Your Brain Specs—The Hardware in Your Head

Posted on February 2, 2014 nate@nfholdings.com www.nfholdings.com

Basically, we're a 20-watt computer operating at 1 kHz, connected to the world with 10M ethernet, with a storage capacity of somewhere from 1 TB to 2.5 PB.

I was doing some research for a different post and came across some fascinating recent research regarding brain capacity. This post is not meant to be strictly scientific but rather to show the direction and magnitude of our current understanding.

OPTICAL INPUT: 10M (CAT-3 ETHERNET OR BAD WIFI)

From these recordings, the researchers calculated that a guinea pig retina transfers data at about 875 kilobits per second. Human retinas have about ten times as many ganglion cells, giving a "bandwidth" of 8.75 megabits per second. —New Scientist referencing a paper from the University of Pennsylvania

Hmph. It appears that my wi-fi connection is better than my eyeball. Not sure how I feel about that.

STORAGE: 1 TERABYTE TO 2.5 PETABYTES (1-2,500 APPLE TIME MACHINES)

The math behind these estimates is fairly simple. The human brain contains roughly 100 billion neurons. Each of these neurons seems capable of making around 1,000 connections, representing about 1,000 potential synapses, which largely do the work of data storage. Multiply each of these 100 billion neurons by the approximately 1,000 connections it can make, and you get 100 trillion data points, or about 100 terabytes of information. —Slate Article

The 100 terabytes number assumes we operate in binary. This seems unlikely. Biology can support much higher encoding than binary. I would predict that we will discover, therefore, that our storage capacity is far beyond 100 terabytes. The way I think about this is that our brain is a giant SQL, or relational, database. Each neuron is a table, and

each synapse is a primary/foreign key relationship. This is an SQL table with 100 billion tables (simple ones but still), each with 1,000 relationships—that is powerful.

CLOCK SPEED: 1 KHZ: (AN OLD COMPUTER)

Each neuron seems to have a "clock speed" on the order of kilohertz, which are a million times slower than gigahertz. (A smartphone's processor speed is around 1 gigahertz.) —Slate Article

I wonder if this accounts for lower-level reactions—the reptile brain. Maybe we'll find that there are two modes: there is storage as described above, but then there is also some kind of solid-state memory that we access quickly for emergencies, like a solid-state drive in my MacBook Air. Overall, this seems right—we didn't need to be good at math to run from tigers.

ENERGY CONSUMPTION: 20 WATTS (LESS THAN A LIGHTBULB)

The brain makes up 2% of a person's weight. Despite this, even at rest, the brain consumes 20% of the body's energy. The brain consumes energy at 10 times the rate of the rest of the body per gram of tissue. The average power consumption of a typical adult is 100 Watts and the brain consumes 20% of this making the power of the brain 20 W. —Power of a Human Brain

Two thoughts: your brain is eating up 20% of the calories you put into your body—feed it well. And two, if you hooked up a light bulb to your brain, it'd be pretty dim. Again, not sure how I feel about that.

OBSERVATION

The really novel takeaway for me is the storage. We're wired for complex relationships and to solve problems that require relational solutions. Our ability to synthesize, not compute, is what makes the brain unique. Case in point: a lone computer will beat a human, but a human with a computer still beats a computer, no matter how powerful (for now). For a good description on where this is heading, I would recommend *Average Is Over* by Tyler Cowen.