

## Exercises – Graph theory

### Question 1.

Model the following situations as (possibly weighted, possibly directed) graphs. Draw each graph, and give the corresponding adjacency matrices.

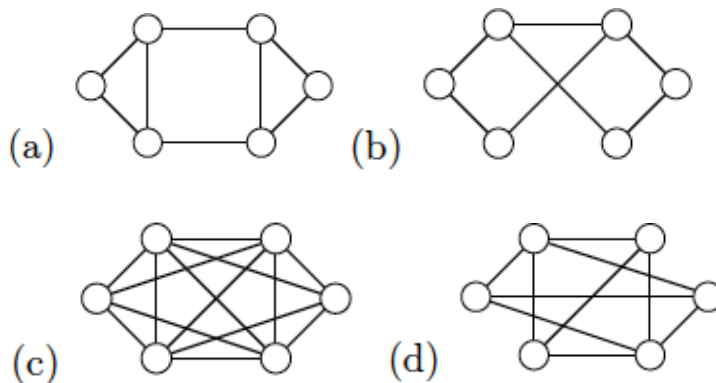
(a) Ada and Bertrand are friends. Ada is also friends with Cecilia and David. Bertrand, Cecilia and Eva are all friends of each other.

(b) Wikipedia has five particularly interesting articles: Animal, Burrow, Chile, Desert, and Elephant. Some of them even link to each other!

(c) It is well-known that in the Netherlands, there is a **2**-lane highway from Amsterdam to Breda, another **2**-lane highway from Amsterdam to Cappel aan den IJssel, a **3**-lane highway from Breda to Dordrecht, a **1**-lane road from Breda to Ede and another one from Dordrecht to Ede, and a **5**-lane superhighway from Cappel aan den IJssel to Ede.

### Question 2.

Answer for each of these graphs: Is it planar? Is it bipartite? Why?



### Question 3.

Draw an example graph for each of these.

(a) A planar graph has 5 vertices and 3 faces. How many edges does it have?

(b) A planar graph has 7 edges and 5 faces. How many vertices does it have?

### Question 4.

What is the maximum number of edges in a bipartite planar graph with  $n$  vertices?