人工智能作业二

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(a)

变量：$V_{ij}, i = 1, 2, 3, j = 1, 2, 3.$

值域：$Dom(V_{ij}) = \{1, 2, \ldots, 9\}.$

约束：

$$V_{i_1 j_1} \neq V_{i_2 j_2}, (i_1, j_1) \neq (i_2, j_2), i_1, i_2, j_1, j_2 = 1, 2, 3.$$

$$\sum_{p=1}^{3} V_{pj} = 15, j = 1, 2, 3.$$

$$\sum_{q=1}^{3} V_{iq} = 15, i = 1, 2, 3.$$

$$V_{11} + V_{22} + V_{33} = 15.$$

$$V_{13} + V_{22} + V_{31} = 15.$$

(b)

图G=(V,E)

变量：$v_i, i = 1, 2, \ldots, k$

值域：$Dom(v_i) = V$

约束：

$$v_m \neq v_n, m \neq n, m, n = 1, 2, \ldots, k$$

$$(v_p, v_q) \notin E, p \neq q, p, q = 1, 2, \ldots, k$$

(c)

变量：I, N, T, L, A

值域：$Dom(x) = 1, 2, \ldots, 9, x = I, N, T, L, A$

约束：

$$(100 * I + 10 * N + T) \times L = 1110 * A + I$$

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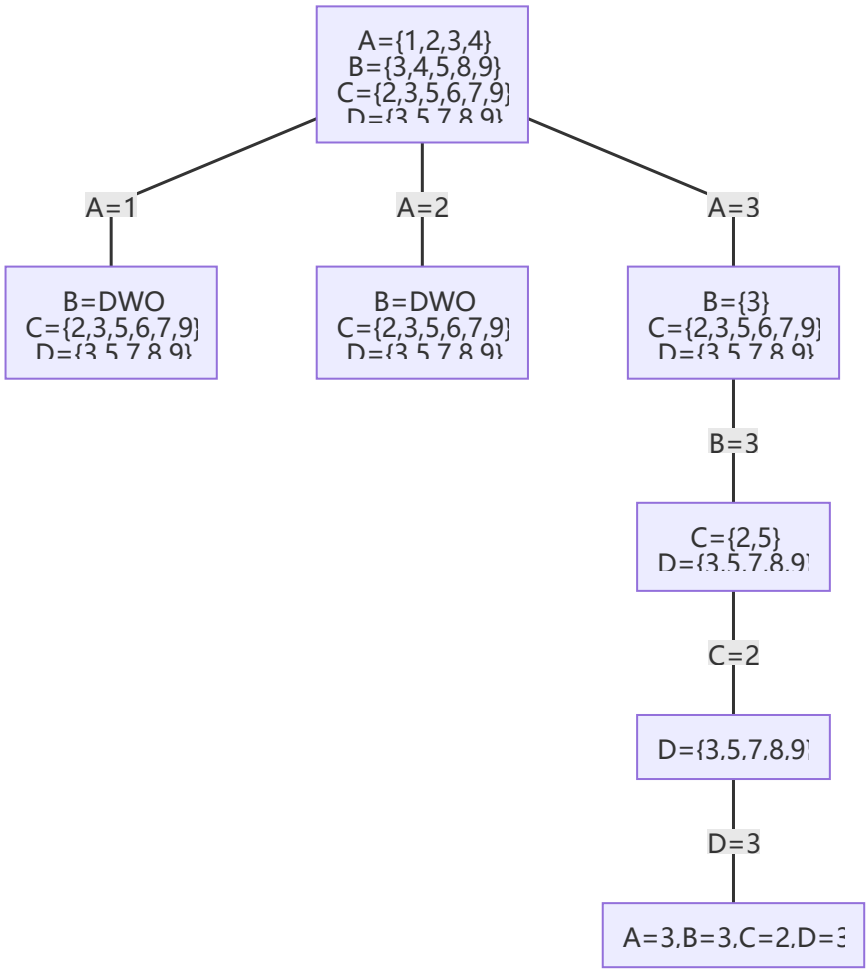
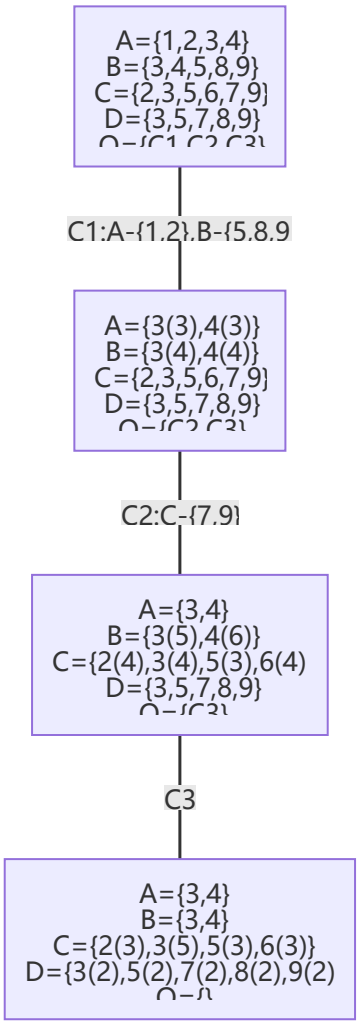
(a)



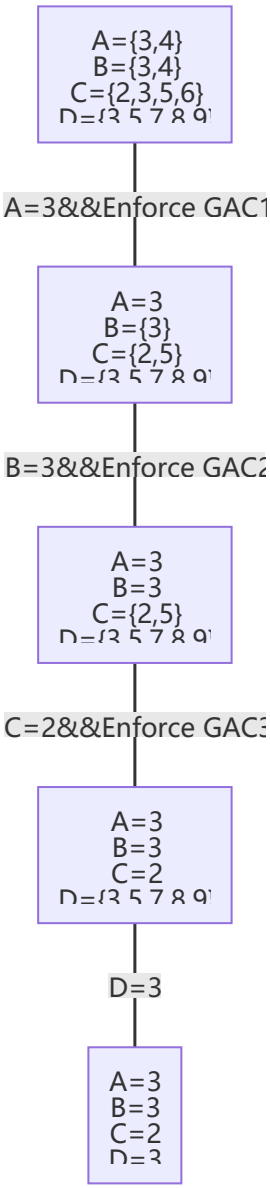
得到了一组解（3,3,2,3）

(b)

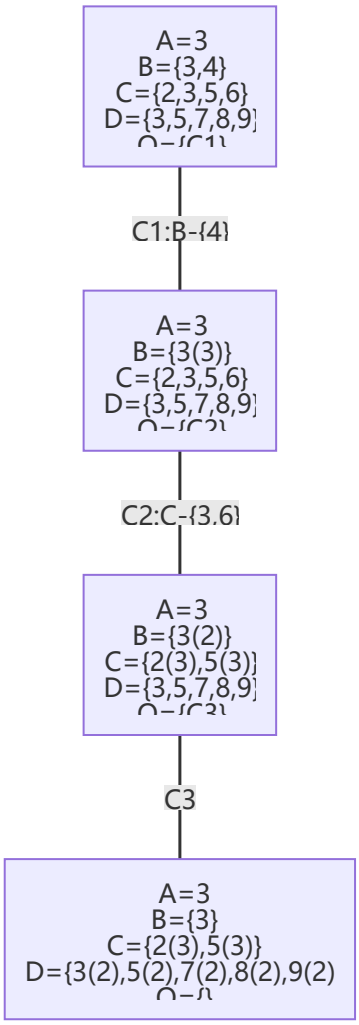
执行Enforce GAC。


A={1,2,3,4}
B={3,4,5,8,9}
C={2,3,5,6,7,9}
D={3,5,7,8,9}
C1:A-{1,2},B-{5,8,9
A={3(3),4(3)}
B={3(4),4(4)}
C={2,3,5,6,7,9}
D={3,5,7,8,9}
C2:C-{7,9}
A={3,4}
B={3(5),4(6)}
C={2(4),3(4),5(3),6(4)
D={3,5,7,8,9}
C3
A={3,4}
B={3,4}
C={2(3),3(5),5(3),6(3)}
D={3(2),5(2),7(2),8(2),9(2)

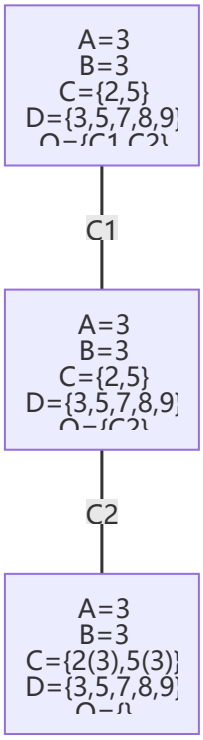
接下来执行GAC算法。



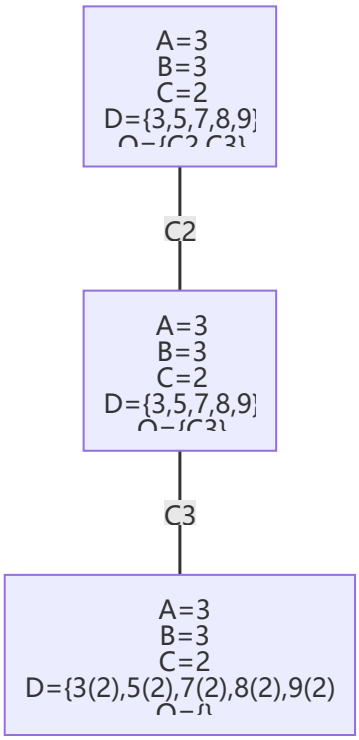
其中Enforce GAC1如下：



Enforce GAC2如下：



Enforce GAC3如下：



得到了一组解（3,3,2,3）

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(a)

$$member(Joe).\ member(Sally).\ member(Bill).\ member(Ellen).$$
$$spouse(Joe, Sally).$$
$$brother(Bill, Ellen)$$
$$\forall X \forall Y, spouse(X, Y) \rightarrow spouse(Y, X)$$
$$\forall X \forall Y, spouse(X, Y) \wedge member(X) \rightarrow member(Y)$$
$$\forall x, member(x) \rightarrow x = Joe \vee x = Sally \vee x = Bill \vee x = Ellen$$

逻辑上，Ellen可以和Bill结婚，他们两人都是club成员，符合规则。所以以上事实不能得出Ellen没有结婚。

(b)

添加如下：

$$\forall X \forall Y, brother(X, Y) \rightarrow \neg spouse(X, Y)$$
$$\forall X \forall Y, spouse(X, Y) \rightarrow X \neq Y$$
$$\forall X \forall Y \forall Z, spouse(X, Y) \rightarrow \neg spouse(X, Z)$$

证明：（反证）假设Ellen结婚了，即$spouse(Ellen, c)$

$\because \forall X \forall Y, spouse(X,Y) \wedge member(X) \rightarrow member(Y)$
$\therefore spouse(Ellen,c) \wedge member(Ellen) \rightarrow member(c)$ (全称实例化)
$\because spouse(Ellen,c) \wedge member(Ellen)$
$\therefore member(c)$ (假言推理)
$\because \forall x, member(x) \rightarrow x = Joe \vee x = Sally \vee x = Bill \vee x = Ellen$
$\therefore member(c) \rightarrow c = Joe \vee c = Sally \vee c = Bill \vee c = Ellen$ (全称实例化)
$\therefore c = Joe \vee c = Sally \vee c = Bill \vee c = Ellen$
1)若$c = Joe$
$\because \forall X \forall Y \forall Z, spouse(X,Y) \rightarrow \neg spouse(X,Z)$
$\therefore spouse(Joe,Sally) \rightarrow \neg spouse(Joe,Ellen)$ (全称实例化,化简律)
这与$spouse(Ellen,Joe)$矛盾
2)若$c = Sally$,由(1)同理矛盾
3)若$c = Ellen$
$\because \forall X \forall Y, spouse(X,Y) \rightarrow X \neq Y$
$\therefore spouse(Ellen,Ellen) \rightarrow Ellen \neq Ellen$ (全称实例化)
矛盾
4)若$c = Bill$
$\because \forall X \forall Y, brother(X,Y) \rightarrow \neg spouse(X,Y)$
$\therefore brother(Bill,Ellen) \rightarrow \neg spouse(Bill,Ellen)$ (全称实例化)
$\because brother(Bill,Ellen)$
$\therefore \neg spouse(Bill,Ellen)$ (假言推理)
这与$spouse(Ellen,Bill)$矛盾
$\therefore$ 综上所述$Ellen$没有结婚

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KB:

$$S_1 \Rightarrow 1.(\neg P(x,y), P(y,x))$$
$$S_2 \Rightarrow 2.(\neg P(m,n), \neg P(n,r), P(m,r))$$
$$S_3 \Rightarrow 3.P(p, f(p))$$

Q:

$$\forall x P(x,x) \Rightarrow 4.\neg P(q,q)$$

推导:

$$5.R[2a,3]m = p, n = f(p) \quad (\neg P(f(p),r), P(p,r))$$
$$6.R[4,5b]p = q, r = q \quad \neg P(f(q),q)$$
$$7.R[1b,6]x = q, y = f(q) \quad \neg(q, f(q))$$
$$8.R[3,7]p = q \quad ()$$

证毕。