Opening slide

Good morning

My name is Donald Bell and I live in London.

This is my first visit to the Gathering for Gardner, although one of my projects was used here four years ago by Laurie Brokenshire as his Exchange Gift.

When I was a student, Martin Gardner's column in the Scientific American introduced me to the puzzles of Sam Loyd, the polyominoes of Solomon Golomb and the geometric dissections of Harry Lindgren.

Today I am going to talk a lot about Polyominoes and Dissections.

A fairly complicated project, too much to explain in a few minutes, so there is also a paper in the Gift Exchange Book, a puzzle you will get tomorrow in the Gift Exchange Bag and even a web page with lots more details.

Slide 2

This is Sam Loyd's famous dissection of the Greek Cross to the Square.

The cross is one of the twelve pentominoes.

And the square is one of the five tetrominoes.

So we have a dissection of a pentomino into a tetromino.

Note the little triangle whose sides are 1, 2 and root 5. We will be seeing a lot more of it.

The obvious question is this: is there some Universal Polyomino Dissection of **all** of the pentominoes into **all** of the tetrominoes?

Slide 3

As you can see, there are twelve pentominoes, and five tetrominoes, seventeen different polyominoes.

And there are therefore sixty different dissections of a pentomino into a tetromino.

Slide 4

There is a wonderful web page, produced by a group at the Politecnico di Torino which shows all sixty of these dissections.

They also found a Universal Polyomino Dissection for all seventeen of the polyominoes in only nine pieces.

It has five small triangles and four other pieces.

Slide 5

So are there any more Universal Polyomino Dissections?

Perhaps one with a group of nine pieces that are all different.

Or one with a set of just eight pieces.

And how would we go about finding such a group?

Slide 6

We make the assumption that all of the dissection pieces will be constructed by gluing together some triangles and some squares.

But before long we have a set of over thirty plausible pieces. How can we possibly select a group of just eight or nine of them and check it against all seventeen of the polyomino shapes?

Slide 7

When an engineer has a problem that he can't solve, he looks for a simpler one to solve first.

This slide shows a rather contrived search for a Universal Dissection of just three target shapes.

They are called "block", "gamma" and "cross", each one has 21 units of area.

And there are seven plausible pieces that I have labelled with letters.

These pieces have a total area of 29 units, so only five of them will be needed to make any one of the target shapes.

Slide 8

The "cross" shape can be made in several different ways, but there are only three different groups of pieces, since the first and third solution use the same group. Each five letter word represents a group of five pieces.

So for the cross shape we have a **set** of three **groups** of five **pieces**

Slide 9

The "block" shape can also be made by three different groups.

And the "gamma" shape also can be made by three groups of pieces.

However, there is just one group that is common to all the shapes, the one called VLTRW

Slide 10

The Venn diagram shows this information in a more familiar way. Each of the circles represents a set of groups of pieces belonging to one of the target shapes.

But only one group is in all three circles. And that is the one we want.

Slide 11

The general approach to a Universal Dissection is pretty simple, but now things start to get complicated.

The well known computer program Burr Tools is very useful, but it needs some more software to handle and interpret the data.

I have put all the details in my Gift Exchange Paper and you can also download it from my web page.

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Now for some results.

There is, indeed a group of nine pieces, all different, that can do the Universal Polyomino Dissection, and here it is.

And there are three groups of eight pieces that I know of. Here is one of them. It is my Gift in the Exchange Bag that you will get tomorrow.

Slide 13

The eight pieces look like this and you (and your grandchildren) will have fun assembling them into all 17 of the polyomino shapes.

Slide 14

So the final, as yet unsolved, challenge is this:

Can you find a set of just eight pieces, all different, to make the Universal Dissection?

Many of you have access to big computers and bright PhD students.

I look forward to getting the email announcing your success!

Thank You