The Mathematics Triple Record

The Academic Portion 07/13/12

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Who Is Taking Notes Today?

The Sky Bridges in SCEB POND are heavily patrolled by the BEND COPS. To travel between the people and the days of the week that require a note taker, one must travel vertically down until a sky bridge that terminates on the vertical line one is following is reached, one must then follow this sky bridge to another vertical line and repeat the steps until one reaches the end of a vertical line.

We investigated the properties of sky bridges. After much consideration, we agreed that there was no way to create an infinite loop because each sky bridge swaps the placement of two people. In the process of this conclusion, the issue of self-looping sky bridges was raised and whether they alter the properties of sky bridges. After further discussion we discovered that there are ways of turning the self-looping sky bridges into regular sky bridges, even if the self-looping sky bridges were in seemingly infinite chains.

Induction!

1. Check base case
2. Assume true for an arbitrary quantity (n=k)
3. Take n=k+1 case, reduce to k case, use to prove true for n=k+1

As an example of induction, we looked at the number of diagonals in a polygon with n sides. We proved by induction that there are $(n(n-3))/2$ diagonals in an n-gon.

Clumps!

A clump is a set with a binary operation (an operation with 2 inputs and 1 output) (C, •), obeying the following four properties:

1. Closed - if a, b $\in$ C then a • b $\in$ C
2. Associative- (a • b) • c = a • (b • c)
3. There is an identity (e) such that e • c = c = c • e
4. Every clump element has an inverse such that $c^{-1} \bullet c = e$ and $c \bullet c^{-1} = e$

We discovered that there is only actually one unique one element clump. We found the same was also true of two and three element clumps, however this is not true of four element clumps as there are two unique four element clumps.

A sub-clump is a clump (S, •) with S $\subseteq$ C and closed and it has the same operation as the original clump.

The Ffrag: The Wwelsh Origin of Lemmaricks (by Bradley)

Ffrags are collections of vertices and edges, where vertices are connected by edges, but no vertex is connected to itself, nor do multiple edges connect the same two vertices. We have learned about many different properties of ffrags, as well as many types of ffrags.

Properties of ffrags:

V is the number of vertices in a ffrag

E is the number of edges in a ffrag.

F is the number of fields in a ffrag. Fields are the vertices of squid ffrags, which have the same number of edges as the chicken ffrag. This is related to Euler's Formula F=E-V+2, which holds for all planar ffrags (see definition there ↓).

Planar/Nonplanar/Toroidal: A ffrag is planar if it can be drawn in a plane without any of the edges crossing each other, otherwise the ffrag is nonplanar. A ffrag is toroidal if it can be drawn on the surface of a torus without any of the edges crossing each other.

Δ(Ff): This notation denotes the highest degree of a vertex in the ffrag.

k-connectedness: A ffrag is connected if there exists a set of edges that can be traveled over to get from any vertex of the ffrag to any other. A ffrag is k-connected if there exists no set of ≤ k-1 vertices whose removal disconnects the ffrag, and is k-edge-connected if there exists no set of ≤ k-1 edges whose removal disconnects.

Degree: The degree of a vertex deg(V_k) is the number of edges that are connected to that vertex. We proved that the sum of all deg(V_k) of a ffrag is equal to 2E.

Ffragment: A ffragment is a ffrag of a subset of the vertices of a greater ffrag and the edges that connect these (and only these) vertices.

ΔRegular: A ffrag is Δregular if all of its vertices have degree equal to Δ(Ff). (The Δ in ΔRegular means that if Δ(Ff)=2, the ffrag is rregular. If Δ(Ff)=23 the ffrag is rrrrrrrrrrrrrrrrrrrrrrregular)

Types of ffrags:

Star ffrag: A ffrag in which outer vertices of degree 1 are connected to a center vertex of degree E. Star ffrags are 1-connected. V=E+1 for these ffrags.

Cycle ffrag: Cycle ffrags have all vertices of degree 2, are 2-connected, and have two ways to get from any one vertex to another.

Path ffrag: Path ffrags have vertices of degree 1 and degree 2 (the vertices of degree 1 are called hhydrogens), are 1-connected, and have only one way to get from any one vertex to another.

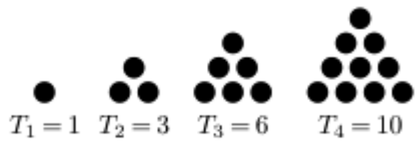
K_n: K_n are Δregular, Δ-connected, and have every vertex connected to every other by an edge. K_5 is one of the two essential nonplanar (but toroidal) ffrags

$K_{n,m,...}$: $K_{n,m,...}$ are Δregular, Δ-connected, and complete and mmultipartite. This means that they have multiple sets of vertices called parts, which are connected by edges to every vertex in every other partition except their own partition. $K_{3,3}$

is one of the two essential nonplanar (but toroidal) ffrags
Eert: An eert is a connected ffrag, which has no ffragments that are cycles. A spannning eert is a ffragment of a connected ffrag, which includes all the vertices of the ffragment and is, of course, an eert. A path ffrag is a type of eert.

Polygon Numbers

If we create polygons with points we start with one point and then add on the next largest polygon of the same size we create the next polygon number. For example, triangle numbers start with one dot then three dots, six dots, etc.



Triangular numbers have special properties, as do most of the polygonal sets of numbers. For example, the addition of the first n triangular numbers is equal to n^2. We also proved that the sum of all the points in a specific triangular number is n(n+1)/2. We also have square numbers, which instead of creating triangles create squares. Square numbers prove that $a^2 - (a-1)^2 = 2a-1$.

The Fine Art of Slicing Pies with Lasers

Given a strawberry rhubarb pie and n number of cuts, what is the maximum and minimum number of slices that we can create? We proved that the maximum number of slices is n(n+1)/2 + 1. The minimum number of slices that we can create will be n+1. This is true as long as there are only a finite amount of slices.

Pascal's Triangle

Pascal's triangle is a triangle in which each term in the triangle is created by adding the two terms above it. Pascal's triangle has many very interesting properties that allow us to do many things. Pascal's triangle shows us how to calculate n choose k, how to find triangular numbers, the sum of the first n triangular numbers, etc.

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1
1 10 45 120 210 252 210 120 45 10 1
1 11 55 165 330 462 462 330 165 55 11 1
1 12 66 220 495 792 924 792 495 220 66 12 1
1 13 78 186 715 1287 1716 1716 1287 715 186 78 13 1

By highlighting certain numbers in the triangle we can create the Fibonacci sequence.

Complex Numbers:

Complex numbers can be represented in the form a+bi where a and b are both real numbers. Complex numbers can be represented on the complex plane where the vertical axis is the real numbers multiplied by i and the horizontal axis are the real numbers. Complex numbers are like vectors on the complex plane and complex addition is like vector addition. Multiplication by i is like rotating the vector 90 degrees counter-clockwise. Multiplication by a real number, n, is like scaling the vector by a factor of n.

Dirichlet's Squid Box Theorem

The squid box theorem allows us to prove things about certain sets. For example, we can prove that if we have a set of 1-n numbers we can create a subset in which there is no a and b in the subset in which a|b. This principle is based around a simple fact. If you are fitting squid in boxes and there are 7 squid but only 6 boxes, there will be some squid that go two in a box, and thus there will be angry squid. No one wants an angry squid.

Lemmarick Competition

The original number of fields = Φ by Bradley
There once was a vertex named v
That had a degree that was d
We took it away
The fields couldn't stay
F's 1 - d + Φ

Lemmarick by Ethan
There once was a vertex named v
That had a degree that was d
It removed equal edges
The fields lost their hedges
And merged at the past site of v

Nate's Favorite Number by Ethan
There once was a number named z
It was raised to the power of d
The product was one
The many solutions with equal length were fun
And the angle was a multiple of (2π)/d