2. ASP Exercises

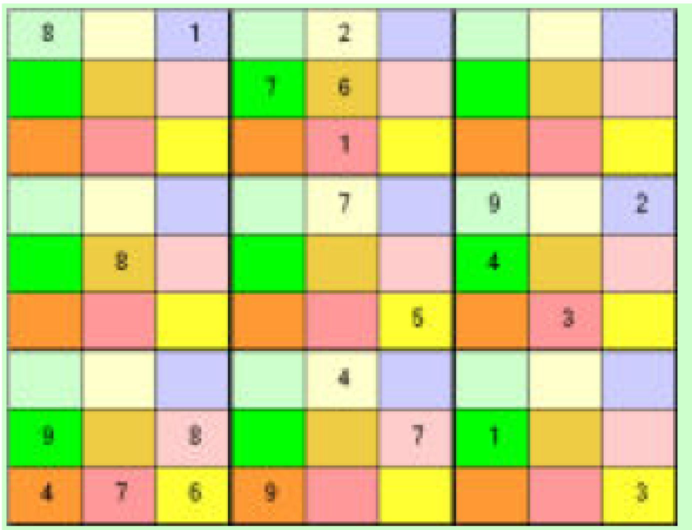
In each of the following exercises, show how to solve the given computational problem using SMODELS. Test your programs using data of your choice if data is not given.

2.1 Sudoku (a.k.a. Number Place) is a game to fill in the grid so that every row, every column, and every 3×3 box contains the digits 1 through 9. The following is an instance of Sudoku.

	6		1		4		5	
		8	3		5	6		
2								1
8			4		7			6
		6				3		
7			9		1			4
5								2
		7	2		6	9		
	4		5		8		7	

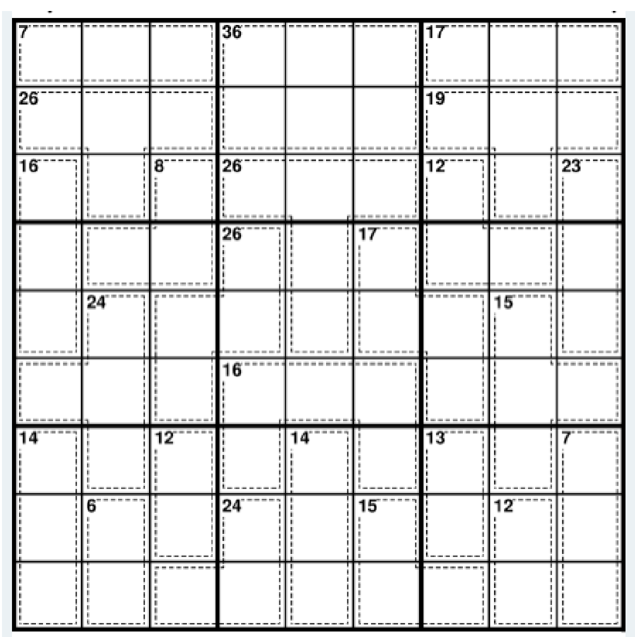
Problem: fill in the numbers.

2.2 Consider the following variant of Sudoku. The same position in each of 3×3 boxes form a "region," yielding 9 total regions (a region is represented by the same color below). In addition to the requirement of Sudoku, every region must contain all the digits 1 through 9.



Problem: fill in the numbers.

2.3 Consider the following variant of Sudoku. Each cage ("dotted area") is associated with a number. In addition to the requirement of Sudoku, the sum of the cells in a cage must be equal to the number given for the cage. Each digit in the cage must be unique.



Problem: fill in the numbers.

2.4 Each of four men owns a different species of exotic pet. Here is what we know about them:

1. Mr Engels (whose pet is named Sparky), Abner and Mr. Foster all belong to a club for owners of unusual pets.
2. The iguana isn't owned by either Chuck or Duane.
3. Neither the jackal nor the king cobra is owned by Mr. Foster.
4. The llama doesn't belong to Duane (whose pet is named Waggles).
5. Abner, who doesn't own the king cobra, isn't Mr. Gunter.
6. Bruce and Mr. Foster are neighbors.
7. Mr. Halevy is afraid of iguanas.

Problem: Find each man's full name and determine what kind of pet he owns.

2.5 There are five houses of five different colors. In each house lives a person of a different nationality. Each of these five men drinks a certain beverage, smokes a certain brand of cigarettes, and keeps a certain pet. No two men have the same pet, drink the same drink or smoke the same brand. We also know the following:

1. The Brit lives in the red house.
2. The Swede keeps a dog.
3. The Dane drinks tea.
4. The green house is on the left of the white house.
5. The owner of the green house drinks coffee.
6. The person who smokes Pall Mall rears birds.
7. The owner of the yellow house smokes Dunhill.
8. The man living in the house right in the center drinks milk.
9. The Norwegian lives in the first house.
10. The man who smokes Blend lives next to the one who has cats.
11. The man who has horses lives next to the Dunhill smoker.
12. The man who smokes Bluemaster drinks beer.
13. The German smokes Princess.

14. The Norwegian lives next to the blue house.

15. The man who smokes Blend has a neighbor who drinks water.

Problem: determine who owns the fish.

2.6 A graph G is said to be *n-colorable* if there exists a function f from its vertices to numbers $1, \ldots, n$ such that $f(x) \neq f(y)$ for every pair of adjacent vertices x, y. Problem: determine whether G is n-colorable.

2.7 A *clique* in a graph G is a subset of its vertices in which every two elements are adjacent. Problem: determine whether G has a clique of cardinality n.

2.8 You are organizing a large New Year's Eve party. There will be n tables in the room, with m chairs around each table. You need to select a table for each of the guests, who are assigned numbers from 1 to mn, so that two conditions are satisfied. First, some guests like each other and want to sit together; accordingly, you are given a set A of two-element subsets of $\{1, \ldots, mn\}$, and, for every $\{i, j\}$ in A, guests i and j should be assigned the same table. Second, some guests dislike each other and want to sit at different tables; accordingly, you are given a set B of two-element subsets of $\{1, \ldots, mn\}$, and, for every $\{i, j\}$ in B, guests i and j should be assigned different tables. Problem: find such a seating arrangement or determine that this is impossible.

2.9 You are in charge of assigning referees to the papers submitted to a conference. Each of the n submissions needs to be assigned to a few referees from among the m members of the Program Committee. The PC members have read the abstracts of all submissions, and each of them gave you the numbers of the submissions that he is qualified to referee; let A_i ($1 \leq i \leq m$) be the subset of $\{1, \ldots, n\}$ given to you by the i-th committee member. You need to select, for each i, a set X_i of papers to be assigned to the i-th committee member so that three conditions are satisfied. First, each X_i should be a subset of A_i. Second, the cardinality of each X_i should be between a lower bound l and an upper bound u. Third, each paper should be assigned to exactly k referees. Problem: find such an assignment of papers to referees or determine that this is impossible.