CS 372
Homework 4

Due date: Friday March 7
Email it to: Robert Xiao (rkx2@cornell.edu) and Yunsong Guo (guoys@cs.cornell.edu) use subject line (HWK4-CS372))

1 The Zebra Puzzle

This is a famous logic puzzle adapted from a puzzle attributed to Albert Einstein. Five men with different nationalities and with different jobs live in consecutive houses on a street. Theses houses are painted different colors. The men have different pets and have different favorite drinks. The Italian lives in the red house. The Spaniard owns a dog. The computer scientist owns a pet-rock. The Dutchman is a painter. The Englishman drinks tea. The Norwegian lives in the first house on the left. The green house is on the right of the white one. The diplomat lives in the yellow house. Milk is drunk in the middle house. The owner of the green house drinks coffee. The Norwegian's house is next to the blue one. The violinist drinks orange juice. The fox is in a house next to the physician. The horse is in the house next to that of the diplomat.

Who owns a zebra and whose favorite drink is mineral water?

2 What To Do?

- a) Formulate the problem in CNF. Describe the clauses in compact form – like the Latin Square was described in class (see the course website, Module 3 - Logic Representations, Part 2).
- b) Create a file in DIMACS format, using the numbering of the variables as in the table below.
- c) Use a solver (we suggest **minisat** – follow the link provided under section DIMACS, below) to get the satisfying variable assignments.
- d) Interpret the solution returned by the solver (i.e., solve the puzzle: "Who owns a zebra and whose favorite drink is mineral water?")

3 What To Turn In?

Email it to: Robert Xiao (rkx2@cornell.edu) and Yunsong Guo (guoys@cs.cornell.edu use subject line (HWK4-CS372). You should submit two files:

- The DIMACS file, i.e. point b) above.
- Your write-up: answers to point a) and d) above. For point d) please make sure to include the output of the solver, the interpretation of the output and the answer to the puzzle question.

4 Variables

Nationality	House		House Color		Favorite Drink		Pet		Job	
Italian	I_{H1}	1	I_{Red}	26	I_{Tea}	51	I_{Rock}	76	$I_{Diplomat}$	101
	I_{H2}	2	I_{White}	27	I_{OJ}	52	I_{Horse}	77	I_{CS}	102
	I_{H3}	3	I_{Green}	28	I_{MW}	53	I_{Zebra}	78	$I_{Physician}$	103
	I_{H4}	4	I_{Blue}	29	I_{Milk}	54	I_{Dog}	79	$I_{Painter}$	104
	I_{H5}	5	I_{Yellow}	30	I_{Coffee}	55	I_{Fox}	80	$I_{Violinist}$	105
Spaniard	S_{H1}	6	S_{Red}	31	S_{Tea}	56	S_{Rock}	81	$S_{Diplomat}$	106
	S_{H2}	7	S_{White}	32	S_{OJ}	57	S_{Horse}	82	S_{CS}	107
	S_{H3}	8	S_{Green}	33	S_{MW}	58	S_{Zebra}	83	$S_{Physician}$	108
	S_{H4}	9	S_{Blue}	34	S_{Milk}	59	S_{Dog}	84	$S_{Painter}$	109
	S_{H5}	10	S_{Yellow}	35	S_{Coffee}	60	S_{Fox}	85	$S_{Violinist}$	110
Dutchman	D_{H1}	11	D_{Red}	36	D_{Tea}	61	D_{Rock}	86	$D_{Diplomat}$	111
	D_{H2}	12	D_{White}	37	D_{OJ}	62	D_{Horse}	87	D_{CS}	112
	D_{H3}	13	D_{Green}	38	D_{MW}	63	D_{Zebra}	88	$D_{Physician}$	113
	D_{H4}	14	D_{Blue}	39	D_{Milk}	64	D_{Dog}	89	$D_{Painter}$	114
	D_{H5}	15	D_{Yellow}	40	D_{Coffee}	65	D_{Fox}	90	$D_{Violinist}$	115
Englishman	E_{H1}	16	E_{Red}	41	E_{Tea}	66	E_{Rock}	91	$E_{Diplomat}$	116
	E_{H2}	17	E_{White}	42	E_{OJ}	67	E_{Horse}	92	E_{CS}	117
	E_{H3}	18	E_{Green}	43	E_{MW}	68	E_{Zebra}	93	$E_{Physician}$	118
	E_{H4}	19	E_{Blue}	44	E_{Milk}	69	E_{Dog}	94	$E_{Painter}$	119
	E_{H5}	20	E_{Yellow}	45	E_{Coffee}	70	E_{Fox}	95	$E_{Violinist}$	120
Norwegian	N_{H1}	21	N_{Red}	46	N_{Tea}	71	N_{Rock}	96	$N_{Diplomat}$	121
	N_{H2}	22	N_{White}	47	N_{OJ}	72	N_{Horse}	97	N_{CS}	122
	N_{H3}	23	N_{Green}	48	N_{MW}	73	N_{Zebra}	98	$N_{Physician}$	123
	N_{H4}	24	N_{Blue}	49	N_{Milk}	74	N_{Dog}	99	$N_{Painter}$	124
	N_{H5}	25	N_{Yellow}	50	N_{Coffee}	75	N_{Fox}	100	$N_{Violinist}$	125

5 DIMACS

For this assignment, you are to compose a file in DIMACS format to solve the Zebra Puzzle in a SAT solver. Fortunately for you, writing CNF clauses DIMACS format is easy.

At the top of the file is a simple header.

```
p cnf <variables> <clauses>
```

Each variable should be assigned an integer index. To simplify grading, please use the indices from the table above. Indices start at 1, as 0 is used to indicate the end of a clause. The positive integer represents an instantition of a variable in a clause, whereas its negation represents its negated instantiation.

For example $(\neg I_{H1} \vee S_{Rock})$ as a clause in a dimacs file should be `-1 81 0`.

Once you've produced your dimacs file, follow the instructions at:

$$www.cs.cornell.edu/gomes/COURSES/INFO372/zebra/index.html$$

to find its solution.