1.

(a) For each variable, the domain is every position in the column they occupied, which is row {1, 2, 3, 4, 5}

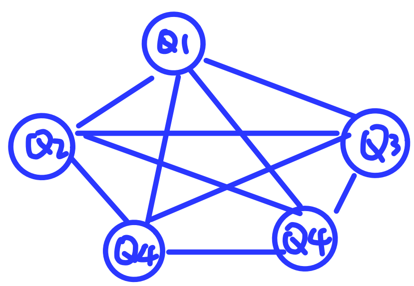
(b) Constraint: for each variable (i_n, j_n) $1 \le n \le 5$,

① $i_n \mathrel{!}= i_n'$ [No queen can on same row]

② $j_n \mathrel{!}= j_n'$ [specified in the question that they can't be in same column]

③ $|i_n - i_n'| \mathrel{!}= |j_n - j_n'|$ [No diagnol]

(c)



Each queen is affected/constrainted by other queens' position

2. V = Red at first

search tree generated:

① V = Red

⇓

② SA = Green [Choose the one with most neighbours]

⇓

③ NS = Blue [Most constraint variable]

⇓

④ Q = Red [MCV]

⑤ NT = Blue [MCV]

⑥ WA = Red [MCV]

Final solution:

Return { Victoria = Red, South Australia = Green, New South Wakes = Blue, Queensland = Red, Northern Territory = Blue, Western Australia = Red }

3. Time complexity

(a) Worst $O(n!d^n)$ in regular DFS in CSP
n is the number of variable and d is the maximum domain size.

(b) Worst $O(d^n)$ in backtracking search in CSP
d is the domain size (max) and n is num of variable

Reason is because in depth first search n variable are assigned with permutation of domain value (Repeative solution)
With Backtrack search, solutions with different domain value but satisfy constraint is considered as one.

Space complexity

(a) Worst $O(n^2d)$. Because regular DFS space complexity is $O(bm)$ where the b is branching factor and m is the maximum path depth. In CSP, the max branching factor is $(n \cdot d)$, n is num of variables and d is max domain. The max depth is the num of variable (n), so $O(n^2d)$.

b) Each level in Backtrack search is only generating one child node from last level. So branching factor is 1, depth of path is n, number of variables, so worst space complexity $O(n)$

4. ①

$$
\begin{array}{r}
CD \\
+\ CD \\
\hline
ABC
\end{array}
$$

0 All Diff (A, B, C, D)

① $D + D = 10 \cdot x_1 + C$

② $C + C + X_1 = B + 10 \cdot X_2$

③ $X_2 = A$

④ $A, C \neq 0$

②

$D \in [1, 9]$

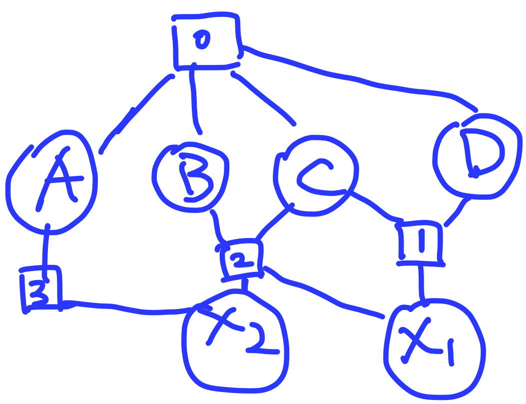
$C \in \{2, 4, 6, 8\}$

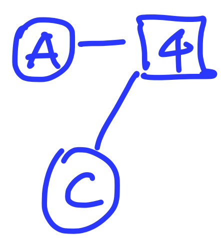
$B \in \{2, 4, 6, 8\}$

$A : 1$

$x_1 : 0$ or 1 $\quad x_2 : 1$

③





4

Var	A	B	C	D	X_r	X_2
Initial	1	2,3 6,7	6	3,4, 8,9	0,1	1
	1	3	0	5	4	2
After FC	1	2,3	6	3,8	0,1	1

5.

(a)

	SA	Q	NSW	V
Current Domain value	RGB	G	RG	RGB
After AC-3	GB	G	R	GB

(b) Queue

1. NSW → Q
2. SA → NSW
3. Q → NSW
4. V → NSW

ADD Arcs since NSW changes Based on 1

5. Q → SA
6. NSW → SA
7. V → SA

ADD Arcs since SA changes Based on 2

8. SA → V
9. NSW → V

ADD Arcs since V changes Based on 4