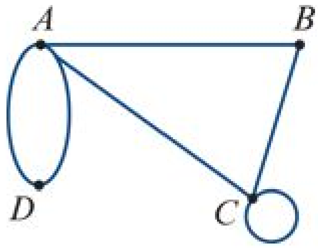
Concept – Networks, Graphs and Terminology

One of the keys to understanding and doing well in this topic is having a solid understanding of the terminology used.
In this topic we will be working with Networks, which we often refer to as graphs. Some of the terms we use to describe parts of graphs are:



Vertex: ______________________________ Edge: ______________________________

Loop: ______________________________ Degree: ______________________________

Multiple edges: ______________________

In other situations we need to describe entire graphs. Some of the terms we use to do this include:

Isomorphic: ______________________________

____

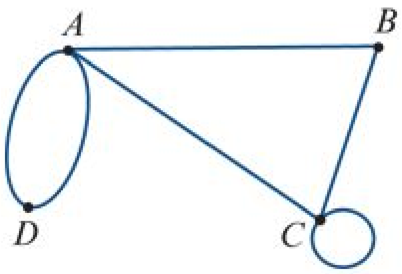
Connected: ______________________________

____

Bridges: ______________________________

____

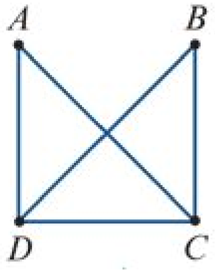
We can also describe networks with an adjacency matrix. These matrices are an array of numbers listing the edges between vertices.



$$\begin{array}{c c} & \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{array}{c} A \\ B \\ C \\ D \end{array} & \begin{bmatrix} 0 & 1 & 1 & 2 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 2 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

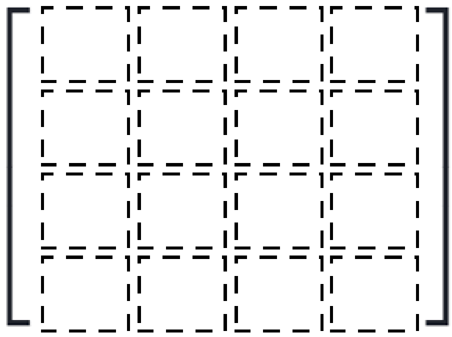
How to

To show that a graph is isomorphic you need to redraw the graph so that all edges, connections and vertices are the same but the graph looks different. An easy way to do this is to start with the vertices in a line.



To draw an adjacency matrix:

1. Count the number of vertices. This will be the number of rows and columns in the matrix.
2. Draw the large square brackets and label all rows and all columns with the vertex names.
3. At the intersection of the vertices write the number of edges between those two vertices. (Recall a loop counts as 2)



To draw a graph from an adjacency matrix:

1. Draw each vertex as a dot and label each one.
2. Look at the intersection of each pair of vertices and draw in any edges (Recall a loop counts as 2)
3. To check you have draw enough edges add all the numbers in the matrix, then divide this by two. This should be equal to the number of edges.

$$\begin{array}{c} \\ W \\ X \\ Y \\ Z \end{array} \begin{array}{c} \begin{array}{cccc} W & X & Y & Z \end{array} \\ \begin{bmatrix} 0 & 0 & 2 & 1 \\ 0 & 2 & 0 & 1 \\ 2 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \end{bmatrix} \end{array}$$

Worked Examples

Draw a graph with at least 5 vertices. This graph must include multiple edges and a loop. Find the degree of each vertex and make a adjacency matrix for this graph.