Team 2 – Jarrett Arredondo, Krystal Grant, Colin Mettler, Chloé Plasse February 20, 2023

CS534-S23-S01 Group Project Assignment #2

**Question 1. *Consider the map-coloring problem in Australia that we discussed in our lecture video. How many solutions are possible if two, three, and four different colors are allowed, respectively, in this problem.***

If only two colors are allowed – There are no possible solutions. SA borders NT and WA which border each other. If SA were one color, both NT and WA would both need to be the remaining color, but this is not allowed since they border each other.

If three colors are allowed – There are 18 possible solutions. Begin with SA as it is involved in the most constraints. Choosing 1 of 3 colors for SA, that leaves 2 remaining colors for WA. Once a color has been selected for WA, the remaining color is selected for NT as it borders both SA and WA. Next is state Q which borders both NT and SA so there is only one option for it’s color. Similar situation for NSW and V, only one-color option. Lastly, T can be any color as it does not border any mainland states.

3 options for SA x 2 options for WA x 3 options for T = 18.

If four colors are allowed – There are 768 possible solutions. Begin with SA as it is involved in the most constraints. Choosing 1 of 4 colors for SA, that leaves 3 remaining colors for WA. Once a color has been selected for WA, there are 2 remaining colors for NT as it borders both SA and WA. Next is state Q which borders both NT and SA so there are 2 color options available. Similar situation for NSW and V, 2 color options. Lastly, T can be any color as it does not border any mainland states.

4 options for SA x 3 options for WA x 2 options for NT x 2 options for Q x 2 options for NSW x 2 options for V x 4 options for T = 768.

**Question 2. *Consider the problem of placing k queens on an n × n chessboard such that no two queens are attacking each other, where k is given and k = n. Formula a CSP <V, C, D> for this problem.***

In order for no queens to be attacking each other, only one queen can be on a particular row, column, or diagonal. This can be done by making the variables represent the columns on the board, 1 through n, and the domain having each Di where 1 <= i <= n be the range of {1,…,n}. The constraints are then such that there are n(n-1)/2 contraints, with any particular constraint defining the relationship between two of the represented columns from the variables, wherein for these columns Ci and Cj, the queens within them are on the same column, row, or diagonal of each other. In CSP notation this can be written as :

V = {V1,V2,...,Vn} where Vi is a variable for the ith column for 1 <= i <= n

D = {1,2,...,n} where n = k and Di = {1,2,...,k} where 1 <= i <= n

C = {C1,C2,...,Cm} where m = n(n-1)/2 because they are binary constraints where Cx = (Vi,Vj), Vi != Vj, i - Vi != j - Vj and i + Vi != j + Vj