Working with lots of zeroes

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Plan

- Google calculator for unit conversions
- Fermi problems
- metric prefixes
- scientific notation

Lecture notes

Have you been alive for ... seconds?

Have you been alive for 1000 seconds? Most of the class thought "yes". To find out, take that number of seconds with three zeroes and convert it to a number of something else with fewer zeroes. Minutes suggest themselves as a natural answer. We do that using the unit conversion methods we have just learned:

$$1000 \cancel{\text{seconds}} \times \frac{1 \text{ minute}}{60 \cancel{\text{seconds}}} = \frac{1000}{60} \text{minutes} \approx 17 \text{minutes}$$

We're all older than that.

How about a 1,000,000 seconds (a million seconds)? That's 1000 times as large, so about 17,000 minutes. Again, too many zeroes to think clearly about, so convert to something we can understand – try hours.

$$17,000 \cancel{\text{minutes}} \times \frac{1 \text{ hour}}{60 \cancel{\text{minutes}}} = \frac{17,000}{60} \text{ hours } \approx 280 \text{ hours}$$

Since there are 24 hours/day that's about 12 days. Yes, we've all been alive that long.

How about a billion seconds. A billion is a thousand million, so we're now thinking about 12,000 days. We can make sense of that in years:

$$12,000 \cancel{\text{days}} \times \frac{1 \text{ year}}{365 \cancel{\text{days}}} = \frac{12,000}{365} \text{ hours } \approx 33 \text{ years}$$

Some of us have been alive that long, some not. The moral of the story: to understand the meaning of 1 billion seconds in everyday terms we need to convert the units so that the number we are considering has very few zeroes. The nine zeroes we needed to write a billion seconds becomes no zeroes when we write that as 33 years.[1]

The google calculator for unit conversions

Zeroes usually come in threes

thousand, million, billion, trillion

kilo, Mega, Giga, Tera

Exponential notation for powers of 10

Small numbers

[1]This is essentially the computation we did in class last time, in reverse. Then we estimated that there were about 3 billion heartbeats in a lifetime, starting from the assumptions that there was about one heartbeat per second and 90 years in a lifetime. Since $90 = 30 \times 3 \approx 33 \times 3$ the answers to that problem and this one are consistent.