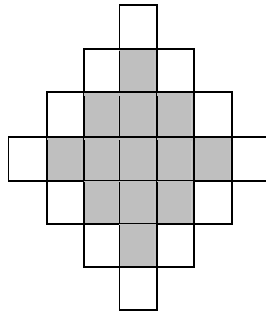
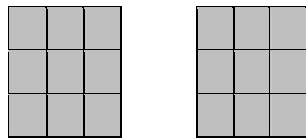


Formulas  
2D cross shape  
Rearranging the Shape

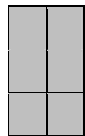


I thought by rearranging the shapes individual squares I might be able to come up to a solution for the problem. I may be able to produce a pattern of squares or any other kind of shapes to show a formula for the crosses

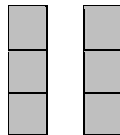
Firstly I found that the largest sized squares I could make from the cross shape above were  $3 \times 3$



Then with the squares I had left I could make a rectangle  $2 \times 3$



But to keep this like the first part I had all ready found I will display it as



Then I only had 1 square left



Then I looked at each of the shapes I produced in their relation to  $n$  or what term the cross shape was in the sequence.

The cross shape I made my shapes from was 4<sup>th</sup> in the sequence the side of the squares were  $3 \times 3$  and the length of the 2 rectangles were 3 all the measurements I had found were one less than  $n$ , all except from the 1 square by itself

An equation I could use for one of the squares was  $+(n-1)^2$

For one of the rectangles was  $+(n-1)$

And for the single square by itself was  $+1$

When I put this together I got  $(n-1)^2+(n-)+1$

But I had 2 squares and 2 rectangles so then I got  $2(n-1)^2+2(n-1)+1$

Then I simplified this equation:

$$2(n-1)^2+2(n-1)+1$$

$$2(n-1)(n-1)+2(n-1)+1$$

$$2(n-1)(n-1)+2n-2+1$$

$$2(n^2-n-n+1)+2n-2+1$$

$$2n^2-4n+2n+2-2+1$$

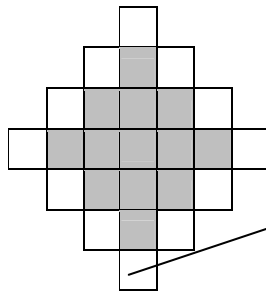
$$2n^2-2n+1$$

I had simplified the equation as far as I could so now I could apply it to the shapes

On the next page I will show the table of results for my equation and show how they can be applied to the patterns of numbers

When I am given any cross shape to construct I am going to need to know how many of the squares are going to be white.

To find out this formula I will look at the correlation between the white squares on a known shape and  $n$



Each of the corners is getting used more than once because the lengths overlap which is why I get 4 more than I should

This shape is 4<sup>th</sup> in the series so  $n=4$  because each side has a length of 4. Also because the shape has 4 sides I now have  $4n$ .

But there is on problem, the results I get are 4 more than the real totals. This is because there are 4 corners and each side has 2 of them. So when I do  $4n$  I am giving my amount for white squares 8 corners. On each one I will have to  $-4$  to get the correct amount for white squares. My new equation for white squares is  $4n-4$

To find the number of black squares I have to take this equation from the total one.

Backwards

In the sequence I found that there are also previous squares in the equation. I found them by reversing the equation. There were 2 previous ones

