Homework 2 - Sudoku

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What is Sudoku?

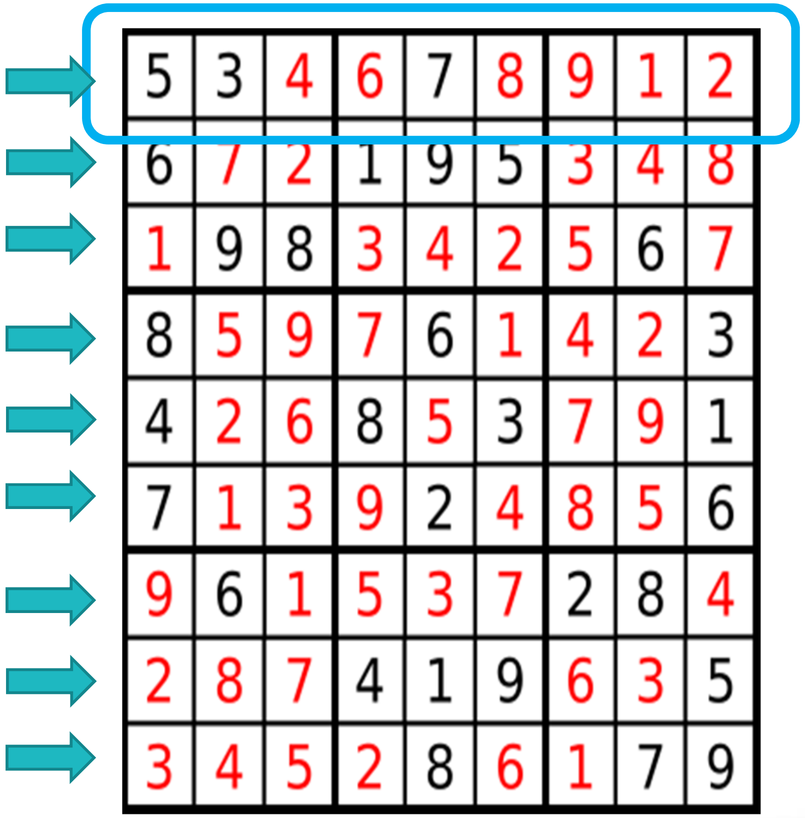
- To play with digits from 1 to 9 in a 9x9 grid

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

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

Solve it! !

- It should contain all of the digits from 1 to 9 in
  1. Each row
  2. Each column
  3. Each of the nine 3x3 sub-grids



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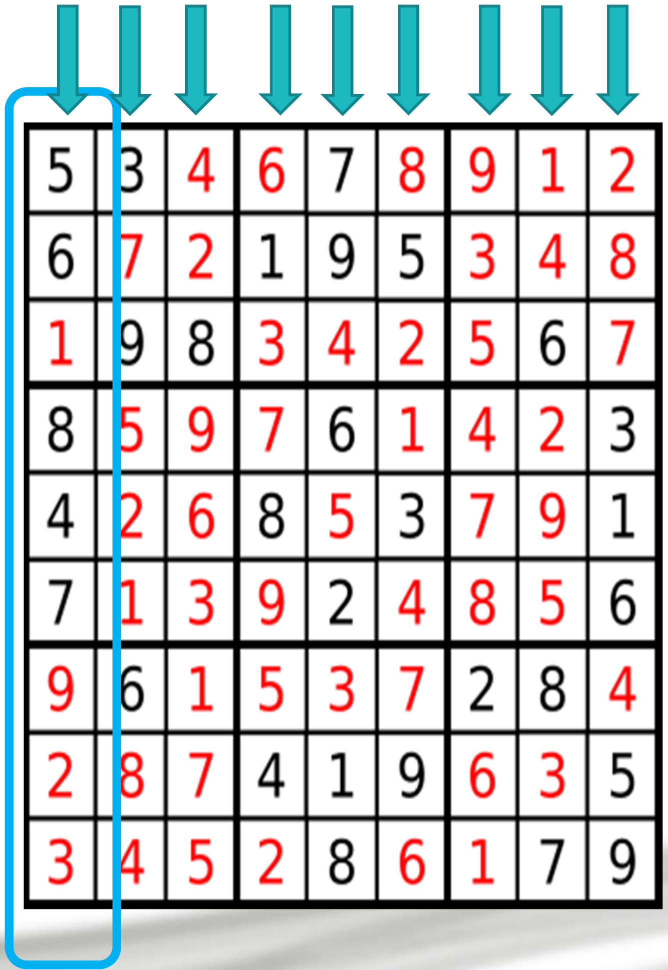

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
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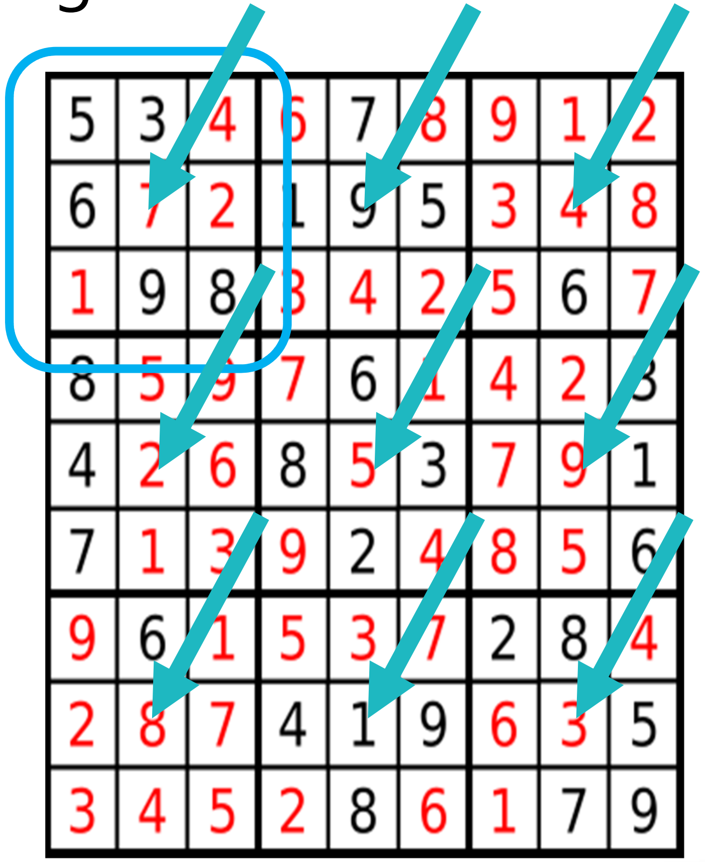
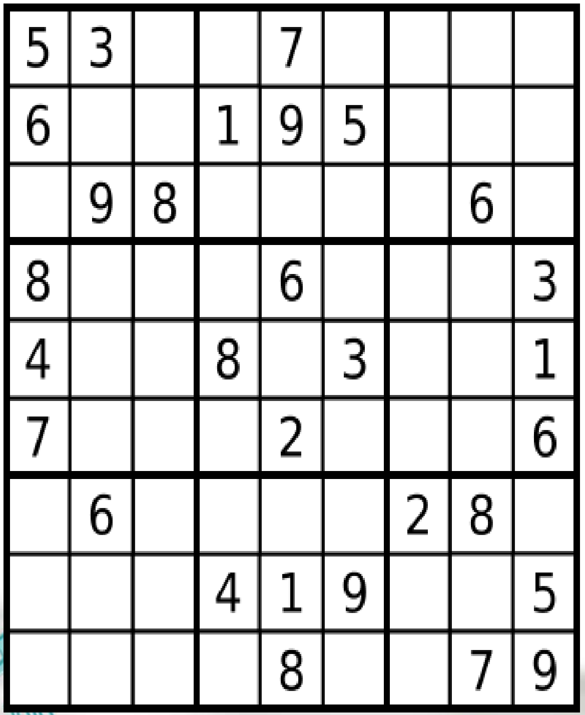


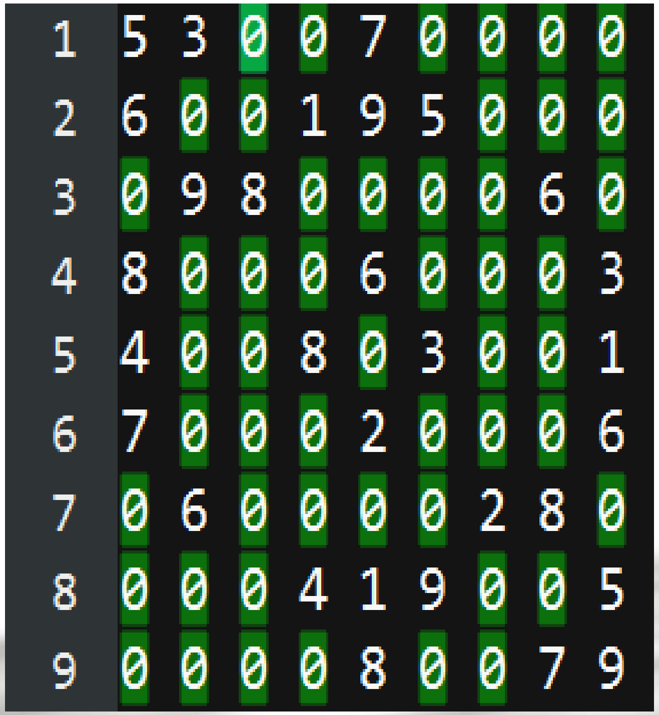
5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9

Task: Give question & Solve

1. Create your own solvable Sudoku board randomly
   - Use ‘0’ character to represent the blanks
   - Add a space between two adjacent digits
   - Your board must have exactly one answer



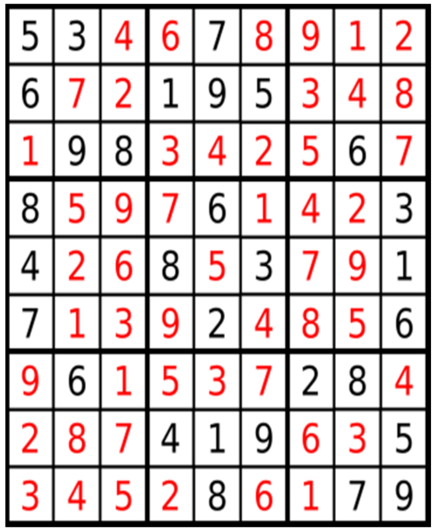
5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9



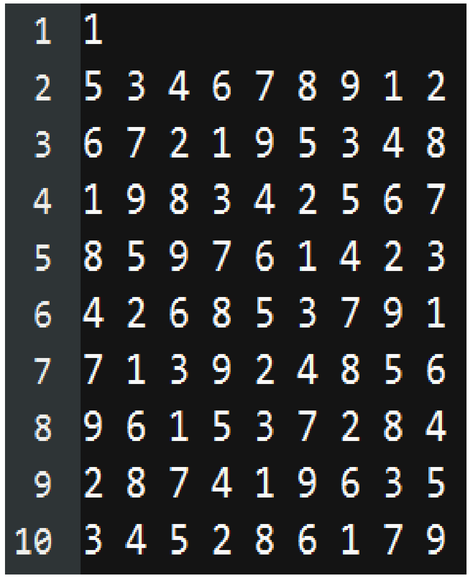
```
5 3 0 0 7 0 0 0 0
6 0 0 1 9 5 0 0 0
0 9 8 0 0 0 0 6 0
8 0 0 0 6 0 0 0 3
4 0 0 8 0 3 0 0 1
7 0 0 0 2 0 0 0 6
0 6 0 0 0 0 2 8 0
0 0 0 4 1 9 0 0 5
0 0 0 0 8 0 0 7 9
```

Task: Give question & Solve

2. Judge if it is solvable, and solve it
   - Unsolvable: output a single character ‘0’
   - Exactly one solution: output a single character ‘1’ in the first line. The next 9 lines are the solution, for example:



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

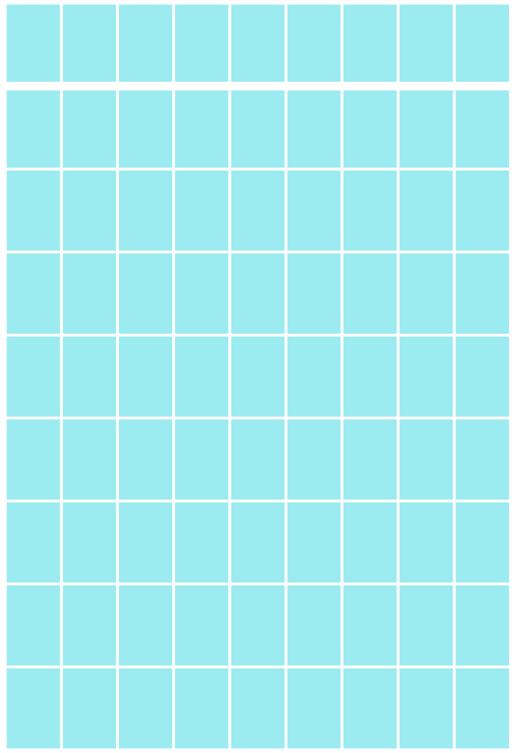


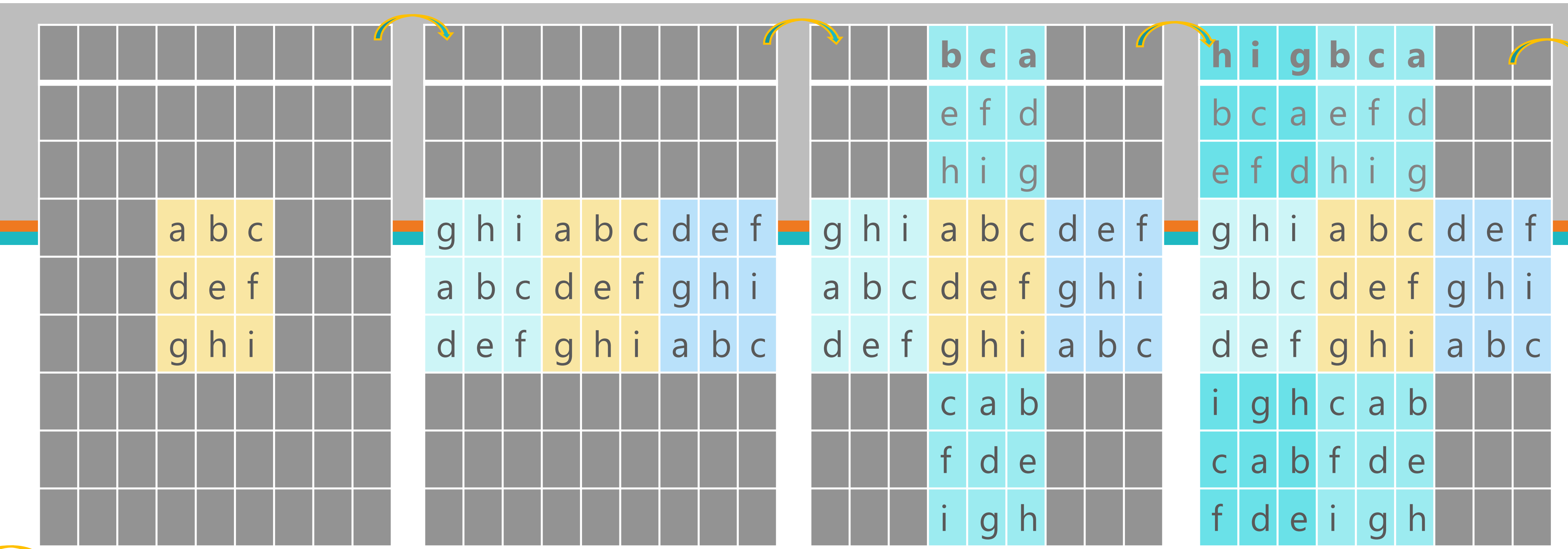
```
1
5 3 4 6 7 8 9 1 2
6 7 2 1 9 5 3 4 8
1 9 8 3 4 2 5 6 7
8 5 9 7 6 1 4 2 3
4 2 6 8 5 3 7 9 1
7 1 3 9 2 4 8 5 6
9 6 1 5 3 7 2 8 4
2 8 7 4 1 9 6 3 5
3 4 5 2 8 6 1 7 9
```

   - More than one solution: output a single character ‘2’

How to Generate a Uniquely Solvable Puzzle?

- Well, in advance, how to generate a solved puzzle?





h	i	g	b	c	a	e	f	d
b	c	a	e	f	d	h	i	g
e	f	d	h	i	g	b	c	a
g	h	i	a	b	c	d	e	f
a	b	c	d	e	f	g	h	i
d	e	f	g	h	i	a	b	c
i	g	h	c	a	b	f	d	e
c	a	b	f	d	e	i	g	h
f	d	e	i	g	h	c	a	b

- Based on the template, we can generate 9! = 362880 solved puzzles !
- Randomly remove some numbers step-by-step, and check uniqueness for each step. Stop whenever you want.
- Try to create other templates on your own!!

Requirements

- Write Makefile to compile your program.
- Two main programs: hw2_give_question and hw2_solve.
- One header file Sudoku.h, and one source code file Sudoku.cpp. In the class Sudoku, at least three member functions GiveQuestion(), ReadIn() and Solve() should be defined. GiveQuestion() is for hw2_give_question, and the others are for hw2_solve.
- hw2_give_question outputs the result to stdout.
- hw2_solve reads the inputs from stdin, solve it, and outputs to stdout.
- You need to consider both correctness and efficiency.

Deliverables

- Use a web browser to connect to http://judge.imslab.org/ to verify your Sudoku.cpp and Sudoku.h first.
- Then electronically submit your entire homework as a .zip file (with file name <*school number*>*_hw1.zip*) to the course webpage on Moodle.
- Be sure to include your **Makefile** and **report**, which explains your design (along with **UML diagram**), **environment of execution**, **results of verification** and why you believe your program to be correct and efficient.

Bonus

- Join the Sudoku tournament, http://judge.imslab.org/ , between 3/31 and 4/6.
- After the tournament, people in the first to the tenth place get 5 points, the eleventh to the twentieth place get 4 points, and so on, until the fiftieth.
- Rules (go to the website for more details)
  - Choose an opponent for a challenge.
  - In each challenge, you'll solve questions created by the opponent, and make questions to him at the same time.
  - We'll call your member function ReadIn(), Solve() to solve the questions created by your opponent, and call GiveQuestion() to him (you can make unsolvable question here).
  - As you can imagine, the winner is the faster one!!

Evaluation

- You should upload your source code and report to Moodle before 3/30 11:00pm.
- Grading Policy
  - Report 10%
  - Correctness 50%
  - Efficiency (speed) 40%
  - Bonus (3/31 ~ 4/6)