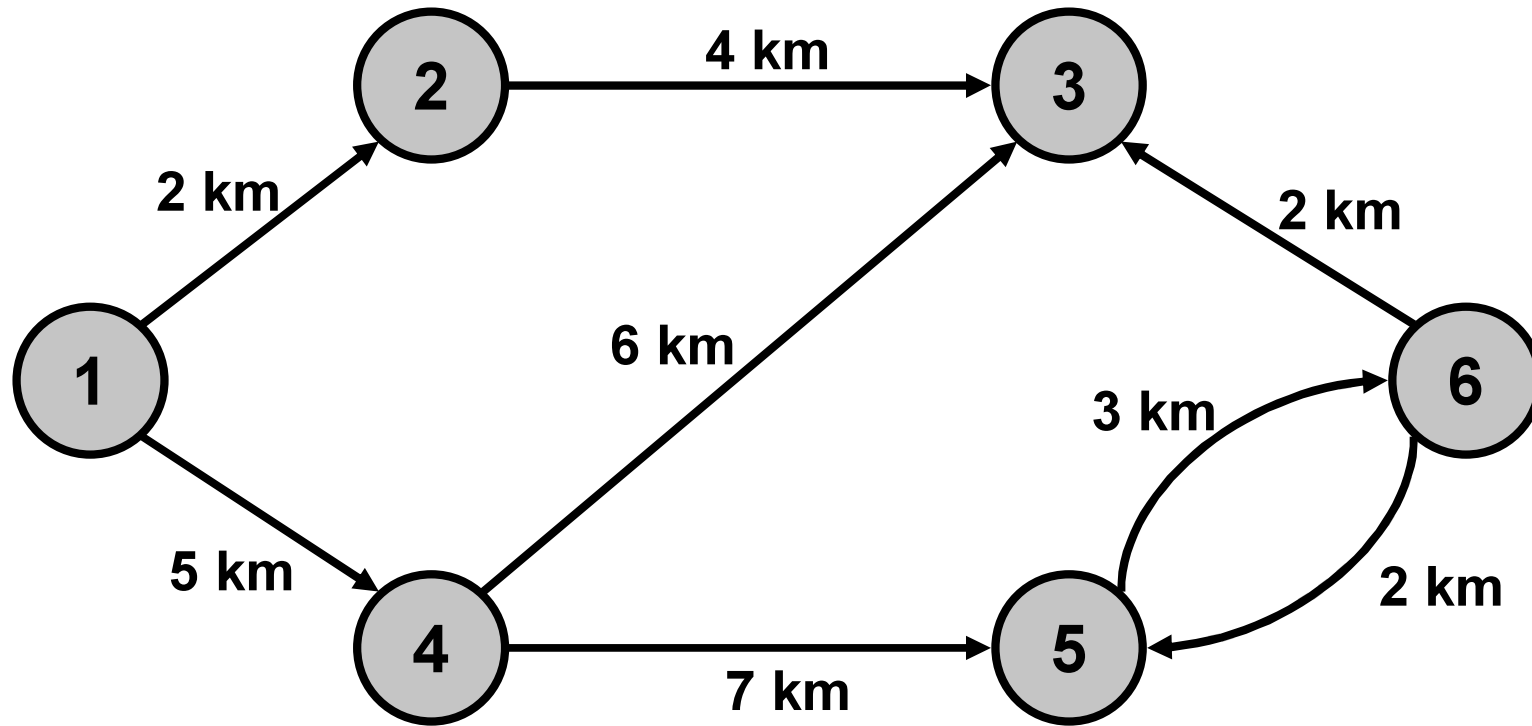


Non-Planar

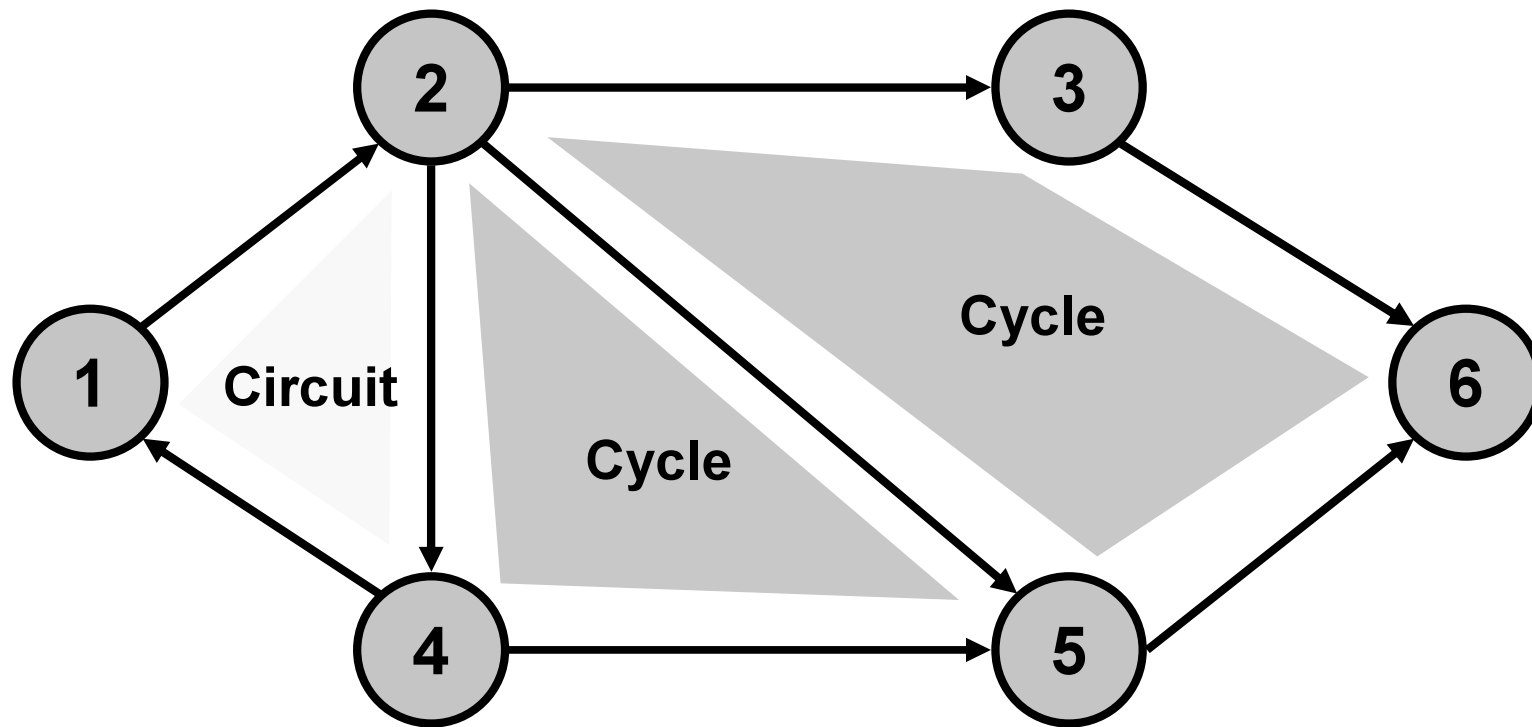
Connections and Paths



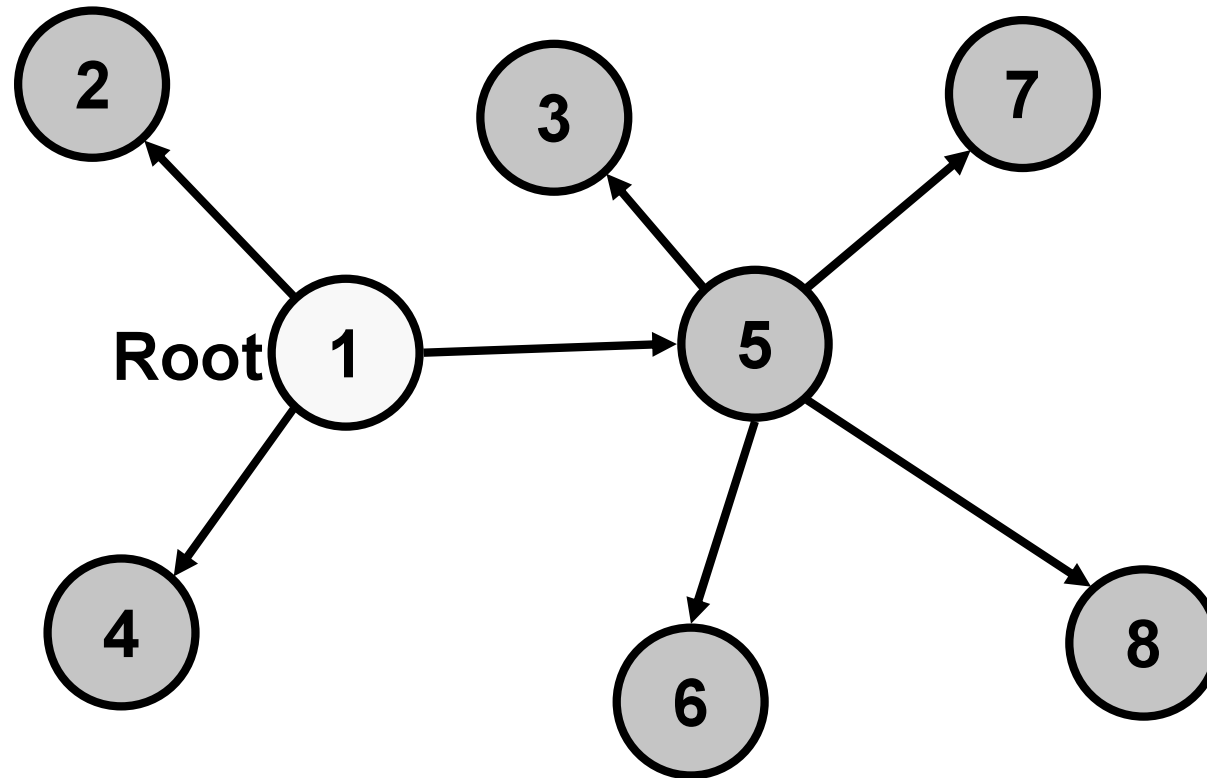
Length of a Link, Connection or Path



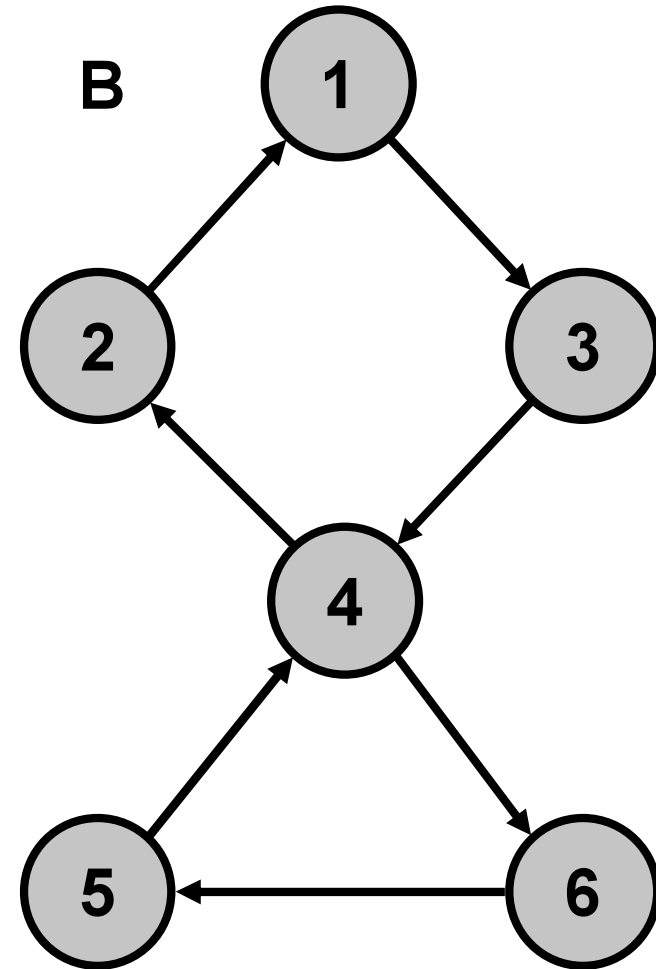
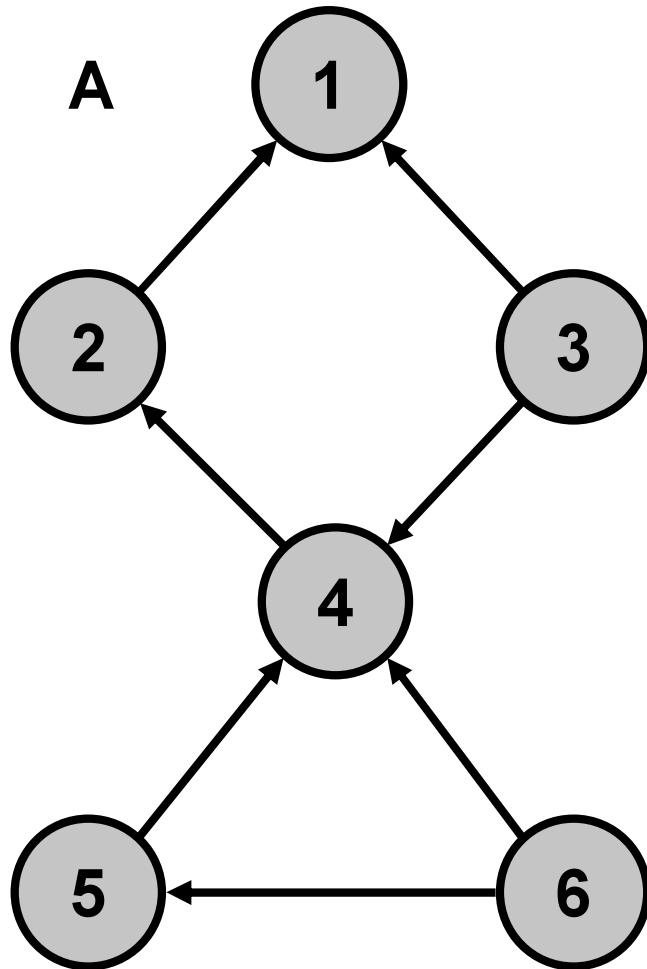
Cycles and Circuits



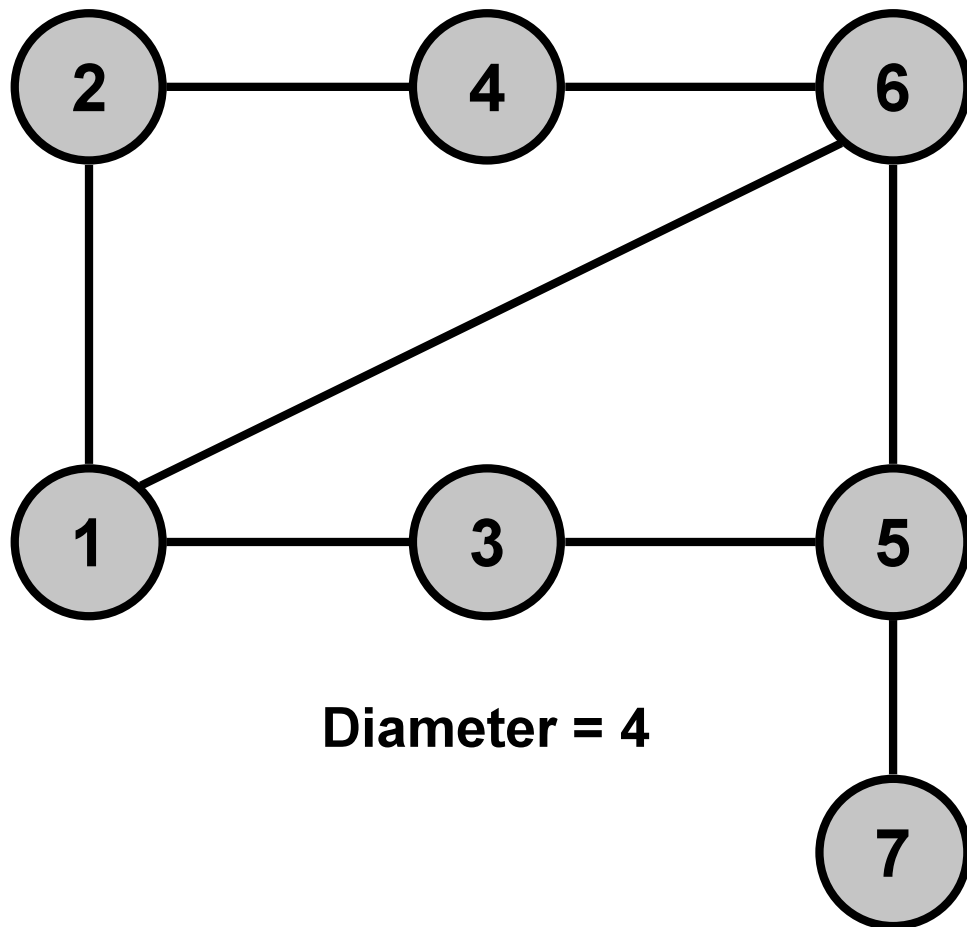
Tree Graph



Connectivity in a Graph

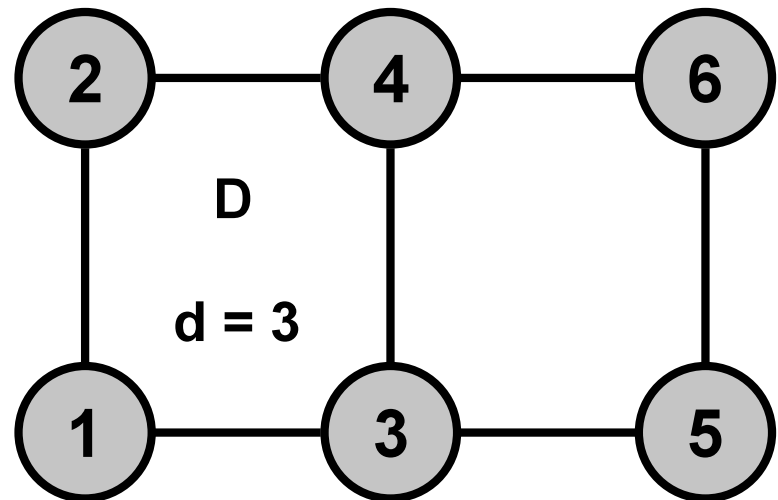
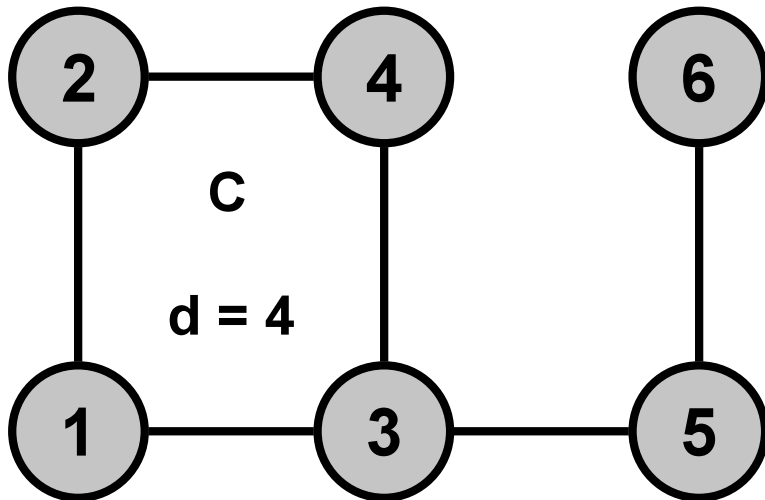
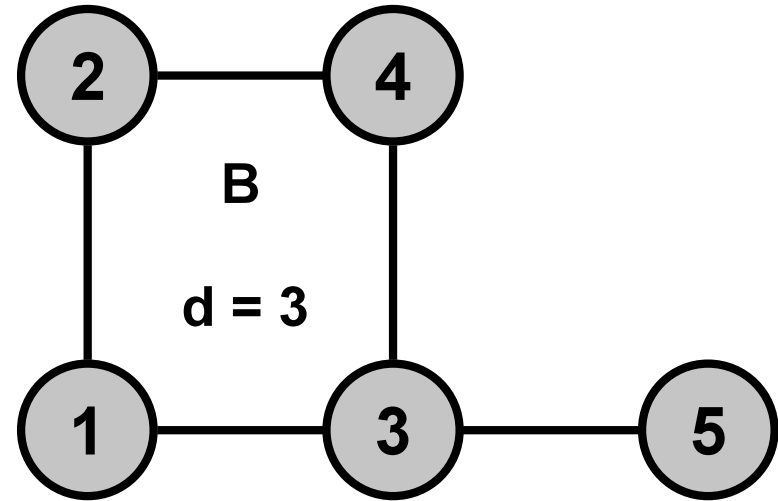
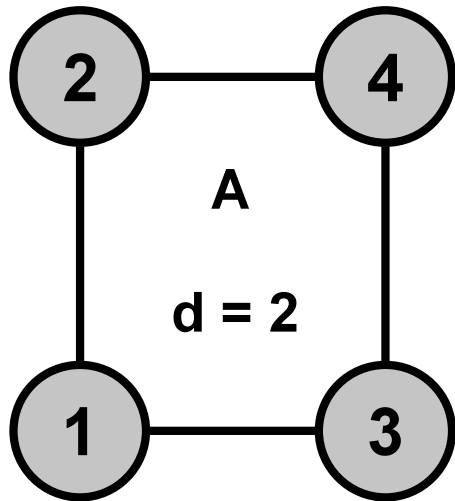


Diameter of a Graph

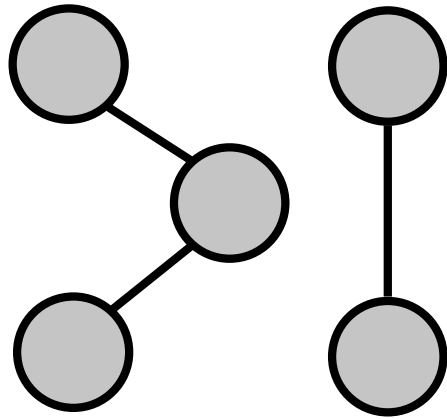


Shimbel Distance							
v	1	2	3	4	5	6	7
1	0	1	1	2	2	1	3
2	1	0	2	1	3	2	4
3	1	2	0	3	1	2	2
4	2	1	3	0	2	1	3
5	2	3	1	2	0	1	1
6	1	2	2	1	1	0	2
7	3	4	2	3	1	2	0

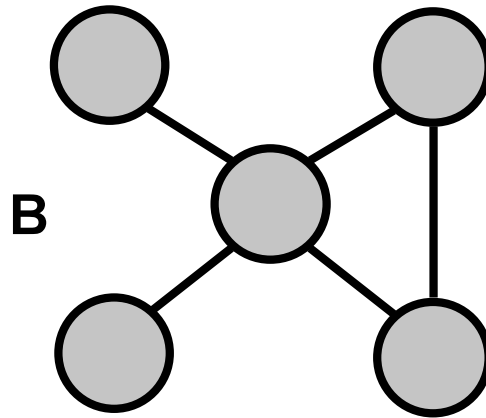
Diameter of a Graph - 2



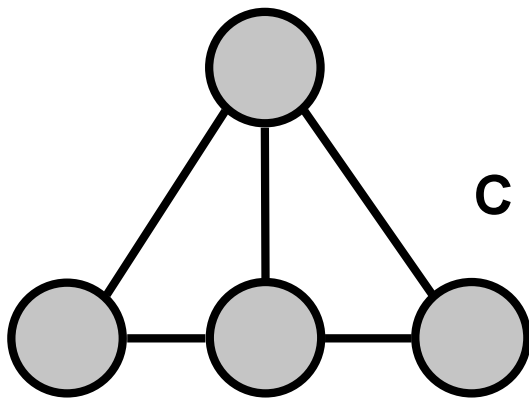
Number of Cycles



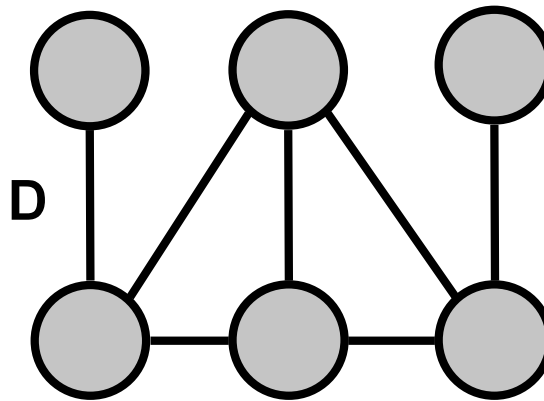
A



B



C

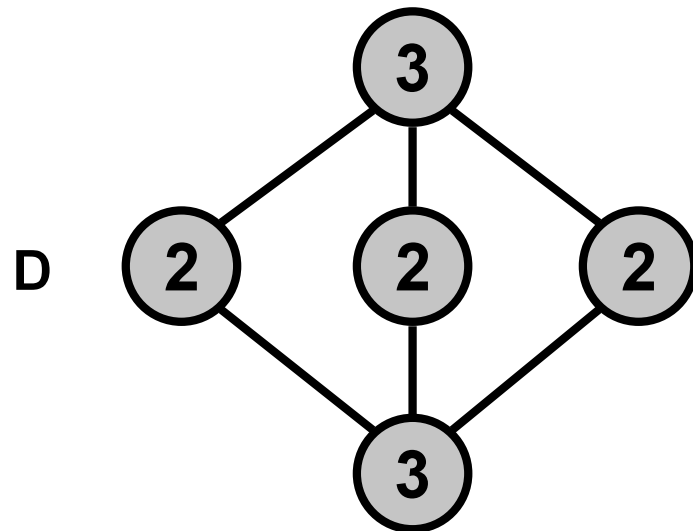
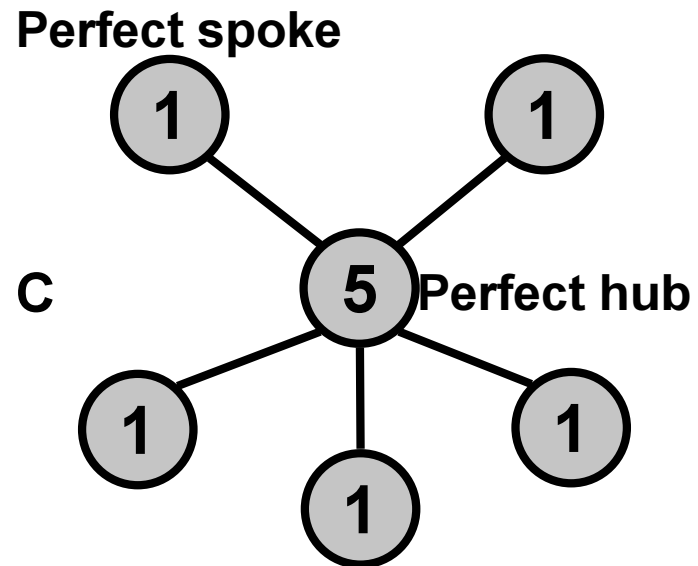
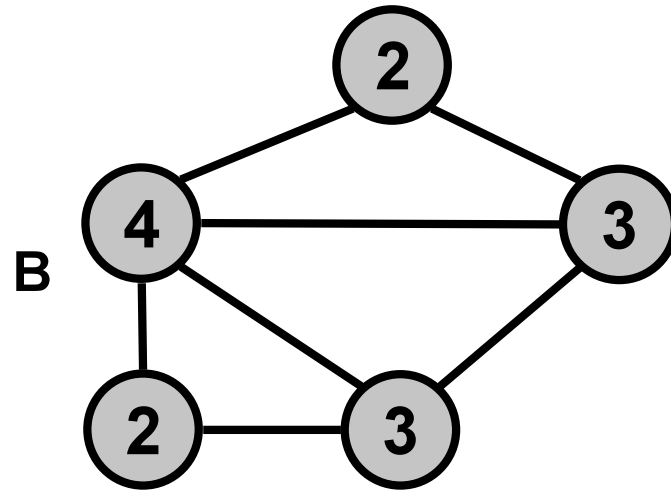
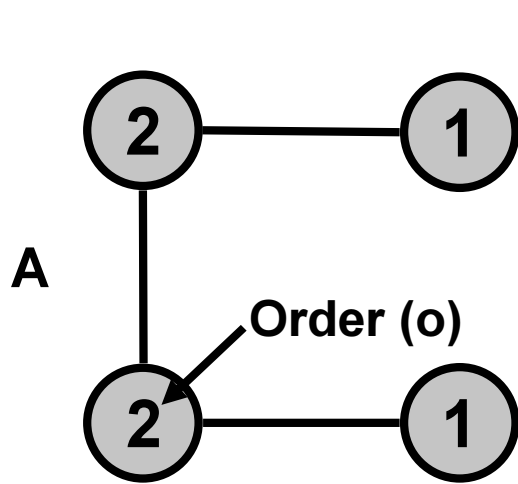


D

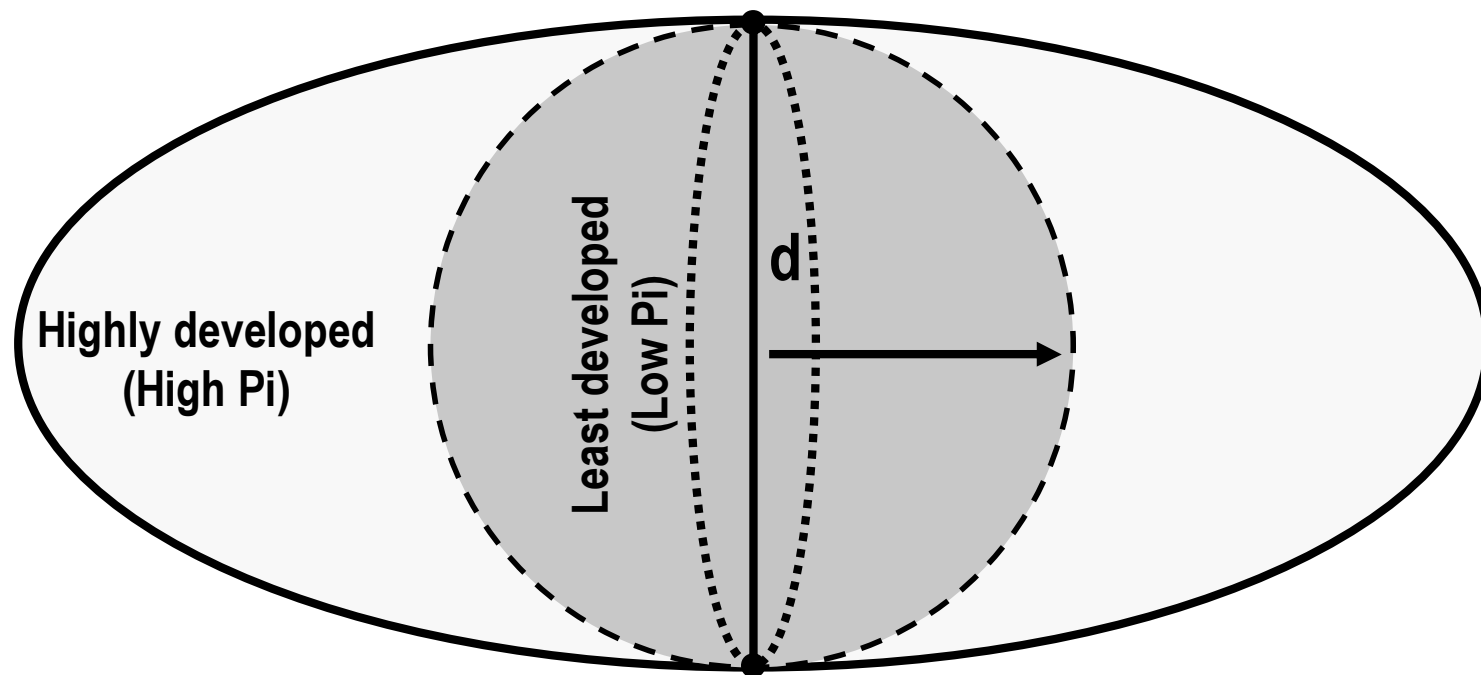
$$u = e - v + p$$

	e	v	p	u
A	3	5	2	0
B	5	5	1	1
C	5	4	1	2
D	6	7	1	2

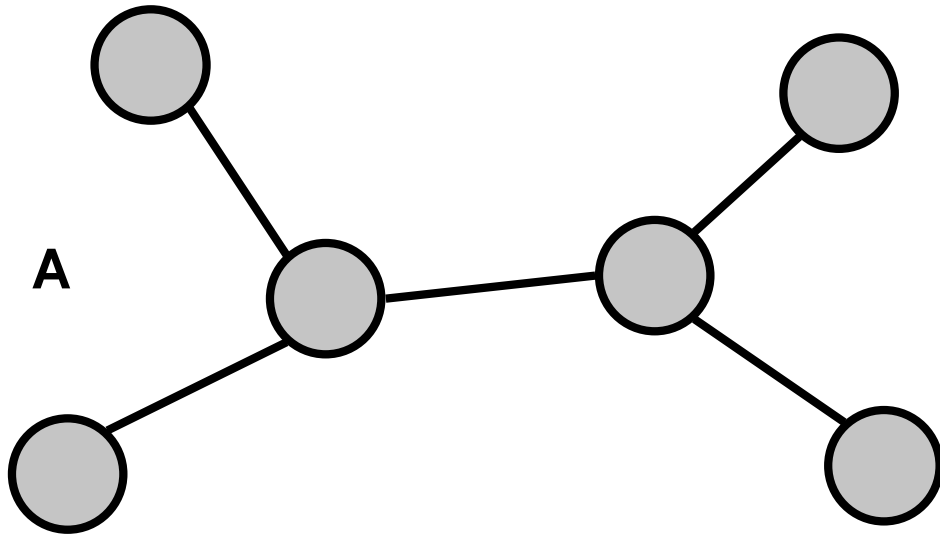
Order of a Node



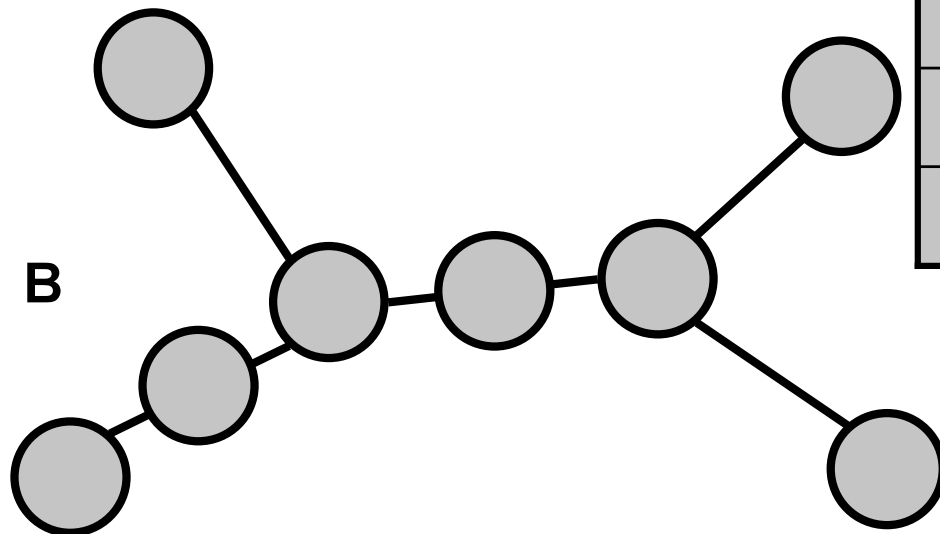
Pi Index and the Shape of Transportation Networks



Eta Index

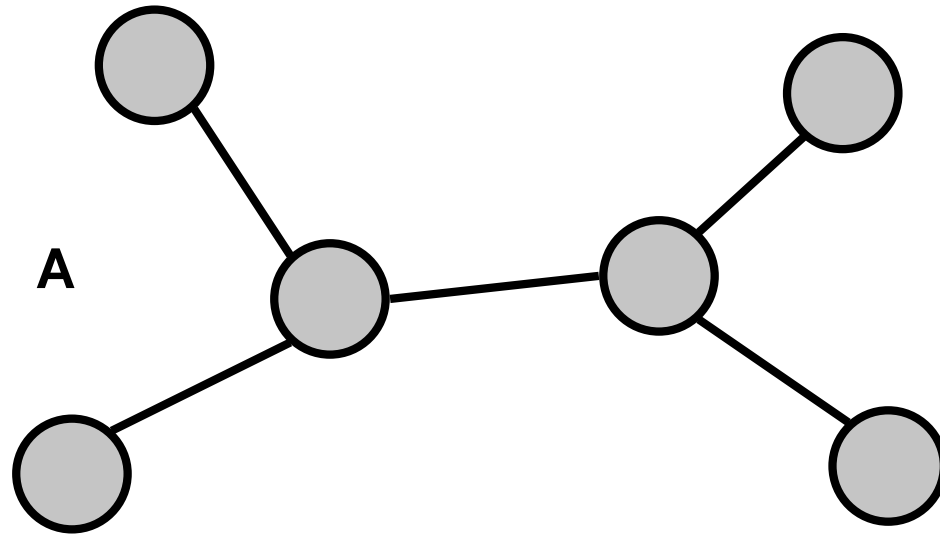


$$\eta = \frac{L(G)}{e}$$

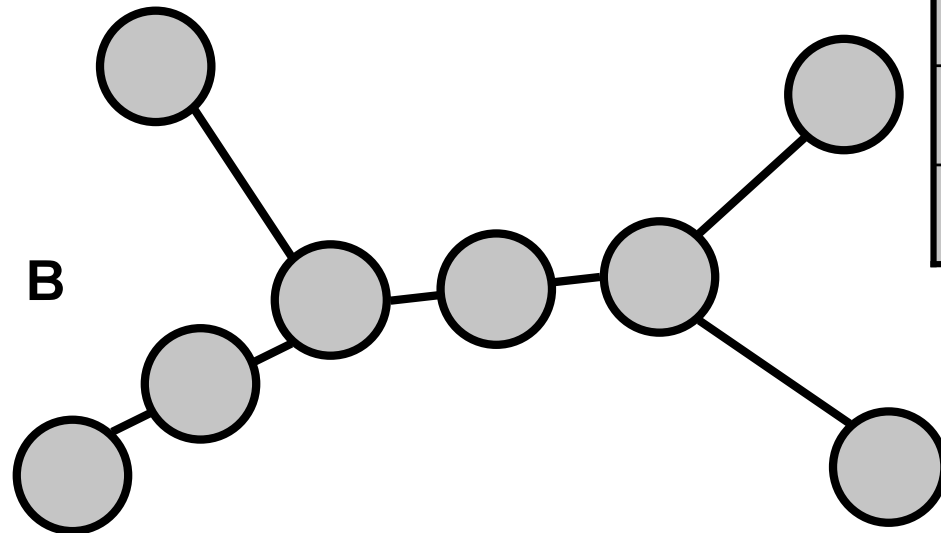


	L(G)	e	Eta
A	80 km	5	16.0
B	80 km	7	11.4

Theta Index

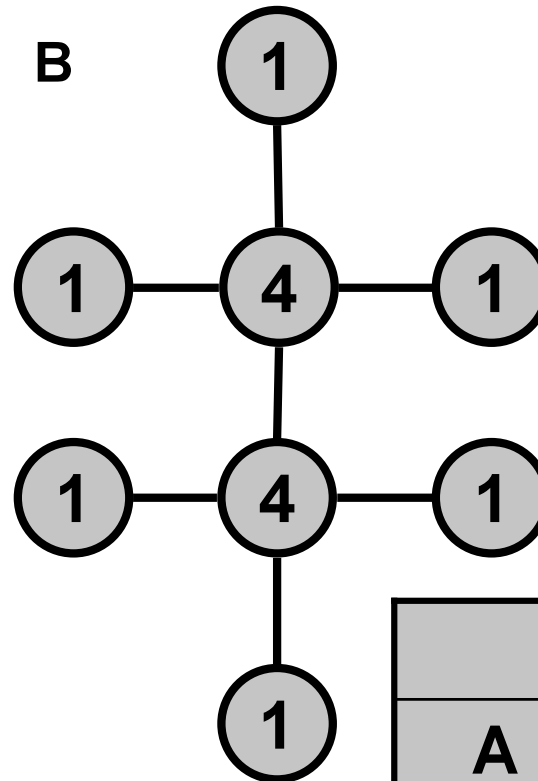
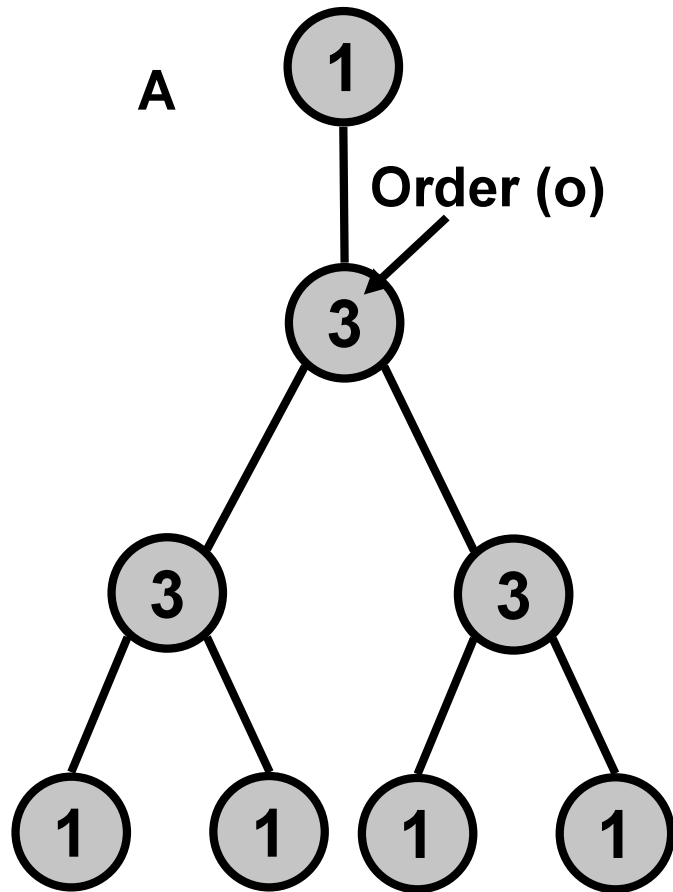


$$\theta = \frac{Q(G)}{v}$$



	Q(G)	v	Theta
A	3,500 t	6	583.3
B	3,500 t	8	437.5

Iota Index



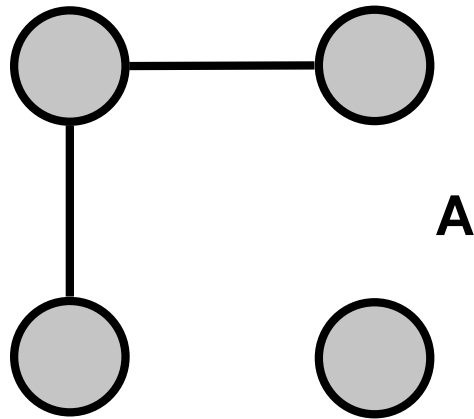
$$I = \frac{L(G)}{W(G)}$$

$$W(G) = 1, \forall o = 1$$

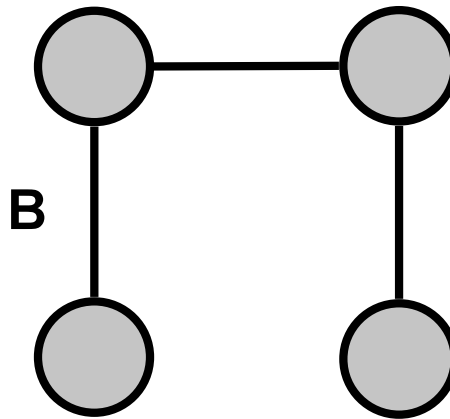
$$W(G) = \sum_e 2^{*o}, \forall o > 1$$

	L(G)	W(G)	Iota
A	80	23	3.47
B	80	22	3.63

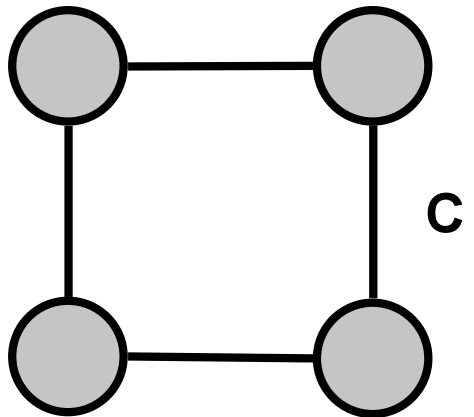
Beta Index



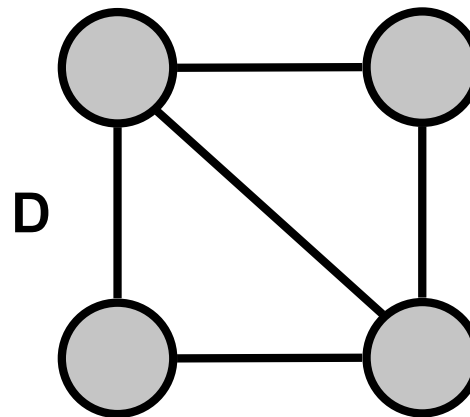
A



B



C

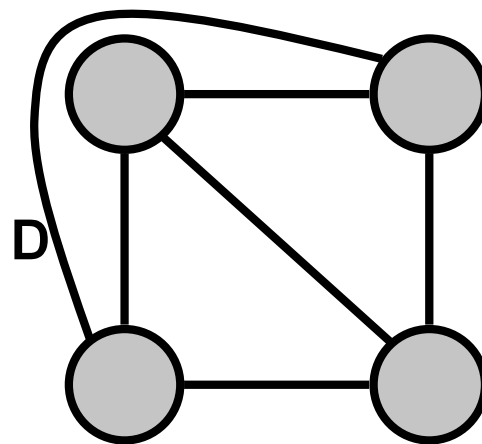
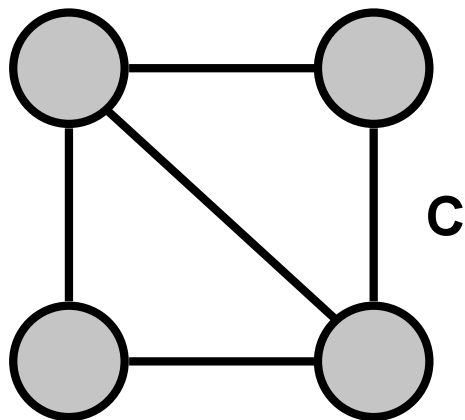
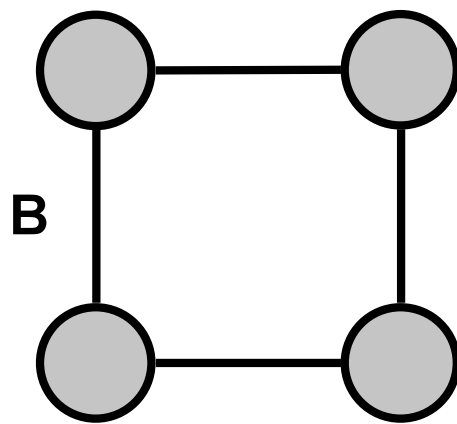
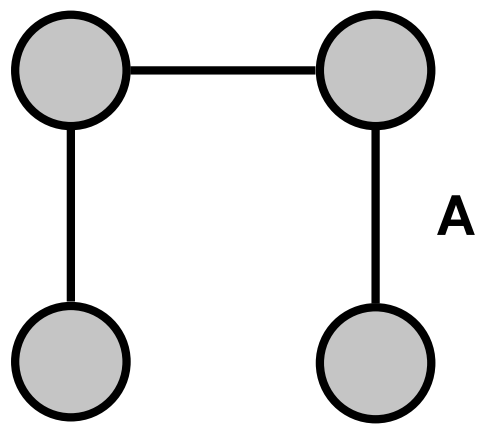


D

$$\beta = \frac{e}{v}$$

	e	v	Beta
A	2	4	0.5
B	3	4	0.75
C	4	4	1.0
D	5	4	1.25

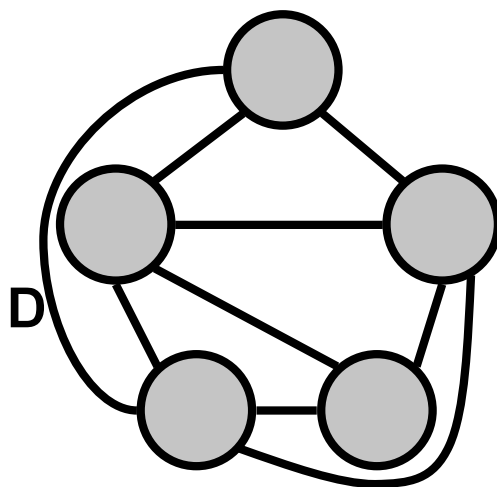
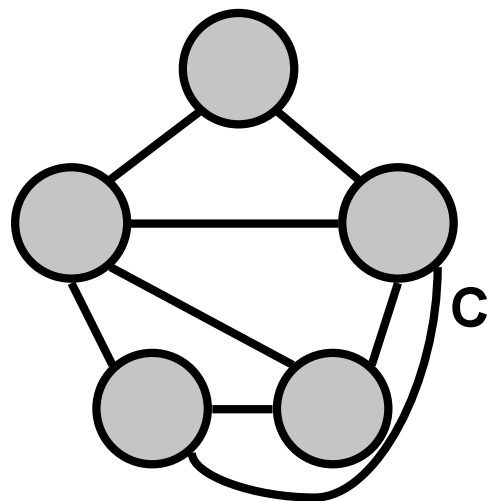
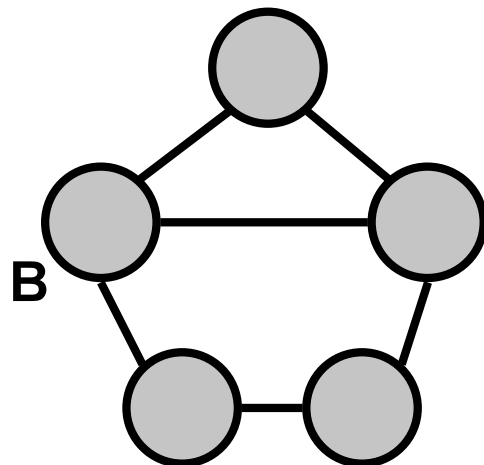
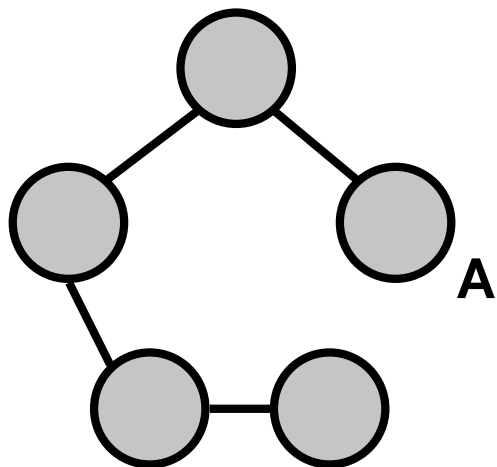
Alpha Index



$$\alpha = \frac{u}{2v-5}$$

	$u (e-v+p)$	$2v-5$	Alpha
A	0	3	0.0
B	1	3	0.33
C	2	3	0.66
D	3	3	1.0

Gamma Index



$$\gamma = \frac{e}{3(v-2)}$$

	e	3(v-2)	Gamma
A	4	9	0.44
B	6	9	0.66
C	8	9	0.88
D	9	9	1.0