

## M2 - NAM (HOMEWORK)

### COMMUNITY DETECTION

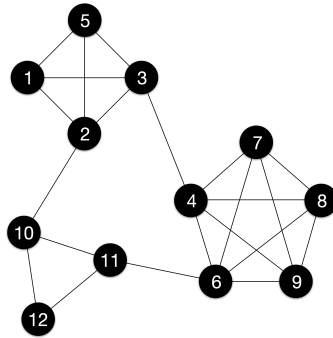


FIGURE 1. Undirected and unweighted graph with 12 nodes.

#### Exercise 1. Open question about community detection

Consider the graph from Figure 1. We ask you to solve the following puzzle: divide the nodes in two separate groups such that the number of links between the two groups is the smallest possible.

**Example:** We may consider the following two groups  $A = \{1, 2, 3, 5\}$  and  $B = \{4, 6, 7, 8, 9, 10, 11, 12\}$ . It can be seen that the number of links between these two groups is 2: the link connecting nodes 3 and 4 and the link connecting 2 and 10.

**Question 1:** Is there a better solution to the puzzle?

**Question 2:** Can there be more than one solution to the puzzle?

**Question 3:** How can we be sure that a solution is the best possible?

**Question 4:** How many possible choices of the groups  $A$  and  $B$  exist?

**Question 5:** If you have to solve this problem for a graph with 1 million nodes, how would you proceed?