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Mathematical ConceptiΦns

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Abstract

The author completed four original works in order to illustrate the connection between writing creatively and mathematics. It is her belief that the two share a symbiotic relationship. The selections published here include two haikus, a short story, and a blank verse narrative poem. Mathematical concepts incorporated into the works include zero vector, Gaussian surfaces, matrices, and contain vibrant descriptions of mathematics.

Cover Page Footnote

Mathematical ConceptiΦns: A Collection

Mary Alice Coulter

The lonely mathematician

Same story, different rendition.
Once upon a time, there was a young mathematician.

Alone he worked, with only his summations and integration,
At the end of the day, he was left alone in isolation.

Sometimes his long lonely days were brutal,
With nothing to look forward to but his soggy Cup-O-Noodles.

Finally, when his loneliness he could no longer stand,
He stood up, and to no one at all, he declared "I have a plan!"

He toiled away, until did arise,
An ellipsoid face, with perfectly round eyes,

Irises of vivacious green to the utmost,
And he built her frame, from line segments, taken from the lines of the cosmos,

Toes of rectangles, built with the care a toe deserves,
And then he added a sine function, to give her curves.

Helices for her hair, cascading.
Strawberry hues, golden color pervading

And when at last his work was done,
He realized the parts were greater than the sum.

She couldn't laugh, or joke or sing,
Because she lacked what makes a being.

But our mathematician wouldn't be stymied on this occasion,
And he said "I'll give her a personality made from a differential equation!"

Well he did just that, truth be told…
And from his numbers, an identity he did mold.

A derivative here, for the impact of family and friends,
A function over there, for her loses and her wins.

All the things, that make us weak and strong,
He fit nicely into an equation 1.618 meters long.

When his work was done, and the day'd gone by,
He sat back, and straightened his paisley bowtie.

He had a girl, as sweet as could be,
With intelligence, and thoughts as deep as the sea.

But it did not take long to find, (and I say this solemnly)
That a soul-mate is one thing a Gollum can never be.

Every laugh, and tear, and thing she'd say,
He would know was coming from miles away.

For every solution to her personality,
Was laid out plainly in his reality.

He had built a love so perfect it seemed irresistible,
But his exploring mind could find no joy from someone so predictable.

Sitting-Duck Geometry

Concentric circles
Annuli grow, chords of frond.
Bob, little duck, bob!

Just Ducky Wakes

Constant angles made,
Arc length ever increasing.
Seven Kelvin Wakes.

Just Ducky Wakes

Constant angles made

Arc Length ever increasing

Seven Kelvin Wakes
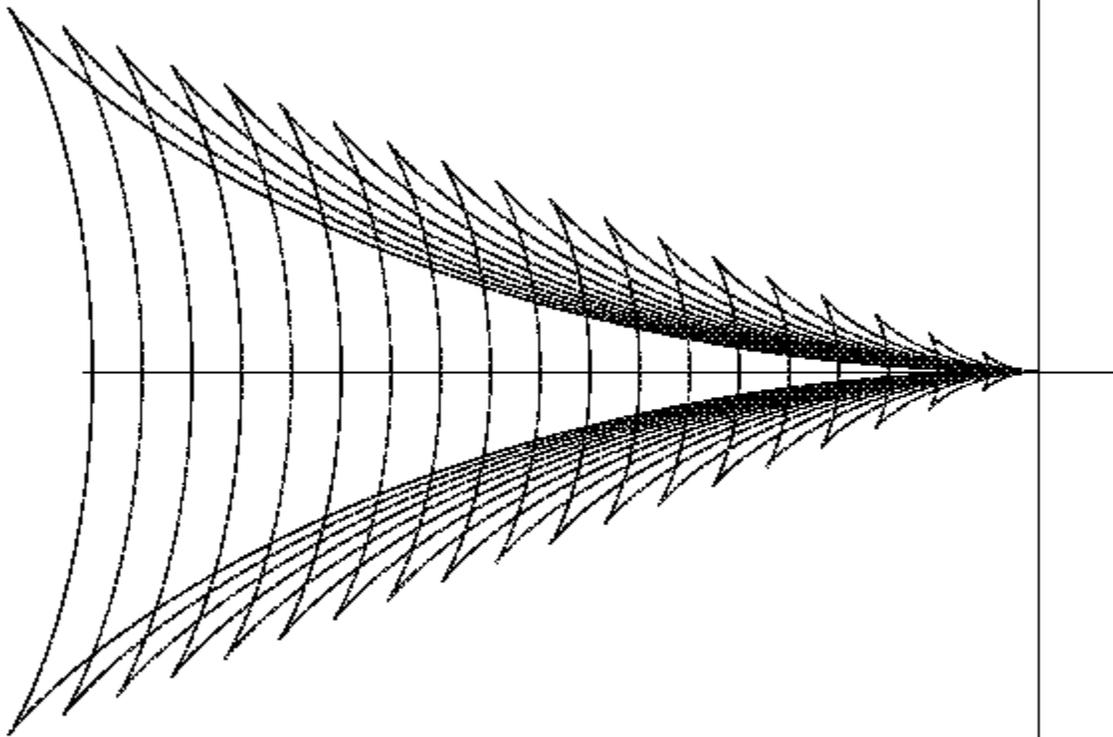
Dimensions

Yesterday, the Old Professor gave me a task. He laid before me a paper, crisp and square, and yet old and tired, as though the page had been studied and pondered many times over, caressed by curious hands. And yet, it seemed to me an ordinary page; it was edged with straight, thick black lines, forming a square which encased a number of irregular black blobs. He chuckled his light-hearted laugh, my bemusement at my latest assignment apparent on my face.

"What is this, exactly, professor?" I asked the man standing at the edge of the mahogany table where I sat.

"Hmmmhmm," he grumbled in his old man-way, "Well now, that's a good question. It might just be the answers to the universe."

"I'm afraid I don't understand." I looked again at the paper, which now seemed more ominous than innocuous.

"Hhrrmm, I'm afraid neither do I." And then he smiled his biggest smile. Another one of the Old Professor's riddles. "Let me explain, or as much as I can," he began again, growing more serious (although I have always had my doubts as to whether the Professor has been completely serious a moment in his life). "Contained within this paper is tremendous information. And before you ask, no I haven't a clue as to what that information might be. But what's even more interesting to me than what's hidden inside, is *how* it's hidden." I looked at him, blankly, waiting for him to continue, he simply stood there, hands on the table, leaning towards me, with a look that clearly said he had just revealed the most enthralling fact known to mankind. Finally, I shook my head that I didn't understand. "Arrrgh!" He cried in dismay, rebounding off the table top as though propelled by some electrostatic force, "My dear *boy!* Don't you understand? I have run, every test and diagnostic, placed this page under every situation," here he gestured emphatically to the many peculiar instruments and devices that whirred and buzzed on various surfaces of the room. "that has been developed on this planet, and then some! Zero gravity, infinite gravity, magnetic fields! I've even gone so far as dividing this page by an infinitesimally small amount to no avail!"

I pondered this. "And the derivative?" We often assessed unknown artifacts or energy surges by taking the derivative of them, which could tell us many things about the physical form (if not the function), as well how that form changed throughout time, if we were lucky.

"Nothing." The Old Professor tugged at the ends of his atrocious paisley bowtie in frustration.

"Surely the derivative must have told you something?" I said, trying to be reasonable, while feeling increasingly as though we were in over our heads on this one.

"No, no. The partials were all nothing! Every single one equaled zero!"

That was a new one. Even if we were looking at a lump of metalloids from a distant asteroid, the partial derivatives always showed something, even the tiniest amounts of radioactive decay as the atoms undergo nuclear transmutation into their new daughter nuclei. I looked again at the page before me which once again seemed innocent, and very nearly unimportant.

"Have we considered that for once, we've got something that is as simple as it seems?" I asked hesitantly, knowing how much the Professor hated everything simple.

"Impossible." He replied, without blinking an eye.

"Why?" A simple response.

"Pick it up."

I obeyed, sliding the paper towards me with my left hand, then lifted it from the table. I stared, agog. The page pulled at my arm as if it were a sheet of lead.

<p align="center">******</p>

I lifted the razor blade, ignoring the Professor's comments about me being "old fashioned" and "tampering creating erroneous solutions." The razor blade sliced into the paper far more easily than I thought it would, considering how dense the paper must be to have such mass in such a small volume. I was careful to slice just through the paper, not edging into the ink that created the outer square. Within ten minutes I had compared the density of the sliver of page to that of paper I had torn from my notepad. Within eleven minutes The Professor and I had resumed our seats, complete with perplexed expressions.

That night, I dreamt I was lost in a fog. I knew that if I could only find my way through I would find the answers. I stumbled blindly, mathematical operations dancing in front of my eyes, making sinusoidal paths through the tendrils of mist: exponents making their graceful curves like shooting stars; the additive identity, zero, so baseline, rolling along before me like a faithful dog; polynomials, ratios, and quotients all dancing before me, like a merry entourage; integrals carved curves in the fog. I felt so very lost and frustrated. Then, suddenly the ground tugged at me, and I fell, landing in the mud. Now I too, was baseline, no height, no substance. Nothing.

I awoke with a start, sitting bolt upright in the narrow cot that I occupied when I stayed too late at the Brainery. I looked about the darkened room, whose only light came from the full moon that was suspended in the indigo sky, while I collected my bearings. I pushed the covers off me, and slipped on my shoes. Careful to not trip over any of the haphazard furniture within the laboratory, I made for the exterior door, sliding open the bolt, and slipping into the breezy coastal evening. I tramped up the rocky pathway leading to the cliff edge, my mind wandering back to the page that still lay on the wooden table in the room I'd just left. Finally, I reached the cliff face that overlooked the ocean, some ten meters below. I squatted, and then threw my legs out over the edge, letting them dangle below me. This is where I went to think when my mind

felt as though it were suffocating.

What do those partial derivatives mean? I wondered to myself. *Clearly, they meant that that page was static. But how? Nothing was truly static in this world. Even the rocks beneath me aren't static. Every atom buzzed with some amount of energy, the strong force keeping neutron and proton bound together in a sort of cosmic marriage, and those tiny specks of electrons encircling that, constantly moving. So what was this paper?* I pulled a printout from my pocket where I'd tucked it earlier that night. It was a copy of The Old Professor's findings. I glanced again at the derivatives listed there. He'd plotted the page on the standard xyz coordinate system, though really, since it was a flat, two dimensional surface, it was bound into the xy-plane, like a flat world on a turtle's back. The partial with respect to x was zero, as though the page were a desert, and the output along every line were simply sand, stretching off into the distance, with not a hill or valley to break the flatness. Constant, flat sand. The same was true of $\frac{\partial \text{page}}{\partial y}$. The output was nothing. The Professor had gone so far as to parameterize the page, which always felt as though we were putting on the opera glasses of time, allowing us to see into the past present and future. This time, however, the Opera was canceled and all we could see was an empty stage, devoid of life and meaning. No change over time. *How strange,* I thought, *since it's the nature of things to change over time. Unless…* I sat, chin on fist, elbow on knee, staring into the darkness as the waves ebbed over the rocks below me, pondering what time truly was. Some people think it's another dimension. I wasn't sure about that. *Speaking of time…* I checked my watch. *3:42AM! I should be asleep.* And yet I remained seated where I was, staring out over the ocean. My mind began to wander again; out, over the waves it went, dancing to and fro just like one of the operations from my dream… *How immense the ocean is.* It seemed to extend out forever. It was deceptive in its flatness, however. Although my hippocampus assured me that the water plunged to extreme depths, on a night like tonight with so little wind, my eyes were convinced that it was simply a plane, with no depth at all, only surface. How strange that a thing so seemingly flat could contain so much of the world. I gasped sharply; realization came to me like the smell of kelp and brine on the breeze. I hauled myself to my feet, running pell-mell back towards the Brainery, arms flailing as though I were a windmill even as I slid across slick stones. As I ran, I tried to cling to my moment of clarity, and at the same time beginning to recall a word from my dream. *Baseline.* I must have skidded into the lab with a crash, because even before I called out, I heard the sounds of grumbling coming from the floor above.

"I've got it!" I cried to the ceiling.

An hour after the sun had managed its ascent above the cliffs, The Old Professor and I had managed to jerry rig half the equipment in the lab together. We had hooked the power generator up to the Divisor machine directly, whose meter we had twisted into a Mobius strip, allowing us to divide by an infinite number. A copper wire twisted to the opposite wall, where we had torn all of the components from the Multiplier, allowing us to hook the two together. After The Professor was assured that all the gauges, meters, and cameras were pointed to the center of the room, we took a moment to admire the octagon of wires, devices and furniture that created a web

around us. With only a nod passed between the two of us, I swiveled the Multiplier towards the center of the room, where the page sat on the table, still and waiting. I flipped the dial to <Vector Form>, and then pressed <Multiply>. The Divisor hummed, shredding it's input number into infinite pieces, until each were so small they were effectively nothing. This nothing charged through the copper wire as an electric charge until it reached the Multiplier, where that nothing was copied down in vector notion. A condensed beam of zero shot from the barrel of the device straight into the mysterious page, leaving us blinded for a moment. When my eyesight returned, I couldn't help but let out one triumph cheer. The page was gone. The Professor beamed at me!

"Well, well! That's the easy part done!" As many times as he'd uttered this mantra, I could never stop myself chuckling at the look of joy upon his face that there were still harder challenges to come.

But then his face softened. "Are you sure about this?"

"I've never been more unsure about anything in my life." I replied, letting a grin spread across my face. He grinned back.

In a moment I had taken the place of the table at the center of our mechanical web. "All ready!" I declared.

"Here," The Professor lobbed a cheese and pickle sandwich at me, "Just in case."

I was just about to point out that there were no scenarios I could call to mind where I would ever willingly eat one of his cheese and pickle sandwiches, when The Old Professor hit the Multiply button.

Every atom in my body was being crushed. I could feel the electro-static repulsion of electron and proton being overcome, as the electrons' orbits were decreasing down to nothing until they resided in the nucleus, and even still, the crushing force continued. This went on and on, for some time (who knows how long?), until finally there was nothing.

Yesterday, The Old Professor gave me a task. Today, I no longer exist. I of course, must exist in some aspect, because I clearly still have enough cognition to give this account. Furthermore, I can see, which is even more curious. Let me explain why this perplexes me. I was given a task to identify how the secret of the page functioned, which I finally realized was impossible under the current conditions: The page was too small, or perhaps, I was too big. So, like Alice down the rabbit hole, I simply needed to get both the page and myself on the same level. Baseline. The page's weight comes not from the traditional sense of density: mass divided by volume; but rather, *information* divided by volume. I realized that night, that there were layers upon layers of information projected, or condensed down upon that page. I just needed to be able to see it. Clearly, I wasn't going to be able to do that when that information was presented to me only in two dimensions, and with me in three. So what's a mathematician to do under these

circumstances? The only thing one can do: Math. By multiplying the page by zero, I reduced both the x and y-components down to zero (the z- was already such). Then, by multiplying myself by zero as well, or more aptly, the zero vector, I reduced my x, y, and z-components to zero. Suddenly, the page and I truly inhabited the same dimension. And what did I find in this zero dimension?

I opened my eyes (though I use the term lightly here) to find before me the page. It was no longer flat by my perception. It floated before me in what I shall call, for lack of better words when the world around you has no depth, width nor height, three dimensions. It was a cube. Upon further inspection I immediately came to the conclusion, this was a matrix. A three dimensional matrix, but a matrix none the less. The black line surrounding the page, had clearly been the projection of the outer edge of the matrix down onto the page. The inner blobs were the transformation of the entries of the matrix into two dimensions. The page had been an isomorphism of this three dimensional matrix. More than that, this matrix was also a message. After a small piece of the infinite time one is afforded when one has no dimensions, I found the message quite clear. It was a love note, which simply read, to the best of my knowledge, "Hello, Sweetie." The resolution of this task cleared the way for the next question: How does a mathematician regain his dimensions? I really needed to think my plans out all the way before jumping into them…

I sat down in the nothingness of zero dimensions, reached "deep" within my pocket, and retrieved the dimensionless sandwich to ponder this very relevant question. Cheese and pickles even taste bad multiplied by zero.

Fin