

**Exercise 1**

Prove that the 3-SAT problem is fixed parameter tractable when parameterized by the number of literals.

**Exercise 2**

Prove that a parameterized problem is fixed parameter tractable if and only if it admits a kernel and it is decidable.

**Exercise 3**

Let  $d$  be a fixed integer. Prove that deciding if a graph with maximum degree at most  $d$  has an independent set of size  $k$  is fixed parameter tractable when parameterized by  $k$ .

**Exercise 4**

An acyclic coloring of a graph is a proper coloring such that the graph induced by any two pairs of colors is acyclic.

We are interested in the problem of finding a 3-acyclic-coloring in triangle-free planar graphs.

- Build a triangle-free planar graph with two vertices  $u$  and  $v$  such that all of the following hold :
  - $u$  and  $v$  are on the same face
  - $u$  and  $v$  are not adjacent
  - there is no acyclic 3-coloring of the graph in which  $u$  and  $v$  have the same color.
- Deduce that deciding if a triangle-free planar graph admits a 3-acyclic-coloring is NP-hard. You can reduce from 3-coloring in planar graphs.