SYMinimetry *plus* - the MA mini taster magazine

MATHEMATICAL ASSOCIATION
supporting mathematics in education

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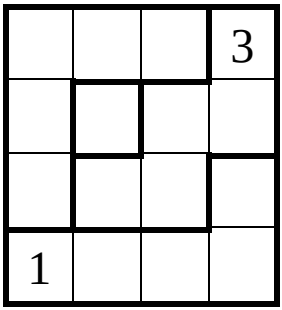
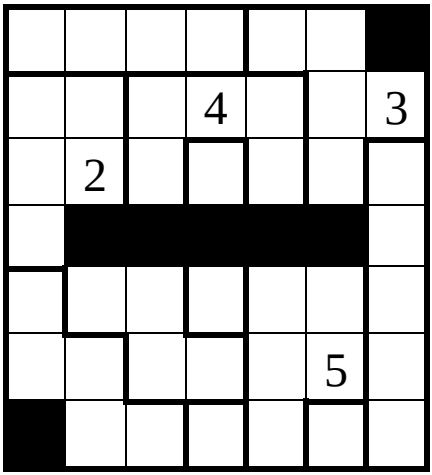
SUGURU PLUS

Suguru puzzles – sometimes called 'Touch-me-not' - are based on rectangles filled with polyominoes (shapes containing various numbers of squares). A *pentomino*, with five squares, must have its squares labelled with the numbers 1, 2, 3, 4 and 5 in some order; a *tetromino*, with four squares, must have them labelled 1, 2, 3 and 4; and so, on down to single squares labelled with 1.



The 'touch-me-not' rule of *Suguru* is: no two adjoining squares may contain the same number.

I have decided to vary things a little with *Suguru Plus*. In these puzzles, the rules above still apply, **plus** an additional restriction: no two adjoining squares may contain consecutive numbers.



But, in *Suguru*, squares touching at the corners cannot contain the same number. In *Suguru Plus*, squares touching at the corners may contain the same number (and in fact often do), or a consecutive number.

PERIMETER MAGIC TRIANGLES

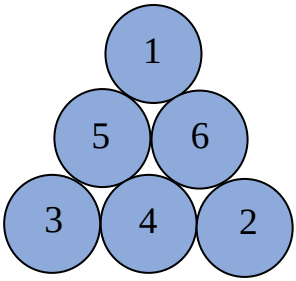
No doubt you know about Magic Squares. This article concerns itself with Perimeter Magic Triangles and for the most part is the work of Terrel Trotter, Jnr., a remarkable mathematics teacher. Born in 1941, he was severely struck by polio at the age of 14 and got around using an electric wheelchair. Upon graduating, he became a mathematics teacher working in Urbana, Illinois. He first published an article on Normal Magic Triangles in 1972.

Terrel Trotter 21 May 1941 – 18 Sept. 2004

Perimeter Magic Triangles (PMT): Order 3

PMTs are classified according to how many numbers appear on one side of the perimeter. Order 3 is the simplest, except for order 1 which would be a single number and so it is not considered. There are no order 2 perimeter magic triangles. In contrast to magic squares, cubes, etc. there are multiple magic constants for the same order.

The diagram below illustrates a triangle where each side sums to 9, using the numbers to 1 to 6.



Activity

a. Using the numbers 1 to 6 once only create solutions where each side will sum to numbers greater than 9. Remember, it will be helpful to apply a systematic approach to the investigation.
Note: rotations and reflections are not considered unique solutions and are therefore not counted.

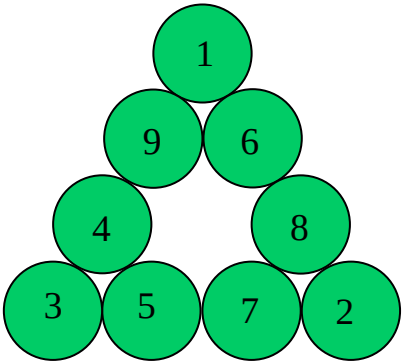
b. How many different magic constants (the sum of each side) were you able to find?

c. Explain how you positioned numbers on the triangle, i.e. discuss any strategies that you might have applied.

d. What is the role of the numbers placed at each vertex?

e. Can you find a relationship between the sum of each side, the sum of vertices and the sum of the digits used? If so, generalise your rule.

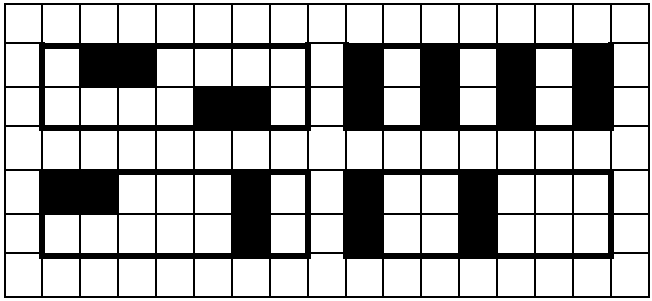
The diagram below illustrates an order 4 triangle using the numbers 1 to 9. In the example shown each side sums to 17.



SOCIALLY DISTANCED DOMINOES

We have all got used to social distancing and I have been interested in how dominoes and other polyominoes fit into rectangular grids for years. I then had the idea of putting these two ideas together!

Social distancing as applied to dominoes in rectangular grids means that no domino is allowed to touch, even by a vertex, any other domino in the grid.



In the diagram above, both of the first two 2 by 7 grids are maximally filled as no extra dominoes could be placed in either grid without touching the ones already there. However, in the third grid a domino could be placed in the fourth column without touching any others, although this is the only possible placing of a third domino in this grid. In the fourth grid a domino could be placed either in the sixth or seventh column or on the far right in the top or bottom row. In other words, the last two grids are not maximally filled.

My suggestion for an investigation is to consider what are the worst cases and best cases for maximal fillings for a particular size grid. For the 2 by 7 grid above, the worst case is 2 dominoes, as in the first grid above, as it is clear that if you only place 1 domino in a 2 by 7 grid, wherever it is placed another domino can always safely socially distance within the same grid. Also placing dominoes vertically fits more dominoes in than horizontally in this grid given it is so thin, so 4 must be the best case, as given in the second diagram above. There is no way we could place 5 dominoes in a 2 by 7 grid as they would only be separated by $2\times7-2\times5=4$ empty squares over the whole grid!

I am posing you a particular question and a more general one.

1) On a normal chess board, a square 8 by 8 grid, what is the worst case and the best case for social distanced dominoes?

2) For the thin 2 by n grids, can you find formulae in terms of n for the number of dominoes in the worst case and in the best case for a maximal filling of socially distanced dominoes?

SIMPLY SOLVE

Here are two of the 16 problems listed in the full version of *SYMmetry*plus.

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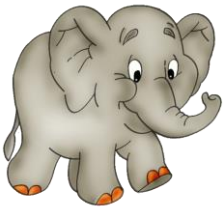

In a group of twelve elephants some are 9 years old and some are 11 years old. The total of their ages is 122 years.

How many are aged nine?

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A taxi driver charges £3, plus £1.50 for every mile travelled. Ms Baker rode in the taxi from her home to the airport and was changed £60. How many miles does Ms Baker live from the airport?

This is a taster of the full version of SYMmetryplus that is a bright, colourful and lively magazine containing articles, puzzles, problems and competitions for all those who enjoy their mathematics. It is aimed at everyone interested in mathematics, but especially those aged 11 to 18. It has 20 colour pages in A4 format and is published three times a year (spring, summer and autumn).

The Society of Young Mathematicians (SYMS) is a society for all young people who enjoy mathematics, whether they are in a primary or secondary school. Members are part of a national organisation which motivates and encourages young mathematicians.

Every term members receive the SYMS Newsletter – *SYMmetry*plus, which contains short articles, news, things to do, calculator hints, book reviews, games, puzzles and competitions. Members also receive termly copies of the journal *Mathematical Pie*. Again, *Mathematical Pie* contains interesting mathematics problems, puzzles and articles. SYMS encourages and supports mathematical activities for mathematicians of all ages. Adults are very welcome to join SYMS.

SYMS members will receive *SYMmetry*plus and *Mathematical Pie* delivered direct to their homes.
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