1 Adversarial Search

1.

node	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
value	12	12	5	19	12	5	12	19	5	6	12	5	1	12	8

2.

0 - 1 - 4 - 10 - 21

3.

6, 13, 14, 18, 26, 27, 28, 29, 30

2 Constraint Satisfaction Problem

1. (a) We can define variables based on the areas of knowledge. The variables and their domains are as follows.

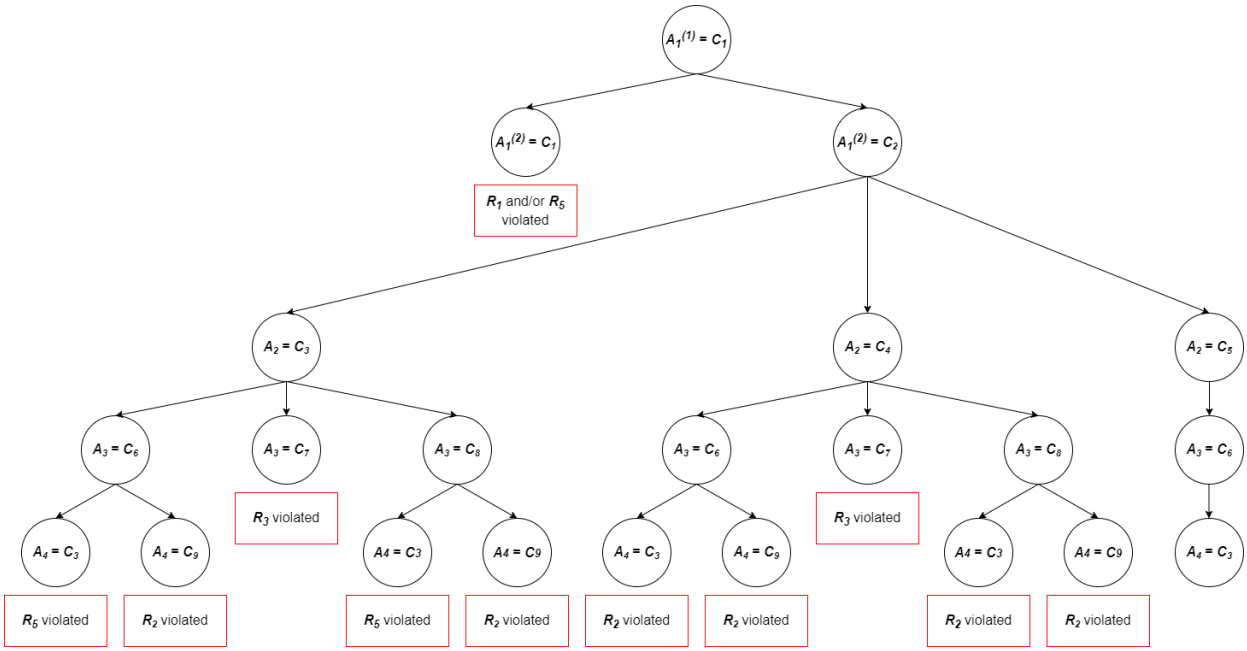
Variable	Domain
$A_1^{(1)}$	C_1, C_2, C_3, C_4, C_6
$A_1^{(2)}$	C_1, C_2, C_3, C_4, C_6
A_2	C_3, C_4, C_5
A_3	C_6, C_7, C_8
A_4	C_3, C_9

   (b) We can define the constraints by rewriting the restrictions as follows.
   - R_1 : $(A_1^{(1)}, A_1^{(2)})$ must be one of (C_1, C_2), (C_1, C_3), and (C_4, C_6).
   - R_2 : Only one of C_3, C_4, and C_9 can exist in a solution.
   - R_3 : Only one of C_1 and C_7 can exist in a solution.
   - R_4 : Only one of C_6 and C_8 can exist in a solution.
   - R_5 : No two variables can share one value.

2. Figure shown in the next page. The solution is $(A_1^{(1)}, A_2^{(2)}, A_2, A_3, A_4) = (C_1, C_2, C_5, C_6, C_3)$, as indicated by the rightmost branch.

3. Let $A_3 = C_8$ and $A_4 = C_9$. Then,
   - by R_4, C_6 is out of consideration from $A_1^{(1)}$ and $A_1^{(2)}$;
   - by R_2, C_3 and C_4 need to be removed from the domains of $A_1^{(1)}$, $A_1^{(2)}$ and A_2.

   Finally, by R_1, the only solution for $(A_1^{(1)}, A_1^{(2)}, A_2)$ is (C_1, C_2, C_5).


$A_1^{(1)} = C_1$
$A_1^{(2)} = C_1$
$A_1^{(2)} = C_2$
R_1 and/or R_5 violated
$A_2 = C_3$
$A_2 = C_4$
$A_2 = C_5$
$A_3 = C_6$
$A_3 = C_7$
$A_3 = C_8$
$A_3 = C_6$
$A_3 = C_7$
$A_3 = C_8$
$A_3 = C_6$
$A_4 = C_3$
$A_4 = C_9$
R_3 violated
$A4 = C3$
$A4 = C9$
$A_4 = C_3$
$A_4 = C_9$
R_3 violated
$A4 = C3$
$A4 = C9$
$A_4 = C_3$
R_5 violated
R_2 violated
R_5 violated
R_2 violated
R_2 violated
R_2 violated
R_2 violated
R_2 violated