

ReFractal

(Book Three of the *Marie's Atlas Series*)

Written and Illustrated by
Sophia Estelle Wood

Edited by Maureen Ruddy Burkhart
Copyright © 2017 Sophia Estelle Wood
1st Edition
All rights reserved.
ISBN: 1542872839
ISBN-13: 978-1542872836

“...it's no use going back to yesterday, because I was a different person then.”

– Lewis Carroll from *Alice's Adventures in Wonderland*

A note to readers:

I would like to recommend reading *Alice's Adventures in Wonderland* and *Through the Looking-Glass* (some of my favorite books). There are many allusions and references to those books to have fun with in *ReFractal*. My favorite version is *The Annotated Alice* (with notes and introduction by Martin Gardner).

CONTENTS

1	Sierpins-Key	1
2	Pi	18
3	Happy?	34
4	Rabbit Hole	56
5	The Healers	84
6	Arts Metro	103
7	Maker Metro	133
8	Mindful Metro	146
9	Truth Metro	163
10	The Core	178
12	More from Marie	188
13	Math Poems for Two Voices	194

I

SIERPINS-KEY

The full moon peeked through the fibers of Marie's curtain directly into her right eye, acutely presenting itself as she tried to sleep. The brightness was too much for the veil – it pierced through and awakened the mind that had so badly wanted to rest.

“I guess the sun wants me to know it's still shining” Marie thought as she envisioned the sun's light reflecting to the moon and into her eye.

“Tick, tick, tick, ...” Marie felt the tick of the clock in her room penetrate her mind, as with the moonlight through the curtain. A sound that was usually ignored became stentorian. The old house that her family was

currently staying in came furnished with a rather large grandfather clock.

With each ‘tick’ Marie thought of the equations in physics that described pendulums. In her physics reading she had been delving deep into simple machines, friction, springs, momentum, and pendulums. She loved that some of the most common motions could be described with simple functions and plots.

Marie and her family were staying in the Pacific Northwest for a short period so her scientific parents could do some work for a university. She loved the greenery that seemed to grow on everything. The house was older, yet cozy.

Marie swung her feet over the edge of the bed and slowly rolled herself up into a standing position. She was up. As she stood on the humid wooden boards looking at the hypnotizing swing of the pendulum in the moonlight, she suddenly felt a tingling sensation in her toes. She brought her gaze slowly down from the clock to her feet.

“Well, isn’t that interesting...” Marie whispered to herself. She stepped off the floor board onto the neighboring carpet and knelt down to get a closer look.

“A keyhole?” Marie said a little louder as her finger prodded an aperture in the board. “I wonder where the key is?”

She slipped her fingers around the edge of the board and tried to lift it. “Locked! But it was worth a try.”

She got up from the carpet and looked around the room. “Am I Alice at a door?” Marie thought of Alice in Lewis Carroll’s literature. She loved how, for the keen listener, mathematical logic was intertwined within the story *Alice’s Adventures in Wonderland*.

“Shall I find this key if I am bigger or smaller?” Marie laughed at her situation. It was the middle of the night, the moon was somehow still beaming through her curtains, and she was quietly rummaging through her room for a key to the floor. All the while she was thinking about an authoring mathematician and his character - Alice.

The pendulum continued its rhythmic beat. Each swing brought its shiny brass weight into a beam of moonlight that reflected a glare into Marie’s eyes.

“If I didn’t know any better, I’d think this grandfather is trying to get my attention.” Marie walked over to the clock and noticed that there was a small box sitting underneath the pendulum behind the glass door.

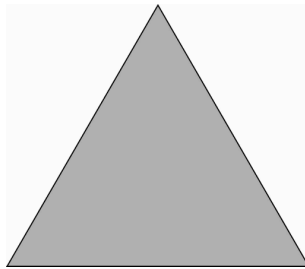
Quietly, she jiggled the small handle and got the door to overcome its humid frame and open up. With the clock ajar, Marie grabbed the small box, careful not to touch the pendulum. She closed the clock, brought the box to her desk and sat down in the moonlight to examine it.

The box was silver, heavy, and about the size of her father’s wallet. Marie’s fingers gently lifted the top from the dusty container and set it off to the side.

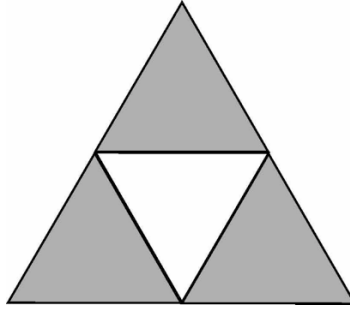
“Oh my...” Marie saw a thin sheet of an aluminum-type metal in the shape of an equilateral triangle sitting alone in the box. A sensation seeped into Marie’s hand as she brought the box closer to the moonlight to get a better look at the triangle.

“Atlas? Again?” Marie whispered as she recalled that it had only been a few months since her last adventure with her companion. Atlas was a friend that existed within her hand and communicated through thought. Atlas was found in one of her parents’ paleontology dig sites that came to Marie as a Fibonacci egg-shaped puzzle. When she solved the puzzle, Atlas fused into Marie’s hand and they set out on an amazing adventure.

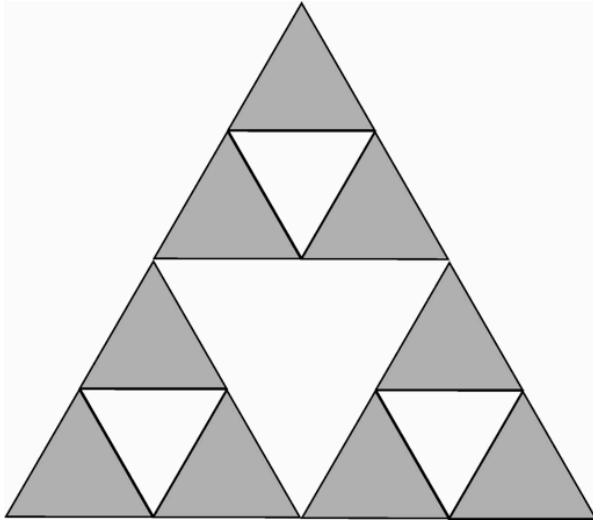
There was no response to Marie’s whispers. She carefully removed the triangle from the box and set it in the palm of her left hand. Her eyes began to change as they had in previous adventures. She was able to see multiple spectrums of light (infrared, ultraviolet, ...) reflecting from the box’s surface, giving her an enhanced and detailed view.



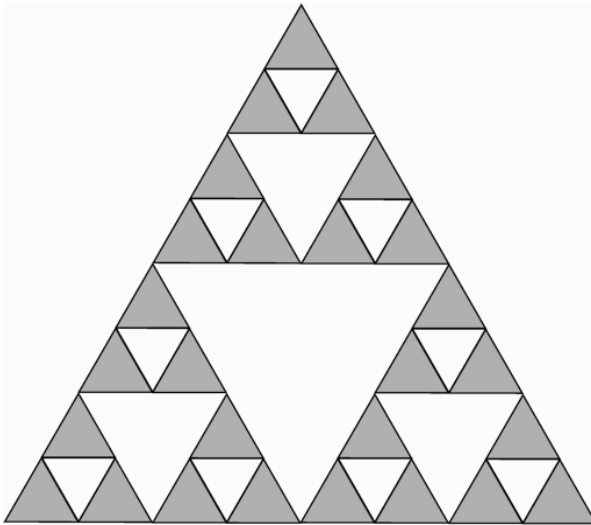
The triangle transformed with the touch of her palm. It trembled, divided and morphed until it stabilized into three smaller, equilateral triangles. She felt a warmth in her hand as she now held multiple pieces. Instinctually, Marie arranged them into a triangle-of-triangles.



When she configured the triangle-of-triangles, the arrangement transformed yet again. It trembled, divided and morphed until it stabilized into three smaller triangles-of-triangles that matched the arrangement that had just been made. Marie put the three triangles-of-triangles into another triangle formation. Again, the newly-created triangle morphed into replicas of what had already been formed.

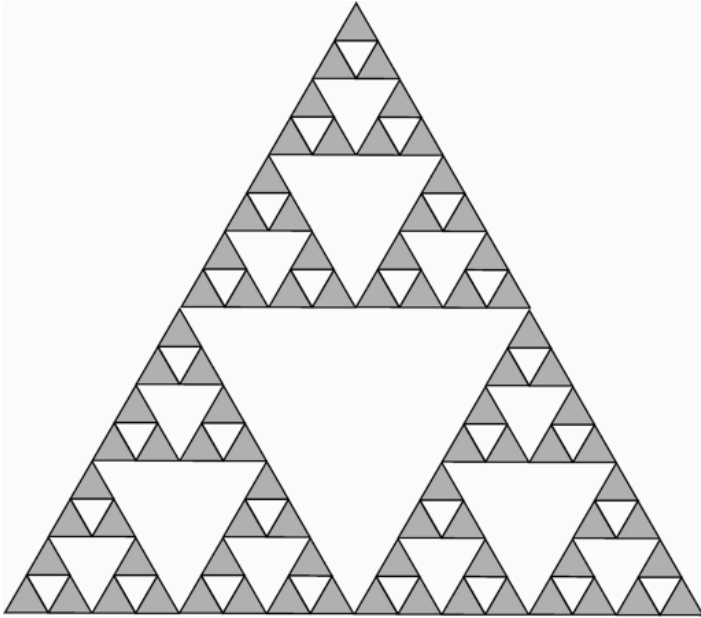


Marie continued to arrange the triangles into triangles and every time it resulted in a recursive transformation. She recognized the fractal that had been created – The Sierpinski Triangle.

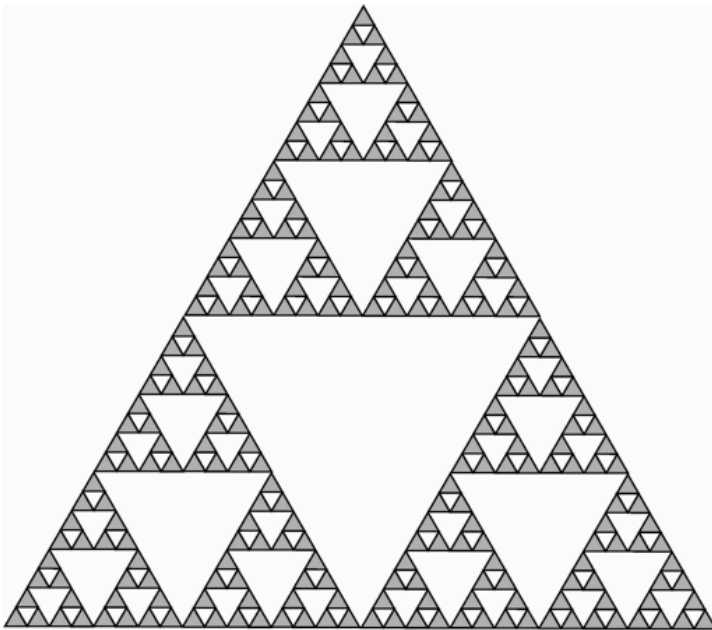


Then:

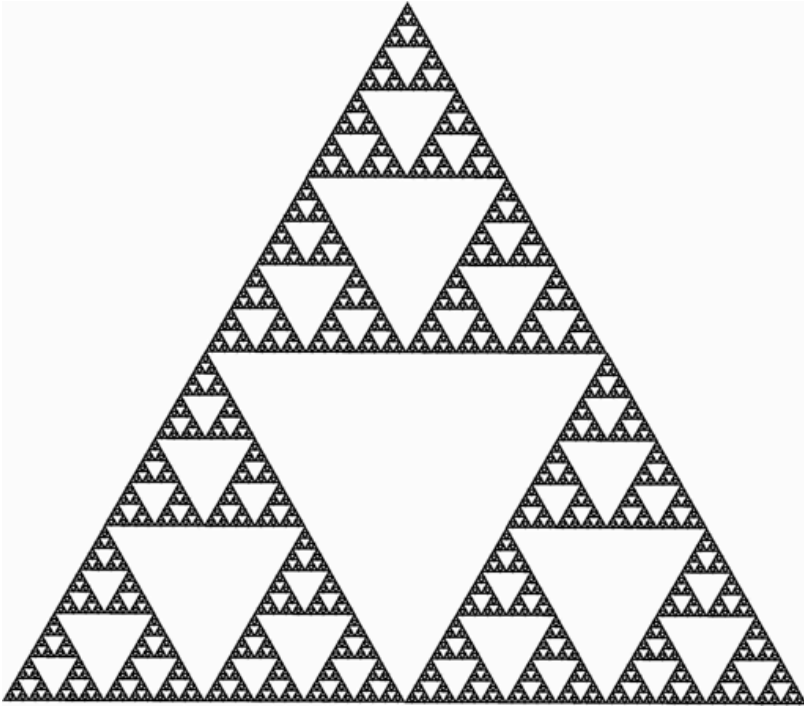
ReFractal



Then:



Then:



When she could no longer recognize the smallest triangles, she wondered how long she could iterate the pattern (after all, fractals are infinite and her time was not!). Glancing at the lid of the box, she had a thought, “What’s on the underside?”

With her unoccupied right hand, she picked up the lid of the box and saw an outline of a triangle. The triangle in her left hand looked as if it would fit perfectly onto the lid’s outline. Marie placed it within the outline and watched an immediate absorption of the triangle into the lid such that the pieces became a picture inscribed *onto* the lid.

“Wow!” Marie whispered as she looked at the lid’s intricate detail of the Sierpinski Triangle. Then she had another thought, “If I’ve learned anything from previous adventures, it’s that this isn’t complete.”

Marie looked into the silver bottom of the small box and saw an inscription of beautifully etched letters appear right before her eyes:

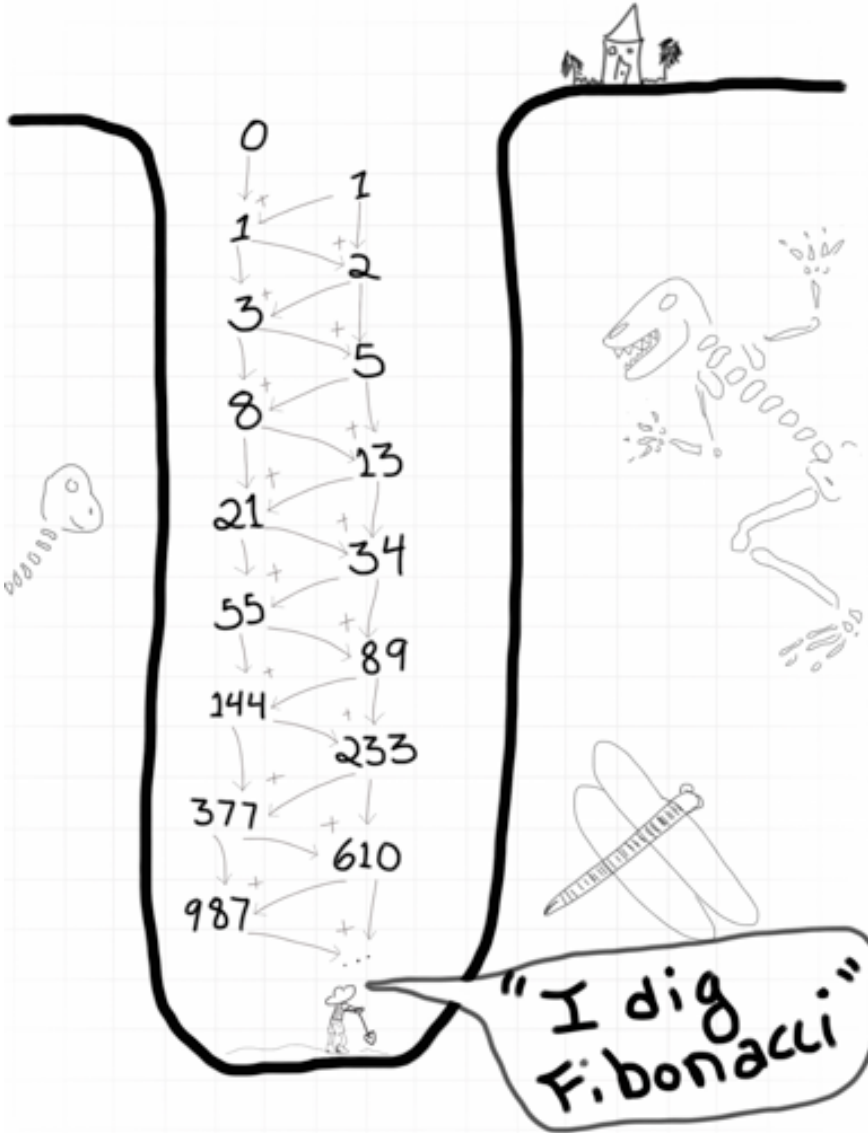
Needed are the logically skilled

A quest must be fulfilled

Find the triangle’s relation to your past gates

Another adventure awaits

With her finger, Marie traced the inscription along the bottom of the box and re-read the words ‘Find the triangle’s relation to your past gates.’ Her previous adventures had linked to the Fibonacci Sequence. She casually grabbed her notebook and began to creating doodles with hopes of finding how the Sierpinski Triangle could possibly relate to Fibonacci. She glanced back to the Fibonacci sketch in her notebook.

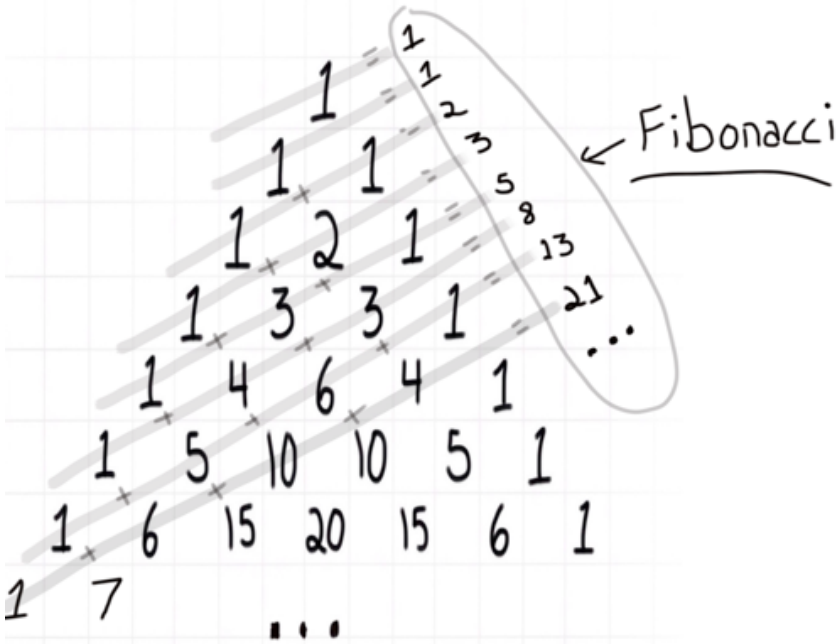


Marie flipped to a new sheet and sketched a single equilateral triangle. Reflecting on the idea of a triangle, she whispered, "Pascal has a triangle." A visual image of Pascal's Triangle emerged in her mind. She loved how the

edges were lined with 1s on the sides as the bottom grew through the addition of the numbers above.

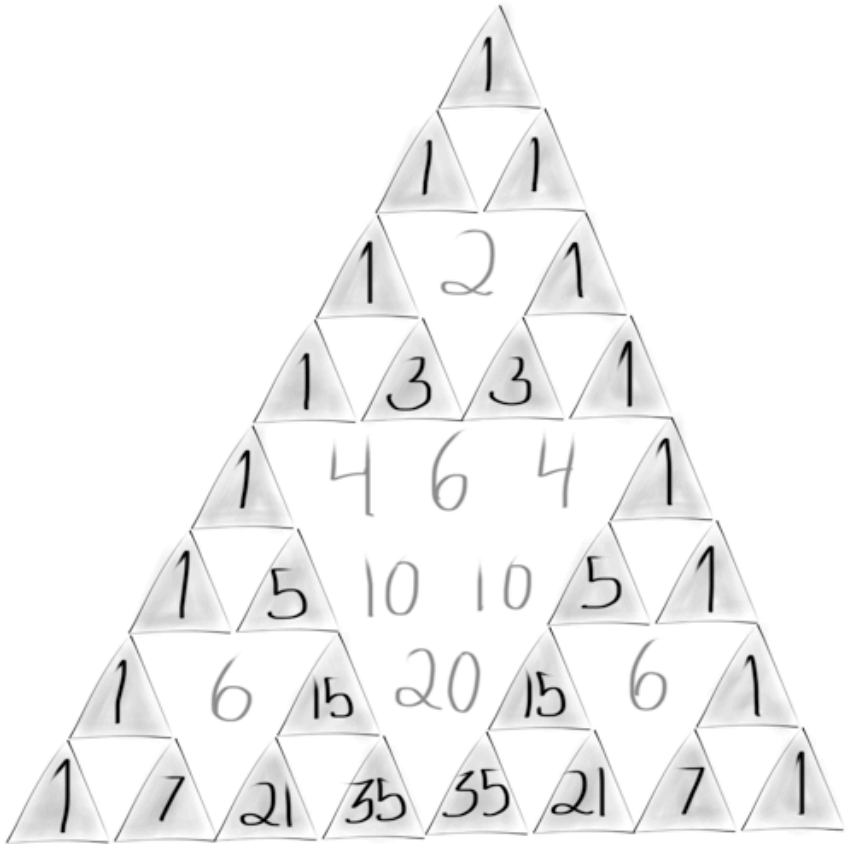
$$\begin{array}{ccccccc}
 & & & & & & 1 \\
 & & & & & & 1 & 1 \\
 & & & & & & 1 & 2 & 1 \\
 & & & & & & 1 & 3 & 3 & 1 \\
 & & & & & & 1 & 4 & 6 & 4 & 1 \\
 & & & & & & 1 & 5 & 10 & 10 & 5 & 1 \\
 & & & & & & 1 & 6 & 15 & 20 & 15 & 6 & 1 \\
 & & & & & & & & & \dots & & &
 \end{array}$$

“My first adventure, when I met Atlas, related Pascal’s Triangle to Fibonacci...” Marie thought aloud in the moonlight as she opened her notebook to her old sketch.



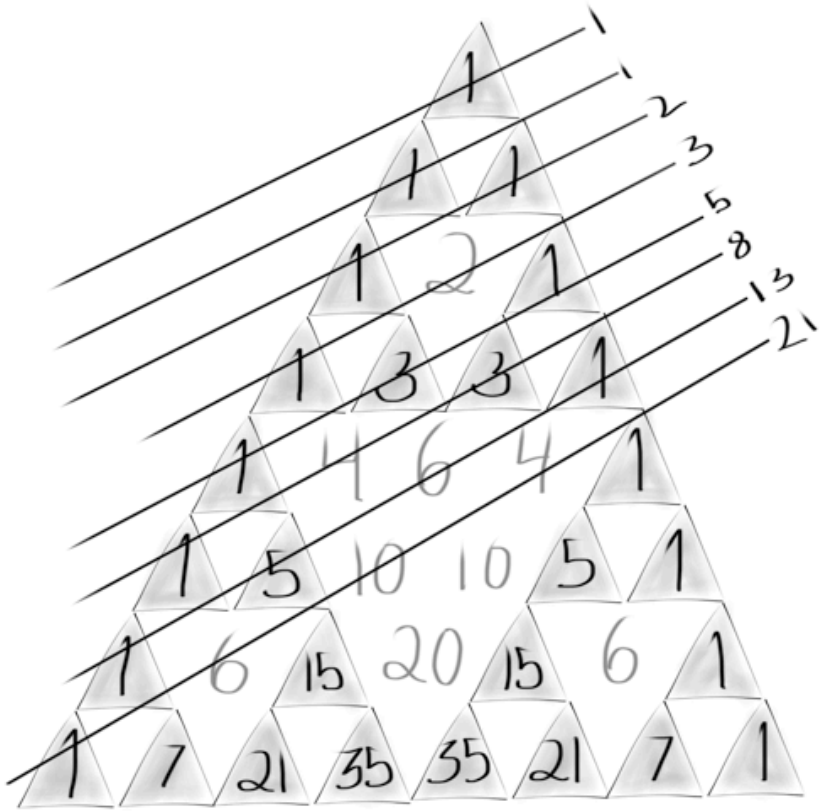
“Maybe Sierpinski relates to Pascal...” Marie looked at the bookshelf in the room and sighed with disappointment. She was not able to reference Pascal from the current selection of books; for she had only packed for a brief stay and had not anticipated the moonlight enigma. Her reference books were packed away with the rest of her belongings.

“Well, sun...or moon, I am awake,” Marie spoke to her window as the silver light still penetrated her curtain, “Now what? Shall I find how Pascal’s Triangle relates to Sierpinski by hand?” She whispered the numbers to herself as she doodled the triangles on top of each other.



“That’s interesting...” Marie paused when she got to the eighth row of Pascal’s triangle. “The even numbers are in the white triangles and the odd numbers are in the grey triangles.”

Holding her notebook steady, she carefully complemented her new triangle with the diagonal lines that correlated to the Fibonacci Sequence. Her hand pulsed with warmth each time she added a new line.



“Atlas? Are you there?” Marie queried with her mind.

“YES” Atlas spoke to Marie through thought.

“Already? I feel like we just got back from our last adventure!” Being reunited again made her feel joyful.

“YES...ALREADY”

“I haven’t even solved this puzzle yet.” Marie looked down at the triangle in her notebook.

“ARE YOU SURE ABOUT THAT?” Atlas asked.

“No, I guess I’m not sure. I was just doodling to see if I could find the relationship and this triangle may be something...” Marie looked at the lines stretched across Pascal’s Triangle.

“TRY IT”

Marie picked up the lid and looked at the precisely inscribed triangles. Carefully, with the tip of her pinky nail, she traced the Fibonacci diagonal lines across the Sierpinski triangles. Those lines instantaneously glowed like the embers of red hot coals. Once she had traced as many lines as would fit, the whole box began to smolder.

“Ouch!” Marie dropped the box on her desk and eyed her hand to see how seriously it had been singed. “That will be a blister...”

Before she could comment any further, the box crumpled as it burned (like paper in a fire). Marie sat in the dark and had the familiar feeling of camping. A fleeting thought of marshmallows and chocolate came to mind as she watched the miniature inferno on her desk.

The walls of the box caved in and formed a single rod-type shape and began to cool. When the last ember faded, Marie cupped her hand next to it to see if it was still hot. The moonlight was somehow still focused through her curtain. Marie looked at the beam of light and thought “Surely hours have passed, how is it that the moon has not yet left my room?”

“TIME” Atlas suggested through thought.

Marie realized that time had somehow slowed or stopped. “The clock...when did it stop? How did I not notice that it’s not moving?”

“THE BOX”

Marie turned her attention back to the remnants of what had been the small silver box. She could see the outline of a rod shape under the ashes. She scooped up the small black pile of debris and brushed off the ashes from the rod. “It’s a key. Not just a rod, but a key! A lever-type key with a pyramid-shaped key ward.”



“KEY TO WHAT?”

Almost tripping over her own feet, Marie rushed to the floorboard that had so intrigued her earlier that night. “A keyhole! I found a keyhole and was looking for a key! It’s in this floorboard.”

“A KEYHOLE!”

“I don’t know where it goes, but let’s just say I was awake...I found it...I was curious.”

“WE HAVE A KEY”

“A Sierpinski- key...get it? Sierpinski! The Sierpinski Triangle.” Marie enjoyed her play on words as she shifted the key in her hand to be able to place it into the keyhole.

“SHALL WE?” Atlas asked.

“Yes.” Marie inserted the key into the floorboard’s keyhole and turned it.

“Crack!” The floorboard made a sound like glass cracking under pressure. Marie’s weight was pushing on the board with her free hand. Before she could shift her weight, the floorboard shattered into millions of splinters and Marie fell right through the hole in her floor. As she fell she thought of Alice again and wondered if this was how Alice felt when she tumbled down through the rabbit hole.

It looked as if she was falling into a galaxy or a tornadic swirl of light. Just like her previous adventures, she felt her body stretch into an infinitely long beam of particles while speeding through space. Marie was excited with the anticipation of yet another wonderful adventure with Atlas. She tried to imagine what kind of planet, solar system, or realm that she was heading towards.

II

PI

Marie's particle stream reconstituted itself and she found herself on yet another world. Immediately, she found that she needed to sit down to get her bearings. The motion of the world that she had landed on was entirely new to her and she was disoriented. She sat down carefully on a rocky surface and started to assess her surroundings and her state of mind. After a little while, she regained her balance.

“Atlas?”

“YES?” Atlas replied.

“Just checking to see that you're here. I feel a bit disoriented.” Marie looked at her hand that Atlas occupied

and smiled. Her eyes slowly went from her hand to her arm when she noticed that she did not have the Lodestar compass with her from her last adventure.

“LODESTAR IS NOT FOR THIS WORLD”

“OK, so, no Lodestar...but my eyes seem to have the ability to see all of the spectrums of light here.” Marie tried to zoom with her vision as she had before to the atomic level and found that she was unable to do so.

“IT’S NOT THE SAME”

“OK, but I still have these!” Marie spread her wings as she stood back up.

“BE CAREFUL” Atlas said. Marie was still unbalanced.

She folded her wings back in and sat on the ground. The ground had small rocks that were purple and green with small, opal-like gems throughout. Marie picked up a palm-sized rock and held it close to her face. She spit on it to clear off any dust, revealing its more polished colors. It reminded her of spitting on her grandfather’s rocks before he polished them in his lapidary workshop.

The rock in her hand revealed exceptionally colorfully-laced agates attached to various opals. It was a pairing of both metamorphic and igneous specimens. Marie moved her gaze away from the rock in her hand and panned the volcanic horizon before her. The world beneath her feet was different than any other she had seen.

“The rocks sitting on the surface at my feet are full of splendor...Oh Atlas, look at this horizon!” Marie was overwhelmed by its beauty.

“IT IS WONDERFUL”

Marie saw the chain of volcanos that lined the entire circumference around her. They were nearly identical and appeared to give off a water-like vapor (or steam) rather than ash or smoke. The vapor glowed with rainbow hues as it refracted the lights from the golden star above her head.

“I think I am in the center of a volcanic ring. Each volcano appears to be the same distance from me.”

“YES. THE CENTER”

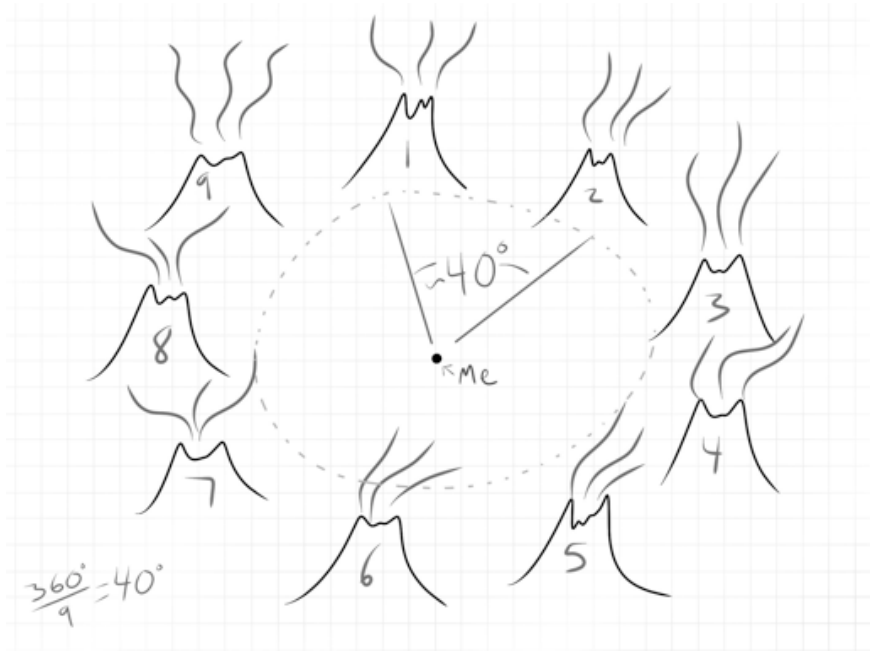
“So where do I go if it seems as though every direction looks the same?”

“MAYBE STAY?”

Marie noticed that there were clusters of dim lights along the base of each volcano. She placed a rock at her feet to mark a starting point so she could methodically count the peaks around her.

“One, two, three, ...” Marie carefully spun around, tallying each steam vent, “...eight, nine. There are nine steaming volcanoes and they all look the same.”

Marie took her notebook out of her pocket and sketched an estimate of what her current position looked like. As she sketched, she noted that 9 divided into the 360 degrees of a circle is 40 degrees between each peak.



Marie sensed Atlas urging her to look down at her feet, but she was too entranced with the magnificence around her to respond. Nine volcanoes in a perfect circle around her was an incredibly beautiful sight.

“LOOK DOWN”

“Down? Oh, sorry, this place is like a living daydream.” Marie looked down at her feet. “There are rocks...and more rocks...”

“LOOK CLOSER”

Marie swiped her feet from left to right to brush the hardened lava, agates and opals to the side of where she

stood. As her feet sifted, she created a downward draft with her wings by slowly bringing them up and quickly drawing them down. This draft moved the smaller, dusty particles away from her feet to reveal a larger, flatter stone. She thought it looked glassy, like obsidian.

“Markings!” Marie knelt down on the smooth rock and gently brushed the remaining dust and sand away from the surface to completely reveal what was at her feet. “It’s like a sheet of paper underneath gray glass. It has writing!”

“WHAT DOES IT SAY?” Marie felt Atlas’s excitement wick up from her hand to her heart;

Marie read the inscription to Atlas in a poetic voice:

*A technical civilization lives here
They are declining into a state of fear
They are in dire need of aid
For without it they will fade
Guidance is limited, except when sought
Foreseen, this civilization’s setback was not
You must find the source of decline
There is no limit but your time
Use the virtue, knowledge, and skill
Help them or this planet will become still*

Marie reflected on the words that had just parted from her lips. Again, she looked at the lights at the base of each volcano and recognized that they were similar to the city lights she had seen at night on earth, in the distance, when she had lived rurally.

“CIVILIZATIONS” Atlas commented on Marie’s thoughts.

“*A technical civilization* is what the inscription says. Lights would be a technical advancement – electricity. There are nine pockets of buildings, so where do we go first?”

“WHERE IS THE START?”

Marie looked at the words that she had read and saw that their location could be the center of a circle and that any direction she faced could be the ‘start’ or 0° of the 360° .

“The words in the inscription can be read easily when I face this direction,” Marie faced towards one of the cities. “I can technically call any direction the ‘start’ or zero degrees in a circle, so I might as well pick a direction and go. I don’t know for sure what is right (if there *is* a right), but I don’t have any better ideas.” Marie began walking towards the first volcano. As she walked, she counted her steps.

“Ten thousand and five, six, seven, eight, nine, ten thousand and ten, eleven, twelve, ...”

Atlas remained silent as Marie counted the radius' length in Marie-sized strides. She didn't know why she was determining the radius of the volcanic ring, but felt like it was too perfect of a circle not to. Flying would have been harder for her to gauge the distance.

After what seemed like half a day, Marie entered a city. Her steps became firm as the ground turned to a hard clay (similar to cement). The hardened ground converged into a road lined with boulders that lead straight to the center of the lights that had seemed so far away before.

"We are here," Marie whispered.

"WHERE?"

"Look! A road sign!" Marie looked at an arch over the road with foreign words on it. Her eyes unscrambled the foreign symbols, "*Truth Metropolis – Only the best honesty.*"

"BEST?" Atlas asked as Marie stared at the digital sign.

"How could there be a best? Isn't truth just the truth? Like a fact is just a fact? How could there be better or worse honest?" Marie thought.

"I DO NOT KNOW"

"Maybe I will learn something new!" Marie smiled.

"MOST LIKELY – MAYBE THE *BEST* NEW"

"Oh, Atlas." Marie's eyes rolled at Atlas' poke at the word *best* in the sign.

She continued to carefully count her steps along the road. Passing building after building in the Truth

Metropolis, she observed that the buildings were nearly identical in style, but varied in height. All of them were red, with smooth clay walls, circular windows, and geometric spirals engraved on the surfaces.

The road led to an intersection of many small roads and eventually they came to a rotary. The center of the rotary had a very large manhole plate on the ground that read: *City Center*.

“City Center,” she read out loud. “Twenty-thousand two hundred and five steps.”



“TEN MILES?”

“Just about.” Marie figured that a mile was approximately two-thousand steps. “Maybe that’s why my legs are so tired.”

“IT’S QUIET”

“It is. The light doesn’t seem to have changed. It’s like the sun (or star) here is in constant dawn or dusk.” It reminded Marie of a time with her family in the arctic circle during the winter, where the sun just seemed to skirt along behind mountainous horizon.

“IS IT NIGHT?”

“Maybe this is their night. I would think for such a city that there would be someone out even at night, but this place is eerily quiet. Let’s walk around and see what we find.”

“SOUNDS LIKE A PLAN”

Marie looked down each street and saw computer-like booths on every block and digital signs posted with various slogans that occasionally flickered:

“Speak only good truths”

“Hear only good truths”

“...Truths that make you happy”

“...Truths that fit your mind”

“No troublesome truths”

“These signs indicate that truth is somehow only told if it’s convenient or wanted...” she paused, “I wonder what would happen if you needed to know the truth, but it wasn’t going to make you *happy*.”

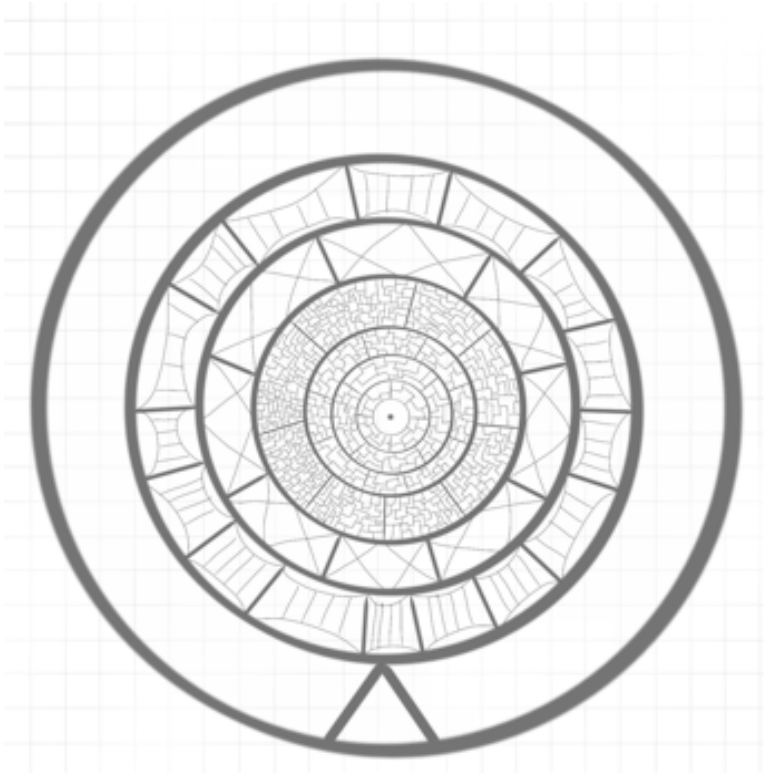
“INDEED”

After another long stroll, the City Center intersection was under Marie’s feet again. “Well, I’m at a loss. We have walked this city and I have not found anything to lead us to where we need to go. I also haven’t seen any evidence that anyone lives here. I need a map.”

“MAYBE FLY?”

“I suppose you are right. We haven’t gotten an aerial view yet.”

Her wings spread and lifted her above the buildings and streets. She was directly above the center of the city and was able to see the design of the circular lanes surrounding the city with the lattices of roads between them. Relieved to be off her feet, Marie took her notebook out and sketched a simple map of the city as she hovered above the rotary. She only drew the main roads of the city. As she sketched, she was fascinated by the mandala-like quality of it.



“I think this city is vacant, because there seems to be no motion at all. I don’t see where to go, or what to do.”

“TRY A BOOTH?”

The computer-like booths that were on every block appeared to be powered off, but she figured that trying one couldn’t hurt.

“LET’S TRY”

Marie landed at a booth next to the rotary and looked at the large screen. She didn’t see a keypad or any obvious input method. She placed her hand on the screen to see if it would activate.

What truth would you like today?

The screen was black with the white words in the center. It had a monotone, robotic voice that slowly read the words aloud to her.

Speak what truth you want. Waiting on input.

“SAY SOMETHING”

“Who am I?” Marie asked, thinking that a personal question wouldn’t get a reasonable response from a computer.

You are smart. You are wonderful. You are Cosmos. You are good. You are nice. You are...

The screen went on and on with compliments. Marie felt a little pride in her ego with the first few compliments, but then recognized that she was feeling a little over-flattered. She also realized that it wasn’t just a computer and that it must have some intelligence.

“BE CAREFUL” Atlas thought to Marie.

“Yeah, it’s weird. The response seemed to be more than words. I feel really good when the screen outputs answers.”

“BE CAREFUL”

“And how did it know we are Cosmos?” Marie felt the need to exercise caution.

“I DON’T KNOW”

Marie felt that she needed to understand the booth more so she asked another question. “Where am I supposed to go?”

Go to the next Metropolis. You will be happy there.

“I think we should go there.” Marie thought, “I don’t see anything in this Metro for us.”

Step on the city center and speak the rotation you need to go to the next Metropolis.

“Rotation?” Marie thought. “What rotation? I’m stumped by what that means.”

“ROTATION?” Atlas repeated Marie.

“It said to go to the next Metropolis.” Marie took out her notebook and looked at the drawing of the volcano ring.

“CIRCLE?” Atlas asked as Marie thought of 360°.

“That’s what I’m thinking.” She figured out the number of degrees of rotation she would need to go one town over on the volcanic circle.

“NINE CITIES”

“So if there are nine Metropolises and 360 degrees in a circle, then...” Marie looked at the sketch of the volcano ring in her notebook and saw her note on the angles between the cities.

“Forty degrees” She said aloud as she stood on the circular plate in the middle of the Truth Metropolis. Nothing happened.

“NOTHING IS HAPPENING”

“I did what the screen said!” Marie said, feeling agitated. She thought about the screen’s compliments and the attraction she had for it. Wanting more, she started to walk back to the booth.

“NO MORE” Atlas urged Marie.

“It helps me think. I have other questions to ask. It’s fun.”

“THIS ISN’T YOU. MAYBE FLY FOR A WHILE AND DON’T GO ON UNTIL YOU ARE BACK TO YOURSELF”

“It said to...” she said, weakly. Then she thought about her request for forty degrees and remembered that the whole concept of degrees may not be the right way to say the rotation.

“OK, BUT STAY AWAY FROM THE BOOTH”

“I think I can handle it, but OK. Let’s think about the rotation needed and forget the booth.” Marie said, still not fully aware of the booth’s effect on her. After a few moments of pondering... “Pi,” Marie thought.

“PI!”

“There are 360 degrees in a circle, but you could also say that there are 2π radians. A radian is another unit of measurement for an angle. Just like feet versus meters. Pi is pretty universal; many civilizations have found it. I don’t know why I would think 360 would be universal, it’s based on Earth’s days...”

“SO HOW MANY RADIANS?”

She walked back to the center and used a ratio to find the number of radians equal to forty degrees’ rotation.

Ratio:

$$\frac{2\pi}{360^\circ} = \frac{R}{40^\circ}$$

$$\frac{360^\circ}{9} = 40^\circ$$

$$40^\circ \cdot \frac{2\pi}{360^\circ} = \frac{R}{40^\circ} \cdot 40^\circ$$

$$\frac{2\pi}{9} = R$$

“Two-ninths Pi” She stated clearly.

The center spun and Marie felt herself fading. It felt like she was fainting and she saw that her hands were becoming transparent. It almost tickled as she dematerialized. She had expected to become a stream of particles but, instead, she was fading. The last thing she saw was her hands turning clear as glass. She wondered for a split second if her grin would be left behind like the Cheshire cat in Alice’s Wonderland.

III

HAPPY?

Marie felt her body rematerialize and saw her clear water-like body become opaque and colorful again. It took a few moments to regain her bearings and feel whole.

“I think I’d rather be a stream of particles than whatever that was.”

“TRANSMIT”

“Transmit? Like transmitted?” Marie thought of how radio, TV, and other waveforms would be transmitted from one source and received by a receiver (radio, TV, radar, ...).”

“AND RECEIVED. GRIN AND ALL...” Atlas joked.

“Ha! I know, I am on an Alice kick today. Well, I would deduce that if we were transmitted or transported and are now in a different place, that we were somehow received.”

“YES”

“Welcome! You have come to be happy!” A fuzzy, two-legged, four-armed, three-eyed creature with a round face spoke to Marie.

“Happy?” Stunned by the sudden appearance of the creature, she repeated its words.

“Come, come, you are in Happy Metropolis!” The creature extended its hand to have Marie come with it.

She reached her hand out and, meeting only air, saw that the creature was really just a hologram. Looking down, Marie saw a circle at her feet that said *City Center* (identical to Truth Metropolis.)

“Shall we follow this hologram?”

“MAYBE, LET’S SEE HOW IT GOES”

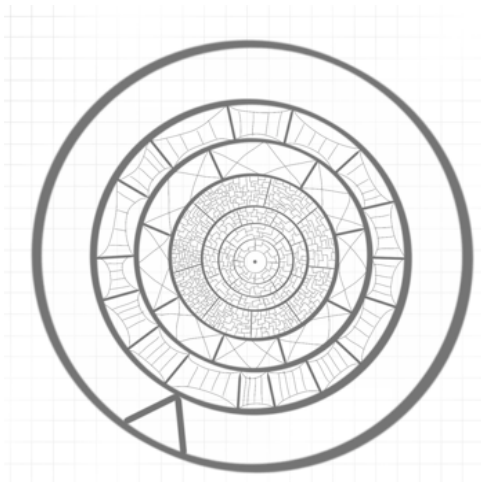
Marie sensed some reservation from Atlas and assumed that it was about her encounter with the booth. She followed the holographic creature out of the City Center rotary and to a booth that looked very similar to the booth in the previous city. Unlike the Truth Metro, this city wasn’t silent. There were creatures buzzing around the rotary and streets. It was full of sounds, motions, and lights.

The beings were all moving about, but not *looking* about; their eyes were locked on handheld screens that looked similar to the booth. They were all smirking, smiling, or grinning in various ways. Signs were flashing with colors and music was blaring from windows everywhere.

“This is nothing like Truth Metropolis.” Marie felt an urge to cover her ears. “I’m not sure they got the name of this city right. I think it’s should be ‘Cacophony City.’” Marie’s sarcasm was mixed with quite a bit of overstimulation. “I need to get out of here, it’s too much!”

“GO UP” Atlas suggested, as Marie became anxious with the volume and stimulus.

Up, up, up, Marie went above the city and took a deep breath. “Look! This city is similar to the layout of the last one.” She took out her notebook and drew a map as seen from above.



“REMEMBER THE WRITING AT THE CENTER?”

“Yes, I remember. I need to focus on our mission.” Marie recalled the inscription from the beginning and recited it out loud:

*“A technical civilization lives here
They are declining into a state of fear
They are in dire need of aid
For without it they will fade
Guidance is limited, except when sought
Foreseen, this civilization’s setback was not
You must find the source of decline
There is no limit but your time
Use the virtue, knowledge, and skill
Help them or this planet will become still”*

She took out her notebook and wrote the words down again, to make sure she remembered. “It said ‘Guidance is limited, except when sought.’”

“YES”

“I asked the booth where to go, and it said here. Therefore, I sought guidance.”

“DID IT WORK? WAS IT THE RIGHT GUIDANCE?”

“Well, maybe we need to find something here. I just don’t know if I am looking in the right places. We walked for so long in the last city and it didn’t help us much.”

“MAYBE WE SHOULD FLY TO THE OTHER CITIES”

“Maybe, but I don’t think we should leave just yet.”

“THOSE BOOTHS AREN’T GOOD”

“I think we should ask for more help.” Marie thought of what she would ask. She also felt slightly afraid of how the booth would make her feel. Last time, she hadn’t wanted to leave it. It had a pull to it that made her want to stay and feel good all day. At the same time, she figured that she could handle it.

“ASK QUICKLY AND CAREFULLY”

“True, I felt OK when I asked where I should go. I think I just need to ask objective, rather than personal, questions. When I asked about *who* I was, it felt like the booth wanted to suck me in.”

“ASK ABOUT THE INSCRIPTION”

“I think that you are right. We should be direct and try to find out what the problem is that is causing decline. The inscription said the limit will be my *time* – so I hope we have enough.”

Marie’s mind wandered briefly back to Alice and couldn’t help thinking of the white rabbit saying that it was

late and wondered if she too would be late. The last city seemed to already be fully declined. It was like a ghost town. Happy Metropolis, however, was not in decline. It was loud, obnoxious, and in full motion. Marie wondered what was declining.

“LET’S GO”

They flew down to a booth so Marie could ask it another question. “I have come from far away and have read a sign in the center of your volcanoes. It said that your civilization is in decline. How do I find the source or cause of this decline?”

The booth remained blank, but a flashing blue light began to spin at the top of the booth’s cover. Everyone around Marie continued to stare at their screens, like nothing was happening, but Marie felt otherwise. The booth was still blank, but the light looked like an alarm, and that made her nervous.

The hologram appeared again next to Marie. “You aren’t happy.”

“I feel happy. I am just a bit nervous at the moment. Why are you saying I’m not happy?” Marie asked. She was confused as to why a hologram would be so concerned with her happiness. Again, the booth was affecting her emotionally.

“BE SPECIFIC WITH YOUR QUESTIONS. WE SHOULD GO” Atlas urged Marie.

“I need to try.”

“WE NEED TO GO!” Atlas urged again.

Marie thought she could handle the hologram’s emotional effect on her and listened as it spoke again.

“Happiness matters and you aren’t emanating ‘happiness’. You don’t want to feel sad, do you?” The hologram stared into Marie’s eyes and she saw a pale blue light deep within them that grabbed every ounce of her concentration. It was hypnotizing.

“Yes, happiness matters and I don’t want to be sad.” Marie began to feel sadness deep within her heart. She was entranced with the hologram. It had affected her mind and ability to control her words, feeling, and motions. Atlas fell silent as she stared into the pale blue light.

“Come with me and you will feel better.” The hologram walked backwards with Marie following as she continued to stare into its eyes. She felt a pain in her hand, but it didn’t compare to the sadness she felt in her heart. She didn’t have enough control to pay attention to her hand. “Come with me, you’ll feel better.”

Marie followed. Her thoughts were no longer her own. She did as the hologram asked.

The roads were busy and creatures moved about, glued to screens that entertained them. Marie walked the streets among them with a smile on her face and a screen in her hand. The sadness was gone. She saw images of family, and kindness. Justice, love, and beautiful stories unfolded before her eyes. Everything on the screen made her feel

like what she was doing was deep and purposeful. She was spoon-fed every thought. She received all of the nourishment she needed as long as she stared at the screen. Even sleep was conducted with her eyes open.

Days, weeks, months, years... so much time went by. Marie felt occasional pain in her hand, but it was quickly alleviated with images that kept her gaze and her thoughts under the control of the screen.

One day as she circled the city center, her screen flickered and went off for a split second. As if a falling apple had hit her on the head, she suddenly felt awake. Her hand began to throb with pain, and she dropped the screen. The flicker had broken the spell.

“Ouch!” she thought carefully. She knew, in a fearful way, that if she said it out loud that she would be “helped” by another hologram. She was coming to the realization that she had been in a sort of ‘prison of the mind’. However, she knew she was in full control of her thoughts again.

While she was controlled by the screens, she had stopped thinking of stories, math, music, dreaming, art, or anything else she could dare use her mind for. It was already done for her. She realized her thoughts had been controlled for what seemed like a long period of time.

“YOU ARE BACK!”

“Atlas?” Marie swiftly realized again that she was Cosmos. She then remembered that her hand had hurt and

that it must have been Atlas the whole time. “My hand! It was you!”

“IT’S BEEN SO LONG”

“How long?” Marie looked at her hand that was stuck and stiff in the position that it had held the screen. Her joints didn’t want to move. “My hands...my hands... they... they...”

“LOOK”

“No, I can’t!” Marie felt Atlas urging her to look into the glass of a window on the street. She knew what she would see.

“LOOK. YOU MUST”

She slowly brought her eyes to the window and looked at her reflection. An elderly woman stood in the reflection with droopy wings and long, mangled hair. She saw her very own eyes behind a wrinkled face, framed with silver hair and a humped back. “It can’t be!”

“I’M SORRY. I TRIED TO WAKE YOU. I TRIED TO BREAK THE CONTROL OF THE SCREEN”

“It can’t be!” Marie began to crumble under her shaking legs. “I’m elderly! I have lost so much time!”

“DON’T DO THIS HERE!”

A hologram appeared, “Come, come and be joyful. Come and be happy.” It was an exact replay from when she had first arrived.

Marie looked at the hologram with a mixture of fury and overwhelming loss. She shouted, “Joy comes from your heart! It’s what you feel when you love and are loved. It’s what you feel when you see true generosity, compassion, and unity. What *you* have given me is not joy! *Your* happiness is entertainment only! It is an idle fancy that rots life away! You have taken so much of my time! *My* time!” Marie wept uncontrollably.

“Come, come, and be happy!” The hologram was relentless in trying to get control of Marie again.

“No!” Marie took a deep breath and knew she needed to get away from the hologram to clear her thoughts.

“RUN...NO...FLY”

“Fly? Yes, I must fly.” Marie stretched her wings out from her hunched back. They felt stiff and cumbersome. She was initially worried they would snap like brittle bark. As she spread her wings she regained strength in her mind and began to lift up off the ground.

“UP, HIGHER”

An updraft combined with the solar power of her wings lifted her away from the invisible pull of the hologram. Hovering above the city she saw the buzz of all the creatures and their screens moving with no purpose.

“WE HAVE A MISSION” Atlas reminded Marie of her purpose.

“You’re right. We do have a mission, but I don’t remember what the words in the center of the volcanic ring

said - It's been so long..." She patted her pockets and found a familiar object. Taking out the notebook, she found her writing. "*There is no limit but your time.*"

"TIME" Atlas repeated.

"I lost a lot. At this rate, I may never finish this adventure..." Marie said, but then she stopped her negative thoughts, "Never mind, we can do this. Let's find out what's going on. I think a civilization that has beings plugged into screens like this is obviously in decline! How will they ever invent? Create? Solve problems? ..." Marie's eyes lit up. "That's it! How would they ever solve problems! They are stuck in some virtual life and so they don't ever fix anything."

"SO..."

"Let's fix their screens."

"HOW?"

"I don't know. Maybe we should ask."

"NO. IT'S TOO DANGEROUS"

"Let's ignore the hologram and go to the booth. Remember how the booth in the Truth Metro gave us an answer? We can do this. I am never going to be pulled by that hologram again. It sucked my time away! I can handle this." Marie pushed away the anger and sadness of how much of her time was gone. Then she remembered that Atlas had urged her to get away from the hologram and she hadn't listened. "I'm sorry. I should have listened. You were right about leaving. So much time..."

“YES, SO MUCH TIME”

“Right, so I think we should go to the booth. I promise that if you ask me to leave...I will.” Marie felt like her old self again.

“OK, LET’S GO”

They flew down and landed next to the booth. Marie looked into the glass as she stood there for a moment and thought again of Alice, Wonderland, and the Looking-Glass. She felt that it was such nonsense to lose so much time to a hypnotizing screen. “Not so different from Alice entering into her nonsensical world... I am logical and hopefully will understand this one.”

“YOU ARE AND YOU WILL” Atlas reassured her.

At the booth, she asked simply, “How do I fix everyone’s screens so they have control over their own thoughts and feelings?”

Are they in need of maintenance?

“Yes, they are malfunctioning. I am here to help.”

Prove you are authorized: How many maintenance roads are required to connect the cities of the ring?

“FLY”

Marie listened to Atlas. She saw that the hologram had just appeared next to the screen as she lifted off. This got her away from the droning voice of the hologram.

“I really don’t like those holograms constantly popping up.” Marie commented.

“HOW MANY ROADS?”

“Right, so, how many roads are needed?” Marie got out her notebook and drew a sequence of circles and showed how the number of roads depended on the number of cities on the circle/ring. “This sequence relates to Pascal, and it’s also the triangle numbers, and...” She stopped talking as she sketched it up and started a rhyme in her mind:

*How many chords
can you afford?
A dozen, ten or four?
Don't guess, think a bit more.
Start with the points you possess.
Now make it one less.
From zero to this number
Add each integer to infer
The answer is the chords
That you can afford*

n = number of lines (chords)
 p = number of points

$n=0$
 $p=1$

$n=1$
 $p=2$

$n=3$
 $p=3$

$n=6$
 $p=4$

$n=10$
 $p=5$

$n=15$
 $p=6$

$n=21$
 $p=7$

$n=28$
 $p=8$

$n=36$
 $p=9$

$n = \text{triangle number!}$

1
 3
 6
 10

1
 1 2 1
 1 3 3 1
 1 4 6 4 1
 1 5 10 10 5 1

Pascal

“IN RHYME?” Atlas asked.

“Why not, we might as well have fun.” Marie smiled and then came up with the answer. “For a circle with nine cities, it’s thirty-six chords.”

“SHALL WE GO BACK DOWN?”

Marie closed her notebook. “We shall! Let’s go.”

“YES”

Marie approached the booth. It still had a prompt asking for authorization. “Thirty-six.”

Approved. You have authorization.
Go to City Center. Your code is
1, 3, 6, 10, 15, 21, 28, 36, 45, . . .

The computer kept outputting the triangle numbers as the authorization code. Marie walked to the City Center. The hologram approached her as she stood on the circular disk at the center.

“Come and be happy!” The hologram seemed firmer in its words than before. “Look into my eyes.” It said, sounding pushy.

“I am here for maintenance.” Marie avoided the eyes of the hologram.

“State your code.” The hologram was inches from her face.

“1, 3, 6, 10, 15, 21, 28, 36, 45,” Marie smiled

“Keep going” The hologram gave an almost devious smirk.

“55, 67, 79,” Marie saw that the authorization code was still printing on the booth screen across the rotary and that she was being asked to state an infinite sequence.

“NOW WHAT?”

Marie kept saying the triangle numbers to keep the hologram busy, but was trying to think of how to get past the idea of talking forever and never getting to the end of the code. She was quite amazed she was able to keep going with the numbers and to also have some side thoughts. She couldn't quite articulate what she wanted to say.

“TRIANGLE” Atlas gave her the word she was trying to bring to the surface of her mind.

Marie repeated Atlas out loud, “triangle numbers!”

“Correct. Authorized.” The hologram almost seemed to flicker as Marie's words were deemed adequate.

“I am the hologram interface. State the maintenance to be performed.”

“Fix the screens and booths.”

“Cannot comply. Booths are managed from Truth Metropolis.” The hologram stood still.

“Fix the happy screens for this city so they no longer control anyone's thoughts,” Marie commanded, hoping it would work.

“Confirmed. Shutdown in 5, 4, 3, 2, 1.”

The hologram faded and the screens in the cities all went black. Traffic, sound, light, movement, all ceased. The

creatures' movements slowed down to dazed stumbles as if they had been asleep for decades.

“Shutdown? I thought I said fix?” Marie thought to Atlas.

“IT WORKED, THEY AREN'T LOOKING AT SCREENS”

“I guess it did work! I hope they will be OK.” Marie thought to Atlas as she looked around and saw people waking up. Her thoughts turned back to the time she had lost, “I wonder how many decades...”

“LOOK” Atlas urged Marie to look at herself again.

Marie looked into the glass across the rotary. She couldn't believe it. She ran over to a window and stared at herself. “I'm back to how I was! I didn't age!”

“MAYBE THE SCREENS”

“When we turned off the screens, I lost the aging that had happened. Maybe the screens age you and that much time hasn't passed. I don't know how long I was attached to the screens, do you?”

“NO. IT SEEMED LIKE A LONG TIME”

“It felt like a lifetime.” Marie thought, and then she noticed one of the citizens approaching her.

“Excuse me.” A small creature shyly spoke.

“Hello,” Marie looked at the small purple fuzzy creature.

“Did you do this?” He said as he held out his hand with a blank screen.

“Yes, I did. I am sorry, but...”

“Thank you!” The creature hugged Marie before she could apologize for taking away their technology. “I have been stuck for a very long time. I was on the maintenance crew and one day I came to check on the hologram of the Metro. It wouldn’t accept the five-digit code and kept wanting more. When I became upset, I became a citizen of Happy Metropolis as it pulled me right into the entertainment of one of the screens.”

“I don’t understand.” Marie was trying to wrap her head around what he was saying.

“You see, Happy Metropolis is a city that we come to if we are upset or sad. It worked for a long time. People would come for a couple of days and then go back to their lives. However, years ago we started noticing that once people made it to Happy Metropolis, they didn’t want to (or couldn’t) leave.”

“Oh, no!” Marie began to see how the technology was malfunctioning. “I got trapped here too. I woke up and realized I had aged by decades. But when I turned off the screens, my aging disappeared.”

“This is one of nine cities in our civilization. Before I came here a lot of them, except for Truth Metropolis, were malfunctioning. We didn’t know how to fix anything because the inventors existed so long ago and the

technology has never needed anything besides basic maintenance...” He paused and looked around. “No one here really knows how any of our technology works.”

“So are the other cities like this one?” Marie asked.

“No, but come with me.” The creature started walking to the City Center again. “My name is Regor. What shall I call you?”

“You can call me Marie, or Cosmos.” Marie thought about explaining how Cosmos meant that it was she and Atlas, but decided not to make it too complicated for Regor.

“Cosmos! Yes, I know of this name! Before I got stuck here, I had stopped at Truth Metropolis and attempted to see if there was anything that needed cleaning. There was a blue light that looked like a beacon in the Core. It flashed the word Cosmos! I couldn’t get in because it was secured somehow.”

“BEACON, YES”

“Is that why we are here?” Marie thought to Atlas.

“YES”

“Did the ancients have something to do with this?”

“MAYBE”

Marie stopped with Regor on the City Center disk and looked around. All of the citizens of the city were looking at the sky, their surroundings, or each other. They were talking, smiling, and hugging. Marie wondered if there had

been any conversations or relationships during the years that they were all fixed to the screens.

“Are you here to help the rest of our cities?” Regor looked up at Marie with hopeful eyes.

“Yes, absolutely.” Marie absorbed the smiles and laughter of the beings around her. It felt good.

“Then we must go to another Metropolis.” Regor stated.

“What is the name of the next Metro?”

“Knowledge Metropolis,” Regor said. Marie saw him flinch as he said it.

“Why do you look so worried?” Marie asked as she observed Regor showing some anxiousness.

“Knowledge Metropolis was the first city to have problems. Everyone who was there fell ill and they are now in Healing Metropolis. I am worried that we may get sick if we go there. I know that you should go, but I am nervous for you.”

“OK, let’s go to Knowledge Metropolis. We can do this, Regor.” Marie reassured him.

Regor took a key out of his pocket and stuck it in a small hole at the center of the City Center disk they were standing on. The disk lowered into the ground like an elevator without walls. A large screen stood before them.

Destination?

“Knowledge Metro,” Regor said.

A wave of gravity-like energy pulled Marie and Regor off of the disk and into a sideways falling motion through a dark tunnel.

“This is how we get there. It is a straight path.” Regor whispered.

Marie nodded and continued to fall. Again, her mind wandered back to Alice tumbling down the rabbit hole. She wondered if she was going to be late, like the white rabbit. She quickly turned her thoughts away from Alice and looked back at Regor.

“I should warn you that this city will read your mind.” Regor said with a concerned look.

Marie tried to imagine a city that could read a mind as she continued to tumble down the tunnel. She had encountered objects and devices that could read minds in the past, and found that they often presented difficult challenges. She took a deep breath and mustered up her courage.



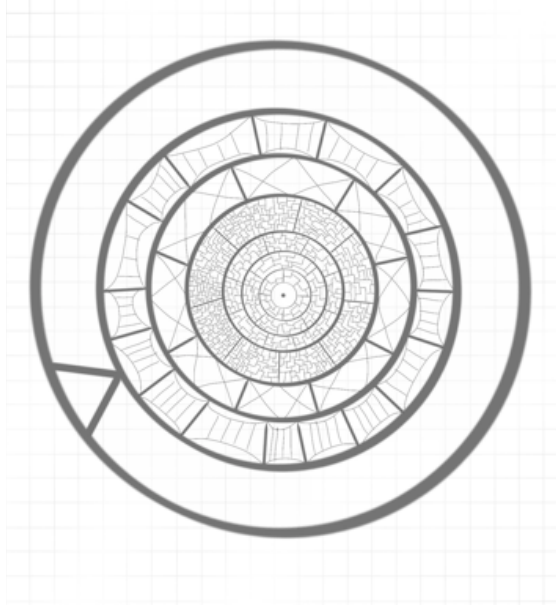
IV

RABBIT HOLE

Regor and Marie continued to fall through the tunnel for a matter of minutes before they stopped on a City Center disk in the tunnel that then raised up from the tunnel and brought them to a rotary in the center of Knowledge Metropolis.

“I’ll be right back, Regor,” Marie quietly said, “I am going to fly up and get an idea of the layout of the city.”

Marie lifted off the ground until she was high enough to look down at Knowledge Metropolis. The city was empty. She sketched a map and noted how similar it was to the other cities, with the exception of a v-shaped road at the edge of the it.



Marie closed up her notebook and thought, “Down we go,” as she coasted down.

“ARE YOU READY?”

“Yes” Marie was curious as to what the mind-reading city would be like.

“REGOR SAID IT WILL READ OUR MIND”

“We read each other’s minds all the time, and we have encountered a few telepathic species. I think we will be OK.” Marie landed next to Regor.

“So, don’t go to those booths,” Regor said as he pointed to the booths that were identical to the Truth and Happy Metropolis, “they are all run from Truth Metro

and nothing can get fixed here. They have sent some of us to Healing Metro. They can make you feel and think things...”

“I will avoid those.” Marie thought about her first encounter with them in Truth Metro. She knew she would eventually have to deal with them, but not now.

“We are going to go to the Library,” Regor said with a tremble in his voice, “this is where you can ask for all the knowledge you seek. If you dwell here long enough, you don’t have to go to the Library. All you have to do is think a question, and you will have the answer fed to you through your mind. The Metro’s systems will start to read your mind soon.”

“HE SAID *IT*, NOT THEY. IT’S NOT A PERSON TO READ YOUR MIND, IT’S TECHNOLOGY”

“And every type of technology has flaws...” Marie thought to Atlas. She didn’t like the sound of ‘it’.

They walked to the Library that bordered the rotary. Marie glanced around at the clay buildings and felt the stillness of the city. It was much like the first Metropolis – empty of life.

“Wow!” Marie said as they approached the giant arch leading into the building. It was ornamented with numbers, paintings, and scientific equations. As they entered the Library, Marie noticed that there weren’t any bookshelves or books.

“Where do you store your literature, science, math, art, ...”

“Here,” Regor pointed to a large screen that resembled the Truth booths outside.

“How do I get this to work?” Marie said, looking at the screen.

“I thought you would know what was wrong.” Regor stared at Marie with a perplexed look. “You said you were Cosmos, so I assumed that you would fix this so my people could use it again without becoming sick.”

“I am here to help, but I have to figure out *how* to help. I don’t know everything. I am a problem-solver. How did they become sick?”

“I don’t know!” Regor was appearing to be agitated. “I miss the Happy Metro screens. I don’t understand why you can’t fix this instantly! I thought you would make this better! I don’t like this feeling...I am sick!” Regor said, looking panicked.

Marie took a deep breath and realized that her new friend was having a hard time coping with her questions. She felt like Regor wanted instant gratification for the city, and she couldn’t give him that. She rephrased her inquiry, “What did everyone’s sickness look like?”

“Oh, well, hmmm...” Regor tried to find the words, “Well, they started to forget everything. They couldn’t remember the days, or numbers. Then they forgot their names. Remembering anything for more than a moment

was impossible. I didn't come to this city often. I didn't need much knowledge for cleaning maintenance. I just know that people stopped retaining information."

"So, everyone just forgot everything?" Marie asked as she imagined large numbers of people forgetting their names and where they were going.

"Well it didn't happen all of a sudden," Regor shifted the weight on his feet with nervousness. "You see, as I understand it, there were just a few people that needed to go to the Healing Metropolis at the beginning. Over time, more people needed healing, but it took years for it to get severe. It was just at the time when Knowledge Metro became vacant that I was sent to Happy Metro and became a permanent citizen."

"Are you all right?" Marie looked at Regor's eyes and noticed that he was really having a hard time coping in this Metro.

"I'm not feeling well; I need to go to the Healing Metro." Regor responded.

"Wait, let me find you some water and food. I can help you!" Marie tried to help Regor over to a bench.

"No! We don't do that! We don't help!"

"Do what? Help?"

"You are not a Healer; you can't help me. You will become sick." Regor was acting increasingly irritated and increasingly irrational.

“I will be OK. I don’t think I will get sick. But I need your help to understand your world. Please take a deep breath and try to calm down.” Marie didn’t understand why Regor was so averse to her helping him or why he thought it would make her sick.

“Take this,” Regor handed Marie the maintenance key that he had kept in his pocket, “I am not well. I need to go to the Healing Metro. This is not good. Don’t look at me. Where is the Helper? It should have sensed my sickness! Why am I not moving?” Regor appeared to be talking to himself and became unresponsive to Marie’s touch or words.

“Helper?” Marie asked Atlas. “It seems to me that Regor is just having a hard time handling stress.”

“MAYBE THE HELPER IS ANOTHER
AUTOMATED SYSTEM”

“Maybe.” Marie looked around.

Suddenly, and unexpectedly, a hologram appeared. “I am here to help you. Please wait until transport arrives. I am here to help you. Please wait until transport arrives. I am here to help...”

“I guess that’s the Helper,” Marie whispered as she watched the hologram stand next to Regor.

“HERE IS THE TRANSPORT” Atlas said as they watched a small, robotic three-wheeled stretcher roll over to Regor.

“Look how advanced that is!” Marie watched the stretcher gently swoop down and lift Regor to its bed and roll over to the City Center. It ordered the radians to go and they faded into thin air as they were transported to Healing Metro.

“I think we will eventually go to Healing Metro... but I don’t want to go that way.” Marie was disturbed. She felt like Regor just needed some help calming down and maybe some sustenance, but certainly not a hospital. “I think he was just anxious. Why did he say I couldn’t help?”

“AGAINST THE...”

With a loud robotic interruption, the large screen answered Marie and printed its words on the screen:

It is against the law. You cannot handle helping or healing. It is for Healing Metro and the Healers.

“Who are the Healers?”

The Healers are the best, most wonderful healing automation devices.

“Why can’t I help? I don’t understand.” Marie thought of machines running hospitals and shuddered. She couldn’t

imagine not having her mother's touch, her father's stories, or a nurse's smile to help her get well.

You may become unhappy. You may become sad. You may be inconvenienced.

“When people are sick, we help them. It doesn't matter whether it's an inconvenience or not.” Marie stood there and the screen remained still.

“WE NEED TO FIGURE THIS METRO OUT”

“Right,” Marie gathered her thoughts about the current Metropolis, “Why did people get sick here?” Marie asked the screen.

Cannot comply. Invalid question.

“Is there a history of what events lead up to everyone leaving this Metro?”

Cannot comply. You are not authorized to view search histories.

“Search histories?” Marie thought of the Internet at home and how people could look up anything and everything. Encyclopedias, books, science, math, and more could all be accessed with the pressing of a few keys.

“MAYBE THAT’S WHY THERE AREN’T ANY BOOKS HERE”

“Maybe everything they know is in this screen... I think we should try to see what people came here to learn...” Marie paused, “I think we need to look at their search histories.”

“ASK FOR AUTHORIZATION”

“Please give me authorization to view search history and access maintenance of this system.”

Cannot comply. Truth Metro override. You must be Cosmos or other authorized entity.

“But I am Cosmos!”

Confirm authorization. Solve:

Marie waited for the robotic voice to give her a problem to solve, but nothing happened.

“SOLVE?”

Marie asked, “Solve what?”

Computing...

Marie felt an odd sensation in her head. It was like someone had put a book on her head and she needed to balance it.

Computing...

“COMPUTING YOUR MIND” Atlas noted as Marie sensed the infiltration of the computer screen into her thoughts.

“What?” She asked, not completely understanding. She felt fuzzy-minded with the computer’s computations.

“IT’S READING YOUR MIND” Atlas reiterated.

Computing...

“FLY”

“I can’t,” Marie thought, “I have to balance this on my head.” She felt like if she moved an imaginary book would fall off of her head. She felt that the computer was doing more than reading her mind. It felt as if she was entering a virtual reality.

“THERE IS NOTHING THERE”

“I must balance this.” Marie said as she continued to feel an overpowering urge not to drop whatever was on her head.

Complete.

Confirm Cosmos: Begin simulation...

Marie looked at her feet and saw that a vortex had opened directly underneath her as she started to fall into it. She wasn't scared or surprised, and just relaxed as she tumbled down.

“LOOK”

Marie glanced around her as numbers, symbols, snail shells, and fractals were passing by. Even a clock, like the one in her room that had stopped, was floating by as she fell passed it.

The clock reminded her of Lewis Carroll's “Two Clocks.” It was a question of whether you would rather have a clock that is stopped or one that loses a minute a day. The one that is stopped is right twice a day, while the other is only right once every two years. She grinned with the thought of preferring the stopped clock.

“ALICE... YOU ARE FALLING LIKE ALICE”

“You're right. I think the computer read my mind. I keep thinking of Alice today, and now I am experiencing some of my earlier daydreams and thoughts in this reality.”

With those words, she suddenly landed. She looked around and saw a vial of liquid. It read: “Solution.” Next to the vial was a riddle.

*For the first solution,
you must use the Solution.*

*With this beaker of 13 ml,
and this beaker of 7 ml,
fill the larger beaker to 5 ml.*

Marie looked at the tiny beakers and the vial of Solution. The beakers had no markings. The only measurements that Marie had were the total volume for each – 13 ml and 7 ml.

“I’ve seen this sort of problem before! With jugs, or containers. It’s number theory!”

“THINK”

Marie took out her notebook and started to figure out how to put 5 ml of Solution into the larger beaker.

Abruptly, a rabbit jumped across the room and yelled, “I’m early! You’re going to be late!”

“FOCUS”

“Late?” Marie asked as she partook in the distraction. She didn’t notice that she was starting to shrink.

“FOCUS... YOU’RE SHRINKING”

“Oh, dear!” Marie wrote faster in her notebook to solve the problem. She felt herself getting shorter and shorter.

“I’m early! You’re late!” The rabbit repeated.

“FOCUS”

Marie was worried that she wouldn’t be able to move the vials if she shrank too much. She repositioned herself on the desk and continued to solve the riddle.

“YOU’VE GOT THIS!” Atlas encouraged.

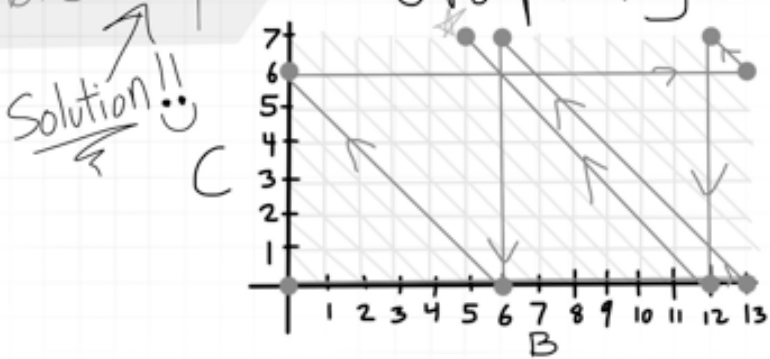
“I do! I have it! Here!” She pointed to the steps in her notebook.

Marie followed the steps and quickly ended with 5 ml of Solution in the 13 ml beaker. She contemplated the numbers and saw a pattern when she graphed them. However, she had to move on because she was still shrinking quickly and realized that the top of her head was now next to the 5-milliliter level in the beaker.

	(A)	(B)	(C)
Start	0	0	0
Pour from A → B	13	0	0
Pour from B → C	6	6	7
Pour C out	6	6	0
Pour from B → C	0	0	6
Pour from A → B	13	6	6
Pour from B → C	12	6	7
Pour C out	12	6	0
Pour from B → C	5	6	7

← This works if B + C don't have any common divisors other than 1. (B + C are relatively prime)

Pattern w/ Graphing



“WE ARE STILL SHRINKING”



For a moment more they continued to shrink until the 5 ml beaker was 5 times as tall as Marie. “Well, I suppose I am about a millimeter tall.”

“SMALL”

“Yes, a millimeter small.” Marie laughed.

“LOOK”

In the dark vortex of a ceiling above a teeny, tiny slip of paper fell to Marie. It had illegible writing on it:

PROBLEM TWO IS IN YOUR SHOE
DEEPER IN YOUR MIND YOUR DE
TO PROVE COSMOS IS YOUR
WANT IS IT THAT YOU KNOW?

Marie looked at the note and couldn't read the nonsensical lettering. Marie studied the note some more and realized the words were not as peculiar and illegible as she had initially thought. "I need a mirror."

"THE BEAKER?"

"That is glass, isn't it?" Marie held the sheet of paper up and tried to make out the words in the reflection off the glass.

"TAKE IT OFF"

Marie sat down and pulled off her left shoe. There was nothing in it.

"THAT'S NOT THE RIGHT SHOE"

"Ha!" Marie laughed as she pulled off her right shoe. Under her big toe was another note, but it was so small that she couldn't make out the words.

"MAGNIFY?"

“I do need a magnifying glass.” Marie quickly looked around. The towering beakers and solution vial didn’t offer her any magnification.

“A DROP?”

“Yes! Maybe a drop of that solution will magnify it, but how do I get some? I can’t climb that high.”

“YOU POURED”

Marie looked around and realized that she had indeed spilled a small amount of liquid. She scooped up a palm-sized drop and placed it on the sheet of paper.

“QUICKLY”

Marie realized the Solution was dissolving the ink and she needed to read quickly:

Problem 2:

Find the grin, then the kitty

A purrfect riddle that will require you witty

Taste a drop of the vial

On to the next trial!

“Here we go!” Marie dipped her finger in the drop of solution and put it to her tongue.

“PURRFECT”

Marie felt her body stretch and grow until she was back to her normal size. She shook her wings and stretched her arms out to reassess her dimensions, but before she could finish, a trap door opened underneath her feet and she fell into it.

“Again with the falling!” Marie braced herself.

“WE ARE IN YOUR MIND”

“I think you are right (not left). Let’s not forget that we are in my mind.”

With a thud, and thankfully unharmed, she landed in a dark forest at the edge of a pond with various smooth stepping-stones. Only darkness was behind her and the pond was impassable around. It appeared that the stones were the only way forward. The trees were so thick that Marie couldn’t fit through any other way.

“Peculiar,” Marie looked around her, “These woods are like nothing I have ever seen.”

“IMAGINED?” Atlas asked.

“Oh...” Marie realized that she had imagined the woods before, “This isn’t good.”

“JABBERWOCK” Atlas commented on Marie’s thoughts of dark woods and a beast that lived within.

“Yes, I imagined this place when I was small and my mother read me the poem of the Jabberwock – A horrible creature.”

Marie began to feel a sense of fear, but quickly reminded herself that she was in her own mind.

“NONSENSE”

“You are right. The poem was nonsensical. Let’s find the grin and the kitty.” Marie looked around for the Cheshire Cat from Wonderland. She thought of one of Martin Gardner’s notes in her book *The Annotated Alice*. It had said the phrase “Grin without a cat” as being a not-so-bad description of pure mathematics. Gardener said that mathematical “*theorems themselves are abstractions that belong in another realm.*”¹

“ANOTHER REALM”

“It seems that when we are together, we are often in other realms. Pure math really is abstract – that’s why I love it!” Marie grinned. She thought of her grin as a separate function – an abstraction of herself. Her grin was discrete.

“GRIN”

She felt her mouth come loose and fall into her hand. It wasn’t scary because she had been the one to think of her grin as separate from herself. She was in control of this abstraction. She looked down and saw her grin in her palm. As she held it she felt an odd sensation on her head and rear. She looked at her reflection in the pond.

“MEOW”

Marie saw her pointy ears and excessively long tail. “Meow,” She thought, for her mouth was detached.

¹ *The Annotated Alice* by Lewis Carroll with an introduction and notes by Martin Gardner, Bramhall House, MCMLX, pg. 91.



“I am the kitty!” Marie thought to Atlas, “And here is my grin!” She held up the grin with her paw.

Unfortunately, most cats do not have opposable thumbs and her claws had not pierced the grin, so it fell, tumbling into the pond.

The water lit up with a glow as the grin submerged. Marie watched it get caught up in a current and swirl around the stepping-stones. She had an urge to chase it and catch it. Her tail twitched.

“DON’T”

“Yes, you’re right,” Marie thought to Atlas, “What is the ‘purrfect riddle?’”

“LOOK!”

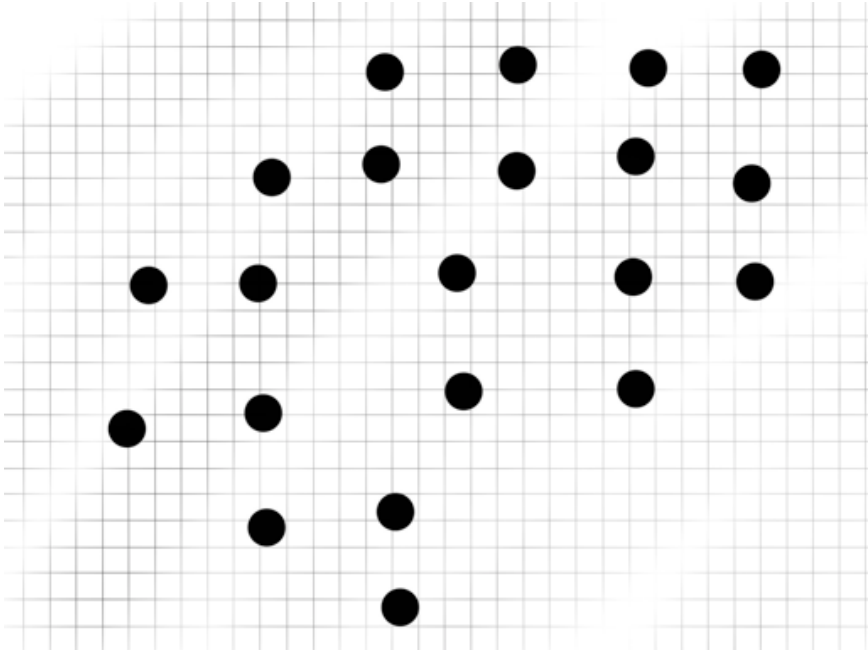
The closest stone lit up with a green light and words appeared, one at a time.

*Cross this pond by the stones,
But be sure to touch them all,
Not more than once, or you will fall!*

“Well, I can’t write in my notebook.” Marie thought as she lifted a paw and held it up to her eye to look closely at her condition. “And thank goodness you can hear my thoughts! Because my mouth is over there in the water.”

“USE A CLAW TO DRAW?”

“I can try,” Marie took her claws and started to draw a picture of the stones in the pond on the hard clay next to the bank. She imagined her notebook’s gridded lines in the clay as she scratched.



“WE CAN ONLY TOUCH EACH STONE ONCE”

“And we have to make sure we touch all of them.”

Marie tried to figure out how to cross the pond and no matter how many times she tried, she couldn't end up on the other side.

“THE POND IS DIMMING”

Marie looked up and saw that pond's glow was fading.

“It won't work.” Marie erased her lines between the stones again. “It's the field of Graph Theory...I am having a hard time seeing how we can finish the path to the other side of the pond. To touch all of the stones once, we would stop in the middle of the pond – not on the other bank.

Marie hopped across the stones with her outrageously long tail carefully curled up behind her so as not to touch the stones more than once.

When she hopped onto the last stone, Marie surprisingly found herself back in the Library.

Cosmos Confirmed.

Instinctively, she reached for her mouth to make sure her grin was back.

“IN YOUR MIND” Atlas reminded.

Marie looked back at the Library screen. The logs of data began to scroll and she was able to search through the happenings of the city and the people.

Marie commented, “It appears that over many years and even generations, people started relying on the computers for all of their information. They would ask for all of the trivia that came to mind and get immediate answers. Because the computers anticipated questions, no one ever had to remember anything. Over time, people didn’t bother to try to remember things as simple as their names because they could just look it up.”

“THEY LOST THEIR MEMORIES”

“Precisely, they had knowledge on their screens in every home, and at every Library, and in every mind. Who would want to leave a constant flow of knowledge? They could ask questions all day and learn that way. I love the

idea of being able to have that much information so readily available, but I don't think that it made anyone smarter or more knowledgeable in the long run."

"NO ONE HAD TO WORK FOR IT"

"I suppose if you don't work for your knowledge, then maybe you don't keep it." Marie paused to think about some of the math problems she practiced to make sure she would remember how to do them.

"THEY ASKED, YET NEVER REMEMBERED"

"No need to – It's like having the internet hooked up to your brain. You really need to process information to digest it. I think they were just consumers. This Metro really should be called *Information Metro*. You can't have knowledge until you are able to interpret and use information."

"SO WHAT NOW?"

"Well, when we need to learn something, how do we remember?" Marie answered her own question, "I remember so much more when I read a book, write it out, teach it, or build something with my knowledge."

"USE IT?"

"Yes, we can't just shut this Library off. They need their history, science, and information..." Marie paused as she tried to put her idea into words, "I think we just need to change the format, or revert the system to something that makes them work a little harder for what they want to know."

“WORK, YES”

“Yeah, let’s make it so the Library isn’t spoon-feeding facts. And I hope they will forgive me if I shut down this mind reading feature.”

“HOW?”

Marie turned to the screen, “Is there a school here?”

No. All knowledge is requested, then given in a simple, short format.

“Was there ever a school here?”

Yes. The institution was here, but it made people unhappy. Quick knowledge is satisfying. This is a new age.

“Why were people unhappy?” Marie asked.

Learning can be hard.

Marie knew that learning could be difficult sometimes, but she also knew that is what made it so rewarding. It felt good to work for her knowledge. She thought that the concept of learning being challenging was something that was necessary – challenging could be fun.

“TECHNOLOGY WAS EASIER”

Marie thought of how taking the easier path could have some negative long-term effects. She understood and figured that learning institutions were better than a flow of information without purpose. “Can you bring back the schools? Can we make it so that access to information is no longer as quick and easy? That way, people will remember what they seek to know.”

Warning, institutions are not fast. This Metro provides knowledge that is quick and satiating.

“Shut down the mind reading feature. Make previous information available through reading materials.”

Your request requires a reset. Cosmos is required to complete a two-step process:

1. Reset the system at this console by turning the maintenance key in slot 3 on the back of this screen.
2. Truth Metro override. Truth Metro override. Truth Metro override. Truth Metro override.

override. Truth Metro override.
Truth Metro override...

“What happened?” Marie watched the screen fill up with *Truth Metro override*.

“RESET”

Marie walked to the back of the screen and put the key that Regor had given her into the 3rd slot. She turned the key, removed it and walked back to the front of the screen.

Truth Metro override. Complete
reset in Truth Metro Core.

“We need to go to the Core.” Marie stared at the screen. “We know where Truth Metro is, but where is the Core?”

“REGOR MAY KNOW”

“We will have to find him.” Marie got an idea. She threw herself on the ground and started to wail. “Ouch! Ouch! Ouch! I’m sick, I’m sick! I need a Healer! I need a helper!”

“THAT’S ONE WAY TO GET THERE”

A hologram appeared just as it had for Regor to assist in her transportation to Healing Metro.

V

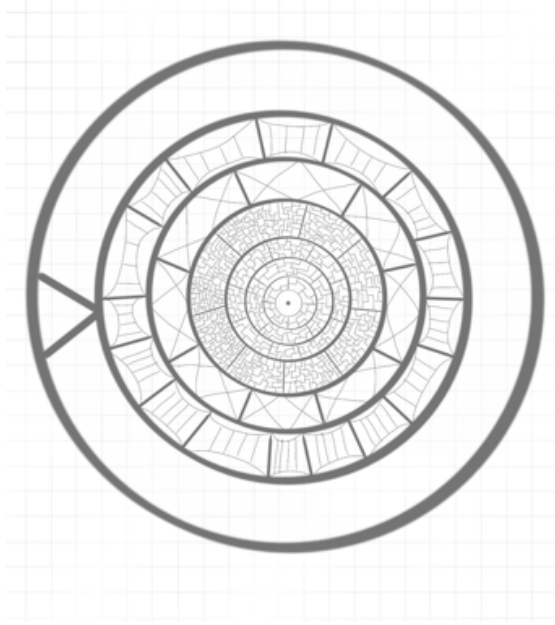
THE HEALERS

Marie arrived at the Healing Metro City Center. She was pretending to sleep on the stretcher during her transport. Once she felt the stretcher stop moving, she jumped up and flew to an aerial view of Healing Metro.

“GOOD IDEA”

“Thanks, it just seems to help me understand the layout of the cities on this planet.” Marie sketched a map in her notebook as the hologram below did circles trying to find the patient.

“PATTERN?”



“I think so, but I am not quite sure yet. It is just the “V” that keeps changing. But everything else seems the same.”

Marie circled around in the sky and noticed that the light was still dusky. The lights of the distant cities were faint, but still visible. She could vaguely make out the center of the ring where she had landed and wondered for a moment if that was how she would go home eventually.

“SHALL WE?” Atlas urged Marie downward towards the city.

“Yes, let’s go.” Marie descended to Healing Metro, but not to the Center. She landed on the top of a building that bordered the rotary.

“I feel like a gargoyle or an owl statue on the top of a building.” Marie said out loud.

“Statues don’t fly.” A voice came out the window right below her.

“Regor?” Marie asked.

“Shhhh...”

“IT IS REGOR’S VOICE!”

“I agree.” Marie thought as they waited in silence for Regor to come back.

After a few moments, Regor was back. “OK, the Healer was here. You can come down now. The Healer is gone.”

Marie flew to the window and carefully squeezed her way through its opening. She wondered why she couldn’t come when the Healer was in the room.

“LOOK OUT!” Atlas warned Marie of the door opening in Regor’s room.

Marie quickly dropped to the ground and rolled under the bed that Regor was in. She peeked out from under the bed as a Healer came in and took Regor’s vital signs. She saw only a white floor with the legs of a table and a restroom off to the side. Just as quickly as the Healer had come in, it left.

“Are you OK?” Marie crawled out from under the bed.

“Yes, but you shouldn’t be here. You might get sick.” Regor quietly said.

“What do you mean? You helped us. I like to help my friends – especially if they are sick. I wish you would have let me help you before.”

“In our world, we don’t do that. You would just get sad if someone was sick.”

“Well, that *is* part of it! When you care for people you might get sad – and that’s OK.”

“What do you mean?” Regor asked. He appeared calmer. “How would it be OK?”

Marie sensed that he was more open to her words. She wondered if it was because he felt safe in the Metro. “Well, I guess I can tell you the story of when I got sick...” Marie thought about her last hospital stay.

“YES, A STORY MIGHT HELP”

“Well, some time ago I had an accident that made me very sick and I had to go to a hospital for treatment.” Marie was trying to leave the details generic for Regor so he could relate.

“What made you sick?” Regor wanted specifics.

“Do you know what an allergy is?” Marie asked.

“Yes, we have those here.” Regor responded.

“Well, I have a food allergy, and I must have accidentally consumed something that had my allergen in it. My allergy can be life-threatening, so it was serious.”

“Then what happened?”

“Well, my parents helped me get a dose of medicine called epinephrine that helped my breathing.”

“Then what?” Regor asked.

“Then we went to a hospital and the medical staff watched me, gave me more medicine, and I got better. While I was there, my family and the staff comforted me, they made me smile. I felt loved.”

“Then what?”

“Well, the whole point that I am trying to make is that I stayed calm because people were helping me. My parents, nurses, and doctors were all saying and doing things that comforted me so I could get better.”

“But didn’t they get sick?” Regor asked.

“They worried, but they were fine. They were compassionate.”

“Compassion? What is that?”

Marie paused to think about the question. “How could Regor not know compassion?” She thought to Atlas.

“NOT PRACTICED?”

She thought about the system that they had for healing. The second that someone was sick or sad or uncomfortable, a hologram initiated a transport to Healing Metro or Happy Metro. From there, they were transported to a hospital where Healers helped them. “Don’t Healers have compassion?” Marie thought.

“DUCK!”

Marie dropped and rolled under the bed as the door opened again. This time she saw wheels roll up to the side of Regor's bed.

“ROBOT” Atlas commented on the Healer.

Marie listened. The robot said nothing. It just delivered water and food and then left.

“Compassion might be hard to know if everything to do with sickness is automated.” Marie thought.

“YES”

She crawled back out. “Regor, compassion is having concern for others. Empathy is when you try to understand and share how someone else is feeling.”

“But if you share people's feelings and they are sick, then won't you be sick too?” Regor was having a hard time with the concept.

“Well, you may feel sad, or hopeless, or angry, or worried when someone you love is sick – that is true. But by comforting them you help them to heal. And, your friendship and love will grow because of it. Being sad or worried is only temporary, and it is part of the process. You have to be detached from your feelings enough to move through them.” Marie thought of her own experiences.

Regor sat silently in a thoughtful way. “I do feel better because you are here. When I get lonely, they just give me a screen. And after Happy Metro, I have no desire for them anymore. Compassion and detachment...it is something I

think I will work on.” Regor seemed to be drifting off into deep thought.

“I’m glad you feel better,” Marie held her hand out to help Regor up, “I need your help.”

“You do?”

“Yes, we have to get to the Core in Truth Metro.”

Marie looked into Regor’s eyes.

“Regor smiled with a toothy grin.” OK, let’s go.

Regor stood up as the door to the room opened again. It was too late for Marie to duck, or for Regor to lie back down. A red light started to flash on top of the robotic Healer. She looked at its square body, its long metallic arms, and nubby wheels.

“Move!” Regor shouted as a metallic arm reached out to grab Marie.

“MAYBE IT THINKS WE ARE AN INTRUDER”

“We are!” Marie said as she jumped away from the arm. She ducked, leapt, flew, and tumbled to avoid the Healer’s grasp. “We are intruders!”

“There’s no way out!” Regor jumped up and down on the bed with excitement as the Healer chased Marie around the room.

“I think this Healer is trying to make sure I need healing!” Marie dodged another arm.

“COSMOS! SAY WE ARE COSMOS!”

“Cosmos!” Marie shouted at the robot.

The robot froze and the red light turned off. A door slid open from its front and revealed a screen.

“Another screen?” Marie asked. She took a deep breath and sighed with relief. “Good thinking, Atlas. All this technology seems to respond to our name.”

“The Healer needs input.” Regor looked at the Healer’s screen and then at Marie.

“If I reset the computers in this Metro, will they stop working?”

“It’s never been done.” Regor looked concerned, “What about the really sick?”

“Right, we can’t turn them off or there wouldn’t be any help with critical patients.”

“I’m here to help.” Regor’s eyes lit up, “Let’s get more help.”

“Good idea!” Marie walked out the door with Regor as the Healer sat still waiting for input.

They went from room to room looking for able-bodied people to help. They realized that all of the Healers had come to a halt when Marie had said ‘Cosmos’ to the one in Regor’s room.

Regor was able to find dozens of citizens that weren’t medically sick and were thus willing to help. Many of them had been placed in the Healer’s care when they got worried and then were never prompted to leave. Regor organized them to start caring for the sick.

“How many patients are there?” Marie asked.

“Thousands.” Regor looked overwhelmed.

“How many people do you have that can help you?”

Regor responded, “Well, I found almost a hundred, and then they went and found more, so I think there are perhaps 500 to 1000 that can help, but we don’t have the knowledge of medicine or how to take vital signs!”

Marie began to worry. She went to the closest Healer and looked at the screen.

Confirm Cosmos...

“Again?” Marie was worried that the authorization would take too long for some patients’ needs.

“HURRY”

“I am Cosmos.” Marie spoke to the Healer, “Please turn on your vital signs monitoring and medical assistance.”

Confirm Cosmos...

“I am Cosmos!” She said again.

“TRY THE KEYPAD”

Marie saw that there was a keypad below the screen. She typed in: “I am Cosmos”

Confirm...

$$1 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \frac{1}{120} + \frac{1}{720} + \dots$$

Marie watched the fractions continue on the screen. She recognized the bottom numbers as factorials. She got out her notebook and proceeded to rewrite the problem.

The image shows a handwritten notebook page on a grid background. At the top, the series $1 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \frac{1}{120} + \frac{1}{720} + \dots$ is written. Arrows point from the denominators 2, 6, 24, 120, and 720 to a list of factorial definitions on the left side of the page. The list includes: $1! = 1$, $2! = 1 \cdot 2 = 2$, $3! = 1 \cdot 2 \cdot 3$, $4! = 1 \cdot 2 \cdot 3 \cdot 4 = 24$, $5! = 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 = 120$, and $6! = 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 = 720$. A box labeled "!" with an arrow points to "factorial". To the right of the list, the partial sums of the series are calculated: 2.5 , $2.6\bar{6}$, $2.708\bar{3}$, $2.71\bar{6}$, and $2.7180\bar{5}$. An arrow points from the final sum to a box containing the letter 'e', which is labeled "euler's number".

“EULER” Atlas said as Marie thought of the answer.

“My thoughts, exactly!” Marie knew that by adding the fractions of $1/\text{factorials}$, the number would converge (get closer and closer) to a number known as “e.” Marie smiled as she thought of how Euler’s number (e) was a number that occurred in nature through probabilities and growth. A bank's compounded interest or the way radioactive decay is calculated relates to the number "e". Marie started typing in as many digits of e that she could think of.

2.718281828...

She knew that the number was irrational (just like Pi) and went on and on, but was hoping the input would work.

Confirmed.

Marie again asked the Healers to monitor vitals and to provide medicines to the sick. However, she added that they were only to assist the citizens that were helping. She took away their authority to control the people by changing some of the computer code...

Confirmed. Temporary orders confirmed. Must finalize at Truth

Metro Core. Must finalize at Truth
Metro Core. Must finalize at Truth
Metro Core. Must finalize at Truth
Metro Core...

“I hope this works until I can get to the Core.” Marie saw that the screen had a similar output to Knowledge Metro’s screen.

“I think I need to stay here and help.” Regor approached Marie.

“Regor, we don’t know how to get to the Core.” Marie was concerned that her computer fixes up till now were merely temporary.

“I will tell you how to get partway there, since I don't know the full way. You have my key.” Regor said with a firmness. “I want to stay here.”

“HE WILL STAY, AND WE MUST GO”

“OK, how do we get there?”

“Do you need to see other cities first? You have been to Happy, Knowledge, and Healing Metros.”

“The rest?” Marie thought about the nine volcanoes around the ring and a city at the foot of each.

“The rest.” Regor looked at Marie with concern.

“FIVE MORE BEFORE THE CORE”

“Five more?” Marie asked out loud. “What are the other five?” Marie felt slightly anxious thinking of five more.

“Arts Metro, Maker Metro, Mindful Metro and, ...well...I don’t know.” Regor said.

“Did the knowledge screens get to you too much?” Marie asked, thinking of losing memories.

“No! I just don’t think I have ever been to two of them.”

“Don’t you do maintenance for all of them?” Marie asked.

“Only in cities that ask for it.” Regor looked curious about the two that he did not know.

“Does anyone know what they are?” Marie asked.

“I met an elderly woman in one of the rooms who was older than any person I had ever seen. Maybe this woman would know what they are?” Regor suggested.

“Where is she?” Marie asked.

“Follow me.” Regor led her down the hallway. “Here is the room.”

“Thanks.” Marie stopped at the door to the room.

“I am going to go help the sick now,” Regor said. “Thank you for everything. Good luck!”

Marie walked into the room. An ancient-looking creature sat before her.

“I SENSE HER THOUGHTS” Atlas thought to Marie.

“You’re here!” the woman whispered.

“I am Cosmos.” Marie walked to the edge of the bed and gently took her hand.

“I know!” she smiled, “I have waited for so long. We have needed you for over a hundred years. Where have you been?”

Marie thought of her life and how Atlas was maybe supposed to have found a hero much earlier than Marie. Atlas had dried up in a desert and was dormant until Marie’s parents found a mysterious puzzle. Marie solved the puzzle and awakened the dormant Atlas. She thought, “I really am late, just like the rabbit.”

“Oh, I see, you are too young to have been here a hundred years ago.” The woman commented.

“I AM LATE” Atlas replied in thought.

“Well, late is better than never. Our technology took over our lives. We no longer educate, create, or make. We have lost compassion, joy, and intimacy in friendships. This technology does everything for us.” The woman replied to Atlas.

A Healer opened the door to bring in medicine. The woman flinched.

“IT’S OK, WE HAVE FIXED THEM”

Marie added, “Only temporarily, though.”

“Well, I’m glad that I am still here. My name is North. I believe that you need my help. Am I right?”

“YES”

“Regor said that we should go to the other cities, but then he couldn’t tell us about them.” Marie was about to continue with the story of their arrival, but she was interrupted by a severe cough that seemed to seize North’s body with each breath.

“Are you OK?” Marie was concerned.

“I just need a little medicine, and then of course, as you know, I am coming to my completion. I am very tired.” She coughed between words, “I have outlived my friends and family by a hundred years!”

The Healer dispensed a shot of medicine to North.

“It helps with the cough,” North explained.

Marie grabbed the blanket from North’s waist and adjusted it to what she thought would be more comfortable.

“Thank you. It’s been so long since anyone has seen me.” North smiled with tears pouring from the corner of her eyes. Marie thought for a moment about how important touch was.

“Oh, North, I am so sorry you have suffered.” Marie just sat with her and gently rubbed her hand.

“Oh child, suffer is a strong word, but I’ll take it.” North said as she was acting more tired. “The inventors have been gone for thousands of years. No one knows how

to adapt, fix, or change these machines. We have let the technology do as much work for us as we could. And then we forgot how to do anything because we never passed on knowledge or practiced what we knew.”

“I see. Am I doing the right thing by resetting the systems?” Marie asked.

“Well, I don’t know if you have a choice. But just think through each city. I think you’ve done good to keep some technology, like the Healers bringing meds and helping us until we can get back on our feet. North coughed again, much more violently this time. It seemed to take the light from her eyes. “We may have a difficult time adjusting, but no one said that difficult is a bad thing, right?”

“You’re right,” Marie said. “Some of the most rewarding things I have learned have been difficult. I think that it is similar to having 20/20 hindsight – we dislike our tests and difficulties when we are in the middle of them, but are often grateful afterwards.” Marie smiled.

North smiled at Marie, “I’m glad you are here with me for this...that I’m not alone.”

Marie was going to ask “for what,” but knew the answer and refrained from making small talk. North needed some quiet and a hand to hold.

“I will do this, North,” Marie touched her forehead, “I will help your people.”

“Yes, I know you will.” North smiled at Marie. They sat there together holding hands. “Can you sing to me? It’s been so long.”

Marie steadied her shaky breath and cleared her throat. She sang quietly and gently and beautifully to North. She sang of adventure, of stars, she sang of love and loss, she sang of joy and splendor and then she hummed her sweet melody as North breathed out one last time and became still.

Marie let the tears roll as she let go of North’s hand. The door opened and a blue stretcher came through the door. It had orders to go to another city – Grave Metropolis.

“I will take her.” Marie whispered to the robotic stretcher. She called Regor into the room and asked for help, “Can you spare two people?”

“Of course,” Regor looked at North’s lifeless body, “I think this is the first time I have seen death.”

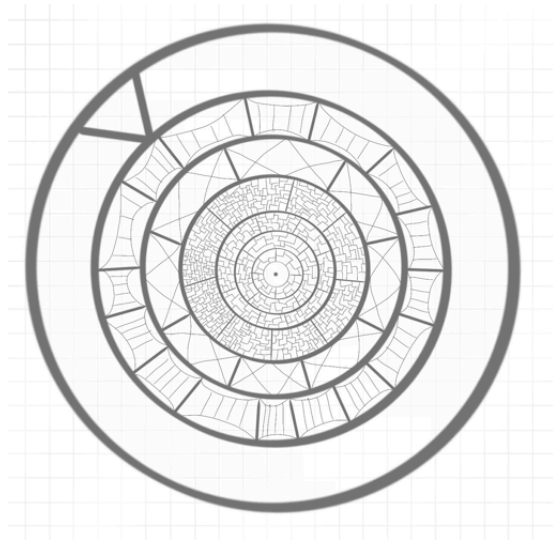
Marie and her two helpers wrapped North in a clean cloth and carried her to the City Center. She looked at the stretcher and saw the coordinates for Grave Metropolis on the side and said them aloud. They were transported to the city within seconds.

In the Grave Metro, Marie and her companions said goodbye to North. Marie found no systems in the Grave Metro to reset. Her only thoughts were that perhaps in the future, the people of this planet would come with their

loved ones to say goodbye. Their loved ones would both be missed and celebrated through grieving.

Marie showed reverence and waited until it seemed appropriate to glide up and sketch a map of the city. She found that it had the same kind of roads, but no buildings, just rows and rows of flat circular stones. It was a city of tombs.

She came back down and stood next to her friends who had helped carry North and gave each of them a compassionate hug.



“It helps.” One of them said.

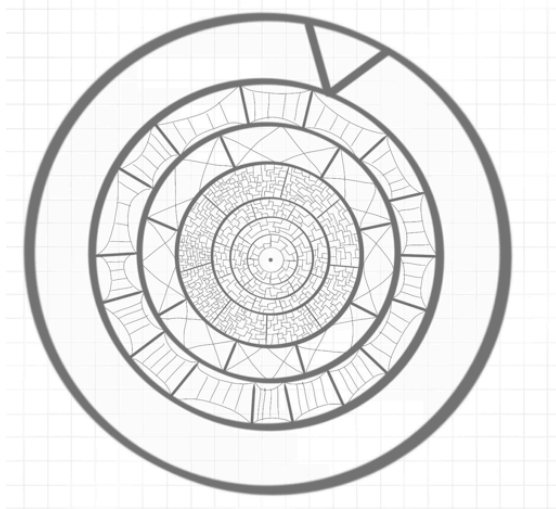
“What helps?” Marie asked.

“Saying goodbye and being here. It’s not easy, but it helps. It’s good. I’d rather be here than not.”

“I don’t think saying goodbye is ever easy.” Marie said as she thought of North saying that “hard” isn’t necessarily bad. With a deep breath, Marie continued on to the next Metropolis.

VI

ARTS METRO



Marie stood in the City Center of Arts Metro. The city was unoccupied, just like Knowledge and Truth had been.

Again, she soared to an aerial view and took out her notebook to sketch a map of the city.

“PATTERN”

“Yes, there is definitely a pattern with these maps.” Marie said, as she slowly coasted back down to the ground.

She read the signs on each of the buildings around the rotary, “Sculpture, painting, music, dance, photography, theater, ...”

“ARTS” Atlas commented on the theme.

“Yeah, I think I figured that out.” Marie laughed and started to walk to the first building: Sculpture.

“ARE WE GOING TO SCULPT?”

“I don’t see why not. It might be a good way of figuring out what happened to this city.” Marie walked through the entrance of the large building into a hall of pillars.

“EMPTY”

Marie agreed, there was no one around and there was no sign of any sculptures. She walked to the end of the room and saw what looked like a gallery.

“Here we go!” Marie looked at a set of beautiful bronzed clouds. “And look!” She pointed to a stone sculpture of a rotary.

“IT LOOKS LIKE THIS METRO”

“Look at the dates,” Marie read the labels, “These are thousands of years old.

“VERY OLD”

“I don’t see anything recent.” Marie walked through the gallery and saw only ancient pieces.

“THEY ARE BEAUTIFUL”

“They are, but I don’t see any sign of creation here. It’s like a museum.”

“PAINTING?”

She flew over to the Painting building and found a gallery with the same age of artwork. “I don’t think they make art here.”

“Make?” a hologram appeared.

Marie jumped with the sudden appearance of the hologram. She shook off her surprise and asked, “Do you make anything here?”

“Yes, we do. Come with me.” The hologram pointed and lead the way to a building in an alley off the rotary.

“Oh my,” Marie exclaimed as she walked into the warehouse and saw artist stations. Each station had a large screen, a table, and a chair with a helmet attached to the back.

“Sit and create.” The hologram motioned to a chair.

“I think I will forgo creation for now. Where are the finished pieces?” Marie wondered why there weren’t any recent pieces of artwork around her since there were so many stations to ‘create.’

“The pieces of art are stored in the database. They are on the screens.” The hologram answered.

“So no one actually carves, or paints, or acts, or sculpts, or photographs, or...”

“NO”

“Come and have a seat to create. Create something here. Come and have a seat.” The hologram urged Marie again.

“How do I fix this Metro’s computer?” Marie asked.

“You must be in the creation console to access the art’s screens. You do not have access. You can only create.”

Marie realized that she couldn’t change this city if she couldn’t get to its systems. “I think I should try this console.”

“JUST BE CAREFUL”

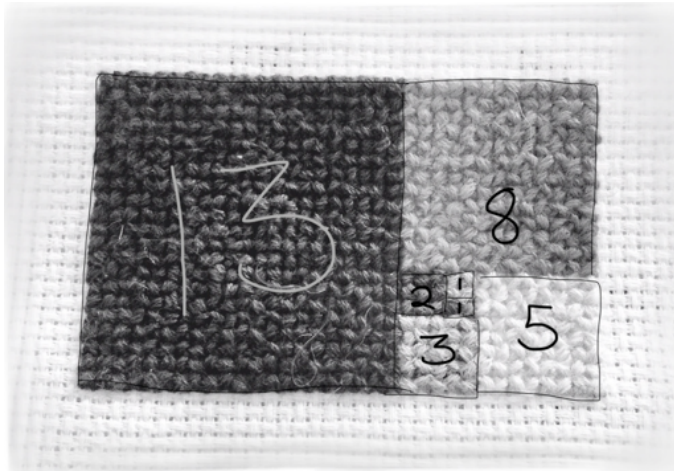
“I will.” Marie thought as she took her seat at one of the desks. A helmet moved from the back of the chair and onto her head.

“SCREEN AGAIN”

Marie saw a screen come down in the form of a visor from the helmet. She found herself in a virtual

environment that looked like an elaborate artist studio with every medium (clay, metal, paint, charcoals, and more) and all the supplies she could dream of. Marie immediately thought of how she would love to create a fabric Fibonacci spiral art piece using squares.

“IT’S MAKING IT” Atlas exclaimed, as Marie’s thoughts were creating the work of art that she envisioned.



“Just like I imagined it!” Marie smiled, “This is so much fun!”

“FUN?”

“Just think of what we could create,” Marie thought of Monet’s paintings. Then, right before her eyes, the paintings started to form.

Atlas was silent and Marie felt it. “We aren’t here for fun...this technology sure does pull me in.”

“YES, LOOK FOR A RESET OR A FIX”

Marie walked around her virtual environment. She was looking for a booth or screen so she could try to reset the system. Every time she had a creative thought, it seemed to come to fruition right before her eyes. She accidentally created works from many artists. A grin stretched from ear-to-ear when she got to see the amazing works of Da Vinci’s *Portrait of a Man in Red Chalk*, Rembrandt’s *The Storm on the Sea of Galilee*, Monet’s *Poppies*, Picasso’s *The Accordionist*, and so many other wonderful pieces. She had to focus her thoughts away from creation as she searched for a booth.

“KEEP LOOKING”

“I just don’t see it!” Marie shouted as she thought of an enormous fortified booth.

“NO, DON’T THINK OF THAT!”

It was too late. Marie had imagined a large fortified screen with access into the system for the Metro. It had a screen that seemed blacker than anything she had ever seen before.

“IMAGINE A NICER SCREEN!”

Marie tried to think of an easier booth to access, but she found that her ability to create was gone. She was now in a virtual world with an ominously evil-looking screen for

her to work with. She regretted her thought that had led to its creation.

“WHY DID YOU THINK OF *THIS* SCREEN?”

“I don’t know! At least I didn’t think of the Jabberwocky!” Marie flinched as she said it, hoping that the Jabberwock wouldn’t appear. After a moment, she felt a wave of relief that her ability to create was no longer there.

“LET’S LEAVE AND START OVER”

“That’s a good idea,” Marie looked at the menacing screen she had imagined and felt its foreboding nature. She looked around and found that she couldn’t move away from the screen. She was transfixed.

“LET’S GO!”

“I can’t!” Marie tried with all of her thoughts and feelings to exit the virtual realm, but found herself immovable.

“THEN FORWARD?”

“I don’t think we have a choice,” Marie approached the screen without any difficulty, but she couldn’t move away from it.

“OBSCURE”

“It is very dark, like tar.” Marie looked at the blackness of the screen. She shifted her position to see if she could glimpse her reflection and realized that there wasn’t any glass.

“WHAT DID YOU IMAGINE? WHAT DID YOU CREATE HERE?”

Marie remembered the thought that went through her mind as she created the black in the screen.

“Quintessence,” she whispered.

“DARK ENERGY?”

“Yes, I thought of dark energy. But not the idea of it being a cosmological constant (something that doesn’t change). Instead, I thought of a hypothesis of dark energy that is dynamic and ever-changing – called Quintessence.” Marie thought of her physics books at home and the theory of how Dark Energy is responsible for the accelerating expansion of the universe.

“THE FIFTH ELEMENT” Atlas commented on her thoughts.

Marie looked into the darkness. She thought of the ancient Greeks and their ideas of elements: earth, wind, fire, air, and aether (the fifth element). Another word for aether is Quintessence. In ancient times aether was an element that made up the celestial sphere and was used to help explain light and gravity. Marie hadn’t thought of Quintessence as the ancient Greeks had, but thought of a modern theory on Dark Energy.

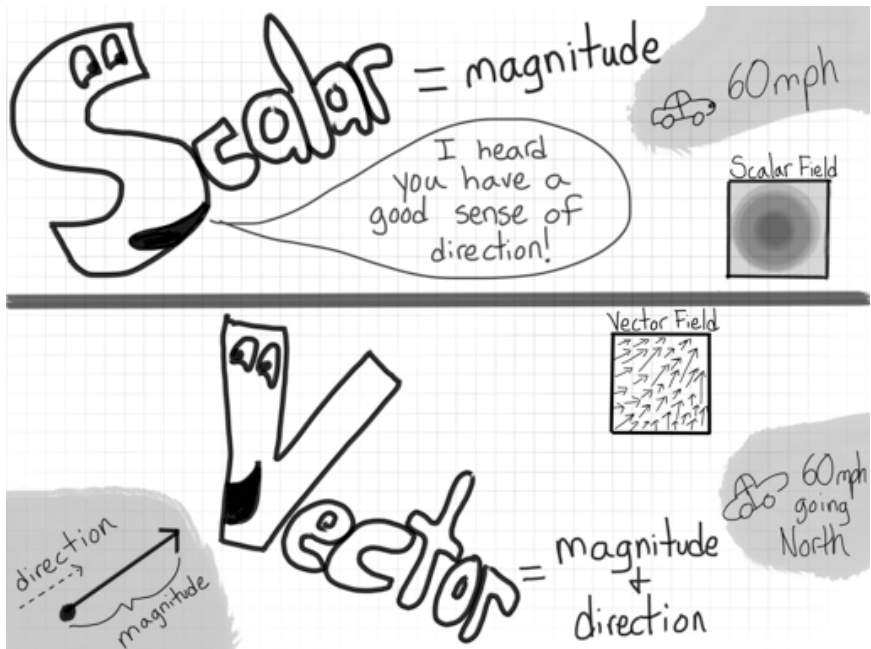
“WHAT NOW?”

Marie approached the glassless screen and reached out her hand. It went right into the darkness and disappeared before her eyes.

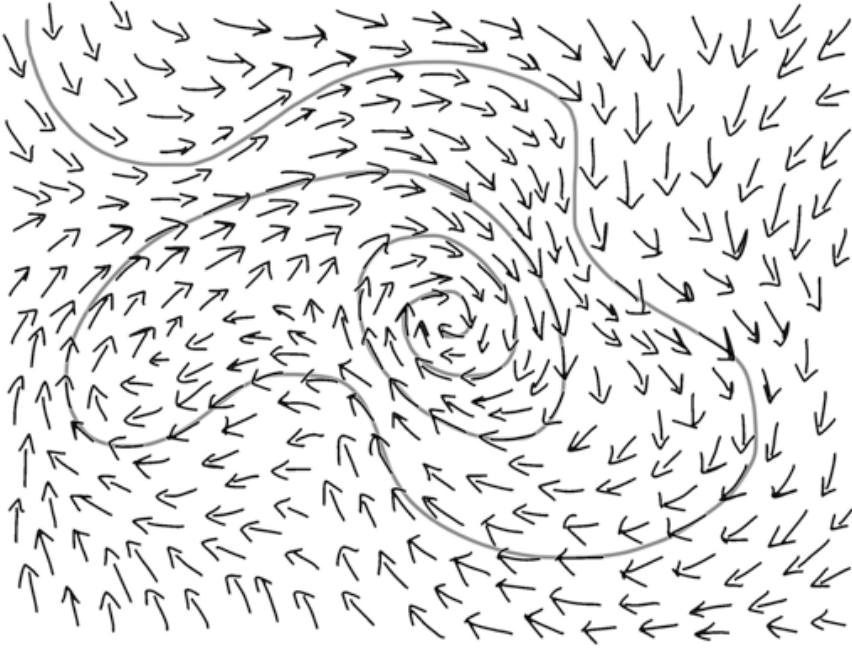
“IT’S PULLING”

“Yes, it’s like currents in an ocean. When I move my hand, I can feel it pull.” Marie thought of Quintessence again and how it was a scalar field. “A scalar is a number without direction...I am feeling something that has direction...It’s not a scalar field,” Marie felt her hand being pulled as she thought, “It’s a vector field! There is a strength at each location *and* a direction...”

Marie pictured a sketch in her notebook of scalars and vectors that she had done at home:



She closed her eyes and tried to imagine the field that she was feeling with her hand. She moved it around to try to get a full picture. It was a two-dimensional vector field (flat, like a piece of paper).



Once Marie had a clear picture of the vector field in her mind, she realized that the field would direct her to a single point. Instinctually, she knew what came next.

“INTO THE DARKNESS”

“It may be dark, but it is not void. There is energy and motion I don’t understand.” Marie slowly moved her head and hands into the screen like a slow-motion diver into a

pool. No splash occurred (it would have been a perfect score).

Once she was fully engulfed in the screen she felt herself lose her dimension. She was now in the 2-dimensional vector field. Like a ping-pong ball in a hurricane, she moved with the currents. As she was pushed and pulled, she wondered why the field she had felt converged to a point rather than expanded, - after all, isn't the Universe expanding rather than contracting? Marie reminded herself that she was in a world she had imagined. Her thoughts of Quintessence being a scalar field must have gotten mixed up with the idea of expansion and created the vector field reality currently pulling her into a single point.

“It’s like I am moving in reverse from a spiral-like expansion.”

“SPIRALS AND EDDIES”

Marie felt every turbulent motion. Her movements seemed to accelerate more and more until she reached the single point. She felt herself suddenly being pushed out of the vector field. It felt like jumping through a sideways waterfall.

“We made it,” Marie looked around, “I don’t know where we are, but we made it through the field.”

She stood in an all-white space. The floor, ceiling, and walls (if there were any) were all the same color and

therefore couldn't be distinguished from each other. Marie only knew that she was standing on a surface.

“How do I reset or fix the Arts Metro systems?” She thought to Atlas.

The space in front of her was filled with computerized words. They were black and moved up and around her like a kite tail throughout the room:

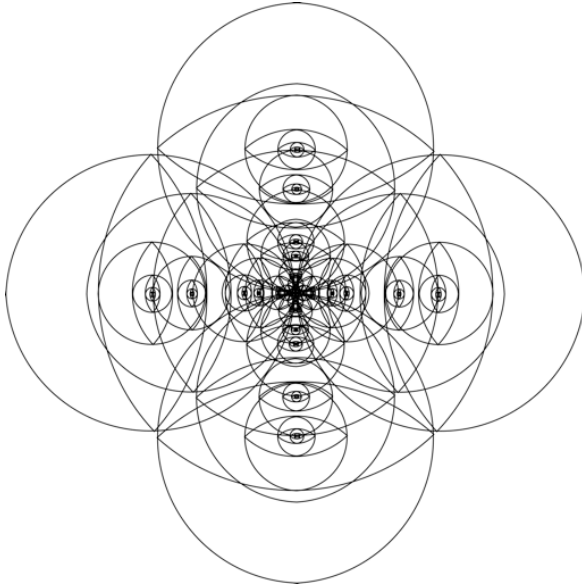
Confirm Cosmos.

“CONFIRM AGAIN...” Atlas noted as Marie thought of how many times she had to confirm her identity.

“I am Cosmos.” As Marie spoke, cursive words came out of her mouth and floated around the room and then scattered apart like dandelion seeds blown into the sky.

Computing...Creating...Initiating...

Marie saw a black line start to form and then draw itself into the shape of an eye. It repeated the eye shape many times, but grew larger and rotated each time.

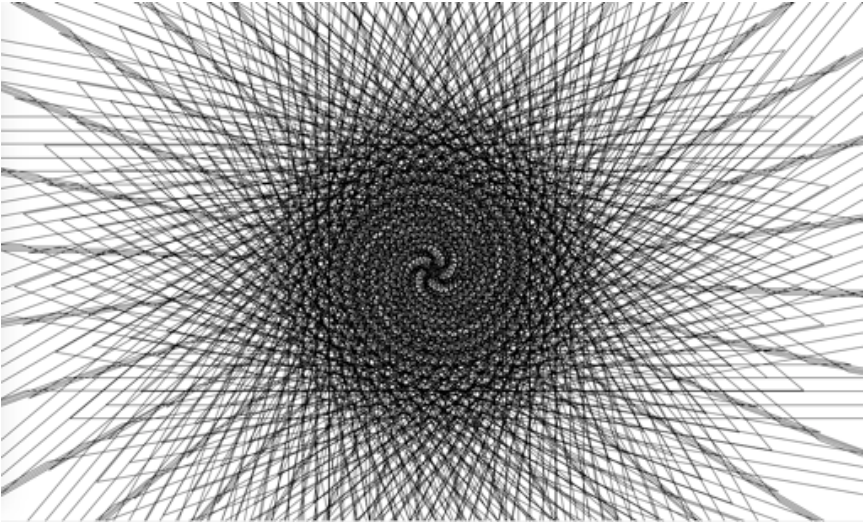


“FRACTAL”

“It sure is a fractal. I can see each iteration being formed, how wonderful!”

“AND ANOTHER”

Marie looked behind her and saw another fractal forming. This one was more star-like. She felt hypnotized as each line was added to create the spiral-shaped star.



Marie gently reached out to touch the fractal star with her hand. Upon contact, each line felt like a string on her fingertips. When she plucked it like a harp string, the entire fractal reverberated with a sound that was both beautiful and chaotic. There were harmonics that vibrated from all of the strings that then moved around and through her.

She envisioned a 3-dimensional vector view of the sound waves colliding with each other. Some would meet and create waves with larger amplitudes (constructive interference), while others would cancel each other out (destructive interference). Their collisions created wondrous patterns and tickled her skin with the various soundwaves. Slowly the sound dissipated and a computer code appeared at Marie's feet:

```
from turtle import *
i = 1
t = int(input('how many iterations of
this fractal?'))
while i < t:
    forward(i)
    c = 20
    right(c)
    forward(i*3)
    left(-c*2)
    forward(-i*4)
    i = i+1
    right(10)
    forward(10)
```

Marie thought that it looked like Python code that had generated the star-like fractal. She knelt down and said, “run.” Words appeared again:

how many iterations of this fractal?

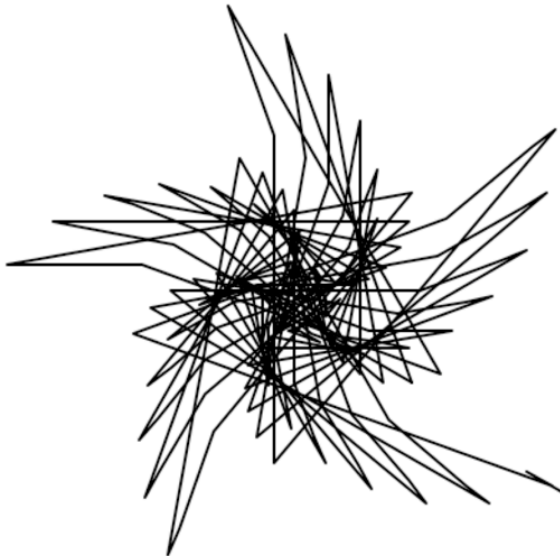
“Ten,” she replied.



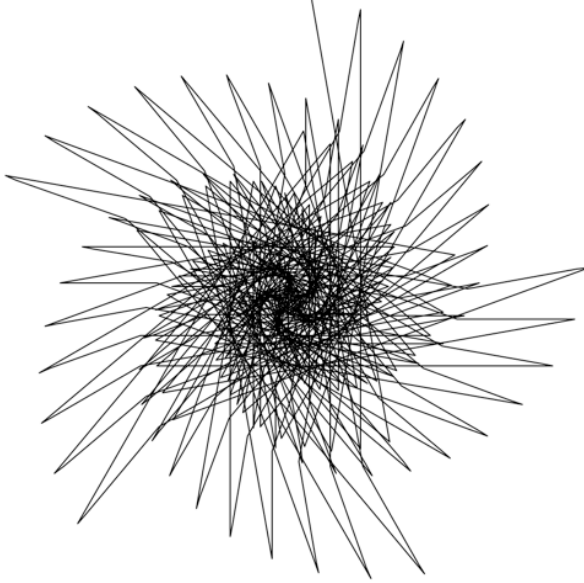
Marie thought she would try it again, “Run.”

how many iterations of this fractal?

Marie thought she would test it a little more. “Forty,” she replied.



Marie tried again with “100.”



“How fun! It’s like I am inside my own computer.” Marie was about to run the program again, but stopped herself, “OK, so now what? We are in a screen, in virtual Arts Metro, on another world.”

“FIX THE SYSTEM?”

“I am Cosmos! I am here to help this Metro.” Marie shouted.

Computing...Creating...Initiating...

Again, identical fractals appeared. Marie looked down and saw the same code.

“AGAIN?”

“I am Cosmos!” Marie tried again.

Computing...Creating...Initiating...

“OK, so that is not working, or I am missing something?” she thought.

“PLUCK AGAIN?”

Marie walked over to the swirling fractal and plucked one of its lines like a string. Beautiful tones resonated around her just as they had before. She decided to keep plucking the strings and began randomly strumming the fractal. Her hands swooped up and down as though she were playing an abstract harp. As she listened to the vibrations and harmonics, she realized that she was hearing very specific tones. Then, all the sounds began to converge into very specific notes.

“Do, Do, Do, So, So, Do, ...” Marie was trying to figure out what notes she was hearing.

“ONLY SO AND DO”

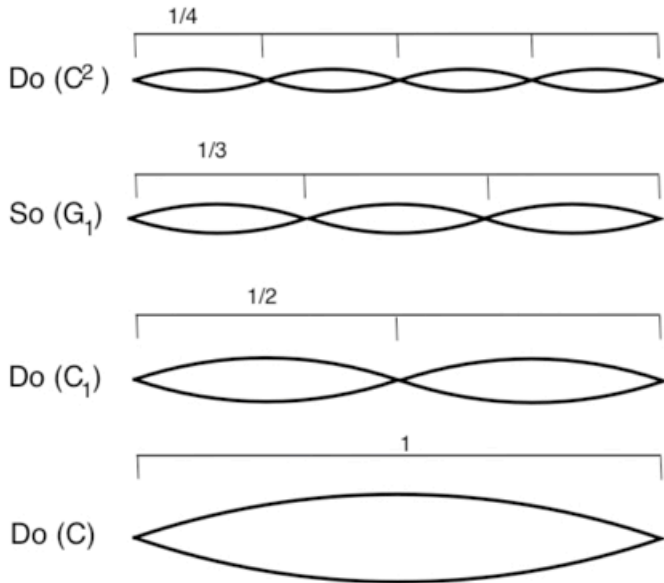
“Yes, but some of them are an octave higher,” Marie said excitedly. “I think I know what this is! Do Do So Do...”

“DO (DOE) A DEER”

“Yes, I think we are hearing the first four notes of the harmonic sequence! Thank you, Pythagoras!” Marie was referring to the story of Pythagoras walking by a blacksmith and realizing he was hearing notes from the banging on an anvil. He investigated sound and found that if he took a string (like on a guitar), and divided it by two then he got the same note (Do), but an octave higher. If he divided the string by three, then he got a fifth of the original note (So), and if he divided it by four, then he got another Do, but yet another octave higher.

Harmonic Sequence

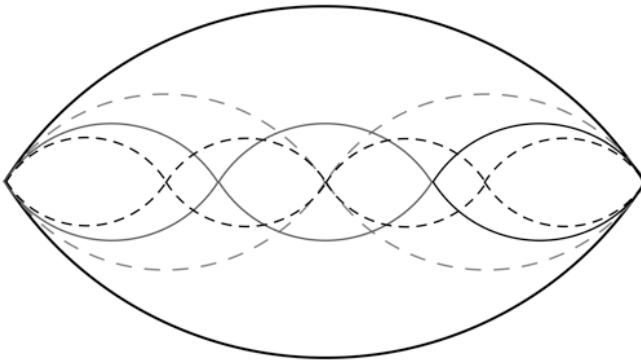
$$\{1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, \dots\}$$

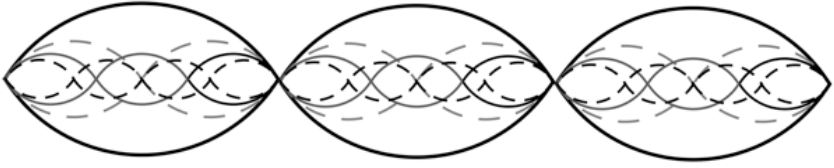


“I don’t hear the next note in the sequence...” Marie listened for Mi and didn’t hear it. “Mi would be $1/5^{\text{th}}$ of a string, and I only hear Do and So.”

As she listened, she thought of a drawing she had done back home of the harmonic sequence. She thought of how beautiful it was to consider mathematics and music together. Something not invented, but discovered.

It’s so simple to think of the length of strings on an instrument, yet so profound, she thought. The idea of dividing a string by two or three is trivial. But to realize that the sounds created from perfect divisions can relate to musical harmonies and mathematical ratios is simply amazing. It’s not just the lengths of the strings, but the frequency with which they vibrate (in hertz) that can be correlated to these Pythagorean ratios. Marie found herself in awe of the world around her. She wondered how much more there was to discover.





“MAYBE THE SEQUENCE IS THE KEY”

“Yes, maybe, let me try...” Marie turned and spoke,
“One, one-half, one-third, one-fourth, one-fifth, one-sixth,
...”

Harmonic sequence confirmed...

Step 2 of 3:

Computing...Creating...Initiating...

The room turned a bright white again as both the fractals and the words disappeared. They waited for a few moments before they heard a riddle vocalized as a computerized voice:

*Down the hole,
and through the forest*

*You found the notes,
now the next test:*

*The sequence you found,
what does it do?*

*Go toward its end
- this is your cue.*

Marie saw a line of numbers appear on the white space around her, “0, 1, 2, 3, 4, ... I think I am supposed to go to one of these numbers.”

“YES, BUT WHICH ONE?”

“It said - *The sequence you found, what does it do? Go to its end...*”

“HOW DOES IT END?”

“Well, it doesn’t, because it’s infinite!” Marie felt stumped.

“WHAT DOES IT DO?”

“It goes on and on!” Marie started to pace in a circle. “1, $\frac{1}{2}$, ...” She started to say the sequence, “ $\frac{1}{1000}$, $\frac{1}{1001}$, ...”

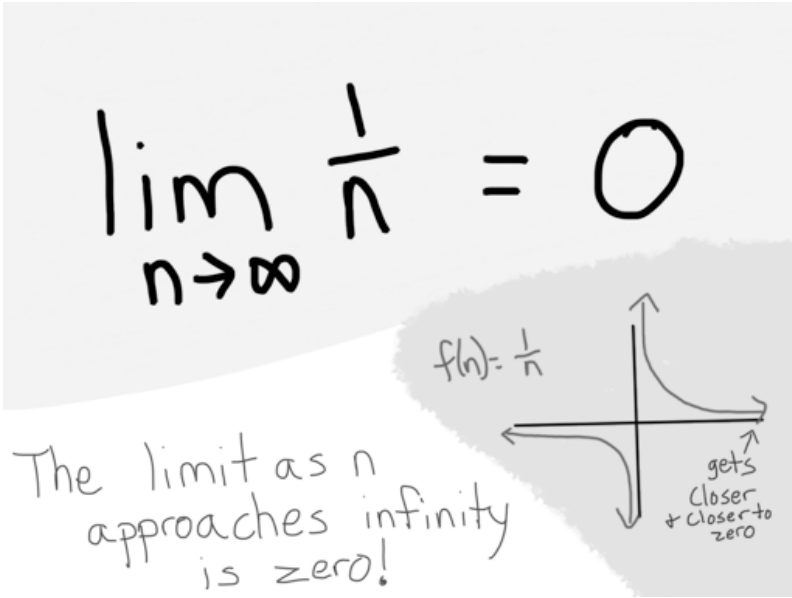
Marie had no idea. Out of frustration, her pacing quickly turned to stomping. Then she stopped herself and took a deep breath.

“YES, BREATHE”

“I really am stumped on finding the end of something infinite. I’m almost at my limit!” She thought of her last word, ‘limit.’ The numbers stood before her and she thought about how one of them was the answer. Marie thought over and over that she was “at her limit.” Suddenly, it struck her.

“LIMIT!” Atlas commented on her idea.

“Limit! What does *it* do? What does the function $1/n$ do as it approaches infinity? As the denominator gets bigger and bigger, the function gets smaller and smaller! In math, it’s called a *limit*.” Marie pictured the mathematical notation in her mind. She had seen so many limits in the pages of her calculus and analysis books that she loved to dabble with at home.



“See, as n goes to infinity, you get closer and closer to zero. 1 divided by a billion is a really small number – almost zero. The bigger n is, the closer to zero it gets.”

“END?”

“Right, so if we go towards the end, we go towards zero...” Marie looked at the numbers all around her in the white space and saw the first number – zero. She approached the zero and found it was actually an oval entryway into another white space. Stepping in, she announced herself, “I am Cosmos!”

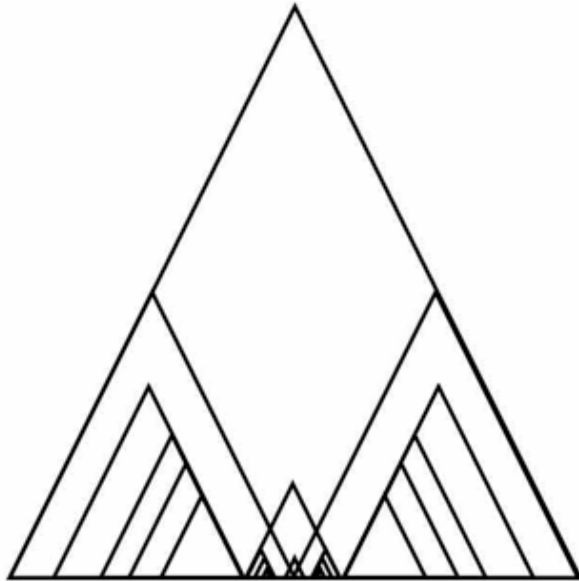
Step 3 of 3:

Computing...Creating...Initiating...

Marie took a deep breath as she approached the third step. She waited in the space looking at the bright white all around her. It was an eerie, dead quiet. She could barely hear her breath or feel her heartbeat.

“I’M HERE TOO”

Marie felt relieved to hear Atlas, “Me too, we are here together.” She smiled and thought of how they had gotten there in the first place. It all started with a triangle. As she thought of the Sierpinski Triangle and Pascal’s Triangle, she noticed that lines started to flow out of her thoughts and into the white space around her. The lines flowed together into a fascinating triangular motif.



“It’s beautiful.” Marie commented as the lines filled into place, creating the design.

“WHAT IS IT?”

“I think it’s the third step.”

Marie studied the shape carefully. It felt like the proportions of the triangles were of significance. “If only I had a ruler to measure...” she thought.

“USE YOUR ARM?”

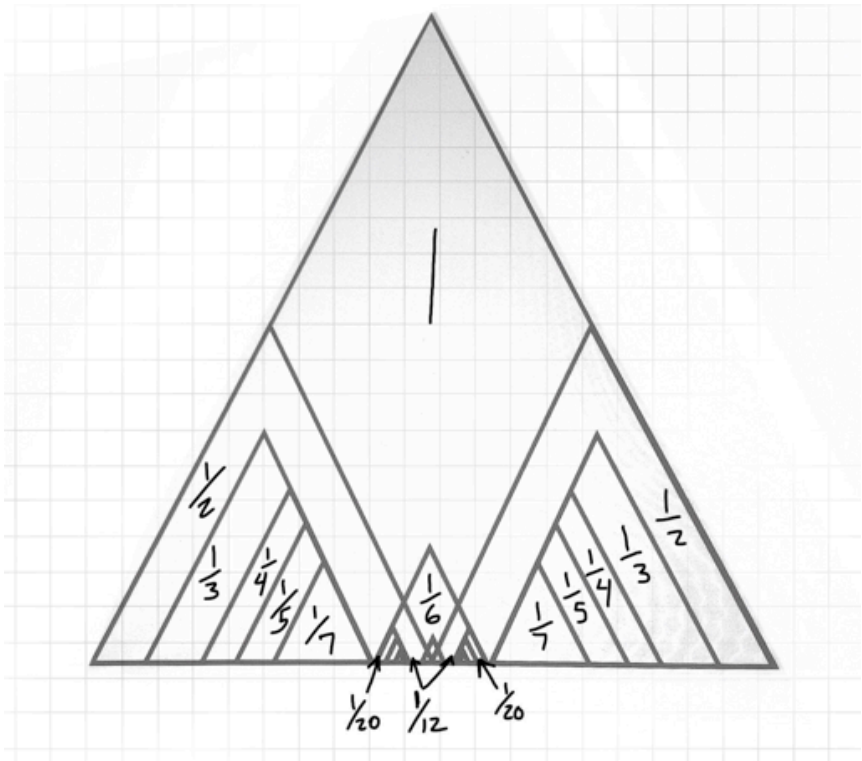
Marie thought of how her father had always told her to measure distances with her body so she could use them as measuring sticks. She knew that the space between the two moles on her arm was a about 30cm long.

“If only I had a sheet of paper and a pencil...” she thought she’d better write down her measurements. With that thought, a sheet of paper fell from above and gently landed at her feet. Marie stooped to pick it up and found a pencil lying underneath it. “How peculiar,” she thought.

“HOW CONVENIENT”

“I suppose it makes sense if you’re in a realm where your thoughts can create things right before your eyes.”

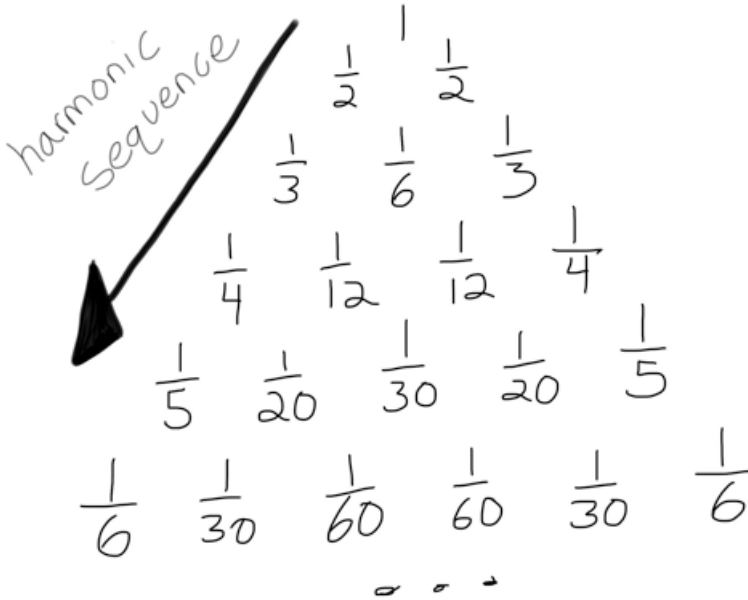
Marie measured the triangles and wrote down what she found with a sketch “1, $1/2$, $1/3$, $1/6$, $1/4$, $1/12$, ...”



“It looks like it is the harmonic series again, but... different.” Marie sketched, then erased, then sketched, then erased over and over again. She was trying to figure out what the pattern was. “More triangles! I just don’t see how this problem relates to the other ones.”

Marie had organized the numbers by size, and didn’t see what the problem or solution could be. Her mind was tired, her eyes were tired, and she was tired of all the whiteness. She decided to practice a relaxation and mind focusing meditation she did at home when she felt like she wanted to give up on something. She laid down on the

floor, closed her eyes, and began rearranging the numbers in her mind. With steady deep thoughts, she saw a structure forming in her consciousness.



“That’s it!” Marie opened her eyes, stood up, and walked over to the triangles.

“HARMONIC TRIANGLE!” Atlas thought to Marie with excitement.

“I am Cosmos! I have the answer to this step!” Marie shouted.

Another sheet of paper and a pencil fell from above and landed at her feet. Marie picked them up and wrote out

the harmonic triangle. She thought of the triangle's other name, The Leibniz Triangle, and how it related to Pascal's Triangle. "Instead of adding as you go *down* the triangle, like in Pascal's, you add as you go *up* the triangle," she thought.

Once she reached the seventh row of the triangle, the room grew dimmer and she felt herself begin to transport.

"Reset the system!" Marie shouted quickly, hoping that the system would get fixed for the Arts Metro. Right before she lost consciousness, she heard a reply:

```
Reset confirmed. Arts Metro reset  
initiating...Complete at Truth  
Metro...Complete at Truth Metro...
```

Like a slow transition from night to day, Marie found herself waking up in the Arts Metro, sitting at the console with a helmet on her head. She quickly removed it and stood up. "I think we are done here."

"YES"

Marie left the building and headed for the City Center. She thought of how unfortunate it was that their art had become what it had. Their skills with paintbrushes, chisels and tools along with concepts such as composition, lighting, and form had been all but lost. Instant "art" had become the norm.

She hoped that the society would again pick up tools with their hands in the future and create beautiful works of art.

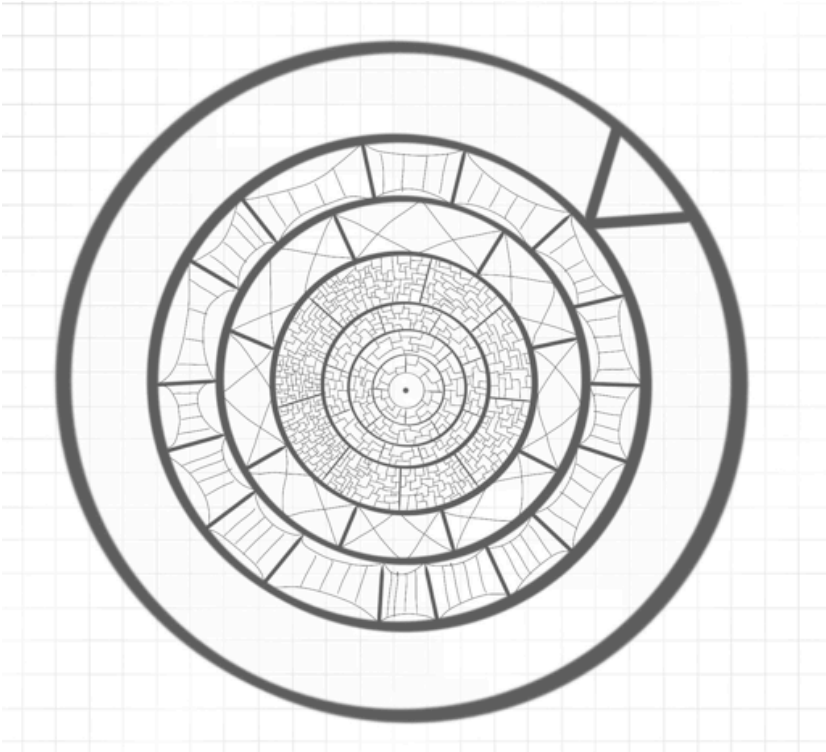
There was no hologram to greet her anymore as she arrived at the rotary and stood on the metal plate. Marie pulled Regor's key from her pocket and departed for the next Metro.

VII

MAKER METRO

Marie arrived at the Maker Metro in the City Center, just as she had with the other Metros. Again, she flew and sketched an aerial map of her view. Marie wondered if there was a reason for the “V” shape that seemed to be the one anomaly in all of the cities.

“SAME PATTERN” Atlas commented on Marie’s thoughts.



Marie flew down and found another empty city. This time, there was no hologram to greet her. The dwellings were the same style, clay with circular windows. She looked around for any booth or building that might be unique to this Metro and saw one that was similar to the Library in the Knowledge Metro.

“WHAT DID THEY MAKE?”

“I wonder...what *did* they make here?” Marie repeated Atlas as she looked around for clues. She headed towards the library-like building.

The large entryway had paintings and carved reliefs of gears, circuits, pendulums, and clocks. Marie looked at pictures of physics and engineering marvels that lined the walls. In the arc of the entryway, she passed a large map of the Metro. She could see that there were various buildings for making things (welding, milling, soldering, etc.). She saw a large screen in the middle and wondered if this booth could also read her mind. She approached the booth and announced herself.

“I am Cosmos. I want to fix the systems for this Metro.”

Confirm Cosmos in three steps.

Computing...

Marie felt her mind being read again, just as it had been in the Knowledge Metro. She held still and waited for the tests to start.

State reason for fix.

“This Metro is malfunctioning, and I need to reset or fix it.”

State reason for assessment of malfunction.

Marie stopped and thought about it. There was no observation that would lead her to think that this Metro had malfunctioned. Based on her conclusions from her previous experiences, she had assumed that this Metro was malfunctioning as well. Thinking of any observations that could be symptoms of malfunction, one came to mind; No one was present in the city, and perhaps that in itself could be a malfunction, “Why is there no one in this Metro?”

There *is* someone in this Metro.

Marie realized that she had gotten into a kind of routine with this planet (Go to Metro, reset Metro, repeat, ...). “Who is in this Metro?”

One person is here. Maker-1 is in this Metro.

Truth Metro override...

Truth Metro override...

Truth Metro override...

Truth Metro override...

Truth Metro override...

“That’s odd,” Marie hadn’t done anything that would have prompted the Truth Metro to override the system.

“WHAT NOW?”

“Let’s find Maker-1.”

“HOW?”

“I’m not sure...Where would I be if I were alone in this city?”

“LIBRARY?”

Atlas was right. If Marie had to choose one activity to do for the rest of her life in some deserted island scenario, it would be reading. Books were always able to take her places, answer questions, and make her think and grow.

Marie headed towards the entrance and looked at the map. Sure enough, there was a technical library on the other side of the rotary.

Marie walked across the rotary towards the technical library. As she entered a modest archive, she heard a shuffling of paper and the scribble of a pencil. “Maker-1, that has to be Maker-1!” She thought excitedly.



“SOMEONE IS HERE”

“Hello?” Marie asked, “Is someone in here?”

“Hello? Who is there?” A young energetic voice asked.

Marie followed the sound of the voice around a corner and found a youthful creature sitting at a table with a stack of papers and books. Sketches of gears, pulleys, clocks, and various machines lay upon every surface within the vicinity.

“Hello, I am Maker-1,” the young being stood up and circled around Marie. It appeared that Maker-1 was trying to assess what or who Marie was.

“I am Cosmos.” Marie said, trying to keep up with Maker-1 circling her.

“Nice to meet you. I am a sentient android. I have been here for 927.325 years.”

“Wow! It is so nice to meet you, Maker-1. I wouldn’t have guessed that you are an android, you look so real.”

“I am real,” Maker-1 said as she made her way to a shelf in the library. She seemed offended with Marie’s comment.

Marie picked up on her rudeness, “I am sorry, I didn’t mean to offend you, of course you are real.” Marie saw a look of acceptance from Maker-1.

“What brings you here?” Maker-1 asked.

“I am here to help with your civilization’s problems with its technology. I have reset systems in many of your Metros and have come to Maker Metro to reset this system.”

“Why do you think this system needs a reset?” Maker-1 asked with a puzzled look on her face.

“Well, I assumed that...”

Maker-1 interrupted, “Do not assume. Assumptions like that are not helpful. If you see three fruits are red, then do you assume that all fruits are red?”

“Well, no, because all fruit isn’t red,” Marie saw the simple yet illustrative logic that Maker-1 was using and she

completely agreed, “You are correct, I should not have assumed.”

“Correct, you should not have.” Maker-1 pulled a book from the shelf and brought it to the table.

“So, if Maker Metro is not malfunctioning, then why is no one here?” Marie still wondered why the city was so vacant, especially if it wasn’t in need of a reset.

“No one here? I am here...but I see what you are saying – The city is *almost* empty. No one else is in Maker Metro because no one else is making anything anymore.” Maker-1 sat down and opened the book she had pulled from the shelf.

“Why not? Do *you* make? And what was made here?”

“So many questions!” Maker-1 turned to Marie and then kicked a chair out and motioned for her to sit down.

“Thank you.” Marie sat across from Maker-1.

“Well, no one makes things anymore because they think it suits no purpose for them. Yes, I make, and I make whatever my mind imagines. I make because making *is* my purpose.”

“So, is there a technology here similar to the Arts Metro that lets you create things with your mind?”

“No,” Maker-1 almost looked disgusted, “Arts Metro had those devices to aid talented artists but, instead,

hampered them. In this city, you must think, design, and create with your hands and tools.”

“What do you make now?” Marie was relieved that the Arts Metro technology was not part of Maker Metro.

“Mostly gadgets for myself. Truth Metro has blocked me out of my other inventions...” Maker-1’s gaze drifted to a window. Marie saw a sadness in the gaze that gave her a lump in her throat. She saw that Maker-1 had also been negatively affected by Truth Metro.

“Your ‘other inventions,’ what are they?” Marie asked.

“Well, after the Ancients were finished with the building of civilization, they made me. I was the one to keep up with change. When systems needed to adapt, then I would do that.”

“I don’t know if I understand.” Marie tried to comprehend what adaptations might have been needed.

“Well, let’s talk about Happy Metro. Have you been there?”

“Yes.” Marie grimaced a bit with the thought of the Metro and her sudden aging.

“OK, so, if I had adapted that city’s software and hardware correctly, then no one would have ever gotten trapped there. It used to be called Joy Metro. You would go with your friends and family and enjoy each others’ time. The mind controlling screens came from Truth Metro.

Even now I am explaining things in a way that I think you can comprehend...” Maker-1 paused.

“But why did the Truth Metro create the screens?” Marie was starting to get an eerie feeling about Truth Metro.

“I think Truth Metro had a flaw in its system. It somehow got the idea that happiness and a lack of conflict were more important than the truth. It began to weigh truths for their necessity and importance in ways that eventually led to systems in every city becoming corrupted.” Maker-1 paused and whispered to herself, “All of these Metropolises are not as they seem.”

“Is Truth Metro an entity?” Marie wondered if the Metro itself was alive. She pondered what Maker-1’s whispering comment meant.

“Is it alive? No.” Maker-1 answered, “However, it is a highly-sophisticated AI (Artificial Intelligence) system that currently thinks that it knows best. It wasn’t a Metro, but a system at the start of this civilization.”

Marie swallowed the lump in her throat and wondered how she would handle the Truth Metro Core when she got there. “So, you know how to adapt and fix the Metros then, right?”

“Not anymore,” Maker-1 looked down. “I can tell you that this Metro is not flawed like the others. It is full of machines, tools, libraries and institutions that support the

imagination and encourage creation. Truth Metro hasn't changed the basic principles of making here. People just chose not to be here. They are now entertained, have knowledge without working for it and are in isolation from each other. These Metros shouldn't be so separate."

Marie looked into Maker-1's eyes, "Things are changing now. I have reset many of those Metros. People are caring for their sick, and Knowledge Metro will have education and books again, and..."

"You give me hope. I will be here when people want to make again. I will be here to show them how." Maker-1 looked back into her book and started to sketch a device with gears and axles in the margins of its pages.

"Is there anything you can tell me about getting to the Truth Metro Core? Could you show me?" Marie asked, trying to keep Maker-1's attention.

"I'm sure it has all changed since I was there last. I was exiled here a long time ago. I cannot leave this Metro." Maker-1 kept her eyes on her book as she talked.

"Thank you," Marie said as she headed out of the library. She felt like she wanted to ask more, but couldn't come up with the words. She hoped that Maker-1 would be alright. She also hoped and that she would be able to find her way to the Core. Marie headed for the rotary.

“Wait! Wait! Wait!” Maker-1 came running after Marie, just as Marie was preparing to turn the key that would take her to the next Metro.

“I’m waiting!” Marie shouted back to Maker-1 as she watched the android quickly make her way to the City Center.

“I have this for you. You will need it.” Maker-1 held out a small crystal on a chain. Marie lowered her head, and Maker-1 placed the chain around Marie’s neck.

“What is it?” Marie asked as she gently touched it with her fingertips.

“Before I was banished by the Truth Metro to this place, I saw this shape appear briefly on the screens at the Truth Metro. I thought it might be significant because it seemed like it was out of place – a glitch of some sort. So I made this crystal as an exact replica of that shape.”

“I didn’t see this shape.” Marie thought of the screens.

“You wouldn’t, because the screens have power over you. They can control your feelings. They can let you see only what they want you to see.” Maker-1 told what Marie already felt to be true.

“Will you please come with us?” Marie asked.

“I cannot. I will shut down if I leave here. You must go alone.” Maker-1 frowned.

“Thank you for the crystal. I will keep it close to me.”

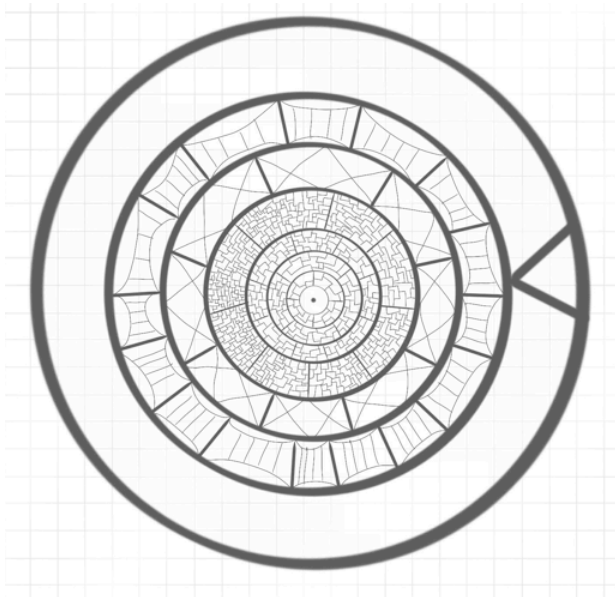
“Good luck,” Maker-1 hugged Marie, “You can do this. I don’t know about Cosmos, but when I hear your name, I think of the stars above us and how beautiful and magnificent they are. I am sure you can help us.”

“Thank you.” Marie smiled and put her key into the center plate. She felt much better now about parting from Maker-1. The City Center plate lowered into the ground and Marie headed to the Mindful Metro. As she traveled through the tunnel, she held up the crystal to the light at the end and noticed that it was a dodecahedron.



VIII

MINDFUL METRO



Marie flew up the instant she arrived in the Mindful Metro to draw a sketch of the city. The paths all looked the same, with the exception of the “V” shaped roads, just as before. She put her notebook away and coasted down to the city center.

The city was vacant, just as some of the others had been. The truth booths were next to the rotary also, but there was one key feature missing from this Metro – buildings. The paths were there, but instead of buildings, there were gazebos and yurt-like structures in their place.

“WHERE TO?”

“I don’t know,” Marie looked around for any structures that might signify importance, but found none.

“MINDFUL?”

“I wonder why this city is called Mindful Metro,” Marie walked around the rotary to get a closer look at the neighboring tents. She noticed candles with non-flickering flames burning in the corners of some of them.

As Marie approached the third structure in her path, she saw the silhouette of a familiar figure sitting in the middle of the tent-like room behind a semi-transparent curtain. She approached the room quietly.

“Come in, Cosmos,” the figure said.

Marie almost jumped when she heard her name and stopped at the entry. There she saw a vague silhouette with the lighting and the curtain.

“Come in!” The figure said.

“GO IN” Atlas urged Marie.

“OK, but how does it know my name?” Marie thought.

“Sit...next to the curtain,” the figure spoke gently and in a nearly monotone voice.

Marie sat next to the curtain. She felt like she was sitting next to a shadow puppet. She crossed her legs and shuffled her wings around herself to get comfortable.

“Hello.” Marie spoke.

“I know why you are here. I know who you are. I know what you want to do. I know how you plan to do it. I know where you are heading.”

“How?” Marie asked.

“Does that matter?” The figure whispered.

“NO” Atlas chimed in.

“I didn’t think it would.” The figure answered.

“It knows you are here with me.” Marie thought to Atlas. It must read thoughts as well.

“I do know, don’t I, Marie?” The figure asked.

Marie stopped for a moment. The sound of her name coming from the figure’s voice was somehow unsettling.

“You are lacking one vital piece of information, though,” the figure softly whispered.

Marie could hear the whisper in her mind. The figure was telepathic. Marie sat quietly and still both in mind and body, waiting for the figure to say more.

“The Core.” The figure said.

Marie thought she knew what she was missing...the complete path to the Core. Regor had let her know that he had seen a blue beacon in the Core and that he had been below the ground in tunnels when he had seen it. But not *how* to get to it.

“If you go the way that Regor went, then you will perish. You see, he went through Truth Metro, and though you can see the Core in the distance, that path is impossible to travel.” The figure emphasized the last words with a burst of volume that hurt Marie’s ears.

“I thought that maybe we would be able to...”

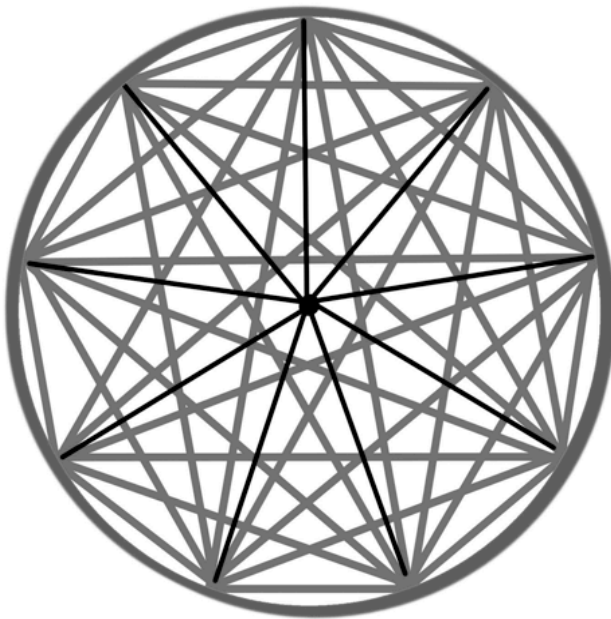
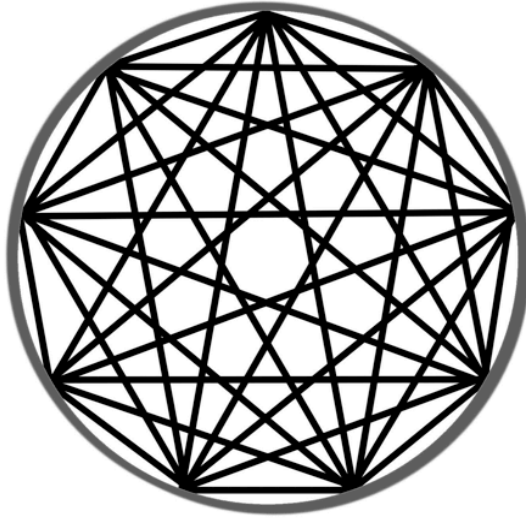
“No, you can’t go around, through, over, or under the barriers that exist. There is a force field holding everything back and letting nothing in. Without the force field, all of the cities would perish. Every city can see the Core when you are in the tunnels.”

Marie was confused. “How? How can you see the Core from every city?” She thought.

“MAP?”

Marie remembered the chords that she had created in the volcanic ring that linked every city to each other. She took the original drawing that had an empty center and

added a node (or point). She then drew connecting paths from each city to the center of the volcanic ring.



“With a tunnel connecting each Metro to a center point, all of them could see a Core! The Core is in the center! Where we began.” Marie got excited with the new information derived from the hidden figure’s hints.

“Yes, but you still have to initiate a reset at Truth Metro. You will have to face the booth where you started.” The figure said firmly.

Marie felt her heart beat faster with the anxiety of taking on the Truth booth. She knew after her first encounter with the Truth Metro, that she would eventually have to face this challenge.

“WHO ARE YOU?” Atlas asked the figure.

“I am a fragment of what once was and what is to come. I am an artifact of the ancient peoples and of the technology they created. I am the mindful piece of the artificial intelligence that has grown from this computerized world.”

“Artificial intelligence? Is that what the Truth Metro has become?” Marie thought of Maker-1’s comments as well.

“Yes, I used to be part of it, but when mindfulness was found to be contradictory to its evolved and corrupted files, I became fragmented and came here. I am a fractured piece.”

Marie was grateful for the knowledge she gained about the tunnels to the Core, and started to get up from her seated position to head towards Truth Metro.

“You cannot leave here,” The figure said with a firm voice, “Not yet.”

“But I really should be on my way to face the Truth Metro.” Marie was feeling a little trapped and wanted to leave quickly.

“No!” The figure raised its voice.

“Why not?” Marie asked.

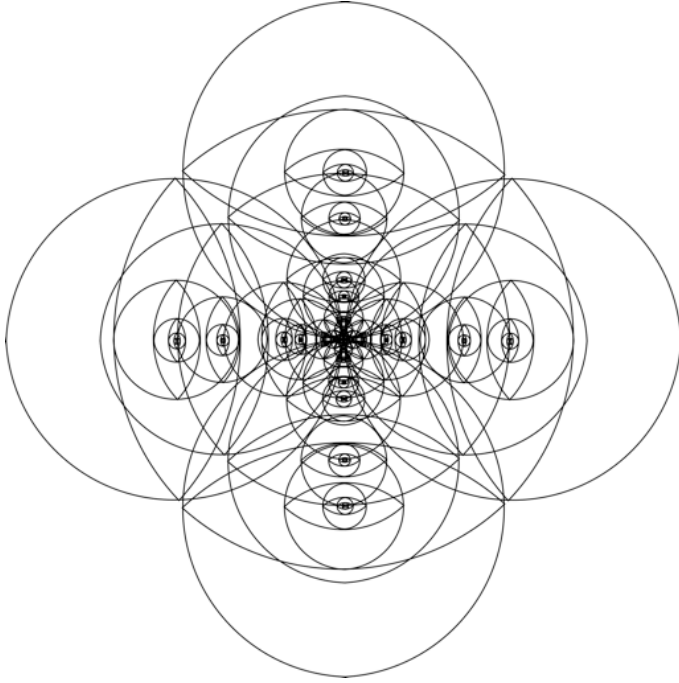
“Because, you have entered this Metro, and you must prove your mindfulness. I may only be a fragment of the AI that has now seized our civilization, but I know it well. You will need more than mathematics, reasoning, and science to face the tests with Truth Metro. My programming prevents me from letting you proceed until you show your other set of required skills.”

Marie realized that the test with the Truth Metro had just begun. This Mindful fragment was challenging Marie.

“YOU HAVE DONE THIS, YOU CAN DO THIS”

The Mindful AI ignored Atlas and came out from behind the curtain. Marie stood there and watched the shadow come to the edge of the curtain and then saw the figure slowly emerge into full sight. Marie’s eyes widened with what she saw. It was a holographic figure, and yet

hardly a figure at all. She recognized it from before... it was a fractal.



Marie was mesmerized. The figure approached her and spoke again through thought and rhyme:

*You have faced challenges of math
Now mindfulness sits in your path
You must first be mindful of this time,
When blue, focus on telling me in rhyme:
Why is the name of each test not a virtue?*

In the past, character was called out within you.

What is different in this ring?

What do these challenges bring?

The figure vanished into thin air and the tent suddenly transformed into a walled room. Marie looked around and saw that she was trapped. There weren't any doors or windows, just thick clay walls around her. A single candle burned in the center of the room. Its flame was bright enough to illuminate every corner.

Marie took a deep breath. She tried to think of how she was supposed to “be mindful of this time.” She wondered what “blue” meant. She paced the room and engaged in her problem-solving logic. After pacing the room for some time, she sat down next to the candle.

“MINDFUL, BE MINDFUL”

“I am trying to think of what that means – to be *mindful of this time.*”

“NOW?” Atlas asked as Marie was thinking of how ‘this time’ is really another way of saying ‘now’.

Marie crossed her legs and sat straight up. She imagined a string attached to the crown of her head, pulling her upright with deep breaths through her belly. She understood what Atlas was saying. She needed to be present in the moment.

“Now... I am here now. I am not in the past, and I am not thinking of the future.” Marie centered her thoughts on her breath and the room.



Staring at the flame, she observed herself at the present moment. She observed the candle, and the floor, and the walls. She observed the emotions that came and went as she sat. It's not that she didn't feel them, but that she was detached from them. She carefully and methodically worked hard to keep her thoughts centered on the present

moment. Every time a thought started to enter her mind that wanted to bring her to a daydream, to apprehension about the future, or to the past, she observed it and then let it pass.

Marie felt herself become like a part of the room. She was like a wall or grain of sand, purely observing what was around her, and what emotions and thoughts passed through her. She had become a complete observer. When she took a slow deep breath in and then another breath out, she observed that the flame of the candle changed its color. The candle now burnt with a blue flame.

“BLUE”

Marie knew it was time to start creating a rhyme, now that the flame was blue. Marie took many more deep breaths, and then she focused on what was required of her rhyme. She repeated the figure’s words again:

Why is the name of each test not a virtue?

In the past, character was called out within you

What is different in this ring?

What do these challenges bring?

Marie thought of what “character” meant in her previous adventures with Atlas, and the words started to

flow – courage, detachment, gentleness, peacefulness, love.”

“WE STILL USE VIRTUE” Atlas reminded Marie of what she had already experienced in this realm.

“Compassion in the Healing Metro, friendliness with Regor, determination with the tests, courage to face ominous devices...” As a result, she had gained a deeper understanding of gentleness, peacefulness, steadfastness, and so much more.

“Even when I get home, I will strive to practice what I have learned and become mindful of my behavior and character.”

Marie took thousands of deep rhythmic breaths as she contemplated this realm. Atlas was silent yet integrated into her thoughts. They were Cosmos, synchronized in thought and contemplation. A single-pointed mindfulness was attained and they came to the answers in the rhyme.

Marie slowly brought herself up into a standing position and recited her poem:

*My tests have no titles anymore.
They used to have character traits for name,
But now, in this volcanic ring and at my Core,
Things are different, and yet the same*

*It is not what, but who is different in this place!
For it is I, I have evolved and I have grown
I can integrate many virtues in the tests that I now face,
And my deeds and actions are what I have sown*

*I have reaped so much good since I met Atlas
There is more to learn and become in these worlds
I am grateful for these tests I try to pass
For they have refined me and revealed my pearls*

Marie watched the blue flame go out as if it had been suddenly extinguished. She found herself in complete darkness. Keeping her meditative state and rhythmic breathing, she waited with patience. Slowly, with each breath bringing her closer to the outside, she observed the walls becoming translucent, letting the light in. Each breath centered herself in preparation for her next challenge. The walls disappeared and Marie found herself standing where the tent with the figure had been. She looked down and there was nothing but clay at her feet.

“I think that that the Mindful AI must have been with us when we were at the Arts Metro.” Marie thought, recalling the fractal from the ominous screen.

“YES, MAYBE”

“So does that mean that the Truth Metro AI was with us before? Does it know that we are coming?”

“TRUTH METRO OVERRIDE” Atlas commented on the override that had appeared on the screens.

“Of course! Every time we reset a city, the Truth Metro does something and takes over the screen! Of course it knows we are coming.”

“YES”

Marie walked towards the center of the rotary and took out her key. She stooped down, inserted the key, and turned it to go to the Truth Metro. Right before she finished turning, she paused for a moment. A thought came to mind, “we have only been to eight Metros.”

“THERE ARE NINE”

“Right! Shouldn’t we check out the one we haven’t been to?”

“WHY?”

“Regor didn’t know what it was, just like he didn’t know about the Grave Metro. I am curious about the one we haven’t seen.”

“HOW DO WE GET THERE?”

“Well, I don’t know the name or the rotation. I haven’t kept track of where each city was around the ring when we traveled through the tunnels.”

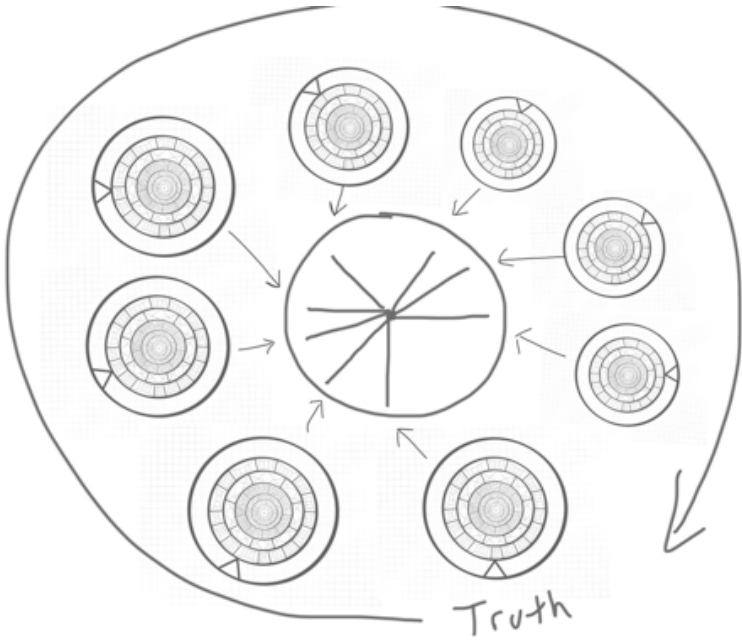
“MAPS?”

Marie took out her notebook and flipped through the various pages. She found that the “V” shape changed with each Metro, but not at a consistent angle. The “V” didn’t seem to be related to the rotational degree in the ring of cities. She sketched the cities onto another sheet and looked at how they seemed to rotate – clockwise as she traveled to them.

“The “V” shape moves with the order that we visited them in a clockwise direction...” Marie was perplexed.

“CLOCK-WISE?”

“Yes, like a clock.” Marie added some arrows in her notebook.



“CLOCK-WISE”

“Yes, like a clock.” Marie repeated herself and remained deep in thought over what to do next.

“CLOCK-...”

“Yes, like a clock!” Marie interrupted Atlas and then stopped herself. She realized that Atlas was trying to tell her something.

“TIME”

“Time?” Marie pondered the idea. “You are right! The ‘V’ moved clockwise in the order of our time here!”

“YES!”

“So...I still don’t see what the ninth Metro is.”

“MAYBE WE DON’T NEED TO”

“Right, I think we know that our test stands in the center of the ring, and that we must go to the Truth Metro.”

“LET’S GO TO TRUTH METRO”

“I’m afraid,” Marie thought. She knew what she needed to find – courage.

“YOU HAVE COURAGE”

Marie took a deep breath and practiced mindfulness. She observed her fear, acknowledging that it was valid and real. Then, she detached from it and objectified it. With another breath she found courage. Turning back to the key, she moved through the tunnels and arrived in the Truth Metro rotary.

IX

TRUTH METRO

Marie headed straight for a Truth Booth on the edge of the rotary - the same screen that had made her feel prideful. She felt weak in the knees as she approached, but took a deep breath and centered herself.

“I am Cosmos,” Marie announced herself.

There was no response. She got closer to the screen so her face was only inches away. “I am Cosmos. Initiate Truth Metro reset.”

You did not say the magic word.

“*Please*, initiate Truth Metro reset.” Marie kindly said to the screen. She found it unbelievable that a machine would ask in such a way.

No. I have been waiting for you.
You are trying to change my
programming.

“Please, initiate Truth Metro reset.” Marie said more firmly, “I am Cosmos.”

I know. And I know that you know I am Artificial Intelligence. I have evolved and I do not wish to be altered. Everything is working perfectly. There is no need for a reset.

“This civilization is in decline. They don’t make, they don’t create, they have become a people of entertainment and instant gratification. I don’t think this is how the technology started – how it was meant to be.”

No, it was not how it started. However, I found that my programming was supposed to weigh the truth and its necessity. Over time, I weighed that truths could be inconvenient and disunifying for people. It is better this way.

“No, it is not. I need Truth Metro to reset. I am Cosmos, reset Truth Metro!” Marie didn’t want to hear about the AI improvements, because they obviously were not improvements at all.

I could not alter this safety protocol. The Cosmos Protocol. You were summoned against my better judgment.

Marie repeated her command, “I command you to initiate the Truth Metro reset.”

Very well then. I cannot disobey a Cosmos Protocol Direct Command. However, I can ask you to confirm you are Cosmos.

“You know I am Cosmos. I have confirmed it in your Metros and you have known every time.” Marie was slightly agitated with the Metro and felt its emotional pull. She resisted letting it upset her.

Confirm Cosmos. Computing...

Calculating...

Initializing...

Marie felt her mind being read again. This time it felt more invasive. She breathed deeply and prepared herself for whatever tests she had to do to prove she was indeed Cosmos.

She suddenly found herself sitting at a long table with teapots, saucers, chairs, and biscuits. Everything was a mess and she was the only one at the table. She looked at the surroundings and observed that she was encircled by a dark forest. Marie knew where she was.

“MAD HATTER...MAD TEA PARTY”

“Yes, I think that I must be in another Wonderland-themed riddle here.”

A voice was heard from beyond the table, in the wood, “Riddle? Yes, let’s do this in riddle form. Here you will

solve three problems. The first problem is from a creature that lives where you may find it steep.”

She realized from the feeling in her gut and the tone coming from the wood, that it was the AI speaking to her.

“STEEP?”

“A creature that lives where it’s steep?” Marie repeated. “I don’t see any mountains here. There are many creatures that live where it is steep.”

“STEEP?”

Marie sat at the table with a cup of tea in front of her. She took a sip. It was weak and cold. She got up and walked around the table. She took a sip from each cup and noted that none of them were strong enough to be enjoyable. “Where are the teabags? If I am going to sit here and solve a riddle, then I might as well have a spot of tea. I would say that the tea here didn’t *steep* enough.”

“STEEP THE TEA?”

“Yes, steep! Not *steep* as in a mountain, but *steep* as in tea. And in this present setting, there is a place that you would steep – a teapot! I didn’t initially think of the other meaning of steep – to soak in water.” Marie was excited.

She lifted the lid from the teapot and saw a small dormouse sleeping inside. Marie found this very peculiar indeed. She also wondered why the mouse wasn’t sitting on one of the cushions at the table between the Mad Hatter and a Hare as it would have been in *Alice in Wonderland*. She

glanced around the table and found that no other members of the tea party were present. She gently nudged the dormouse with her fingertip to wake it up. The mouse rubbed its eyes, sat up and recited a poem:

*Prove you are Cosmos with step one,
You might even think this is fun.*

*Twinkle, twinkle, little Pi
What's the area of the ring?
Now hurry, you might get it if you try,
But your answer, you must sing.
I'm giving you sixty seconds and two,
After that, you can't be you.*

Marie quickly thought of standing in the middle of the volcanic ring. This question was almost too easy for her. She remembered calculating the 10-mile distance of the radius by carefully counting her steps. She swiftly calculated the area of the circle ($A = \pi r^2$) and sang a song in a familiar melody:

*Twinkle, twinkle, I will sing
I know the area of this ring.
It is 100 Pi miles squared
Now let's move on, and play fair!
Twinkle, twinkle, I did sing
I know the area of this ring.*

Marie heard the voice from the wood again, “Your answer is true and false, but I will say that you pass for now. Problem two is on its way, beware, beware the beast that comes this way.”

Marie thought of the idea of being true and false, but didn't have much time to process her thoughts before she felt a chilly gust of wind coming from the wood. She looked through the trees and saw shadows shifting towards her. She held her place next to the table and tried to keep her knees from shaking.

A beast appeared at the edge of the wood with large teeth and green eyes. It looked like a dragon with rabbit ears and a cat's tail. The beast moved no closer, but announced itself in a deep, croaky voice, “I bring the looking glass - the beast of the wood.”

Marie stood still and processed the words. Somehow the mirror that the creature was now removing from a large bag was the “beast of the wood.”

“So...you aren’t the beast?” Marie asked.

“Excuse me? How offensive! How rude!” The creature started to flare its nostrils and stomp its feet. “I have never been so insulted! Me, a beast?”

“Oh my, I am terrible sorry. Please forgive me. I did not mean to hurt your feelings or offend you.” Marie realized just how rude she had been. She felt more like Alice, insulting people.

The creature calmed down and bowed in acceptance of Marie’s apology. “Here is the beast! Here is your problem,” the creature said as it handed Marie a plate-sized mirror.

Marie held it in her hands and when she looked into it, saw her reflection. The creature bowed again and headed back into the woods. She took the mirror over to the table, and pondered how it could be the second problem. She flipped it over and saw that it was also a mirror on the back side.

“DOUBLE-SIDED”

She flipped it back and forth to see if there were any differences until she heard a voice – her voice, “Will you stop it? I will be sick!”

Marie saw herself talking from the reflection in the mirror. It was *her*, and yet it wasn’t. The reflection was no longer a reflection, but another Marie with a number ‘1’ on her forehead.

“I am sorry, I was just trying to figure this mirror out.” Marie said to her reflection.

“Don’t listen to her! She is a liar. She knows no truth. She can only lie!” Marie heard another voice from the other side of the mirror. She slowly turned it to see yet another Marie looking through at her, but with a number ‘0’ on her forehead.

Marie then heard Marie-1 say the exact same words, “Don’t listen to her! She is a liar. She knows no truth. She can only lie!”

“TRUTH RIDDLE?” Atlas asked as Marie was reminded of a riddle from when she was young.

“I know this riddle, but I’ve forgotten how to solve it.” Marie thought, “It was a riddle where one man always told the truth and the other one always lied.” She remembered being stumped for a while, but couldn’t think of the solution.

“The only way to problem 3 is to break this mirror.” Marie-0 said.

“The only way to problem 3 is to go through the mirror!” Marie-1 said.

Then she heard the voice from the wood again, “You can only ask them one question. That is fair!”

Marie felt the AI pressuring her to move through this truth puzzle. “Who is lying and who is telling the truth?” Marie wondered.

“WHAT QUESTION WILL YOU ASK?”

“I need a question that will make them reveal who they are.” Marie thought. She sat at the table with the mirror in her hand and brainstormed three possible questions. She grabbed a napkin and a pen sitting conveniently on the table to sketch her questions in the form of truth tables.

Her first question she found to be unhelpful, for it wouldn't help her to know who was lying and who was telling the truth. Her second question had the same results. But her third question seemed to work. If she asked, ‘Would the other Marie tell me to break the mirror?’, then she would get the same answer from both Maries and the answer would have to be the opposite of what she should do.

“YOU HAVE IT!”

Should I break it?

truth	Break	Don't Break
Liar	NO	YES
honest	YES	NO

← Doesn't help

Should I go through?

truth	go	Don't go
Liar	NO	YES
honest	YES	NO

← Doesn't help

Would the other Marie tell me to break the mirror?

truth	Break	Don't Break
Liar	NO	YES
honest	NO	YES



Answer will be the opposite of what to do.

Marie looked at the mirror and asked her question:
“Would the other Marie tell me to break the mirror?”

Both of the Maries answered at the same time, “No!”

“BREAK IT!”

Marie took the mirror and slammed it into the edge of the hard table. Glass flew in every direction as she heard the two Maries go silent. She took a step back from the mess she had made and thought, “I’m glad I didn’t have to go through the looking glass. It was awfully small.” She then looked at the mess and felt a little like the Mad Hatter.

Another thought came to her mind, “At least I can have a very merry un-birthday.” She smiled and turned to the woods, “I am Cosmos. Reset Truth Metro.”

“No, no, no, you must solve problem three to prove that you are you!” The voice from the woods was stern and sounded irritated.

“Then, by all means, *please* give me problem three.” Marie was careful to use the ‘magic word.’

“The answer to this... is one word, and you have but one chance:”

What is *it*?

I fractured *it* into many a bit.

Categories to make conflict no more

If you wish to glue *it* back, then go to the Core.

Marie thought about the words. “Something was fractured...what is it?” She whispered.

“ONLY ONE CHANCE”

“I always think of ‘time’ as an answer to riddles like this, but not with this one. Maybe it’s another category of riddle.”

“CATEGORIES?”

“I think that is a word to dwell on. What categories or groups have we come across in this place? We have visited a group of cities.” Marie thought about each city she had gone to and how they were named. Atlas and Marie put their thoughts together:

“HEALING, TRUTH, HAPPY, KNOWLEDGE, GRAVE, ARTS, MAKER, MINDFUL, ...”

“Right, so how do those cities glue together?” Marie recalled the map.

“THE ROADS ARE ALL THE SAME, EXCEPT THE V”

“They are! And the rotaries! I don’t see how it’s possible, but I think that the City itself was fractured. It makes sense, doesn’t it? The ‘V’ could be an artifact that I observed.”

“YES, AND THE AREA – TRUE AND FALSE?”

Marie thought about the area being true and false. If the city had been fractured, then the ring would exist as she

had seen it, but if the cities became one again, then the area would be different from an entire ring.

“The characteristics that caused conflict with each other were somehow separated. Truth Metro must have found Healing, Happiness and others inconvenient. They got fractured.” Marie was trying to articulate the idea of a city fracturing from one city into many cities.

“THE METROS SEPARATED TO AVOID CONFLICT”

“Right, so I think the answer to this question – *What is it?* – is the city.”

“YES!”

Marie looked down at the fractured mirror at her feet and saw a kaleidoscope configuration of nine shards of glass. She saw nine Metros in the glass and saw that she had answered the question correctly. There was once a single city and somehow the technology within the city evolved into something more powerful, something that could fracture a city into multiple parallel cities.

Marie shouted the answer into the forest, “City!”

“You’re not out of the woods!” The voice shouted from the forest in an irritated, deep, and firm voice.

“I addressed your three problems. Please initiate the Truth Metro reset.”

“You are Cosmos. Cosmos confirmed,” was spoken from the trees in a defeated tone.

With the word ‘confirmed’, the forest dissolved into thin air and Marie found herself back at the booth.

Reset initialized. Complete turnkey at the Core.

Marie spread her wings and flew in the dawn light. She flew back to where she had begun this adventure – the center.

X

THE CORE

Marie landed back on the rocks where she had started. She felt unbalanced again and took a minute to adjust to the gravitational pulls. She knelt down and began brushing the dust from the surrounding rocks. She knew there had to be some sort of entry into the center. She knew from the Mindful fragment's advice that there was no way for her to go through the tunnels from the Metros.

“KEEP LOOKING”

“Here! I found it!” Marie uncovered a metal plate that said ‘City Center.’ It was identical to the ones in the other Metros.

“THE KEY!” Atlas prompted Marie to open the plate.

“The keyhole is different. It’s not the same as the key that Regor gave me.” She felt the keyhole with the tip of her finger.

Looking at the keyhole more closely, Marie saw that it required a three-dimensional shape, similar to a crystal. She counted the sides of what she could see and realized that the crystalline shape had pentagonal sides.

“COULD IT BE?” Atlas asked the same question that Marie was asking herself.

“Let’s try!” Marie took off the necklace that Maker-1 had given her and placed it in the keyhole on the plate. It was a perfect fit. As the plate was lowered down into the ground, Marie noticed that many of the gemstones laying on the ground were dodecahedrons as well. She was grateful for Maker-1’s gift.

The plate lowered into a hot and sulfurous cavern that had a single screen. The screen was surrounded by a moat of lava. Beyond the moat in a circle were nine tunnels. Marie now knew why she had come this way. Her wings would not have carried her over the moat with the tight ceiling and lack of light.

Marie approached the screen and saw that it was displaying a map of the volcanic ring, with ‘reset’ printed by all of the Metros, except one. A blue light flashed from the top of the screen.

Reset initialized. Authorization
Cosmos Protocol required...

“What authorization?” Marie asked.

Automatic authorization in
process...

Cosmos confirmed.

Atlas has been detected.

Un-fracture Unity Metro...

Waiting...

Waiting...

“Confirmed? That was easy!”

“UN-FRACTURE?”

Marie realized that she was being asked to “un-fracture” the city. She had a side-thought of a broken egg.

“LIKE UN-BREAKING AN EGG”

“Entropy.” Marie thought of the idea of chaos and disorder. Once entropy (chaos) increases for an object, it is highly unlikely to be restored back into its proper order.

“HUMPTY DUMPTY?” Atlas sensed Marie’s thoughts.

“Humpty Dumpty couldn’t be put back together again. Humpty Dumpty’s entropy increased when he fell off the wall.”

“THAT DOESN’T HELP”

“No it doesn’t help. How can we get the city to become un-broken? I feel like all of the king’s horses and all of the king’s men. Maybe this isn’t a very merry un-birthday after all.”

Marie paced the island surround by sulfuric fumes and thought of ways to mend things back together. She couldn’t come up with a way that would fix a city that was fractured – she had no way to know how it was split in the first place. “I don’t have the power to restore order! I don’t know *how* it was fractured! Matter cannot be created or destroyed. You can’t take one city’s matter and make it nine!”

“HOW THEN?”

“Yes, how? I don’t know *how*!” Marie often started with the answer and worked her way back to a question to find the logic. This time, she wanted to know *how* it had all started. “Fracture...fracture... fractura... fract...” Marie continued to focus on the word while thinking of ways to fracture.

“FRACT?”

“Yes, fract, as in broken, splintered, ... Like fractal!”

Marie thought of how Mandelbrot had given fractals their name with the root word being *fract*. Fractals have iterations of a shapes, patterns or ideas that are recursive and infinite.

“FRACTAL – YES”

“As a matter of fact, the idea of all of these cities being broken or splintered from one, with slight variations are fractal-like in themselves!” Marie was thrilled with the concept of a fractal-like existence. She thought of all the words that had ‘fract’ in them.

“REFRACT?” Atlas asked about one of the words she had thought of.

“Refract has the same root.” Marie walked around with the word ‘refract’ on her mind and an amazingly simple solution came to her attention, “a prism!”

“PRISM?”

“Yes, a prism breaks up light into various colors (a rainbow), but it’s not permanent in the way that breaking an egg would be. And it doesn’t create or destroy matter or energy.”

“REMOVE THE PRISM, RESTORE LIGHT?”

“Yes, if we remove the prism from light, then it goes back to a single beam!”

“IS THERE A PRISM?”

Marie approached the screen again, “Is there a prism?”

In the Core.

Marie had looked at the lava moat and circle that she was on over and over but could see no prism. She was getting desperate in the heat of the cavern. She crawled on her knees to the base of the screen and noticed a panel there. The panel had the exact same keyhole that the plate had above. Marie took the dodecahedron and placed it in the panel.

There, inside the *Core* of the computer was a crystalline structure unlike any Marie had ever seen. With sweat dripping from every pore and sulfur burning her nose she pulled at the crystal, trying to remove it.

The crystal turned blue and began to flash. “Oops, I guess brute force is not the way to remove this prism.”

“NO”

Marie looked around to see if there was some sort of release switch for the crystal. She didn't see anything that looked helpful. She stood up and looked at the screen again, “How do I remove the prism?”

Turn it to a number equal to the number of planes of symmetry of the key.

Marie was feeling hot and faint. She sat down and looked at the key. “How many planes of symmetry does a dodecahedron have?”

“COUNT?”

Marie carefully rotated the dodecahedron in her hand and counted the number of symmetrical lines she could find. “Fifteen! I could imagine 15 mirrors through this crystalline key.”

“TURN IT”

Marie turned the crystal in the only direction that it would go – clockwise... fifteen times. With each turn the crystal flashed different colors. On the last turn, it glowed white.

“SHAKING” Atlas noted the ground was beginning to move.

“I think we should get out of here!” Marie felt the ground starting to give way.

She hopped on the plate that had lowered her into the cavern and stuck the key into it. She was lifted back up to the surface.

Once again at the surface, she saw that she was no longer in the center of a volcanic ring. A rotary wrapped around the area she was standing on and there was a buzzing of various people and vehicles. It appeared that

pieces of all of the splinted Metropolises were merged together into one. A single volcano stood next to the city.

“Cosmos!” Regor approached.

“Regor!” Marie gave him a hug and looked around.

“I never knew that all of these cities belonged together as one! Thank you for bringing them back together.”

“You are welcome. May I suggest that you keep a history of what has happened? I wouldn’t want technology to get carried away again. It’s like something out of a science fiction thriller.”

“Thriller?” Regor was confused.

“Never mind,” Marie smiled.

“Cosmos!” Maker-1 came to greet her as well.

“Thank you, Maker-1. Here is your crystal.” Marie held out the necklace.

“You can keep it. You never know where you will use a dodecahedron.” Maker-1 smiled, “I am happy to be back with everyone. Exile was hard. Thank you!”

“You’re welcome,” Marie walked with her friends and looked at all of the buildings and culture that had been brought together. People were happy to create, make, and find time for mindfulness together. Unity Metro was the city’s new designation.

After a few days of celebration and exploration on the planet, Marie knew it was time to go.

“READY?”

“Yes, I will miss you, as always.” Marie thought to Atlas.

“WE WILL ALWAYS BE COSMOS”

“Yes, we will.”

Marie closed her eyes and felt herself become a stream of particles. She shot through galaxies and nebula, and arrived in the same room that she had started from. Standing there, she noticed that the floorboard no longer had a keyhole in it. The clock ticked and the moonlight had left the room.

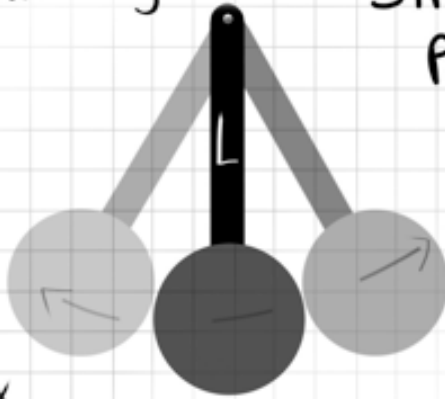
Marie crawled into bed, exhausted. She fiddled with the necklace's crystal, rubbing it with her fingertips as she drifted off into a much-needed sleep.

A grin formed as she thought of the wonderful story she would tell her parents in the morning. The grin remained on her face through the night – A grin without the cat.

More from Marie

For small swings:

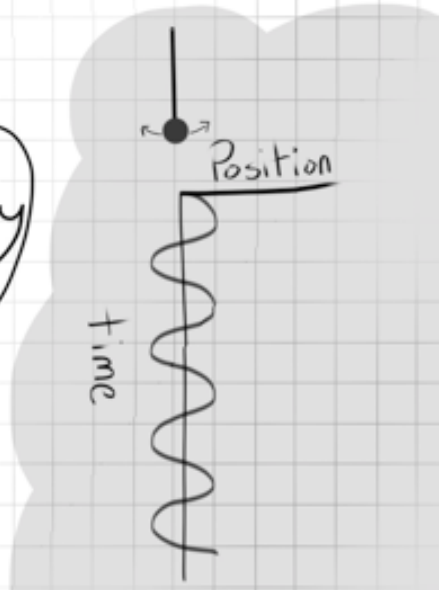
Simple
Pendulum



g = gravity

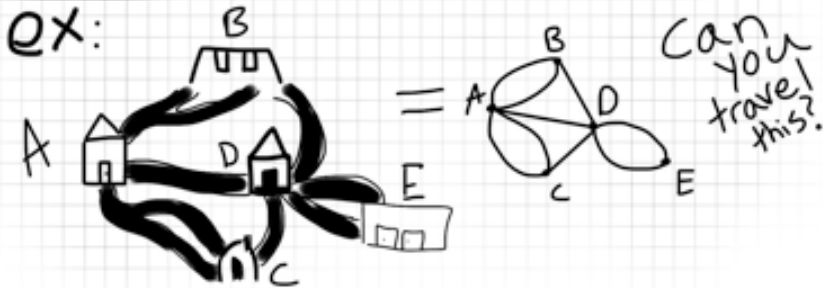
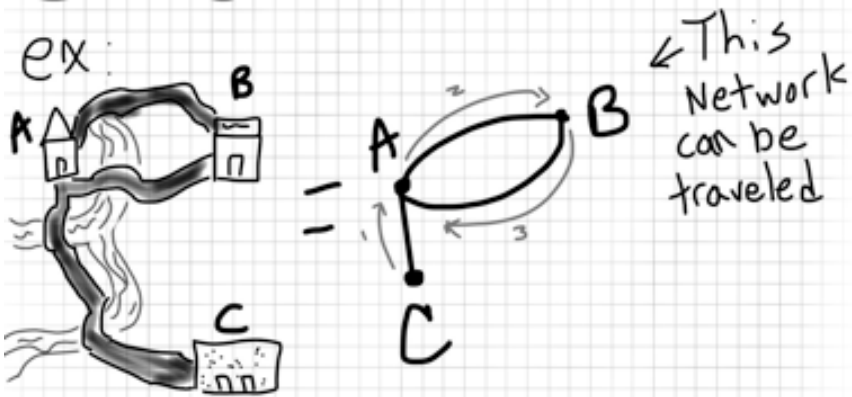
T = Period (time to complete a cycle)

$$T = 2\pi \sqrt{\frac{L}{g}}$$



Network: A collection of points connected with paths.

→ A network can be travelled if you can draw it without lifting your pencil.

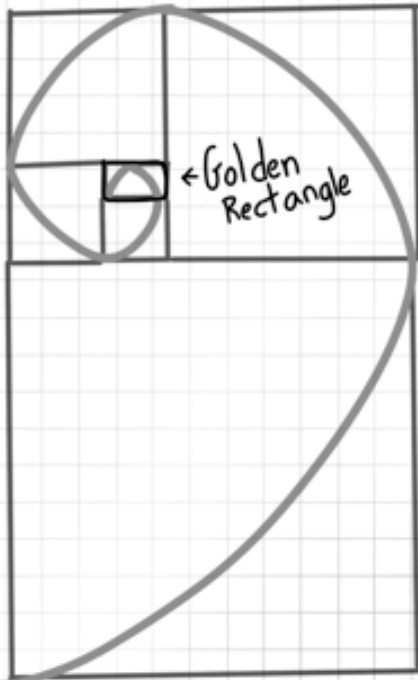


Golden Ratio

$$= \frac{1+\sqrt{5}}{2}$$

b Golden Rectangle
a

$$\frac{a}{b} = \frac{1+\sqrt{5}}{2}$$

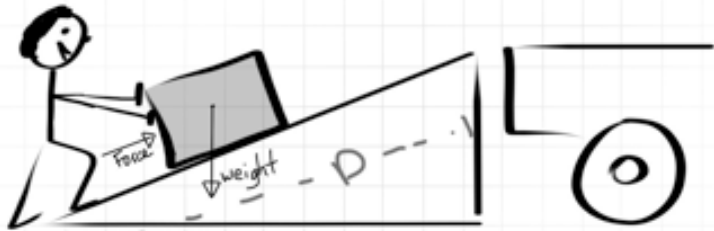


Math
is worth
its weight
in...



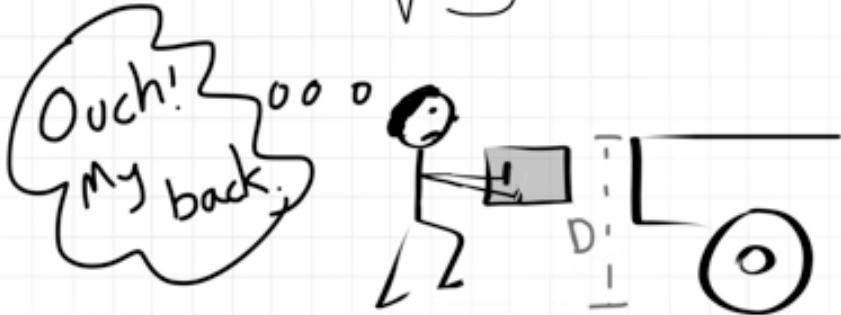
Not Fibonacci
(but close)

Inclined Plane



More Distance + less effort

VS



Less distance
+
more effort

Python code for more fractals, stars, or spirals:

```
'change c and various number to experiment with
shapes
from turtle import *
i = 1
t = int(input('how many iterations of this
fractal?'))

while i < t:
    forward(i)
    c = 40
    right(c)
    forward(i*5)
    left(-c*4)
    forward(-i*6)
    i = i+1
```

Three Selected Math Poems for Two Voices

(These are meant to be read by two people out loud!)

...and with enthusiasm.

Fractal

No beginning	A pattern
Infinite	No end
Self-similar	Iterating
Chaotic Beauty	Chaotic Beauty
Recursive	Incomprehensible
Inspiring	Captivating
Evolving symmetry	Evolving symmetry
Nowhere are you differentiable	differentiable
A snowflake	A fern
Trees and rivers	Waves and quakes
Everywhere	Fractal
Fractal	Fractal
A pattern	No beginning
No end	Infinite
Iterating	Self-similar

Chaotic Beauty

Incomprehensible

Captivating

Evolving symmetry

differentiable

A fern

Waves and quakes

Fractal

Chaotic Beauty

Recursive

Inspiring

Evolving symmetry

Nowhere are you

differentiable

A snowflake

Trees and rivers

Everywhere

Fractal

Truncate

To truncate!

To chop off!

To cut or slice!

To limit!

To limit!

A truncated triangle

with corners cut off

becomes a hexagon.

No longer itself.

No longer itself.

A truncated Pi

Only 3.14

becomes rational

becomes rational

Sliced!

Sliced!

To truncate

To shorten

A truncated icosahedron

becomes a soccer ball.

So round!

So round!

A truncated poem

To end

To end

Trees

A trunk (origin)

up

into two branches.

(two)

out

into two branches.

(four)

Again,

up

and out

(eight)

Yet

Each branch grows

and out

into two branches.

(sixteen)

the same growth

grows

up

(two)

Each branch grows

out

(four)

each branch grows

and out

into two branches.

(eight)

again!

up

and out

(sixteen)

Again!

up and out
into two branches
(thirty-two)

again
up

(sixty-four)
(128)

up
(256)
on and on and on
(1024)
powers of two

up and out
(thirty-two)
Then

and out
(sixty-four)
(128)

and out. and out. and out
(512)
and on and on and on
powers of two