“Father Sun, even you will eventually die too?”
Earth asked in this way.

“Indeed—don’t be fooled by my current youthful vigor.
I might only be able to lead my whole family for another five billion years;
The hydrogen I burn can no longer sustain this household of nine.
I might even have to eat yours, drink yours, and live in your home!”

“The Galactic Government won’t grant my pension until I reach nine billion years—
Who knows what a decrepit old fellow I’ll be by then?
Perhaps my belly will grow so enormous it could swallow you all whole;
So when you see me, be sure to tread carefully…”

“Brother Mars used to be as fresh and dewy as you are,
But ever since he headed off to the worksite, his skin has turned a sallow yellow—it truly breaks one’s heart.”

Earth continued, “Though I’ve only lived for 4.6 billion years, there are many days yet to come,
Still, I can keenly feel the march of time.
There was a time I could orbit Old Sun over 400 times in one go—each orbit then taking only 22/24 of the time it does now—
Now, I manage only 365 rounds.
Sometimes, when living day by day, I hardly feel the aging,
Yet when I look back over billions of years, the truth of aging is unmistakably real.”

“Perhaps that’s just how life is—before you’re ready,
You’re flung into this world and then worn smooth by it, losing all your edges.”

Sixty-five million years ago, Earth had not a single gray hair;
Its lush, black locks were like the youthful blades of grass in spring.
Back then, its skin was a single, unbroken sheet—not cracked into five parts as it is now.
It even used to feel the rhythmic thumping of fleas that made it itch a bit.
Then, after a near-fatal car accident, it nearly got a concussion—
And for some unknown reason, those little fleas vanished from then on.
Now, it clearly senses that no large fleas remain.
Though it never exchanged words with them, it seems they weren’t very clever.
Not like now—the mites on its surface seem to be throwing a wild party, packed in tight.
They’ve become so “smart” that countless buzzing little bugs fly before my eyes—

Perhaps they built their own tiny flying machines,
For neither the electric mosquito racket nor any floral spray can exterminate them.
I'm even developing a bit of a bald spot on my head, and a patch of my ozone layer is missing—
Could it be their mischief?
My temples have even begun to frost over with a thin icy layer;
I once had not a trace of ice anywhere.
They infuriate me so much that my face starts to heat up,
And I even resort to thermal therapy—a hot treatment for my hair—
Hoping to melt away just a bit of that icy fringe at my temples.
They must not think they can do as they please on my body.
I truly couldn't care less about whether they're doing well or not.

Old Sun admonished him, "You must treat the Moon well—remember, the palm and the back of your hand are both flesh;
It used to be a part of you,
But through your mischief you hurled it away."
"Ha! How can I possibly look after it?
Every month, for a few days it tugs at me,
And it never faces me directly—it always hides behind."
While speaking, Old Sun blew a gust of solar wind at Earth,
And ripples like colorful ribbons spread across Earth's temples.
"Old man, when you were a child you used to love spitting in my direction,
Watching my temples sparkle—what was so amusing about that?"
"Oh, how delightful—it's a rare reminder of the days when I was still young. Alas, time waits for no one."
"And then? What comes after death? What lies beyond the end of time?"
No one knows—perhaps just as we arrived in this world, so we must depart.
It is only fair, or perhaps there has never been any absolute 'should' or 'should not.'
That is the way of the world.

He had, in fact, long ago completed this little simulated ecosystem project—
The universe was the result of several all-night coding sessions.
He gazed unblinkingly at this soap-bubble–like, crystalline, transparent world.
It was the fairly decent result he achieved after testing hundreds of millions of initial parameter sets.
He complained about how the teacher never made the documentation clear enough—the process of refining the initial parameters was truly torturous.

But don’t underestimate this project—even if others have reinvented the wheel,
They still had to build everything layer by layer from the very bottom up.
First came the construction of the underlying physical theoretical framework.
He allocated a vast expanse of four-dimensional spacetime to this universe,
And in one respect, he didn’t follow the teacher’s manual—
He defined his own rule that the mere twisting of space itself produces gravity,
So that the geometric structure of this spacetime canvas naturally creates interactions with every object in the universe.
He secretly rejoiced—doesn’t that make it look like one giant ski resort?
To ensure the universe appeared as continuous as possible,
He made the smallest units of time, space, and energy as tiny as possible;
Alas, his universe machine’s storage was limited,
So infinite divisibility was impossible—there was a smallest unit, though the jaggedness became nearly imperceptible.
To save on computing power, he had to implement some engineering optimizations;
For example, only particles that are actually observed by entities would be computed and rendered.
This simple optimization instantly saved a huge amount of computing power!
But reducing the computational frequency in this way could sometimes lead to glitches—for instance, particles might tunnel right through a wall—
He wasn’t too happy about this phenomenon, but could only console himself: it was a necessary sacrifice of precision to save on computing power.

For example, by allocating a fixed number of bytes to jointly describe a particle’s position and momentum,
It meant that the two could never be measured precisely at the same time.
The faster a particle moves, the more bytes its momentum consumes—leaving fewer bytes for its position,
Thus its position becomes indeterminate, and vice versa.
But coding it this way—giving each particle a fixed-size “slot”—made management easier.
After all, his household wasn’t exactly wealthy, and the transmission bandwidth was similarly limited—no workaround.
So, neither the speed of information nor that of matter could exceed the maximum bandwidth of his universe machine.
When nearing that limit, time slows down, scales contract, and mass becomes nearly infinite—
At that point, the broadband company has to throttle the traffic.

He later discovered that even with fixed bytes for both position and momentum,
He couldn't escape the use of linked lists—a linked list that stores the address of the next particle's location.
He found that this operation was the only way to remotely "call" particles across the bandwidth limit,
And he was a bit puzzled by this implementation—as if it were some ghostly entanglement effect.
Though it wasn't the prettiest solution, it at least met the need, so he didn't fuss any further.

Regarding the forces between particles, he implemented a kind of electric force;
Once he set up this force, he found that under a fixed maximum bandwidth,
The relativistic effects of the electric force would, for high-speed charged particles, produce an orthogonal magnetic force.
He was somewhat confused as to whether this extra force should be considered a bug,
But for now, he decided to treat it as a feature!
He didn't realize that the more code he wrote, the more likely problems were to arise.
In some small corners of the universe, there exist bottomless black holes—
Dead loops he had inadvertently coded,
From which, even if data were transmitted at maximum bandwidth, escape was impossible.

Speaking of what he was most satisfied with—it wasn't really the construction of the universe's overall environment;
What he took the most pride in was the self-replicating, evolving little machine he built piece by piece using NAND electronic components.
Do you know? In its earliest stage, this little machine was like a fertilized egg that kept dividing into different cells—a tree-like structure in which various cells continued to differentiate into different functional types.
Although NAND might seem very simple, it can be used to build a NOT gate,
Then from that, AND gates and OR gates.
And from the combination of AND and OR gates, one can create XOR gates.
XOR gates together with AND gates can form a half-adder,
Then a full adder—an n-bit adder.
Taking the complement gives you a subtractor.
After that come multipliers and dividers,

Then various arithmetic units are integrated into an arithmetic logic unit.
NAND can also be used to construct storage units, latches,
Which in turn can form the structures of memory and registers—
Memory, an arithmetic logic unit, and registers together constitute a CPU.
And so on—with computation and storage cooperating,
An operating system can be built.
This little machine runs on that operating system.
It's hard to imagine that such a precise and complex gadget could be created from a single component.
He even wrote a low-level instruction set specifically for this little machine.
Let's call it DNA—the most primitive self-replicating program embedded within a cellular automaton.
This interface is extraordinarily versatile; any class that inherits from it can directly call it—
Even billions of years later.
Sometimes he would stare blankly at the evolution of the cellular automaton,
Never expecting that such a simple program—once it met the bootstrapping condition—would unleash so many possibilities.
Evolutionary algorithms are truly beautiful.
DNA originally was just "acgt acgt," bit by bit.
From the very beginning of a quaternary machine language,
To the painstakingly designed instruction set and CPU pipeline architecture,
Then to the compiled language that controls cell differentiation,
And finally to the high-level language that governs evolution and genetic mutation.
He really learned a lot from this project,
And he believes that someday he too can become a universe-development engineer capable of standing on his own.
What if I were to slightly increase the universe's fine-structure constant?
Maybe I'd just re-run the simulation.
Oh, by the way—the parameter from earlier was pretty good; I should back it up—
But alas, in the end the universe still succumbed to entropy and faded into heat death.
I had hoped that the little wise creatures within might detect a bug in my program and then change the compilation rules,
But they did their best; after exhausting all their energy—even using every bit of energy they could muster—
They still couldn't catch up with the universe's expansion,

Even if they traveled at nearly the speed of light, they couldn't reach the neighboring stars to harvest energy,
And so they silently awaited their demise, turning back to dust on a planet half a million light years away from home.
But how could the 0s and 1s in a computer ever affect the creator in the slightest?
Once something is created, it has meaning;
And even for the 0s and 1s, their meaning—
Will it really have the faintest connection to me?
Enough said—after all, school never taught what to do when a simulated universe faces heat death.
Should I randomize some parameters and re-run the simulation?
Might I be able to detect the conditions for heat death before it finishes,
And occasionally reshuffle the galaxies at random—could entropy return?
He clenched his fists, ready to grab those bonus points as well, designing a way to break out of this heat-death deadlock.
Maybe he'll even come up with a new trick and publish a paper.
He felt that his coding speed wasn't what it used to be two years ago—
Could it be that he's already past his peak?
For some inexplicable reason, he said to his father: "Father, even you will eventually die too?"

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Written by Pengcheng Xu, May 2023