

The Mass of Unread Email in My Inbox

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Abstract

I present a solution to the Fermi question, “What is the equivalent mass of the unread email in Yan’s inbox?”

1 How much mail have I not read?

I use Gmail, which currently offers about 10GB of space. My inbox is around 85% full. I ignore roughly 4 out of every 5 emails that I receive and don’t delete anything. The amount of unread email in my inbox is therefore approximately $0.85 \times 0.8 \times 10\text{GB} = 6.8\text{GB}$.

2 Conversion to Mass

To convert this amount of information to mass, use Landauer’s Principle, which applies the Second Law of Thermodynamics to give a theoretical lower bound on the amount of energy required to perform a logically irreversible computation (such as deleting email). Landauer’s Principle states that the minimum energy to change one bit is:

$$E = kT \ln 2 \tag{1}$$

where k is Boltzmann’s constant and T is the absolute temperature of the circuit in Kelvins. For 6.8GB at room temperature (300K), this gives $2 \times 10^{-11}\text{J}$, or $2 \times 10^{-25}\text{g}$. This is around 1/8 of a proton mass!

3 Mass of the World’s Digital Data

As a bonus question, let’s estimate the mass of all the digital data in the world in the Landauer limit. According to <http://news.usc.edu/#!/article/29360/How-Much-Information-Is-There-in-the-World>, the amount of data stored in the world was estimated to be 295 exabytes in 2007, 94% of which was digital. Based on this and the correlation between digital data storage and Moore’s Law, let’s estimate the amount of digital data in the world today to be 1200 exabytes. This gives $4 \times 10^{-14}\text{g}$, which is roughly a tenth of the mass of the smallest photosynthetic organism on earth (marine cyanobacteria).