

Isomorphic, connected graphs and adjacency matrices

Year 11
General Mathematics

www.maffsguru.com

Learning Objectives

By the end of the lesson I hope that you understand and can apply the following to a range of questions from the Unit 1 and 2 General Mathematics course.

- Understand what a graph is
- `Understand why a graph is important to us in the real world
- Understand what the following parts of a graph are:
    - Vertex
    - Edge and multiple edges
    - Degree of a vertex
    - Loop
- Know the following different types of graphs
    - Isomorphic
    - Connected
- Know what a bridge is
- Know what an adjacency matrix is and how to use it.

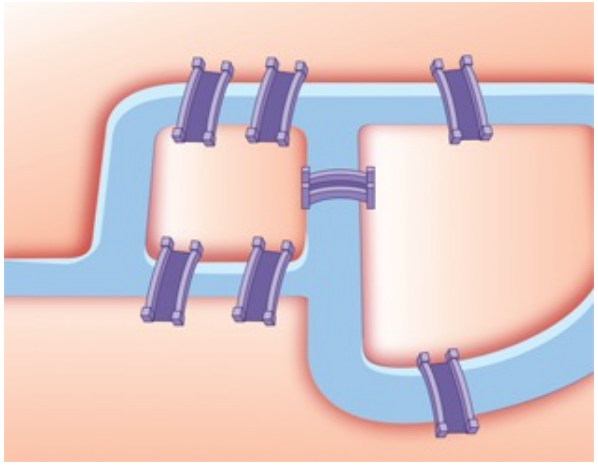
Recap

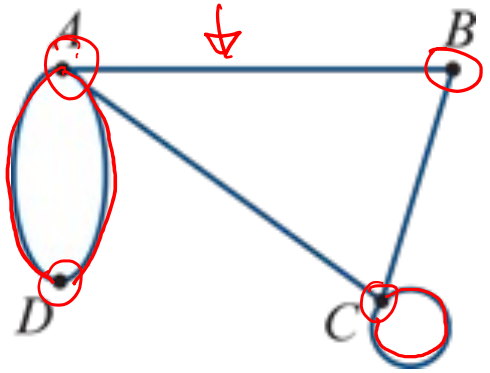
In the previous lessons we have looked at the bridges problem and found that graphs have the following:

- Vertices
- Edges (and sometimes multiple edges)
- Loops

We know that we can tell a lot from the degrees of vertices.

Now we need to look at the types of graphs we can have and how they can help us solve real world problems.





More language: Isomorphic graphs

I always smile when I see this as, when I was a kids, there was a character in one of the kids TV shows on the BBC called Morph.

He could do exactly that … morph.

Oh how I miss my childhood …

And, I've just worked out, that it was animated by the same people who did Wallace and Gromit (and a lot more!).

But back to the maths …

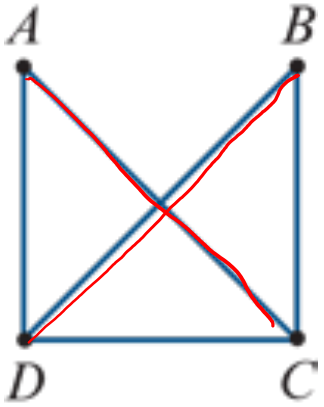


More language: Isomorphic graphs

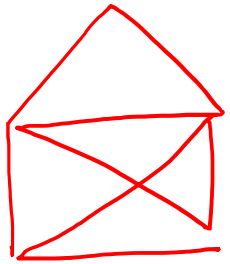
When we have a graph we can, in many cases, draw it in lots of different ways.

This is one for the Studio Arts students (or other colouring in subjects).

Can we draw the following graph in a different way but maintain the correct connections between the points A, B, C and D?

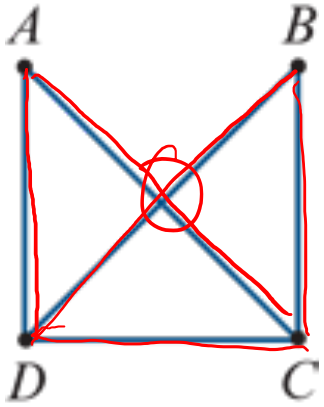


Graph 1

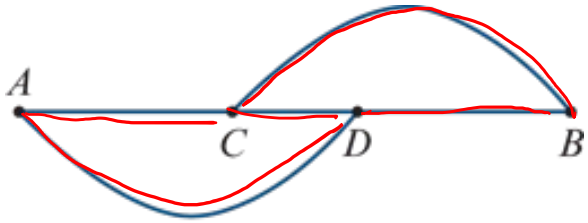


More language: Isomorphic graphs

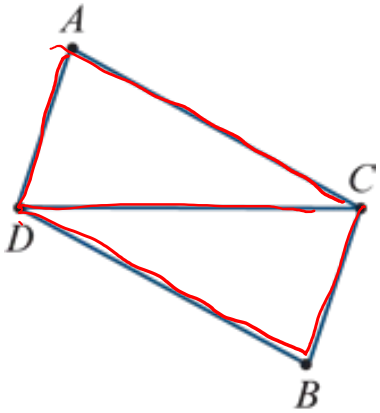
As it turns out … yes we can!



Graph 1



Graph 2



Graph 3

The most important thing to note here is that Graph 2 and Graph 3 have something which Graph 1 does not ….

None of the lines cross!

This becomes really important in later sections of the course.

When a graph can be drawn in a different way but still contain the same information it is called **isomorphic.**

More language: Connected graphs

We all want to feel connected in life.

I'd like friends.

Respect.

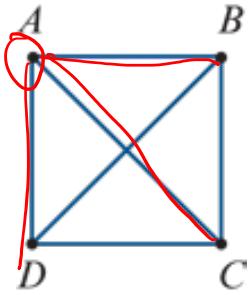
A pay rise.

Fame.

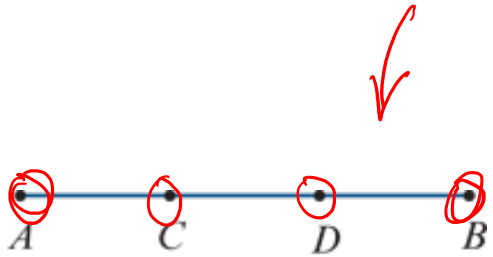
Fortune ....

But connections in graphs are also important.

The graphs shown are all **connected**.

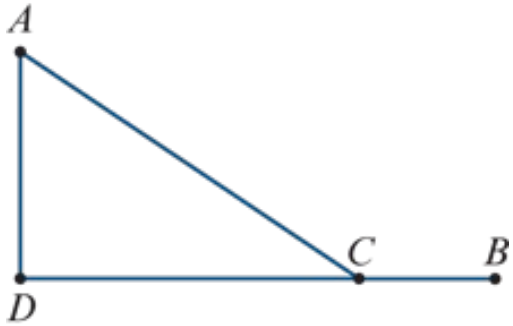


Graph 1



Graph 2

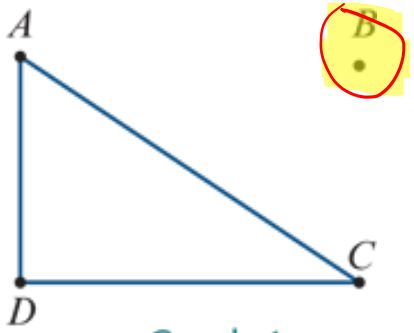
A graph is connected when every vertex is connected to every other vertex either directly or via another vertex.



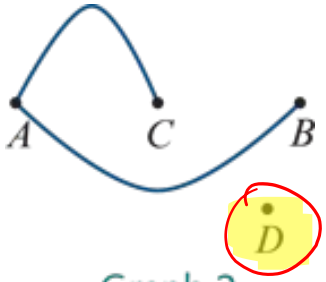
Graph 3

Graphs with a loner or two

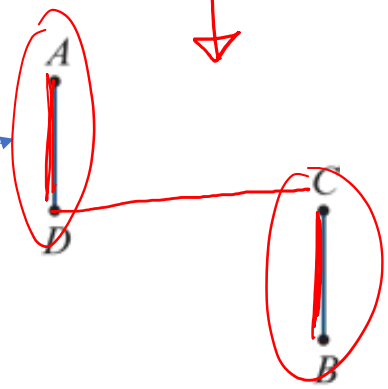
If we look at the graphs shown we can see that, like me in a nightclub, there are some loners.



Graph 1



Graph 2



Graph 3

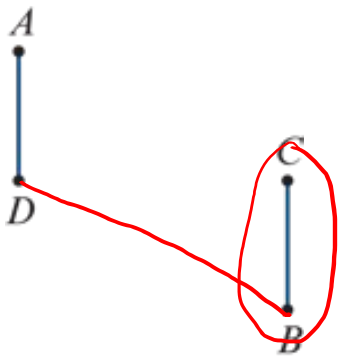
Don't get tricked with this one! Although two pairs are connected, they aren't connected to each other. Hence, they are **not connected**. Much like boys and girls at their first disco on Year 7.

Let's build some bridges

In the previous example we saw that there were two sets of connected graphs which seemed separated from each other.

We could actually join these together with a **bridge**.

A bridge is an edge which, if removed, would leave a graph disconnected.



Graph 3

Adjacency matrices

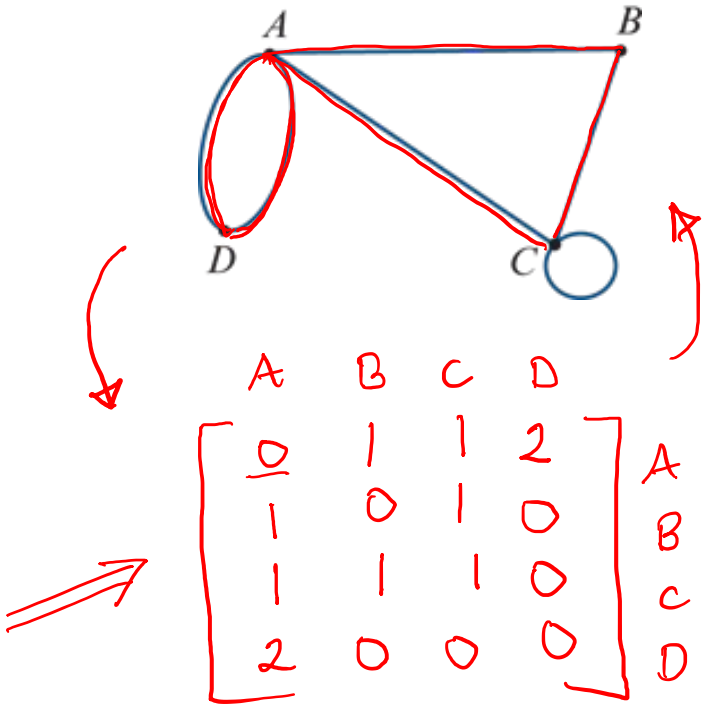
And, just when we thought it was safe to get back into the water again, we are back to matrices again!

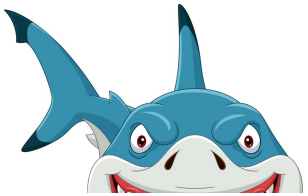
Graphs and matrices go hand in hand.

We can represent a graph as a matrix (which we call an **adjacency matrix**). All the matrix does is show, using numbers, the connections between each vertex.

We've already seen the example on the right.

How would we express this as a matrix?





Adjacency matrices

And, just when we thought it was safe to get back into the water again, we are back to matrices again!

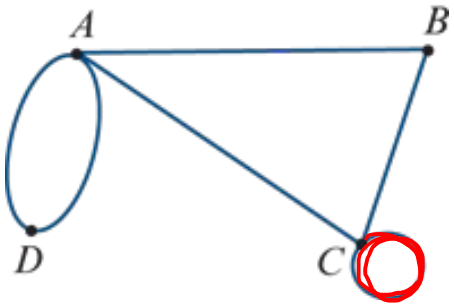
Graphs and matrices go hand in hand.

We can represent a graph as a matrix (which we call an **adjacency matrix**). All the matrix does is show, using numbers, the connections between each vertex.

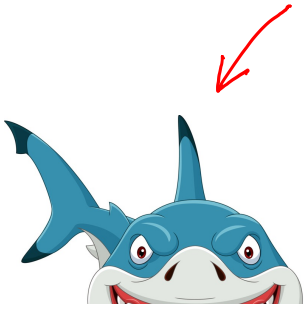
We've already seen the example on the right.

How would we express this as a matrix?

Remember: A loop counts as 1 edge!!!



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

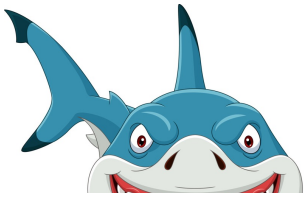


Leading diagonals are really important

As I've said before, please remember that the leading diagonals of a matrix (be they adjacency or not) are really important.

In adjacency matrices, they show loops.

	A	B	C	D
A	0	1	1	2
B	1	0	1	0
C	1	1	1	0
D	2	0	0	0



Work to be completed

The following represents the minimum work which should be completed.

The more questions you answer from each exercise, chapter review and Checkpoints the better you chance of gaining an excellent study score in November.

General Mathematics Units 1 and 2 Textbook

Chapter 9
Exercise 9C: Isomorphic, connected graphs and adjacency matrices
Questions: All from 9C-1, 9C-2 and 9C-3

www.maffsguru.com