ICS-211 Lab

Assignment 7

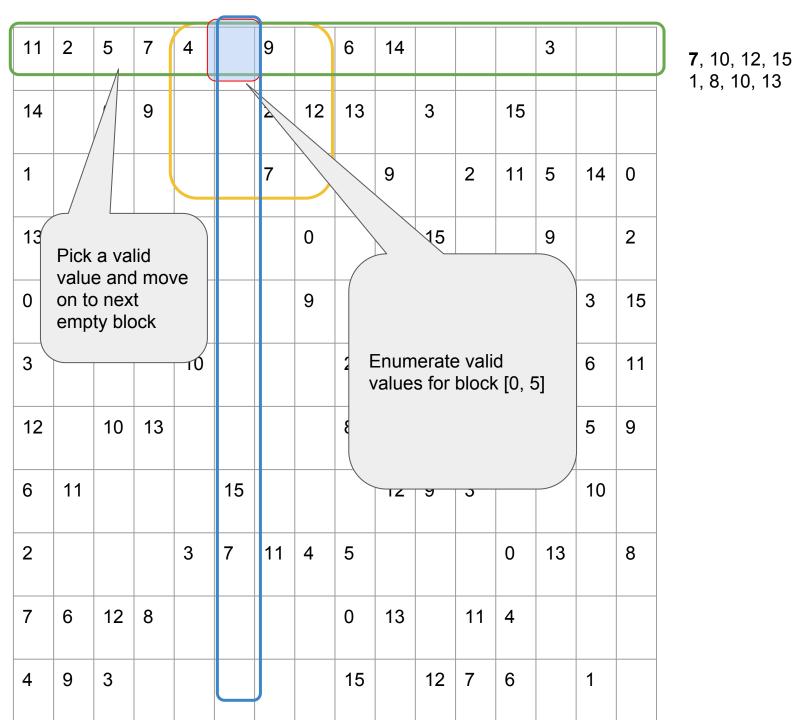# Notes

- Start assignment 7 early
  - I.e., you should probably have already started
  - Recursion is often something that takes time to comprehend
  - In addition to recursion, there's a lot of array manipulation
- Note that there are two methods that you *must* implement
  - `solveSudoku` and `legalValues`
  - Implement as per instructions
- Sample puzzles with solutions have been provided in the assignment
- Last extra credit will be with assignment 8 (15 points)

11	2	5		4		9		6	14				3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15

Find first empty block at [0,3] (has -1 in test code) and enumerate all legal Sudoku values.

11	2	5	7	4		9		6	14				3		
14			9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13							0			15			9		2
0							9							3	15
3				10				2						6	11
12		10	13					8						5	9
6	11				15			12	9	3				10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15			12	7	6		1

7, 10, 12, 15
1, 8, 10, 13

Pick a valid value and move on to next empty block

Enumerate valid values for block [0, 5]

11	2	5	7	4	1	9		6	14				3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 13, 15

11	2	5	7	4	1	9	8	6	14				3		
14		0	9			2	12	13		3		15			
1						7		9		2	11	5	14	0	
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3			10				2	4	13	15			6		11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12

11	2	5	7	4	1	9	8	6	14	0			3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15			12	9	3				10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12

Note the stack-like structure that's being formed.

11	2	5	7	4	1	9	8	6	14	0	10		3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, 13

11	2	5	7	4	1	9	8	6	14	0	10	12	3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, 13
13

11	2	5	7	4	1	9	8	6	14	0	10	12	3	13	
14		0	9			2	12	13		3		15			
1					7			9		2	11	5	14	0	
13	8		5			0			15			9		2	
0	7	14	2			9				5			3	15	
3			10				2	4	13	15			6	11	
12		10	13				8				7		5	9	
6	11			15				12	9	3			10		
2			3	7	11	4	5				0	13		8	
7	6	12	8				0	13		11	4				
4	9	3					15		12	7	6		1		

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, 13
13
Backtrack

There's no valid value for block [0,15], so backtrack (stop recursion)

11	2	5	7	4	1	9	8	6	14	0	10	12	3		
14		0	9			2	12	13		3		15			
1					7			9		2	11	5	14		0
13	8		5			0			15			9			2
0	7	14	2			9				5			3		15
3			10				2	4	13	15			6		11
12		10	13				8				7		5		9
6	11			15				12	9	3			10		
2			3	7	11	4	5				0	13			8
7	6	12	8				0	13		11	4				
4	9	3					15		12	7	6			1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, 13
13 (backtrack)
Backtrack

13 was the only possible value here, so this isn't a good solution, backtrack.

11	2	5	7	4	1	9	8	6	14	0	10	13	3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, **13**   Try 13...
13 (backtrack)
Backtrack

11	2	5	7	4	1	9	8	6	14	0	10	13	3		
14		0	9		2	12	13		3			15			
1					7		9			2		11	5	14	0
13	8		5		0		15						9		2
0	7	14	2			9			5				3		15
3			10			2	4	13	15				6		11
12		10	13				8				7		5		9
6	11			15			12	9	3					10	
2			3	7	11	4	5			0	13				8
7	6	12	8				0	13			11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, **13**
12

12 is ok now

11	2	5	7	4	1	9	8	6	14	0	10	13	3	12	
14		0	9		2	12	13		3			15			
1						7			9		2	11	5	14	0
13	8		5			0			15			9			2
0	7	14	2				9			5				3	15
3			10			2	4	13	15					6	11
12		10	13				8					7		5	9
6	11			15				12	9	3				10	
2			3	7	11	4	5					0	13		8
7	6	12	8				0	13		11	4				
4	9	3					15			12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, **13**
12
backtrack

11	2	5	7	4	1	9	8	6	14	0	10	13	3		
14		0	9			2	12	13		3		15			
1						7			9		2	11	5	14	0
13	8		5				0			15			9		2
0	7	14	2				9				5		3	15	
3			10					2	4	13	15		6	11	
12		10	13					8				7	5		9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15			12	7	6	1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, **13**
12 (backtrack)
backtrack

11	2	5	7	4	1	9	8	6	14	0	10		3		
14		0	9			2	12	13		3		15			
1						7		9			2	11	5	14	0
13	8			5			0			15			9		2
0	7	14	2				9				5			3	15
3				10				2	4	13	15			6	11
12		10	13					8				7		5	9
6	11				15				12	9	3			10	
2				3	7	11	4	5				0	13		8
7	6	12	8					0	13		11	4			
4	9	3						15		12	7	6		1	

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, 12
12, **13** (backtrack)
12 (backtrack)
backtrack

11	2	5	7	4	1	9	8	6	14	0	12	??	3		
14		0	9		2	12	13		3		15				
1					7		9		2	11	5	14	0		
13	8		5		0			15			9		2		
0	7	14	2		9				5			3	15		
3			10			2	4	13	15			6	11		
12		10	13			8				7		5	9		
6	11			15			12	9	3			10			
2			3	7	11	4	5			0	13		8		
7	6	12	8			0	13		11	4					
4	9	3				15		12	7	6		1			

7, 10, 12, 15
1, 8, 10, 13, 15
8, 10, 13, 15
0, 10, 12
10, **12**

Etc...