

# CPSC 4420/6420: ARTIFICIAL INTELLIGENCE

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Consider MAP coloring problem for South Africa, and let's use the following abbreviations for 9 provinces for brevity.

Note: Skip the middle part. It is Lesotho, another country.

1. EC: Eastern Cape
2. FS: Free State
3. GG: Gauteng
4. KN: KwaZulu-Natal
5. LP: Limpopo
6. MP: Mpumalanga
7. NC: Northern Cape
8. NW: North West
9. WC: Western Cape

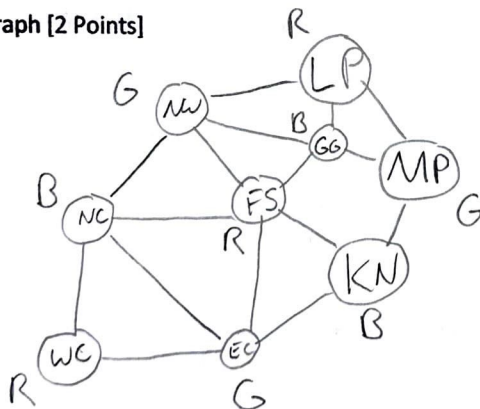


Ignore the small islands.

We are allowed to use three colors "R": Red, "B": Blue, and "G": Green so that neighboring regions do not take the same color. For example, we show assignments as {EC= "R", FS= "B", ....., WC= "G"}.

We follow our common constraint that neighbor states can not take the same color. For example, we can not have  $NC=WC$ , or we can not have  $NC = "R"$  and  $WC = "R"$  simultaneously as part of any assignment.

A – Draw the contact graph [2 Points]



NW = G  
NC = B  
WC = R  
FS = R  
EC = G  
KN = B  
MP = G  
GG = B  
LP = R

B- Is the following assignment consistent with constraints or not? Why? [1 Point]

{ EC = "R", FS = "G", GG = "B", KN = "G", LP = "R", MP = "B", NC = "G", NW = "R", WC = "B" }

No it is not because KN and FS are both = to "G".

They cannot be because they are neighbors.

C- How many do there exist assignments in total (including consistent and inconsistent assignments)? [1 Point]

$3^9$  assignments = 19683 assignments

D. Consider that we have the following domains for two neighboring states LP: Limpopo and NW: North West. [3 Points]

Domain of LP is {Blue }

Domain of NW is {Blue, Green, Red}

D1. Is LP arc consistent with NW? why?

Yes because NW has the option of being red or green, and the constraint is that two neighbors cannot be the same color. NW does not have to be blue.

D2. Is NW arc consistent with LP? Why?

No because LP can only be blue, violating the rule that every value in NW must have some value in LP that doesn't violate a constraint. NW cannot be blue next to LP.

D3. If they are not consistent, how we can alter the domain of NW so both NW and LP become consistent with respect to the other? Write "Not Applicable" if they are already consistent.

We need to alter the domain of NW so that it can only be either green or red. This would make it arc consistent both ways.

From now on consider the map of England with the following 10 regions.

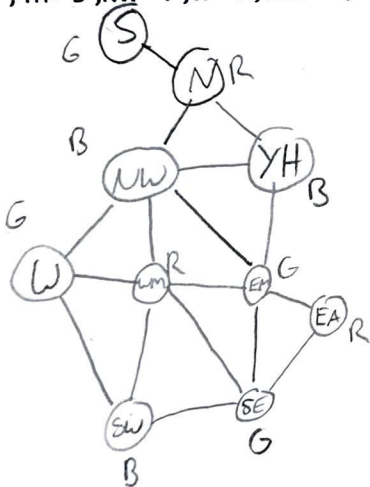
1. S: Scotland
2. N: Northern
3. YH: Y+H: Yorkshire and the Humber
4. NW: North West
5. W: Wales
6. WM: West Midlands
7. EM: East Midlands
8. SW: South West
9. EA: East Anglia
10. SE: South East



E- Complete the following assignment by assigning colors to blank states until all regions take some color. When there is more than one option you can take any of them (for this part). Is it possible to complete this assignment? Why?

[1 Points]

{S="?", N="?", YH="B", NW="?", W="?", WM="?", EM="", SW="B", EA="R", SE="?"}



EA=R  
YH=B  
SW=B  
SE=G

You cannot complete the assignment because EM & SE have to be green, however that violates the constraint of neighbors being different colors. Later on, NW would become blue which is also invalid since YH is blue.

F- For the above problem, using the most constrained variable, which region you would select next (to assign a color) after the three states YH, EA, SW. Explain why? [1 Points]

I would select either SE or EM because the only option they have is to become green.

G- Now, consider the following situation. If we select "Wales" after the three states EA="Red", SE="Green", SW="Blue". What color [s] would you assign to it. Explain why? [1 Points]

I would make Wales green, as it would allow WM to be set to red. This would make sure neighbors were not the same color. If you tried to make it red, WM would not be able to be any color.

