人工智能基础 HW2

1. （第 1 题）

   a) 变量：$X = \{X_{(1,1)}, X_{(1,2)}, \dots X_{(4,4)}\}$

   值域：$D = \{D_{(1,1)}, D_{(1,2)}, \dots D_{(4,4)}\}, X_{(i,j)} \in D_{(i,j)} = \{1, 2, \dots 16\}$

   约束：

   $$X_{(1,3)} = 2, X_{(1,4)} = 13, X_{(2,3)} = 11, X_{(2,4)} = 8, X_{(3,1)} = 9 \cdots\cdots (1)\sim(5)$$

   $$X_{(3,3)} = 7, X_{(3,4)} = 12, X_{(4,3)} = 14, X_{(4,4)} = 1 \cdots\cdots (6)\sim(9)$$

   $$X_{(i_1, j_1)} \neq X_{(i_2, j_2)}, (i_1, j_1) \neq (i_2, j_2) \cdots\cdots (10)$$

   $$\sum_{j=1}^{4} X_{(1,j)} = \sum_{j=1}^{4} X_{(2,j)} = \sum_{j=1}^{4} X_{(3,j)} = \sum_{j=1}^{4} X_{(4,j)} = \sum_{i=1}^{4} X_{(i,1)} = \sum_{i=1}^{4} X_{(i,2)}$$

   $$= \sum_{i=1}^{4} X_{(i,3)} = \sum_{i=1}^{4} X_{(i,4)} = \sum_{i=1}^{4} X_{(i,i)} = \sum_{i=1}^{4} X_{(i,4-i)} = 34 \cdots\cdots (11)$$

   b) 根据约束(1)~(10)缩小值域：

   $$D_{(1,3)} = \{2\}, D_{(1,4)} = \{13\}, D_{(2,3)} = \{11\}, D_{(2,4)} = \{8\}, D_{(3,1)} = \{9\},$$

   $$D_{(3,2)} = \{6\}, D_{(3,3)} = \{7\}, D_{(3,4)} = \{12\}, D_{(4,3)} = \{14\}, D_{(4,4)} = \{1\}$$

   $$D_{(1,1)} = D_{(1,2)} = D_{(2,1)} = D_{(2,2)} = D_{(4,1)} = D_{(4,2)} = \{3, 4, 5, 10, 15, 16\}$$

   再对以下方阵①进行回溯搜索：

		2	13
		11	8
9	6	7	12
		14	1

   假设 $X_{(1,1)} = 3$，则根据约束 $\sum_{i=1}^{4} X_{(i,i)} = 34$，$X_{(2,2)} = 23$，不在值域范围内，返回方阵①。

   假设 $X_{(1,1)} = 4$，则根据约束 $\sum_{i=1}^{4} X_{(i,i)} = 34$，$X_{(2,2)} = 22$，不在值域范围内，返回方阵①。

   假设 $X_{(1,1)} = 5$，则根据约束 $\sum_{i=1}^{4} X_{(i,i)} = 34$，$X_{(2,2)} = 21$，不在值域范围内，返回方阵①。

假设$X_{(1,1)} = 10$，则根据约束$\sum_{j=1}^{4} X_{(1,j)} = 34$，$X_{(1,2)} = 9$，不在值域范围内，返回方阵①。

假设$X_{(1,1)} = 15$，则根据约束$\sum_{i=1}^{4} X_{(i,i)} = 34$，$X_{(2,2)} = 11$，不在值域范围内，返回方阵①。

假设$X_{(1,1)} = 16$，根据约束$\sum_{j=1}^{4} X_{(1,j)} = 34$，$X_{(1,2)} = 3$，根据约束$\sum_{i=1}^{4} X_{(i,i)} = 34$，$X_{(2,2)} = 10$，根据约束$\sum_{j=1}^{4} X_{(2,j)} = 34$，$X_{(2,1)} = 5$，根据约束$\sum_{i=1}^{4} X_{(i,1)} = 34$，$X_{(4,1)} = 4$，根据约束$\sum_{i=1}^{4} X_{(i,2)} = 34$，$X_{(4,2)} = 15$。

得到补齐后的 4 阶幻方。

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

2. （第 3 题）用 ✖ ✖ 分别表示α, β剪枝，五次剪枝的顺序为从左至右，被修剪的叶节点的总数为 5