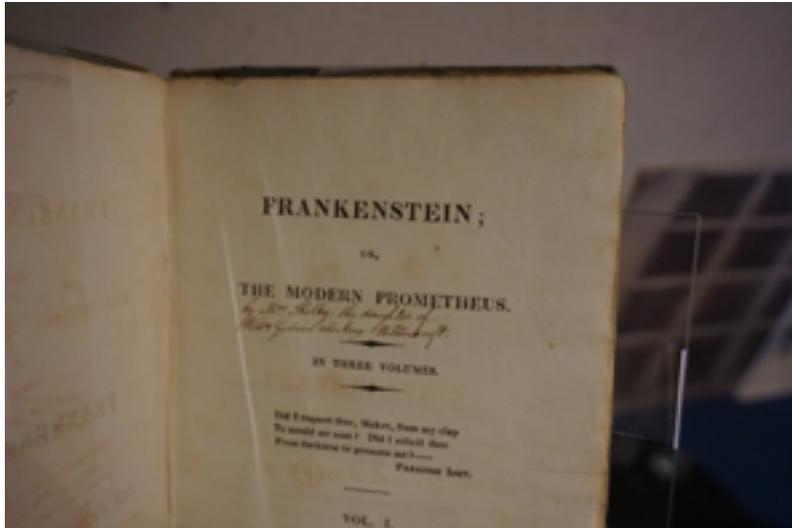


“Everything must have a beginning, to speak in Sanchean phrase; and that beginning must be linked to something that went before. The Hindoos give the world an elephant to support it, but they make the elephant stand upon a tortoise. Invention, it must be humbly admitted, does not consist in creating out of void, but out of chaos; the materials must, in the first place, be afforded: it can give form to dark, shapeless substances but cannot bring into being the substance itself”.

-Mary Shelley's *Frankenstein; or, The Modern Prometheus*, introduction, pg. IX

Shelley's meditation on the emergence of new phenomena touches on the very nature of invention and its potential, the materials and means needed to push the boundaries of knowledge.

Whether this is applied to the discoveries of fluid movements or to the gait cycles of a walking machine, the notion that the core of invention lies in something brute and at the base of being human holds true.



## FRANKENSTEIN

In the preface to her novel, *Frankenstein*, Mary Shelley mentions the work of Luigi Galvani. She recounts chatting with Lord Byron and Percy Shelley late into the night while summering in a castle. They spoke of the philosophy of “Galvanism”. One of the crucial paragraphs, reproduced below, illustrates the moment of recognition that life is a force, a creative force, though it is often outside of our control.

From *Frankenstein*, Chapter 5-

IT WAS on a dreary night of November that I beheld the accomplishment of my toils. With an anxiety that almost amounted to agony, collected the instruments of life around me, that I might infuse a spark of being into the lifeless thing that lay at my feet. It was already one in the morning; the rain pattered dismally against the panes, and my candle was nearly burnt out, when, by the glimmer of the half-extinguished light, I saw the dull yellow eye of the creature open; it breathed hard, and a convulsive motion agitated its limbs.

This passage from *Frankenstein* brings to bear the idea of life lost, but later restored. Life is in springs, in mechanical parts, in liquids, images, just about anything. It is an error to differentiate so quickly.

Where could ideas come from other than the world?

To know a truth- the biology is distinct from technology, that the world is purely physical, that machines are made of mechanical parts- is to know that we can question the status of these truths and endeavor to change them. The very nature of the idea of “life”, “the living”, “the real”- all are easily turned on their heads through the ages by the brilliance of certain individuals.

When you put your life into something, it might come to life.



## THE CLOCK WAS INVENTED SO WE COULD ALL BE LATE

Ivan was in Australia lying on the beach and had the idea for the first in/first out register set in which the entire set of latches was fully symmetric from the front to back.

When Oracle bought Sun Microsystems, Ivan moved to Portland to found the “Asynchronous Research Center” with Marly Roncken. His primary focus is figuring out a way to help the industry escape from the “Tyranny of the clock”. Ivan is spending his time rethinking time, the way it works, and how it structures our world.

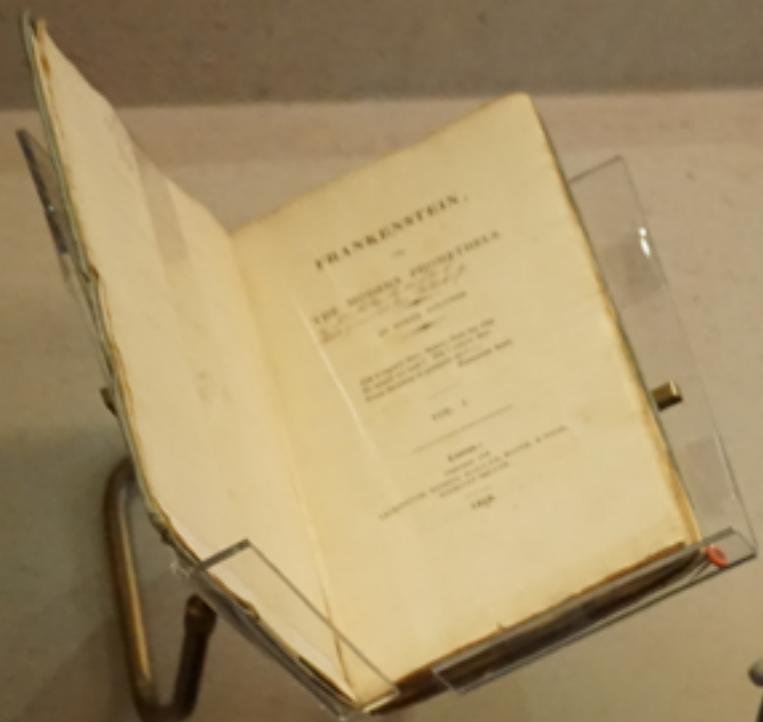
He continues doing VLSI design and works with students at Portland State University.

Ivan said in a lecture once, “As the sands of time begin to run out, you mostly have memories. But young people are wonderful”

## ACTA ERUDITORUM

Translated as “Reports/Acts of the scholars”, this was the first scientific journal, published from 1682-1782. It was founded by Otto Mencke and Gottfried Leibniz. A monthly publication, it was a fulcrum point for advances in science and a place where ideas were shared among enthusiasts, laying the groundwork for our era’s advances.

Below is the first published illustration of the “Step reckoner”, a digital mechanical calculator invented by Leibniz. Completed in 1694, it was the first calculator that could perform addition, subtraction, multiplication and division. Only two prototypes were ever built.



Somewhere in this design one could find the idea of the computer, the concept of which has taken several hundred years to ferment.

#### BIG DOGS

Raibert founded Boston Dynamics in 1992, after many years developing legs with colleagues in his labs at CMU and MIT. Boston Dynamics was purchased by Google in 2013.

Little Dog, seen here, is a smaller version one of Boston Dynamics most widely publicized accomplishments. A smaller version of their groundbreaking Big Dog, it is quadruped designed to further develop research on legged locomotion. Each leg has three electric motors, and its torso houses an onboard computer for sensing, actuation, and control.

#### THE STORY

I found the parts of the Trojan Cockroach in the hallway of the basement of Wean here at CMU.

Jessica Hodgins told me Chris Atkeson had picked them up from the basement of a local family that had recently moved out of Pittsburgh. I had been eyeing them for several weeks as I thought it was an interesting pile of junk.

Finding out that this pile of junk was a huge hexapod walking robot invented by Ivan Sutherland was a very intense thing. It instilled in me a sense of reverence for the lost personality of this moving machine, as the person that made it was somehow, somewhere inside of it. It was, almost, a living thing.

Working on this project was a significant part of my life. I got to meet Raj Reddy, who walked me underneath Carnegie Mellon to find the “garage” where Ivan and crew once worked. Now it’s a closet.

I was able to meet Ben Brown and Matt Mason, both of whom are still here working on hands and legs. A young roboticist working with Ben Brown inspired me with his amazing designs for walking robots, and it’s a joy to look towards the future at where this science will go.