# CSC 545/645 - Artificial Intelligence - Assignment 4

Due date: Tuesday, October 13, 2015, 23.59 pm, upload to home folder of class.

The Four Color problem is one of the most famous problems in Mathematics. The problem consists of the question whether any map can be colored using four colors in such a way that adjacent regions (i.e. those sharing a common boundary segment, not just a point) receive different colors. This problem has been formulated first by Francis Guthrie in 1852 (published in 1878) and was unsolved for roughly a century. Wolfgang Haken und Kenneth Appel could prove the four color theorem with the help of a computer program in 1977 .

Exercise 4.1

 a) Define in your own words the terms constraint satisfaction problem, constraint, back-tracking search, back-jumping, and min-conflicts.
  [2.5 points]

 b) How many solutions are there for the three-color map-coloring problem in the figure? Elaborate your answer.
  [1.5 points]
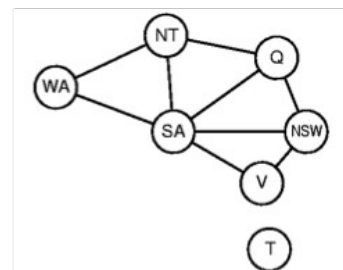
Exercise 4.2

Consider the political map of the South-Eastern states of the USA (states North Carolina, South Carolina, Virginia, Tennessee, Kentucky, West Virginia, Georgia, Alabama, Mississippi, and Florida). How can we color this map with the four color theorem using a Genetic Algorithm?

a) How is this problem represented in general (write in your own words). Define the states, the goal-test, and the successor function of your problem.
  [2 points]

b) Implement your algorithm and show the results. You may want to use the framework provided by Alexander Härtl (download Java, C++, C).
  [14 points]

c) Optional:Use your implemented genetic algorithm from b) to find a solution for coloring all states of the US.
  [2 extra points]

Bibliography
[1]   K. Appel and W. Haken, "Every planar map is four colorable. Part I. Discharging," *Illinois J. Math,* vol. 21, pp. 429-490, 1977.