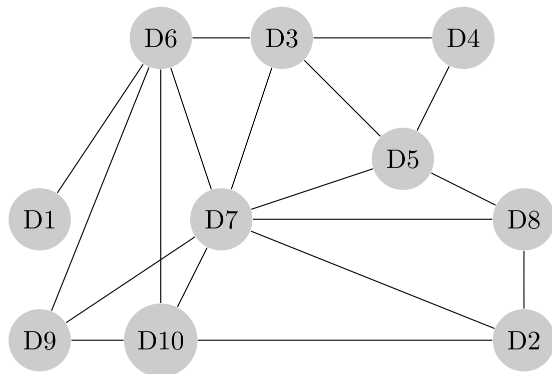
Problem 1. A graph of the CSP



Variables: Domains
D1: District 1 $\{blue, chartreuse, green, red\}$
$D2 : District2 \{blue, chartreuse, green, red\}$
$D3 : District3 \{blue, chartreuse, green, red\}$
$D4 : District4 \{blue, chartreuse, green, red\}$
$D5 : District5 \{blue, chartreuse, green, red\}$
$D6 : District6 \{blue, chartreuse, green, red\}$
$D7 : District7 \{blue, chartreuse, green, red\}$
$D8 : District8 \{blue, chartreuse, green, red\}$
$D9 : District9 \{blue, chartreuse, green, red\}$
$D10 : District10 \{blue, chartreuse, green, red\}$

Constraints
D1$\neq D6, D2 \neq D7, D2 \neq D8, D2 \neq D10, D3 \neq D6, D3 \neq D7, D3 \neq D4,$
$D3 \neq D5D4 \neq D5, D5 \neq D8, D5 \neq D7, D6 \neq D7, D6 \neq D9, D6 \neq D10,$
$D7 \neq D9, D7 \neq D8D7 \neq D10, D9 \neq D10$

Problem 2

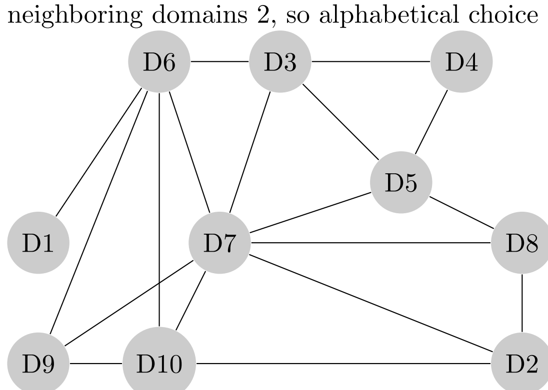
D7 would be chosen since it has 6 constraints which is the most in the constraint problem D7$\neq D2, D7 \neq D3, D7 \neq D5, D7 \neq D6, D7 \neq D8, D7 \neq D9$

Problem 3 Variables: Domains
D1: District 1 $\{blue, chartreuse, green, red\}$
$D2 : District2 \{blue, chartreuse, green, red\}$
$D3 : District3 \{blue, chartreuse, green, red\}$
$D4 : District4 \{blue, chartreuse, green, red\}$
$D5 : District5 \{blue, chartreuse, green, red\}$
$D6 : District6 \{blue, chartreuse, green, red\}$
$D7 : District7 \{blue\}$

$D8 : District8\,\{blue, chartreuse, green, red\}$
$D9 : District9\,\{blue, chartreuse, green, red\}$
$D10 : District10\,\{blue, chartreuse, green, red\}$

Revise(csp,District 2, District 7)
District 2 = $\{blue, chartreuse, green, red\}\, District7 = \{blue\}$
$x = blue$
$CheckConstraintifx \neq District7(false)$
$removexfromDistrict2domain$
$District2 = \{chartreuse, green, red\}$
$x = chartreuse$
$CheckConstraintifx \neq District7(true)$
$KeepxinDomain$
$District2 = \{chartreuse, green, red\}$
$x = green$
$CheckConstraintifx \neq District7(true)$
$KeepxinDomain$
$District2 = \{chartreuse, green, red\}$
$x = redCheckConstraintifx \neq District7(true)$
$KeepxinDomain$

Problem 4 District 2 is the next node to consider
It is assigned chartreusu because removing any other color will make both neighboring domains 2, so alphabetical choice is made.



Domains
D1: District 1 $\{blue, chartreuse, green, red\}$
$D2 : District2\,\{chartreuse\}$
$D3 : District3\,\{chartreuse, green, red\}$
$D4 : District4\,\{blue, chartreuse, green, red\}$
$D5 : District5\,\{chartreuse, green, red\}$
$D6 : District6\,\{chartreuse, green, red\}$

$D7 : District7\,\{blue\}$
$D8 : District8\,\{chartreuse, green, red\}$
$D9 : District9\,\{chartreuse, green, red\}$
$D10 : District10\,\{chartreuse, green, red\}$

$NowAfterArcconsistency$
$D1 : District1\,\{blue, chartreuse, green, red\}$
$D2 : District2\,\{chartreuse\}$
$D3 : District3\,\{chartreuse, green, red\}$
$D4 : District4\,\{blue, chartreuse, green, red\}$
$D5 : District5\,\{chartreuse, green, red\}$
$D6 : District6\,\{chartreuse, green, red\}$
$D7 : District7\,\{blue\}$
$D8 : District8\,\{green, red\}$
$D9 : District9\,\{chartreuse, green, red\}$
$D10 : District10\,\{green, red\}$
chartreuse is removed as domain value from neighbors of D2

Problem 5

1. D8 is next pick green

Thus D2 domain is $\{chartreuse, red\}$

2. D5 is selected as chartreuse

D3 domain is $\{green, red\}$

3. D3 is selected as green

D4 domain is $\{blue, red\}$

4. D4 is selected as blue

5. D6 is selected as chartreuse

D1 domain is $\{blue, red\}$
$D9domainis\,\{green, red\}$

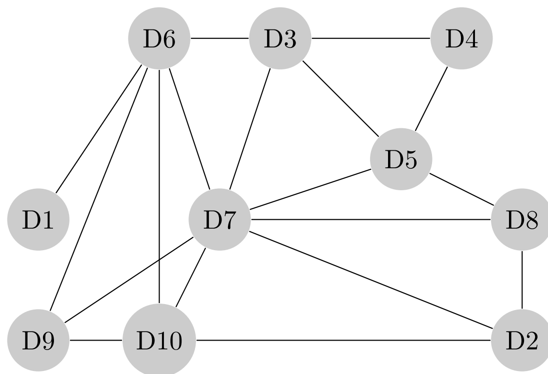
6. D9 is selected as green

D10 domain is $\{red\}$

7. D10 is selected as red

D1 domain is $\{blue\}$

8. D1 is set to blue Final Graph and Domains is



D1: District 1 $\{blue\}$
$D2 : District2\,\{chartreuse\}$
$D3 : District3\,\{green\}$
$D4 : District4\,\{blue\}$
$D5 : District5\,\{chartreuse\}$
$D6 : District6\,\{chartreuse\}$
$D7 : District7\,\{blue\}$
$D8 : District8\,\{green\}$
$D9 : District9\,\{green\}$
$D10 : District10\,\{red\}$

If we didn't use forward checking we would end up in a fail state more often because we chose a new state without considering the future possible conflicts (consequences)

Problem 6
Steps:
Bicondition elimination
Implication elimation
Distributive properties

1. $\mathrm{W}_{3,3} \leftrightarrow \big(S_{2,3} \wedge S_{3,2} \wedge S_{3,4} \wedge S_{4,3}\big)$

2.$W_{3,3} \rightarrow \big(S_{2,3} \wedge S_{3,2} \wedge S_{3,4} \wedge S_{4,3}) \wedge (S_{2,3} \wedge S_{3,2} \wedge S_{3,4} \wedge S_{4,3}\big) \rightarrow W_{3,3}$

3.$\big[\neg W_{3,3} \vee \big(S_{2,3} \wedge S_{3,2} \wedge S_{3,4} \wedge S_{4,3}\big)\big] \wedge \big[\neg\big(S_{2,3} \wedge S_{3,2} \wedge S_{3,4} \wedge S_{4,3}\big) \vee W_{3,3}\big]$

4.$\big[\neg W_{3,3} \vee \big(S_{2,3} \wedge S_{3,2} \wedge S_{3,4} \wedge S_{4,3}\big)\big] \wedge \big[\big(\neg S_{2,3} \wedge \neg S_{3,2} \wedge \neg S_{3,4} \wedge \neg S_{4,3}\big) \vee W_{3,3}\big]$

5.$\big(\neg W_{3,3} \vee S_{2,3}\big) \wedge \big(\neg W_{3,3} \vee S_{3,2}\big) \wedge \big(\neg W_{3,3} \vee S_{3,4}\big) \wedge \big(\neg W_{3,3} \vee S_{4,3}\big)$
$\wedge \big(\neg S_{2,3} \vee \neg S_{3,2} \vee \neg S_{3,4} \vee \neg S_{4,3} \vee W_{3,3}\big)$

Transcript

```
to_cnf("W33 <=> S23 & S32 & S34 & S43")

>>((W33 | ~S23) & (S23 | ~W33) & S32 & S34 & S43)

to_cnf("(~W33 | S23)&(~W33| S32)&(~W33| S34)&(~W33| S43)& (~S23| ~S32| ~S34| ~S43 | W33)")

>>((~W33 | S23) & (~W33 | S32) & (~W33 | S34) & (~W33 | S43) &
(~S23 | ~S32 | ~S34 | ~S43 | W33)
```