For answering this class's quizzes, the following programs may be useful:

- GCP Model with K_max:
 - Model gcp.mod.
 - Data gcp.dat.
 - AMPL run file gcp.run.
 - Python program gcp.py.
- GCP Model with fixed k:
 - Model gcp_fixed_k.mod.
 - AMPL run file gcp fixed k.run.
 - Python program gcp_fixed_k.py.
- Maximum stable set files:
 - Model ssp.mod.
 - AMPL run file ssp.run.
 - Python program ssp.py.
- 1. Consider the coloring problem in the following graph:



- (a) Determine a solution of using the "standard" formulation, with an upper bound for the number of colors equal to the number of vertices (i.e., $K_{\text{max}} = |V|$).
- (b) Using the model with a fixed number of colors K = 2, determine the minimum number of "bad edges" (edges whose end nodes have the same color).
- (c) Solve the problem using the *fixed-k formulation* and the bisection method in a "manual" way, using initially 2 as the lower bound and |V| as the upper found for the chromatic number.
- 2. Consider the following graphs:



For each of the graphs, instantiate a model and identify the solution to the following problems:

- (a) Graph partitioning;
- (b) Maximum stable set;
- (c) Maximum clique;
- (d) Graph coloring.