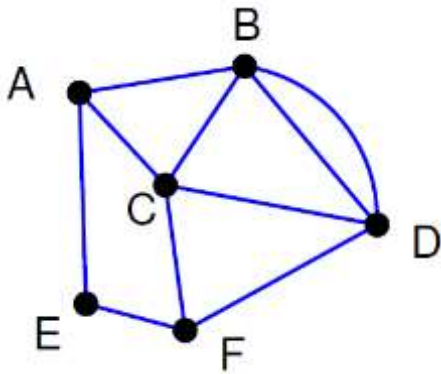


# Graph Theory and real life applications.

Exercise 1:

a) Write down the degree of each vertex



Vertex	Degree
A	
B	
C	
D	
E	
F	

b) Write down the sum of the degrees of all vertices.

Exercise 2:

a) Can you draw a graph with the sum of degree of vertices to be an odd number?

b) Is it possible for 5 people to shake hand with exactly 3 of them ?

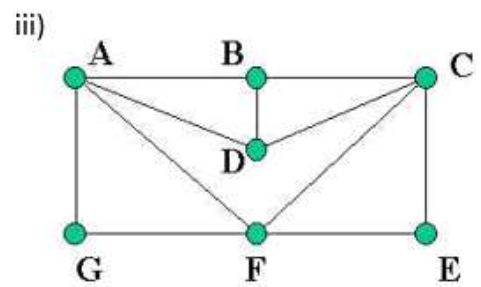
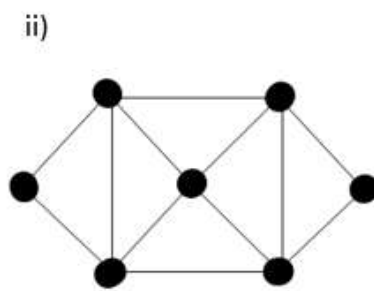
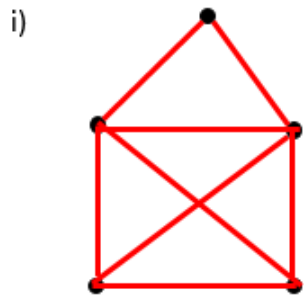
Exercise 3:

a) In an octagon, what is the sum of its edges, if we draw all of its diagonal?

b) Write down the general formula for the number of sides of a closed polygon if we join all its vertices.

Exercise 4:

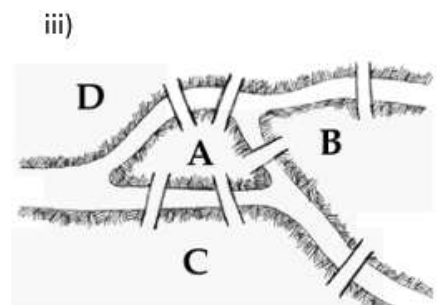
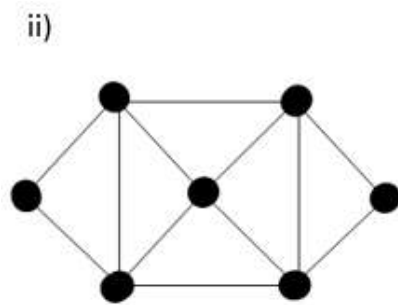
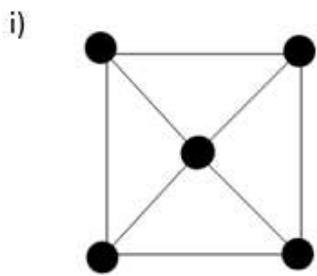
a) Which of the following graphs have a Eulerian path?



b) For those graph that there exist a Eulerian path find it.

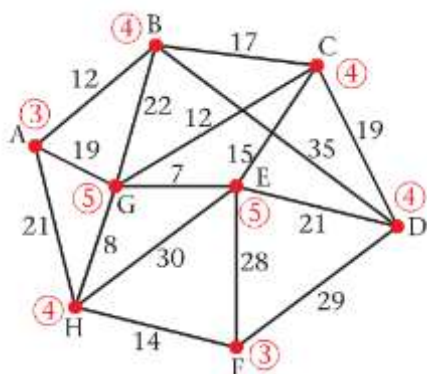
Exercise 5:

Which of the following graphs have a Eulerian circuit?



Exercise 6:

Solve the route inspection problem for this network starting and finishing at A.



Information for the problem

Below is a list of all trains servicing the northeast, as well as the connecting cities.

**Acela Express:** Boston → New York → Philadelphia → Washington

**Capital Limited:** Pittsburgh → Cleveland → Waterloo → Chicago

**Cardinal:** Washington → Hinton → Cincinnati → Lafayette → Chicago

**The Federal:** Boston → New York → Philadelphia → Washington

**Keystone:** New York → Philadelphia → Harrisburg

**Lake Shore Limited:** Chicago → Cleveland → Albany → Boston or New York

**Metroliner:** New York → Philadelphia → Washington

**Pennsylvanian:** Pittsburgh → Philadelphia → New York

**Three Rivers:** New York → Youngstown → Chicago

Number of miles between any two cities

	Albany	Boston	New York	Philly	Wash DC	Pitts	Cleve.	Chicago	Cincy	Harris
Albany	0	144	138	216	342	532	646	958	1208	310
Boston	144	0	282	360	486	676	790	1102	1352	376
New York	138	282	0	78	204	394	508	820	1070	172
Philly	216	360	78	0	126	316	430	742	992	94
Wash DC	342	486	204	126	0	190	304	616	866	220
Pitts	532	676	394	316	190	0	114	426	676	410
Cleveland	646	790	508	430	304	114	0	312	562	524
Chicago	958	1102	820	742	616	426	312	0	250	836
Cincy	1203	1352	1070	992	866	676	562	250	0	1086
Harris	310	376	172	94	220	410	524	836	1086	0

Exercise:

a) Connect the cities using graphs

b) Chose a path that can optimized the trains routes for connected cities.

c) Identify the most central cities based on their distances and place them in rank position.

(hint the city with the smallest distance to all the rest will be the most central)

d) Chose a path that can optimized the trains routes with respect of their distances.