An Introduction to An Introduction to Sudoku for Kids

This document is a work in progress, and your comments on its improvement are most appreciated. I have tried to "voice" the document in such a way as to be easily readable by a bright 10-year-old like my son Alex.

Additional chapters will be added as time permits.

An Introduction to Sudoku for Kids

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http://www.madoverlord.com/projects/sudoku.t

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

Sudoku (Japanese for “one number”) are fun logical puzzles. Your brain will get quite a workout figuring them out!

A Sudoku is a 9x9 grid of squares. Some squares have digits in them, from 1 to 9. Some of the squares are blank.

There are 9 **rows** of numbers in the puzzle. The top row is called row 1, and the bottom row is called row 9.

There are 9 **columns** of numbers in the puzzle. The leftmost column is called column 1, and the rightmost column is called column 9.

Look closely and you'll see that the puzzle is divided up into 9 3x3 square sections (sort of like a tic-tac-toe board made out of tic-tac-toe boards!). These are called **blocks**. The blocks are numbered from top-left to bottom-right, just as you would expect.

Look for the 5 in the bottom row of the puzzle on the first page. What column is it in? What block is it in? If you answered "column 5 and block 8", you're right.

Now the fun begins!

To solve a Sudoku, all you have to do is fill in the blank squares with numbers. But you can't just put any number in a square. There is a rule! Only one, but it's a tricky one!

"The number in each square can only appear once in its row, column and block."

So how does this work? Look at the square in the top-left corner of the puzzle. It is in row 1 and column 1, so we call it square "R1C1" for short. What block is it in? Block 1, of course!

What numbers might it be? Well, lets figure out what numbers it **can't be**. It has to be a number that isn't already in row 1, column 1, or block 1.

The other numbers in row 1 are 7,3,6,2 and 9. So it can't be any of those.

The other numbers in column 1 are 3,9 and 2. Hey, that didn't get us anywhere, because those numbers are already in row 1. Grrr!

The other numbers in block 1 are 7, 4 and 3. Well, we already knew that it couldn't be 7 and 3 from row 1, but now we know it can't be a 4 either.

So R1C1 can't be a 2,3,4,6,7 or 9. It must be a 1, 5 or 8. But which one is it? So far, we can't tell! Argh! But maybe later we'll be able to narrow it down. So for now, you could just pencil in a small "1 5 8" in R1C1 to remind you of what it could be.

This is called "**pencilling in the possibilities**" and it is the first step to solving the puzzle.

Now lets look at R4C7. Can you find it? It's the blank square right above a "2" that has been filled in. What block is it in? That's right, block 6.

What numbers can it be? No being sneaky and looking ahead for the answer. You are on your honor to do the work!

Well, look at row 4. There are three numbers there already.

Write them down here: ________________________

Now look at column 7. Five numbers there.

Write them down here: ________________________

Finally, look at block 6. It also has 5 numbers.

Write them down here: ________________________

Now list all the numbers together.

Write them down here: ________________________

So now ask yourself, "what numbers are missing?" What are the possibilities for R4C7?

The answer is on the next page (I didn't trust you not to look ahead!)

Did you figure out that R4C7 has to be a 4? If you did, give yourself a pat on the back!

Since possibilities 1,2,3,5,6,7,8 and 9 were taken by other squares in row 4, column 7 and block 6, R4C7 has to be a 4! This is called a **force** because R4C7 is **forced** to be a 4.

So go and put a big 4 in R4C7! You've solved a square. Here's what your puzzle should look like now:

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

You should have the 1,5,8 possibilities in R1C1, and 4 in R4C7.

Now lets consider square R5C8. That’s the square right in the middle of block 6.

What possibilities can it have?

If you answered 3 and 8, you’re right. Pencil them in!

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

Well, you didn’t solve a square, but you did learn something. Oh well, let’s try another square. What about R4C8, the square right above it? What possibilities does it have?

If you answered, “Hey, R4C8 has to be an 8!”, you’re right! Fill it in!

And did you notice something else? Remember R5C8, the square right below that had to be a 3 or an 8. Well, if R4C8 has to be an 8, then R5C8 can’t be an 8 (duh!)

So you can scratch out the little 8 you pencilled into R5C8. This is called **removing a possibility**. (double-duh!). In fact, you can scratch out 8 in any square in row 5, column 8 and block 6, but since we haven’t figured out those possibilities yet, you don’t have to.

So what’s left in R5C8? We knew it had to be a 3 or an 8, and now we know it can’t be an 8. So it must be a 3! (triple-duh!). So fill it in.

Now look at R6C7. It’s the only square in block 6 that we haven’t filled in. So (double-double-duh!) it can only have one possibility. What number is left? Easy huh? It has to be a 1!

So we can fill in block 6 like this:

4	8	6
2	3	5
1	9	7

Now you know everything you need to know to solve the first puzzle. All you have to do is:

• Pick squares and figure out what numbers might go into them.

• If there are 2 or more possibilities, pencil them into the square.

• If there is only one, then fill in the square with its number, and scratch that number out of the squares in the same row, column or block.

Go ahead and solve the puzzle on the first page. Pretty easy, huh? Well don’t worry, because some Sudokus are a lot trickier!

Lesson 2 - Pin to Win

Ready for a tougher Sudoku? Try this one! To make it easier on you, all the possibilities have been pencilled in.

1 45 7	1 45 7	**8**	3 6	5 7 9	**2**	1 4	1 34 67	3 67
2 7	2 7	**6**	3 8	**4**	**1**	**5**	3 78	**9**
9	1 45 7	**3**	6 8	5 78	56	1 4 8	1 4 678	**2**
123	12	**7**	**5**	**6**	**8**	**9**	12	**4**
6	1 5	**4**	**9**	**2**	**7**	**3**	1 5	**8**
2 5 8	2 5 8	**9**	**1**	**3**	**4**	**6**	2 5 7	5 7
4 78	**3**	**2**	4 6 8	5 89	56 9	4 8	456 89	**1**
4 8	4 6 8	**5**	**7**	**1**	3 6 9	**2**	34 6 89	3 6
4 8	**9**	**1**	**2**	5 8	3 56	**7**	3456 8	3 56

Look carefully at this puzzle and you'll see something horrible! Awful! Terrible!

All of the squares have two or more possibilities! There are no forced squares! But if you look carefully at row 1, and in particular square R1C5, you'll see something interesting. What's special about R1C5?

Did you figure out that R1C5 must be a 9? If you did, congratulations, you've found your first **pin**!

What's that? You didn't get it? Okay, let me explain.

Look carefully at all the squares in row 1. Check out their possibilities. R1C5 is the only square that has 9 as a possibility! Since none of the other blank squares can be a 9, R1C5 must be the 9!

When a square is the only square in a row, column or block than can contain a certain number, we say it is **pinned** to that number.

You'll need to find two other pins in the puzzle to solve it. Hint: they are all in rows.

Pretty cool, eh?

You can test your **pin perception prowess** with the puzzle on the next page. It is filled with pins, in rows, columns and even blocks!

While you are doing it, think of ways to make it easier to find pins. Can you come up with a good way of doing it quickly? If you are learning to Sudoku with some friends or in a class, why not tell each other how you do it. Maybe someone will come up with a really good method.

PS: Don't you hate it when your teacher gives you "busywork?" Me too. So no "pencilling in the possibilities" busywork for you! All the rest of the puzzles in this tutorial will have the possibilities filled in.

1 456 8	12 456 8	**9**	56 8	5 8	6 8	**7**	345 8	1 5 8
7	5 8	**3**	5 89	**4**	**1**	**6**	5 89	**2**
1 456 8	1 456 8	56	**3**	5 789	**2**	1 45	45 89	1 5 89
1 3 56	**7**	**8**	56 9	123 5 9	3 6 9	3 5	3 56 9	**4**
1 3456	123456	2 56	456789	123 5 789	34 6789	3 5	3 56789	56789
9	3456	56	45678	3 5 78	34 678	**2**	**1**	5678
3 6 8	3 6 89	67	**2**	3 789	**5**	1 4	4 67	1 67
2	5 9	**4**	**1**	**6**	7 9	**8**	5 7	**3**
3 56 8	3 56 8	**1**	4 78	3 78	34 78	**9**	2 4567	567

The Pin Perception Prowess Puzzle!

Lesson 3 - Locking In Progress

4	**9**	**2**	**8**	**7**	**1**	**5**	**6**	**3**
3 78	**1**	**5**	**6**	23	23	**4**	**9**	2 78
6	78	3 8	2345 9	2345 9	23 5	1 8	12 7	12 78
123 8	**4**	**7**	23 5 9	123 5 9	23 5 8	1 89	12	**6**
12 8	**6**	1 89	**7**	12 9	**4**	1 89	**3**	**5**
5	2 8	1 3 89	23 9	123 6 9	23 6 8	**7**	**4**	12 8
12 78	2 78	1 8	2 45	2 456	2 56	**3**	1 7	**9**
12 7	**5**	**4**	23	23	**9**	**6**	**8**	1 7
9	**3**	**6**	**1**	**8**	**7**	**2**	**5**	**4**

Time to really put on your thinking caps, kids! At this point, the puzzle has no forces and no pins! How can you possibly make progress?

Look carefully at row 2. Is there anything special about the blank squares? Anything you can use to make some progress?

This is a toughie, so don't be too hard on yourself if you don't get it!

Okay, if you figured out that R2C1 and R2C9 can't contain a 2 or a 3, go to the head of the class! In fact, tell Mom and Dad you deserve extra dessert tonight!

Here's how it works:

Look at R2C5 and R2C6. Both of these squares have possibilities 2 and 3. This lets us make an important logical deduction.

Think about it. If R2C5 is a 2, then R2C6 will be forced to be an 3. And if R2C5 is an 3, then R2C6 will be forced to be a 2.

Either way, one of them will be the 2 in row 2, and the other will be the 3. And that means **no other square in row 2 can be a 2 or a 3**!

Possibilities 2 and 3 have been **locked** into R2C5 and R2C6, thus we call them a **simple locked pair** of squares. There are sneakier versions of locked pairs you'll learn later, which is why these are called "simple" locked pairs.

Extra credit: Did you notice that R2C5 and R2C6 are also a **simple locked pair in <u>block 2</u>**? They just happen to be both in row 2 and block 2. So you can not only remove 2 and 3 as possibilities from R2C1 and R2C9, but also R3C4, R3C5 and R3C6!

Note that after removing 2 and 3 from R3C4 and R3C5, they become a new locked pair. However, this doesn't help you because it doesn't let you remove any possibilities. Not every locked pair is useful, but enough are that you should definitely keep an eye out for them. Good thing they are easy to see!

You'll need to find at least one more locked pair, and a lot of forces and pins, in order to solve the puzzle. Good luck!

Homework: Let's say you find a row that has <u>three</u> empty squares, all with possibilities 1, 2 and 3. Could this help you remove possibilities from other squares in the row?

Here's some space to write down your answer:

____

____

____

____

____

____

Lesson 4 - Hidden in Plain Sight

First, the answer to the homework question. You will remember that I asked “Let’s say you find a row that has three empty squares, all with possibilities 1, 2 and 3. Could this help you remove possibilities from other squares in the row?”

The answer is yes - and it works just like a locked pair. If you have three squares, each of which can be 1,2 or 3, then one of them has to be the 1, one of them the 2, and the other one the 3. So no other squares in the row could be a 1, 2 or 3. This is called a **locked triplet**. And if you guessed that you can have **locked quads** too, you’re right! But locked triplets and quads are very rare.

Okay, enough homework! Turn to the next page to see your next challenge!

4 7 9	**8**	6 9	23 67	**5**	23 67	234 9	**1**	23 9
7 9	**3**	**5**	12 7	**4**	12 7	**8**	**6**	2 9
2	4 6	**1**	3 6	**9**	**8**	**5**	34	**7**
34 9	45	**7**	**8**	12	34	**6**	234	123 5 9
8	456	2 6 9	34 6 9	12	34 6	234 9	**7**	123 5 9
34 9	**1**	2 6 9	34 6 9	**7**	**5**	234 9	**8**	23 9
1	**7**	**4**	**5**	**6**	**9**	23	23	**8**
6	**9**	**3**	2 7	**8**	2 7	**1**	**5**	**4**
5	**2**	**8**	1 4	**3**	1 4	**7**	**9**	**6**

Now the puzzles are getting really tough. You won't find any forces, pins, or locked pairs at this point!

How can you possibly proceed? The key is that there is something very special about column 9. Can you see what it is? It's sort of like a locked pair, but not quite the same.

Look at R4C9 and R5C9. What do they have in common that no other squares in column 9 share?

Both R4C9 and R5C9 have possibilities 1 and 5, and no other squares in column 9 can be a 1 or a 5. So that means one of the squares has to be a 1, and the other one has to be a 5. This is called a **hidden pair** because it is hiding inside a bunch of other numbers.

So now that you know that the 1 and the 5 must go in R4C9 and R5C9, that means that all their other possibilities - the 2, 3 and 9 - can be removed. This is called **possibility reduction**.

Many players call this a **hidden <u>locked</u> pair**, because once you've done the possibility reduction, you are left with a locked pair.

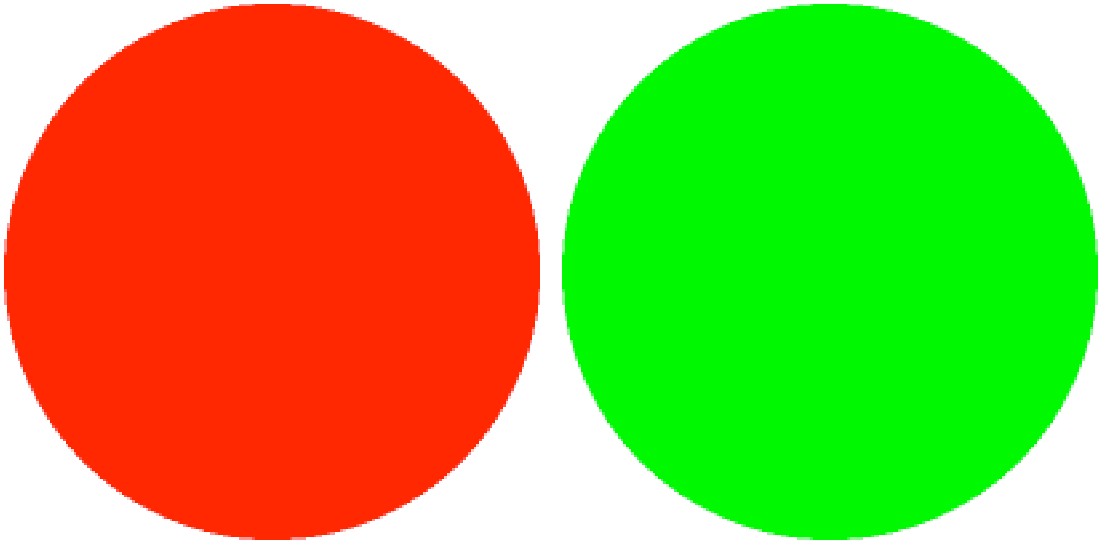
Once you've found this possibility reduction, the rest of the puzzle is easy; just a couple of pins and a lot of forces. Enjoy!

Lesson 5 - Ice Cream & Chocolate Cake

5	4 6	6 9	**3**	**7**	**8**	4 9	**2**	**1**
1 4 9	**2**	**3**	1 5	1 45	**6**	**8**	**7**	45 9
7	1 4 6	**8**	**9**	**2**	1 4	**3**	456	456
2	**9**	1 6	**7**	1 3 6 8	1 3	**5**	4 6	4 6 8
1 6 8	**3**	**7**	**4**	1 6 8	**5**	**2**	6 9	6 89
4 6 8	4 6 8	**5**	**2**	6 8	**9**	**7**	**1**	**3**
1 8	1 5 8	**4**	1 5	**9**	**2**	**6**	**3**	**7**
1 9	**7**	**2**	**6**	1 345	1 34	1 4 9	**8**	45 9
3	1 56	1 6 9	**8**	1 45	**7**	1 4 9	45 9	**2**

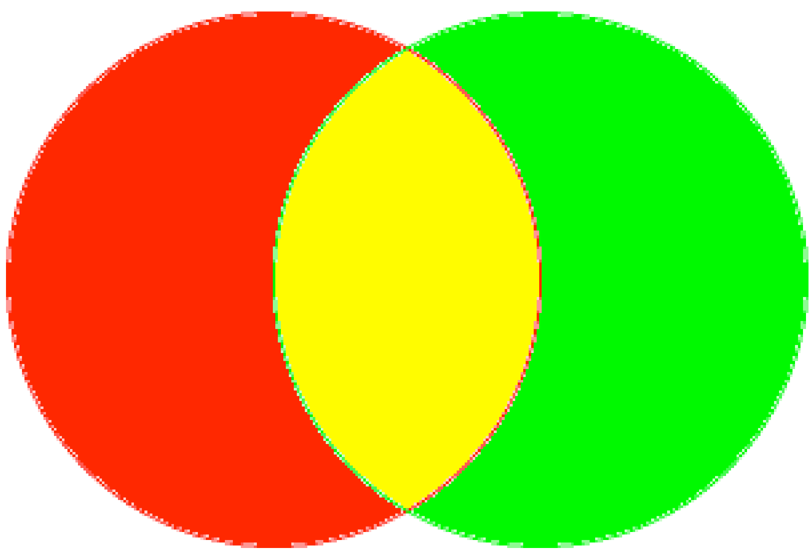
This puzzle will drive you crazy if you don't know the secret of **Intersections**. There's something special about row 1 and block 1 that lets you make progress. Can you figure it out all by yourself?

If you haven't figured it out, here are some more clues. Your teacher may have already taught you about **sets** and **intersections**, but in case she hasn't, or you need a reminder, this diagram might help:



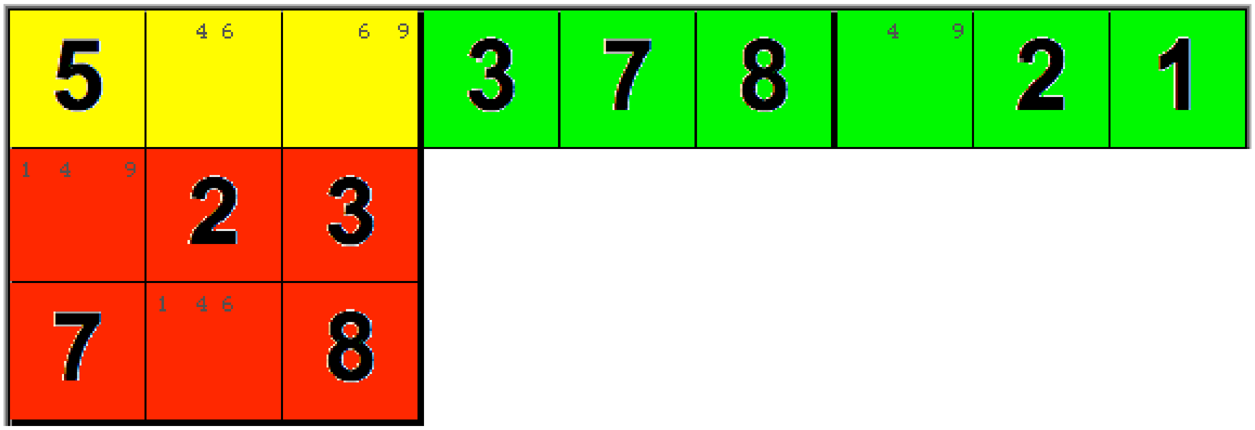
Lets say the red circle represents all the kids in your class who like ice-cream, and the green circle represents all the kids in your class who like chocolate cake. These are called **sets**.

What's that, you say? Some of the kids like both ice-cream **and** chocolate cake? Well, I'm not surprised. I do too! In fact, I like ice-cream on my chocolate cake, and even ice-cream **in** my chocolate cake. Yuuuuuum! Fortunately, we can redraw the circles to show this.



Now the yellow area represents all the kids who like **both** ice-cream and chocolate cake! That's called a **set intersection**.

Now lets look at the puzzle again, and at the intersection of row 1 and block 1.



Look at the yellow squares. They are in both row 1 and block 1; that means they are in the **intersection** of row 1 and block 1.

So how can this help us? Well, it's super-tricky. If you've already figured it out, then I think you deserve **both** chocolate cake and ice-cream!

Look at row 1 again. Notice that the only place to put a 6 in row 1 is in one of the yellow squares. Either R1C2 or R1C3 must be a 6.

But these squares are also part of block 1, because they're in the intersection. This means that the 6 in block 1 must also be in R1C2 or R1C3. And that means you can't have a 6 in the other (red) squares of block 1!

Isn't that cool? I'll bet when you first learned about sets and intersections you thought they weren't much use. And now you've learned that they can be used in a fun way.

It makes you wonder if some of those other boring math facts your teacher wants you to remember might have fun uses, doesn't it?

Now go back to the original puzzle. Can you find other intersections in it? Believe it or not, there are 4 other useful intersections in the puzzle.

Can you find all four? I'll tell you where they are on the next page, but if you can find them, write them down here. One is really hard to find!

Well, how many did you find? All four? Great!

Here are the answers:

The intersection of column 1 and block 4 is the only part of column 1 that can contain a 6. So you can remove 6's from the rest of block 4.

The intersection of block 2 and row 2 is the only part of block 2 that can contain a 5. So you can remove 5's from the rest of row 2.

The intersection of row 3 and block 3 is the only part of the row that can contain a 5. So you can remove 5's from the rest of block 3.

and here's the hard-to-find one:

The intersection of block 3 and row 3 is the only part of block 3 that can contain a 6. So you can remove 6's from the rest of row 3.

Isn't that interesting? The same intersection actually generated two different reductions! Also, did you notice that when you're looking for intersections, you don't just compare the rows and columns against the blocks, but also the blocks against the rows and columns.

Here's my method for finding intersections:

I look at each block, and divide it up into 3 rows of 3 squares. Then:

> If a possibility only appears in those squares and not in the rest of the **row**, I can eliminate it from the **block**.
>
> If a possibility appears only in those squares and not in the rest of the **block**, I can eliminate it from the **row**.

Then, I look at each block again, and divide it up into 3 columns of 3 squares. Then:

> If a possibility only appears in those squares and not in the rest of the **column**, I can eliminate it from the **block**.
>
> If a possibility appears only in those squares and not in the rest of the **block**, I can eliminate it from the **column**.

Whew! Bet that got your brain all over-heated. You need to cool it down. I suggest you eat some ice-cream!

Yuuuuummmm! Iceeee-creeaaaaam! I think I deserve some for writing this lesson!