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Mathematics Found in Poetry

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Mathematics is found everywhere, whether it be building a house or planting a tree. Yet, you may not know that mathematics is also found in poetry, ranging anywhere from the amount of lines within a stanza to internal rhythm patterns.

Like everyday life, poetry is surrounded by patterns and rhythm. Biologists say that even before you were born, you could feel the rhythm of your mother's walking pattern and of her heartbeat. From the human heartbeat many sounds have derived, all based on the soft then loud stresses of the heart: lub-DUBB, soft, hard. Due to the theory that we speak in the pattern of heartbeats, we can measure and count the hard and soft stresses. The most common one is iambic, from the Greek. This pattern is soft hard, soft hard, soft hard.[1] We use this pattern often, adopting it as the basic unit of speech, such as found in William Shakespeare's quote, *To be or not to be, that is the question*. Patterns within the syllables are also important. Usually the writer expresses him/herself in hidden ways of repetition, such as in ancient Greece, where they used the length of syllables to make patterns. We also use syllables to express important ideas. You would not want a soft stress on an important word. To account for both syllables and patterns we use the method of Syllable-stress. This measures how much of both are in each line. To make a poem where one thought is understood and remembered, some poets use repetition, either of words or phrases. The repeated lines usually come in the idea of waves. Once you reach the end of a Iine or wave, a new wave starts with the same type of rhythm, bringing you to the end of the next line. Poetry can also be measured in musical notes, which dictate to the reader how long one word should be held. Music is found in poetry a lot. It is the measure of chronometric time. Once you start dividing the full unit of time you come out with different patterns; one beat equals a whole note, half a beat equals a half note and so on until you reach sixteenth notes.[2]

Poetry can also be compared to geometry, for in some ways they are alike. What makes a geometric figure is the consistency of its elements such as angles or line segments which stay proportional as it goes through different transformations. In other words, one reason a triangle is considered a geometric figure is because if it were flipped and expanded to a hundred times its original size, its angles and lines would still be in the same proportions as it was originally. Within poetry and other well-written works, proportion is a very important. One example of this in poetry is in a fourteen line poem, where the line stanzas are divided into the proportion 6:8:14.

Fibonacci numbers play a big part in understanding and analyzing both literature and biology. For instance, if you look at a sunflower it seems to be an unorganized mess of petals and untamed yellows, but if you look closely enough, you see that there is an order to its growth. When you look you find that there are twenty-one florets spiraling in the clockwise direction and thirty-four going in the counterclockwise direction. These two numbers are part of the "golden number" sequence, also known as Fibonacci numbers.

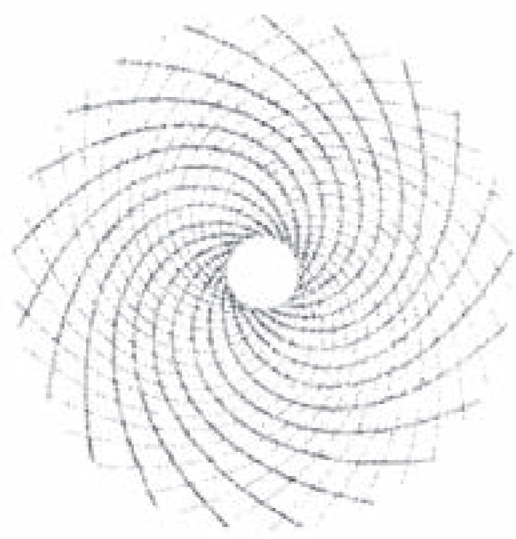

Figure 1:
Spiral pattern in the sunflower

In poetry you can find parts of this "golden sequence." In the Aeneid, for instance, one part of book five has lines grouped in numbers of five, eight and thirteen. Another place where Fibonacci numbers might be found are in the number of syllables found within poem's lines.[3]

In order for figures to be classified in geometry they have to have certain characteristics.[4] This is also true in poetry. A square is listed under quadrilaterals because it has four sides. In poetry a fourteen line poem is classified as a sonnet, yet there are more detailed descriptions for each. Not only does a square have four sides, but they all have to be equal. If this were not true it would not be a square, but instead a rectangle. It is the same for a sonnet. This type of poem has to have some sort of ordered rhyme scheme. Rhyme scheme is the art of placing a letter at the end of each line according to what sound is found there. For instance, if your first line is, *come out and play* you would place an A at the end of the line signifying *play* as your first sound, then if you found anything which rhymed with play later in the poem, you repeat the letter A to show the same sound has been repeated. This lets you trace the repetition of sound throughout the poem. Such set examples of rhyme schemes can be found in any well written sonnet, yet some of the best examples are Shakespearean sonnets. Some patterns found within his poems are abab cdcd efef gg, abba abba cde cde, and abba abba cde edc. In Sir Philip Sidney's poem, "With How Sad Steps, O Moon," the rhyme pattern is abba abba cdcd ee.

With How Sad Steps, O Moon

With how sad steps, O moon, thou climb'st the skies,
How silently, and with how wan a face.
What, may it be that even in heavenly place
That busy archer his sharp arrows tries?
Sure, if that long-with-love-acquainted eyes
Can judge of love, thou feel'st a lover's case;
I read it in thy looks; thy languisht grace,
To me that feel the like, thy state descries.

Then even of fellowship, 0 moon, tell me
Is constant love deemed there but want of wit?
Are beauties there as proud as here they be?
Do they above love to be loved, and yet
Those lovers scorn whom that love doth possess?
Do they call virtue there ungratefulness?

Besides the mechanics of creating a poem, there is also the need for creative language and situations. Without the understanding of why the scene is taking place, no poet can create a good poem. Within geometry you also have to know the reason and theory behind accepted facts, because without that you could not fully understand geometry. In order to accomplish this you use the facts which you know are true. Then, using deductive reasoning you combine statements which are accepted as true and piece them together, coming up with a logical conclusion, for if they say p is true then it can't be not p. For example, you know that the vertices of a triangle have a total of one hundred and eighty degrees. Although you could prove this mathematically, most people accept it as a fact. In poetry you do the same thing. You are given a situation that the poet tells you is true and then from clues found within the poem, you come up with an ending which the writer hoped you would discover. For example: *Darkness creeps over the sleeping mountains*. You know that darkness means night and that sleeping also has to do with night, so it is most likely nighttime. Because it is nighttime, then it can't be day. In Shakespeare's "Sonnet 130," he describes his mistress whom he loves dearly, yet he confides in the reader that she is truly not pretty. He goes through telling about how her lips are not red like coral and her eyes are not like the morning sun. Although in this society beauty is sometimes considered the measurement of love, this poem defies that and instead says the opposite. In this case her ugliness only enhances her beauty.

Sonnet 130

My mistress' eyes are nothing like the sun;
Coral is far more red than her lips' red;
If snow be white, why then her breasts are dun;
If hairs be wires, black wires grow on her head.
I have seen roses damasked, red and white,
But no such roses see I in her cheeks;
And in some perfumes is there more delight
Than in the breath that from my mistress reeks.
I love to hear her speak, yet well I know
That music hath a far more pleasing sound.
I grant I never saw a goddess go;
My mistress when she walks treads on the ground:
And yet, by heaven! I think my love as rare
As any she, belied with false compare.[5]

Within deductive reasoning there are certain elements which must be present: terms, axioms and theorems. Terms within geometry can be categorized as undefined or defined. Undefined terms are points, lines and planes. You know they exist but they have no dimensions or mass. In poetry undefined terms are abstract feelings or events, ones which you know exist, but have no color, smell, taste or sound. Because undefined terms are important, people have come up with symbols which help them visualize what they are talking about. A point is represented by a dot and a plane is represented by a flat surface which extends indefinitely, yet can be represented by any flat surface. In poetry anger might be associated with red or depression with black. Although undefined terms are shapeless, they are very important to the plane they are describing, as are the abstract thoughts which help illustrate concrete images. One poem which shows the use of intangible objects to create a feeling is "Fantasy."

Fantasy

The night's sweet breath,
breathes desires past my ear,
whispering songs of fantasies,
which I keep contained under lock and key.
And only in the darkness do I let my mind wander
forgetting about reality,
letting my soul run free.
—Alexis Mann

In this poem there are almost no concrete images, yet the poet gets her point across. Although you can not touch, smell or taste the desires, you know they are there. She lets you experience the speaker's desires by relating them through feelings which every person has.

Axioms are another idea that makes up geometry. They are statements which are assumed to be true and therefore go without being proven, such as Euclid's fifth axiom or parallel postulate. This states that there is a point not on a given line and only one line can be drawn through the point parallel to the given line. For years scientists have been trying to prove this axiom right or wrong, yet none have been able to do either. Thus, it is still classified as an axiom. In poetry axioms can be described as a situation made up of unproved facts. This is because the author is telling you the situation is real so there is no reason for the reader to investigate further, such as in *the little girl walks down the dirt New Hampshire road*. The writer is telling you the little girl is in New Hampshire, so there is no reason to use other facts to prove this is true.

The next and final part is theorems. Unlike axioms, theorems can be proven using deductive reasoning. To do this, though, you need references to other proven theorems or additional information. One example is how to find the congruency of two triangles. Based on other knowledge, you know that if all three corresponding angles and corresponding sides are the same, then the triangles must be congruent. So, if you know that two sides and one angle of triangle ABC are congruent to the same two sides and one angle in triangle DEF, then you have just proved their congruency, using side angle side (SAS). Theorems can be proven in poetry. To prove an idea or situation, you use facts found in earlier stanzas or information you have collected in everyday life, then relate it back to the line you are reading. This helps you to understand what is truly going on within the poem. This also helps by making sure you do not become confused due to the metaphors or symbols the poet might be using.[6] Such an example can be found in "My Papa's Waltz" by Theodore Roethke.

My Papa's Waltz

The whiskey on your breath
Could make a small boy dizzy;
But I hung on like death:
Such waltzing was not easy.

We romped until the pans
Slid from the kitchen shelf;
My mother's countenance
Could not unfrown itself.

The hand that held my wrist
Was battered on one knuckle;
At every step you missed
My right ear scraped a buckle.

You beat time on my head
With a palm caked hard by dirt,
Then waltzed me off to bed
Still clinging to your shirt.

The writer here wants you to think of the father's drunkenness as a waltz, but you know by past knowledge that this dance is no dance at all but instead a father beating his son. If you read this poem literally without relating it back to prior knowledge, you would have never understood the poet's attempt to hide this horrible event within a beautiful dance. Therefore, using deductive reasoning, you have proven that the father is not actually dancing.

In my final comparison between mathematics and poetry I will look at direct and indirect proofs. In mathematics, proofs are arguments which establish a statement's truth. A mathematical proof has a certain defined structure, which can be divided into steps. First is the initial step or hypotheses, which are assertions that are considered true without having to be proven. In poetry, the hypothesis is the structure of the situation, whether it be true or false.[7] For example, if you are writing a poem about a cat and in the first line you say it lives in a house and drinks water, then throughout the poem you must make sure your facts stay consistent. If in stanza one she lives in a house and in stanza four she lives in an apartment, then that original statement is now false because she no longer lives in a house. To make the first statement true you must make the cat still live in a house even in stanza four. Indirect proofs can also be formed if there is a contradiction found, or if you assume the conclusion is false. This is found in poetry. When you read a poem, and as you get toward the end, a simple fact switches the meaning of the poem, such as in William Shakespeare's "Sonnet 33."

Sonnet 33

Full many a glorious morning have I seen
Flatter the mountain tops with sovereign eye,
Kissing with golden face the meadows green,
Gilding pale streams with heavenly alchemy;
Anon permit the basest clouds to ride
With ugly rack on his celestial face,
And from the forlorn world his visage hide,
Stealing unseen to west with this disgrace.
Even so my sun one early morn did shine
With all-triumphant splendor on my brow;
But out alack he was but one hour mine,
The region cloud hath masked him from me now,
Yet him for this my love no whit disdaineth;
Suns of the world may stain when heaven's sun staineth.

This poem at first shows a dark lifeless morning. Shakespeare then goes through describing it and how terrible it is, yet towards the end the sun comes out for a instant. This is the turning point of the poem when the whole meaning switches from the feeling of depression and hopelessness to the possibility of happiness.

Before I this started researching this paper, I was not sure how much mathematics really related to writing and poetry, yet as I searched I started to realize poetry's connection with mathematics. I hope you have learned a little something while reading my report; I know I have learned a great deal.

Mistress of mine, time and
Again you have wooed me with your
Theorems and proofs,
Held me captive with your abstract beauty, and
Enchanted me with your dance.
Mistress of mine, time and again I have been
Awed by the
Transcendent melodies you weave and the
Infinite tapestries you spin from only a sparse
Collection of symbols and signs.
Mistress of mine, it has been a long and glorious romance[8]

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Continued on page 34

was "too big" for a rod of length **a** to be broken for the purpose of making a rectangle that big. But what are the lengths of the vectors that made the sides of our rectangle in 4-space? They are $\sqrt{x^2+y^2}$ and $\sqrt{u^2+v^2}$, or $\sqrt{b}$ in each case; hey! — we've even got a square, not just a rectangle! Those are pretty long segment lengths, big enough so that the square they build in 4-space is sure enough of area **b**. But we found earlier that long things like that can't partition a segment of length **a**. Indeed, the sum of these two *lengths* is $2\sqrt{b}$, which is certainly not **a**.

Well, what was the problem? Did we ask for **a** to be partitioned into two pieces whose lengths add to **a**, or did we ask for **a** to be partitioned into two numbers whose sum was **a**? We solved the latter problem, by finding complex numbers whose (complex) sum was **a** but whose lengths were big enough to make a square of size **b**.

Do I hear someone cry fraud?

"Fraud!" cried the maddened thousands, and echo answered fraud; But one scornful look from Casey and the audience was awed.

Partitioning a into *complex* pieces that make, in a suitable geometric interpretation of complex numbers, a suitable real rectangle is no more fraudulent than interpreting the garden problem as one of finding coordinates of a point in the Cartesian plane, rather than lengths of wall, or using negative numbers in the manner of DeMorgan to represent the past instead of a putative future.

We all know there is no date at which the son *will* be half the age of the father; it's too late for that already. In De Morgan's time it was still questionable whether using a negative answer amounted to a swindle. Unfortunately, "hardly a man is now alive," (to quote from another narrative poet) who still appreciates the intellectual effort it took to overcome this natural disinclination to treat mathematical artifices as if they had real significance, and it is a rare teacher who recognizes there is even a problem.

A garden plot with negative sides is really every bit as silly, at first glance, as a square with complex sides. But you can get used to these things after a while. The important thing is to understand just what it is you are getting used to.

Editor's Note: In the last issue of the Humanistic Mathematics Network Journal Mr. Raimi's e-mail address was incorrect. It should be: rarm@db1.cc.rochester.edu, with a 1 instead of an l. We apologize for the error.

Mathematics Found in Poetry

continued from page 20

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