

# Squares on a Chess Board

July 31, 2018

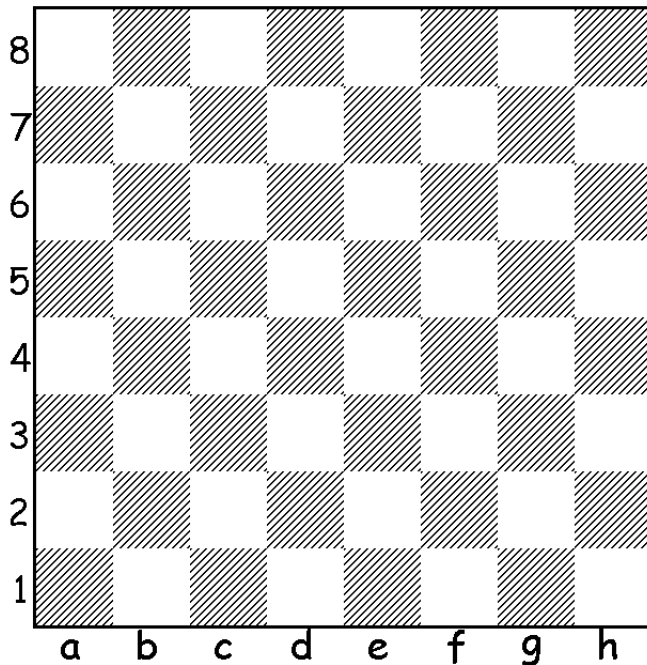
## Warm up

1. Anna, Ben, Cindy and Dan play in a chess tournament. Every person played everyone else once. How many games did they play all together?
  
2. Anna won more games than Ben. Dan won more games than Cindy. Anna won her game against Dan. Ben lost to Dan. Cindy lost all her games. There were no draws. Who won the tournament?

## Names of cells on the chessboard

Shade the following cells on the chessboard below:

c3, c4, c5, c6, d5, e4, f3, f4, f5, f6



What letter do these cells form together?

# How many squares are there on a chessboard?

A chessboard itself is a square with side length 8.

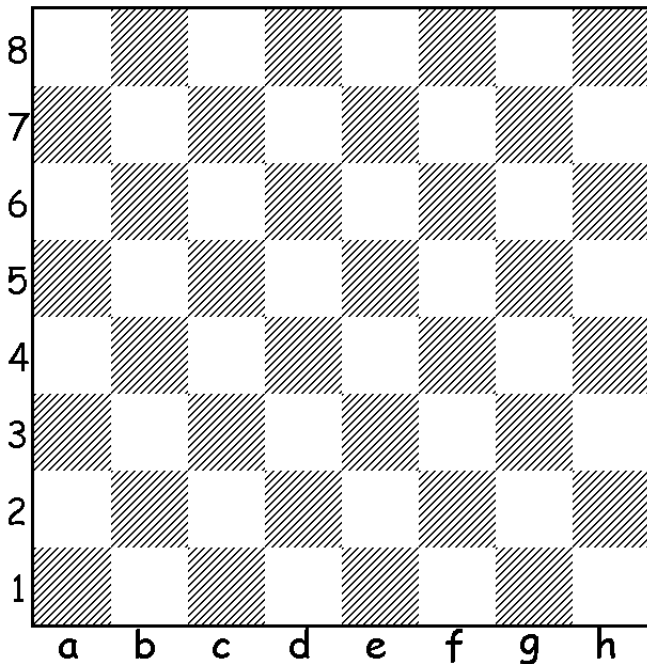
- The cells on the chessboard are squares of size  $1 \times 1$ . How many squares of size  $1 \times 1$  are there in all?

*Answer:*

What about bigger squares? Let us first count squares of size  $2 \times 2$ .

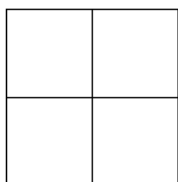
Notice that some of these squares can overlap.

On the chessboard below, trace two squares of size  $2 \times 2$  that overlap:



Idea: *Instead of counting  $2 \times 2$  squares, we will count the cells which can serve as the left lower corners of the  $2 \times 2$  squares that fit on the chessboard.*

1. First, shade the left lower corner of the  $2 \times 2$  square below:

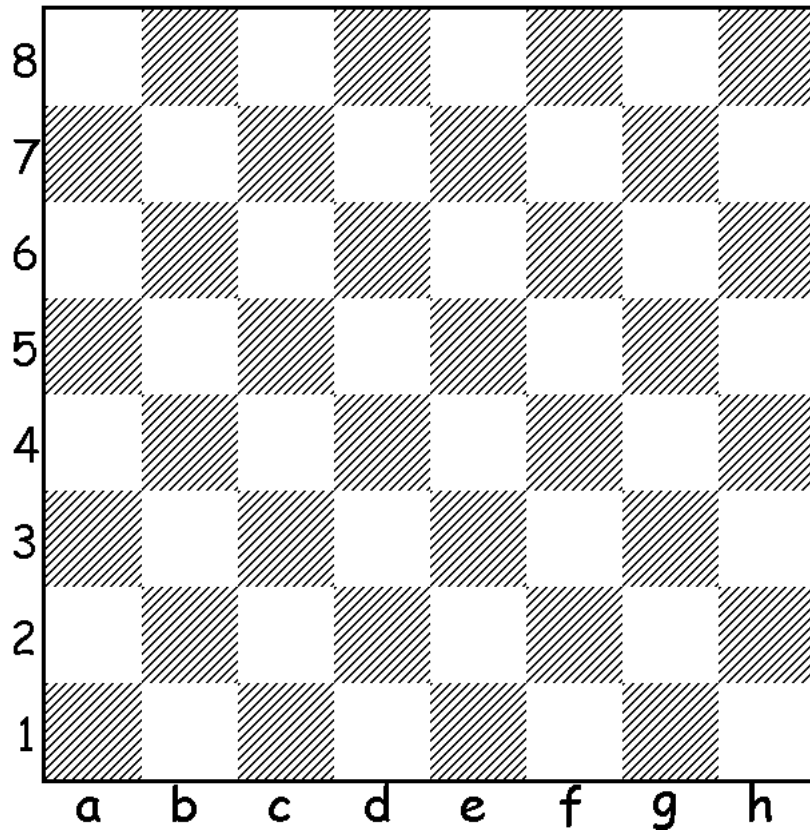


2. For each of the cells below, decide if it can be a left lower corner of a  $2 \times 2$  square:

(a) c3	Yes	No
(b) g6	Yes	No
(c) f8	Yes	No
(d) h2	Yes	No

3. Name two cells that are left lower corners of a  $2 \times 2$  square:
4. Name two cells that can not be left lower corners of a  $2 \times 2$  square that fits on the chessboard.

5. Now shade *all* cells that can serve as the left lower corners of a  $2 \times 2$  square.



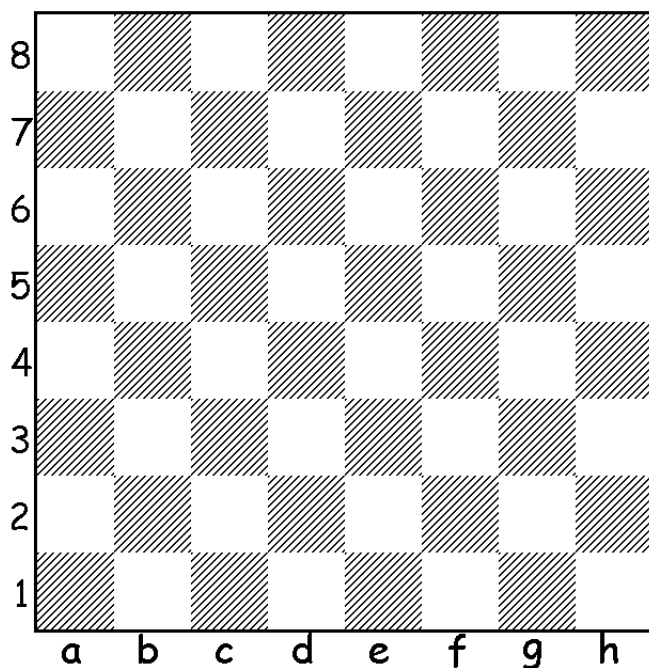
How many  $2 \times 2$  squares are there a chessboard?

*Answer:*

6. For each of the cells below, decide if it can be a left lower corner of a  $3 \times 3$  square:

- |        |     |    |
|--------|-----|----|
| (a) e6 | Yes | No |
| (b) g3 | Yes | No |
| (c) a7 | Yes | No |
| (d) f6 | Yes | No |

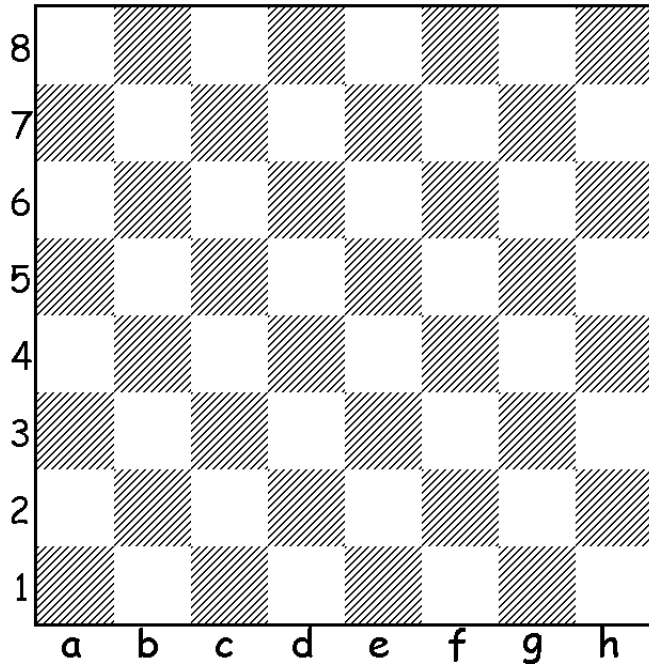
Now shade *all* cells that can serve as the left lower corners of a  $3 \times 3$  square:



How many  $3 \times 3$  squares can you fit onto a chessboard?

Answer:

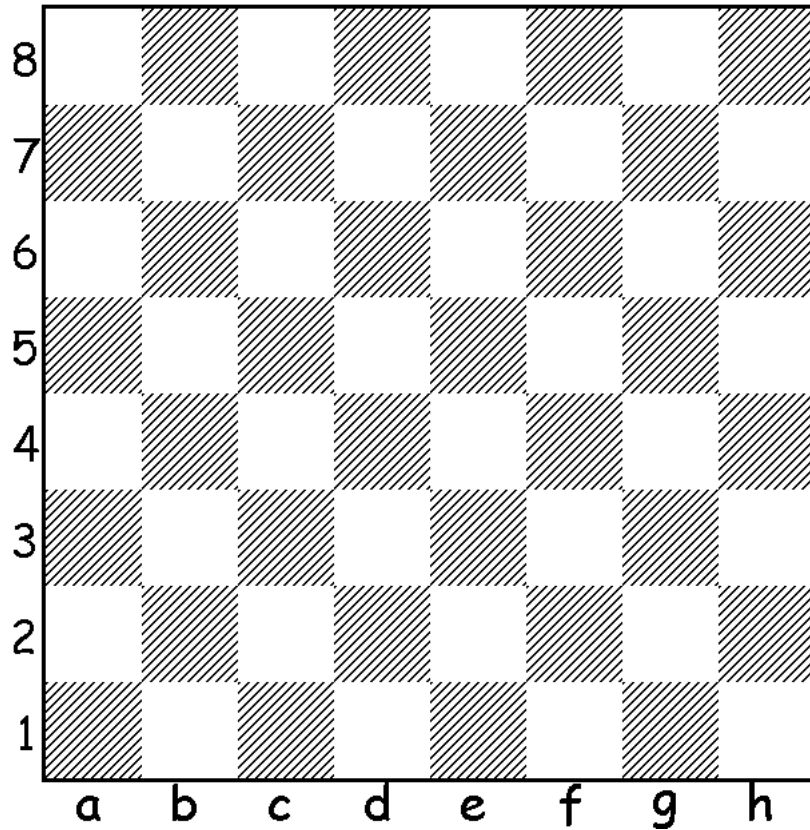
7. Shade *all* cells that can serve as the left lower corners of a  $4 \times 4$  square:



How many  $4 \times 4$  squares are there a chessboard?

*Answer:*

8. Shade *all* cells that can serve as the left lower corner of a  $5 \times 5$  square:

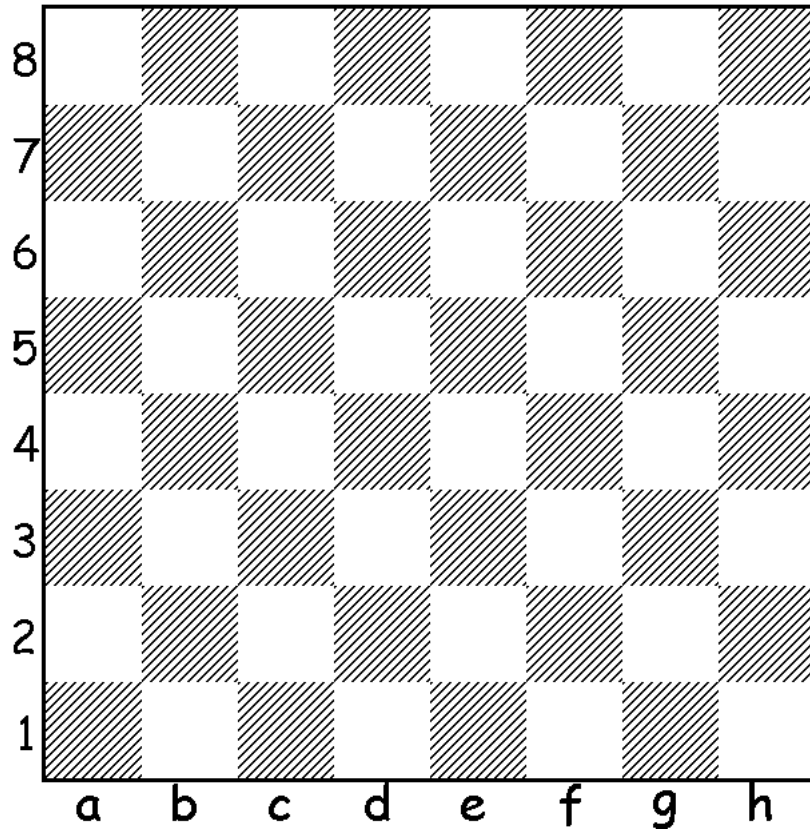


How many  $5 \times 5$  squares are there a chessboard?

*Answer:*



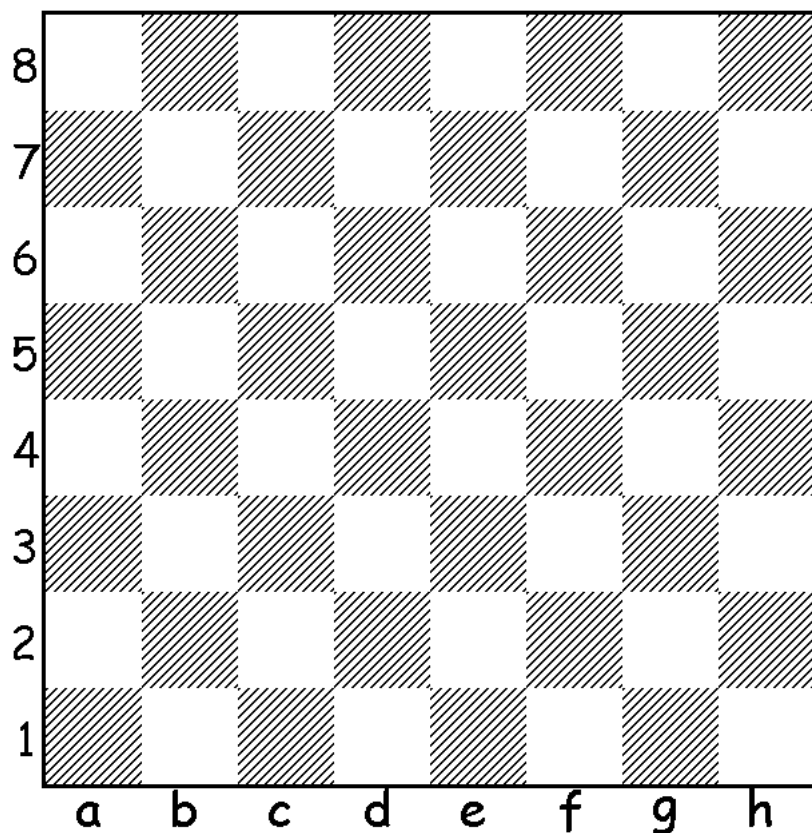
9. Shade *all* cells that can serve as the left lower corner of a  $6 \times 6$  square:



How many  $6 \times 6$  squares are there a chessboard?

*Answer:*

10. Shade *all* cells that can serve as the left lower corner of a  $7 \times 7$  square:



How many  $7 \times 7$  squares are there a chessboard?

*Answer:*

11. Fill out the table below with the numbers of squares:

size of the square	# of squares of this size
$1 \times 1$	
$2 \times 2$	
$3 \times 3$	
$4 \times 4$	
$5 \times 5$	
$6 \times 6$	
$7 \times 7$	
$8 \times 8$	

Now add up all the numbers in the right column to find the total number of squares of all sizes.

## Homework

Finish the problems from the class and explain the project of counting all the squares on the chessboard to your parents.