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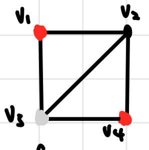

figure 1

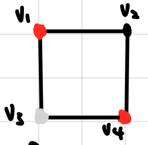

figure 2

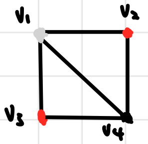

figure 3

let n be number of Vertices of G

let m be number of edges of G

Each vertices must be assigned to one colour, which means one vertice can have only one colour at a time within the colour {Red, White, Black}

Hence, we only can have at most one and at least one colour on one Vertices

At least one, (V_1Red | V_1white | V_1Black)

At most one, $\neg(V_1 red \wedge V_1 Black) \wedge \neg(V_2 red \wedge V_2 white) \wedge \neg(V_2 Black \wedge V_2 white)$

$= (\neg V_1 red \vee \neg V_1 Black) \wedge (\neg V_2 red \vee \neg V_2 white) \wedge (\neg V_2 Black \wedge \neg V_2 white)$

So for each vertice has 4 clauses. Hence, is $4n$ clauses

Adjacent vertices must have different colours. We calculate how many clauses will produce by one edge. We take Figure 1 as example, if V_1red then V_2 can't be red if V_1White then V_2 can't be white. In another word, V_1red and V_2red can't exist at the same time and same for other edges. As V_1 to V_2 are same as V_2 to V_1

eg. $\neg(V_1 red \wedge V_2 red) = \neg(V_2 red \wedge V_1 red)$. Hence, count one time for every edge

V_1 to V_2 edge : $\neg(V_1 red \wedge V_2 red) \wedge \neg(V_1 White \wedge V_2 white) \wedge \neg(V_1 Black \wedge V_2 Black)$

$= (\neg V_1 red \vee \neg V_2 red) \wedge (\neg V_1 White \vee \neg V_2 white) \wedge (\neg V_1 Black \vee \neg V_2 Black)$

Therefore each edge has 3 clauses. Thus is $3m$ clauses

The Sum of total clauses in $\varphi G = 4n + 3m$