Answers:

1. Initial State (S0), which is represented by the current map in Figure 1. **[2 Marks]**
   1. Use the following order of provinces and territories {BC, AB, SK, MB, ON, QC, NB, NS, PEI, NL, NU, NT, YT}
   2. For each province and territory, use the first letter of each colour to represent its colour. {b->blue, o->orange, r->red, j->jungle}
   3. The initial state (S0) should look like: S0={b,o,o,………………………………………………………………………………..}
   4. Complete the initial state S0

*S*0 = {b, o, o, o, r, r, j, j, j, j, j, j, j}

1. Successor Function (Transition Model): Change the colour of a region. **[2 Marks]**

* Think about a method to change the colour of a single region only. This is how you generate a new solution. Document your steps.

We can first select a province randomly based on the given order. Then we will change the color of the selected region to any of the other “k - 1” colors, ensuring that the two adjacent regions do not share the same color.

1. Cost Function. **[2 Marks]**

The cost of using colour units in each region is as follows: red=2, blue =1, orange=3, jungle=5.

* Write a mathematical formula for the cost function.

The total cost of a state *S* can be calculated using the formula:   
  
Cost (*S*) = , Where *i* is the number of regions (13 in our case), and is the State (color) assigned at the *i*th region.

Therefore, our initial state would look something similar to:  
  
Cost (*S*0) = 1 + 3 + 3 + 3 + 2 + 2 + 5 + 5 + 5 + 5 + 5 + 5 + 5 = 49

1. Heuristic Function *h(Si)*: Returns the number of adjacent regions that share the same colour. **[2 Marks]**

* Write a mathematical formula for the Heuristic function.
* Use the following adjacency matrix **A**, where **aij =1** when the region **i** and **j** are adjacent.

A grid of numbers and letters

Description automatically generated

*h* (*S*) = ,

Where *h* (*S*) is a function responsible for checking if the Matrix *A* at regions *i* and *j* are adjacent to the State matrix *S.*

And (Kronecker delta) is a function that checks whether the States (colors) for regions *i* & *j* are the same and is shown as:

1. Goal Test: The map all coloured such that two adjacent regions do not share a colour. **[2 Marks]**

* Write a mathematical formula to perform this test.

The goal is to colour the map such that no two adjacent regions share the same color. We can represent it mathematically such that: