Prof. Dr. Rüdiger Ehlers Francisco Palau, M.Sc.

Applied Computational Engines 2018 – Assignment Sheet 1

Due: Monday, 16th April 2018, 8:30am

Please indicate your **name** and **email address**. You can work in **groups** of up to **three** students. Only one submission per group is necessary. However, in the tutorials every group member must be able to present the solutions to each problem solved by your group.

Please submit your solutions either

- by e-mail to `fpalau@uni-bremen.de` **and** `rehlers@uni-bremen.de`, or
- on paper in **letter box 52** (Francisco Palau-Romero) on floor 6 of the MZH building.

Note that you will need 50% of the points on all exercise sheets in order to take the "Fachgespräch" OR the oral exam. We may ask you to present your solutions in the tutorial, especially if you work in a group. We aim for asking everyone taking part in the course to present at least twice during the course of the semester.

Exercise 1: Graph Coloring (50 pts.)

In this exercise, we will have a look at the coloring problem of the graph depicted in Figure 1.

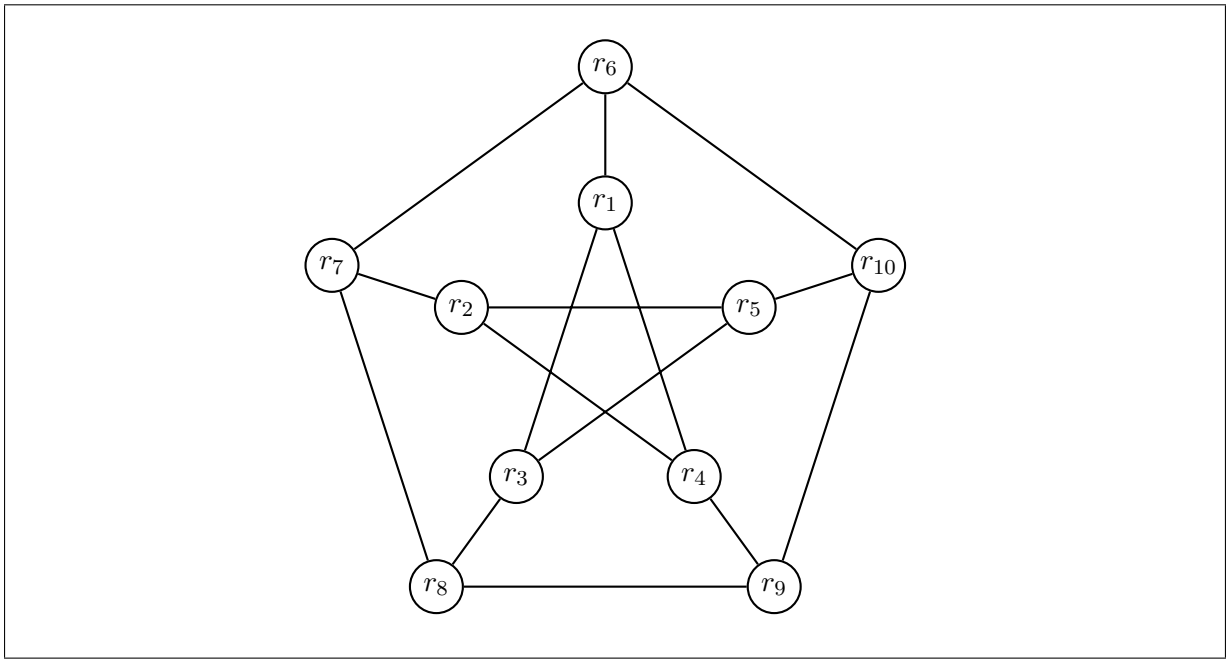

Figure 1: The *Petersen Graph*.

Solve the following problems:

- Encode the 3-coloring problem of the Petersen graph into a SAT instance. Give a DIMACS compatible input file and give a list of the meanings of the SAT problem variables. Then, apply a SAT solver to solve the instance. If it has a solution, give the SAT solver's output along with its interpretation, i.e., the colored graph. (*15 pts.*)
- In the lecture, we only considered the *vertex coloring* variant of the graph coloring problem, in which the vertices of the graph are to be colored in a way such that no two vertices that are connected by an edge may have the same color. Let us now consider the *edge coloring* variant, in which we color the edges and not the vertices. No two edges that have a joint vertex may have the same color.

  Perform the following tasks:

  - Describe in a similar style as in the lecture how we can encode the c-edge coloring problem of a graph $\mathcal{G} = (V, E)$ into a SAT instance. (*20 pts.*)
  - For the Petersen graph from Figure 1, give a DIMACS-compatible SAT instance that encodes its $c = 3$ edge coloring problem. Also give a list of the meanings of the SAT instance variables. Apply a SAT solver to solve the instance. If it has a solution, give the SAT solver's output along with its interpretation, i.e., the colored graph. (*15 pts.*)