WHEN ARE WE?
IN TIME

Using probability to reason about the future

https://www.youtube.com/watch?v=dI7SbZx_Qiw

CHRONOCENTRISM

COPERNICAN PRINCIPLE

ANTHROPIC PRINCIPLE, SELF-SAMPLING ASSUMPTION

DOOMSDAY ARGUMENT

CHRONOCENTRISM

Our time is special.

COPERNICAN PRINCIPLE

No it’s not.

ANTHROPIC PRINCIPLE, SELF-SAMPLING ASSUMPTION

Maybe it is.

DOOMSDAY ARGUMENT

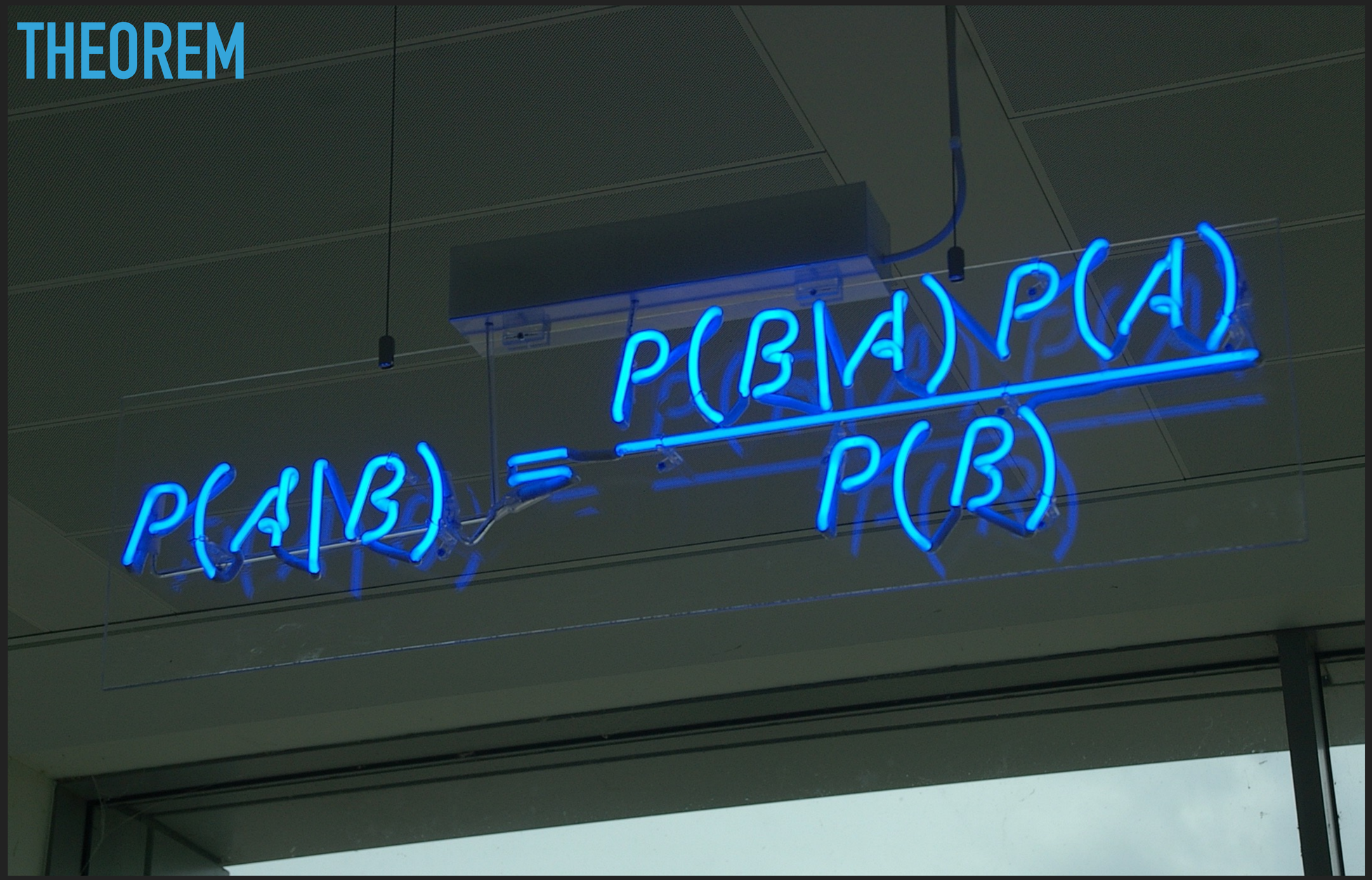
How much time is left?

PROBABILITY AND STATISTICS

Pascal Fermat

~ 1654 correspondence re: probability
https://www.york.ac.uk/depts/maths/histstat/pascal.pdf

BAYES' THEOREM



Bayes' theorem (1763) at the offices of HP Autonomy
Wikipedia

DRAKE EQUATION

$$N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

The number of civilisations in our galaxy in which communication might be possible.

The fraction of stars with planets

The fraction that can go on to support intelligent life.

Length of time such civilisations release detectable signs into space.

The average rate of star formation per year in our galaxy

The average number of planets that can potentially support life (per star with planets.)

The fraction that can go on to support life.

The fraction of civilisations that develop a technology detectable from space.

The Drake Equation.

DRAKE EQUATION

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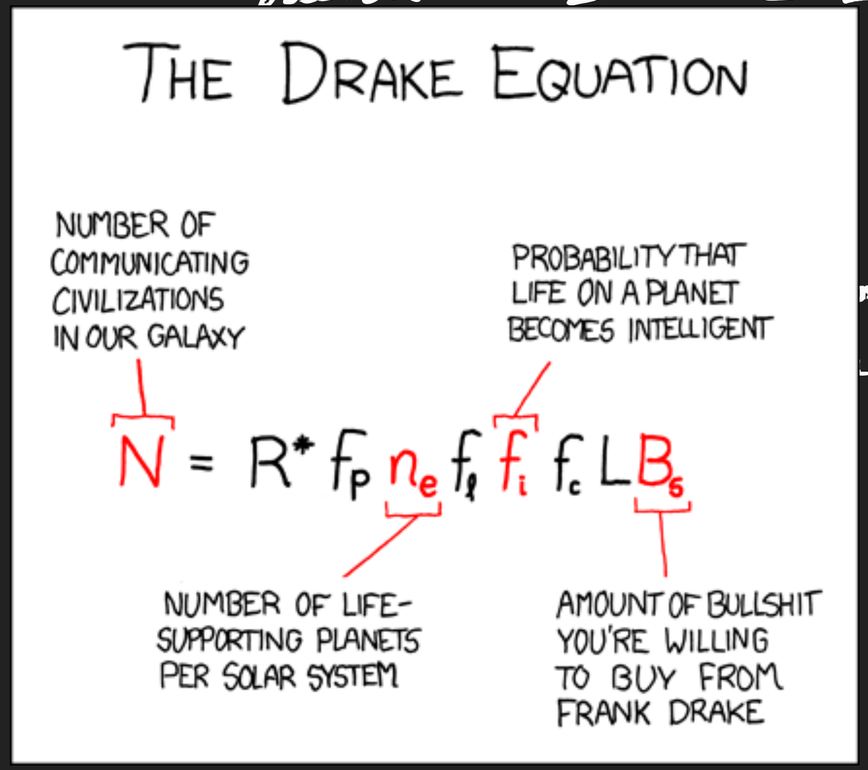


The average number of planets that can potentially support life (per star with planets.)

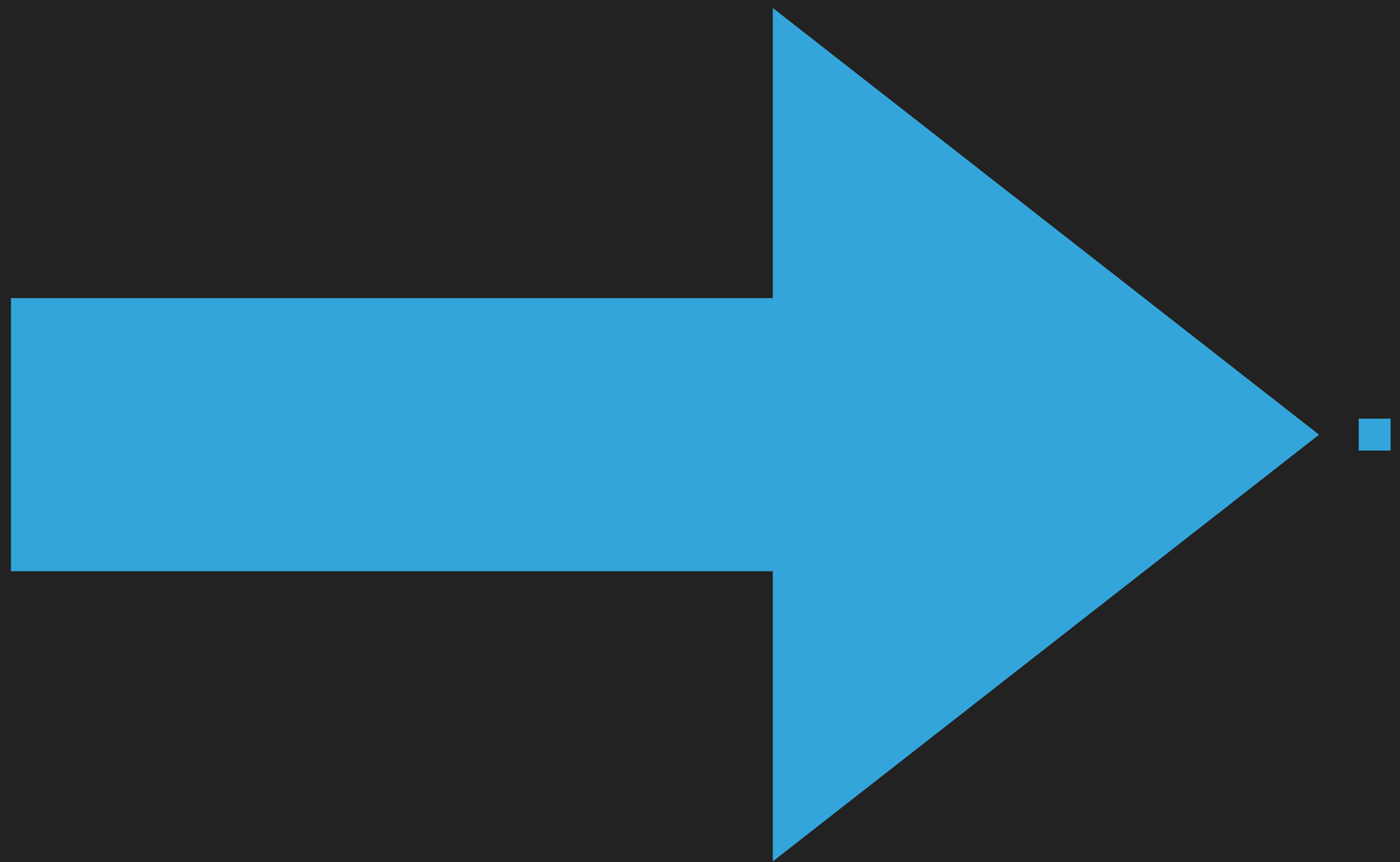
The fraction that can go on to support life.

The fraction of civilisations that develop a technology detectable from space.

The Drake Equation.

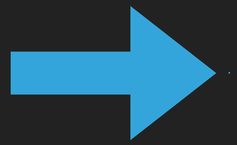
https://www.xkcd.com/384/

noeticscience.co.uk



14 billion years

A civilization would have to last
10 million years to be visible
on this timeline as a single pixel



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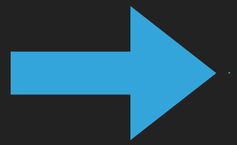


Fermi paradox: Where is Everyone?

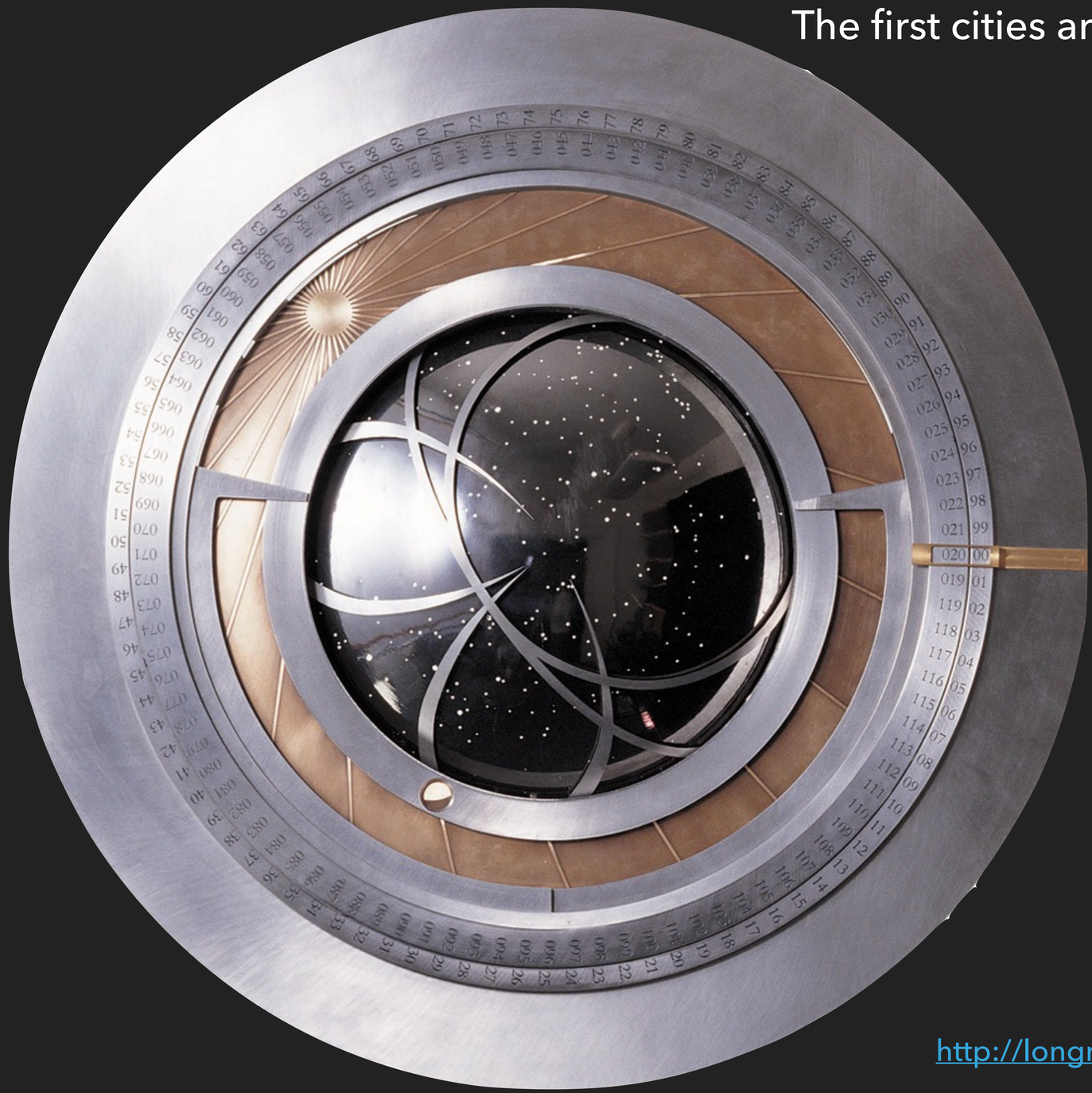
WHAT ASSUMPTIONS SHOULD WE MAKE ABOUT TIME?

The typical mammalian species lasts about a million years.
Anatomical humans evolved around 300,000 years ago.

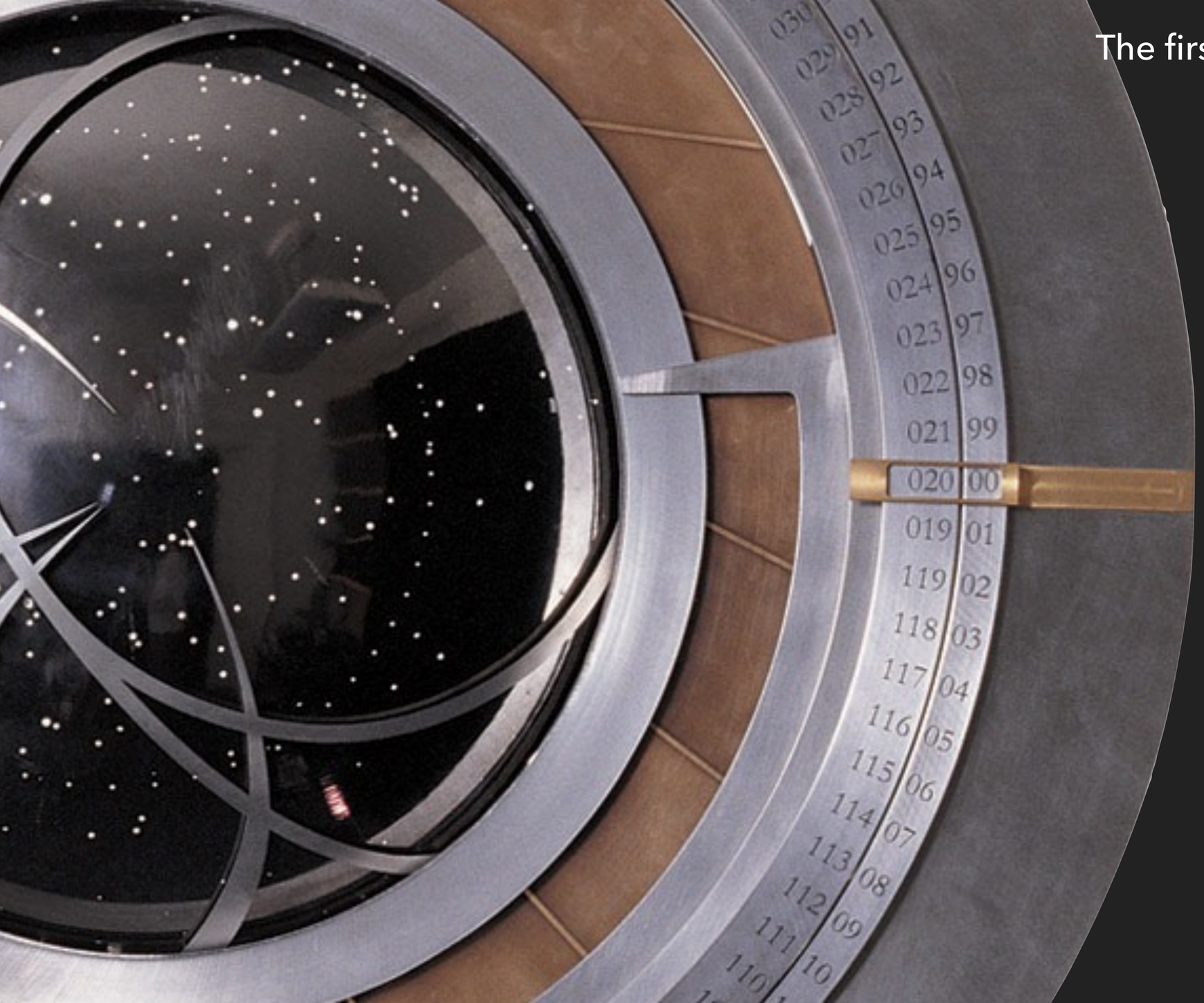
The first cities are about 10,000 years old.

About 100 billion people have lived.
About 8 billion are alive now.

The first cities are about 10,000 years old.



http://longnow.org/clock/



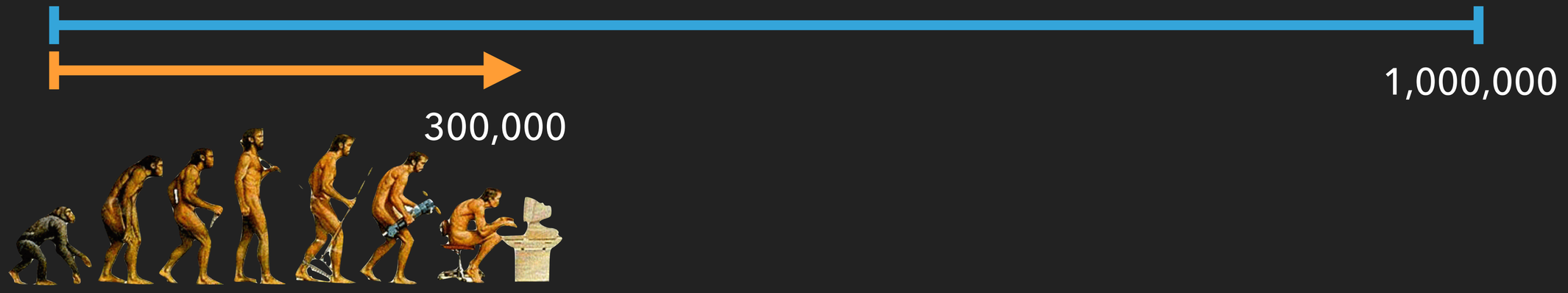
The first cities are about 10,000 years old.

Long Now adds a leading zero to the year as a reminder to think of the next 10,000 years of human history

http://longnow.org/clock/

The typical mammalian species lasts about a million years.
Anatomical humans evolved around 300,000 years ago.

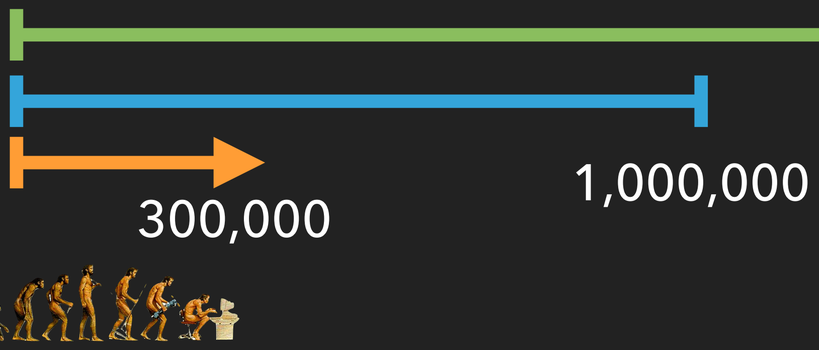
So maybe we’re about 1/3 of the way through out time…



The typical mammalian species lasts about a million years.
Anatomical humans evolved around 300,000 years ago.

But new species can evolve from old ones…

So maybe we’re just the first stage of…



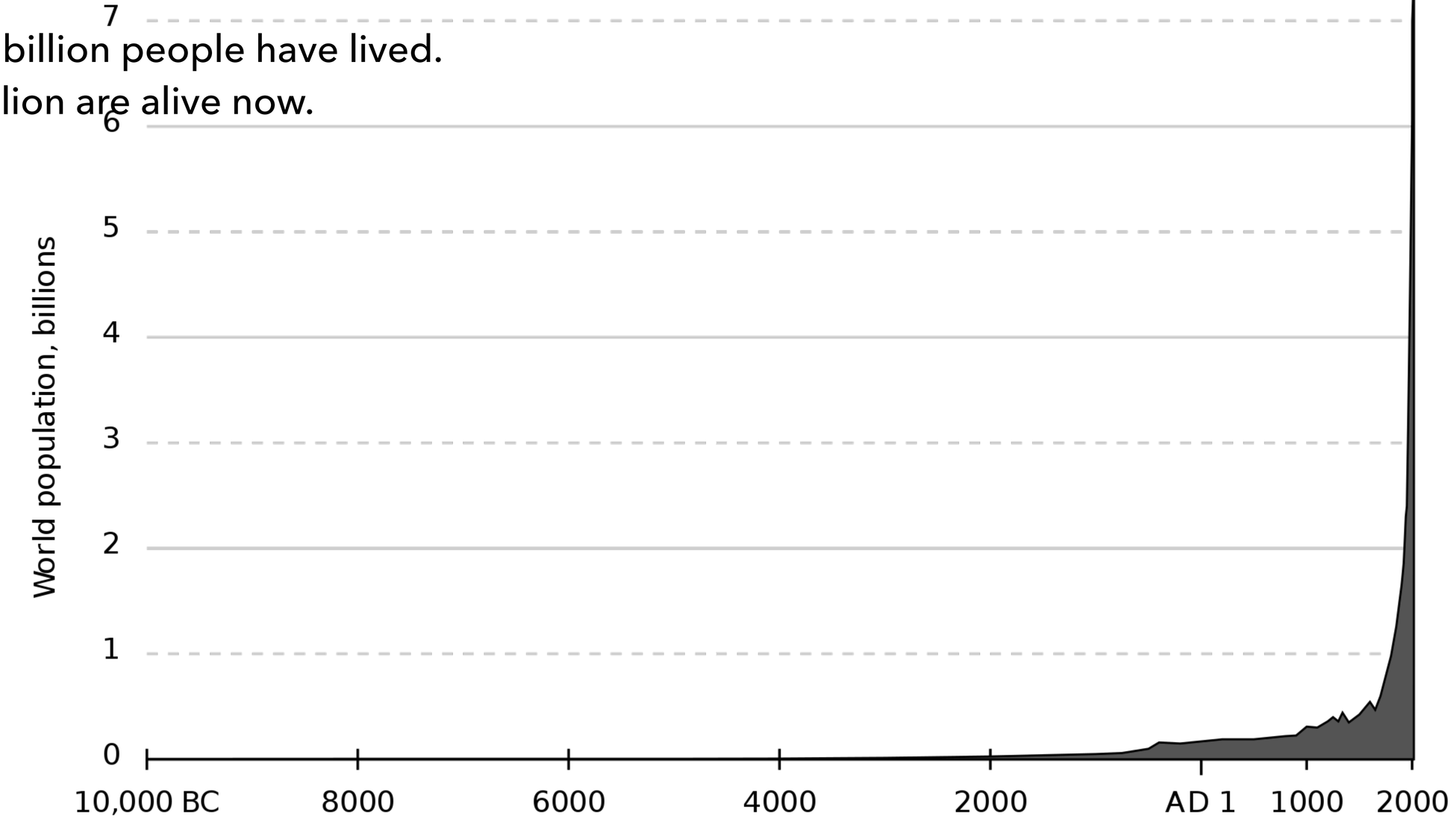
How Many People Have Ever Lived?

Year	Population	Births per 1,000	Births Between Benchmarks	Number Ever Born	Percent of Those Ever Born
50,000 B.C.E.	2	–	–	–	–
8000 B.C.E.	5,000,000	80	1,137,789,769	1,137,789,769	0.4
1 C.E.	300,000,000	80	46,025,332,354	47,163,122,125	0.6
1200	450,000,000	60	26,591,343,000	73,754,465,125	0.6
1650	500,000,000	60	12,782,002,453	86,536,467,578	0.6
1750	795,000,000	50	3,171,931,513	89,708,399,091	0.9
1850	1,265,000,000	40	4,046,240,009	93,754,639,100	1.3
1900	1,656,000,000	40	2,900,237,856	96,654,876,956	1.7
1950	2,516,000,000	31-38	3,390,198,215	100,045,075,171	2.5
1995	5,760,000,000	31	5,427,305,000	105,472,380,171	5.5
2011	6,987,000,000	23	2,130,327,622	107,602,707,793	6.5
2017	**7,536,000,000**	**19**	**867,982,322**	**108,470,690,115**	**6.9**
2030	8,563,000,000	16	1,806,595,106	110,277,285,221	7.8
2050	9,846,000,000	15	2,833,529,982	113,110,815,203	8.7

Source: Toshiko Kaneda and Genevieve Dupuis, *2017 World Population Data Sheet* (Washington, DC: Population Reference Bureau, 2017); United Nations Population Division, *World Population Prospects: The 2017*

About 100 billion people have lived.

About 8 billion are alive now.



Wikipedia

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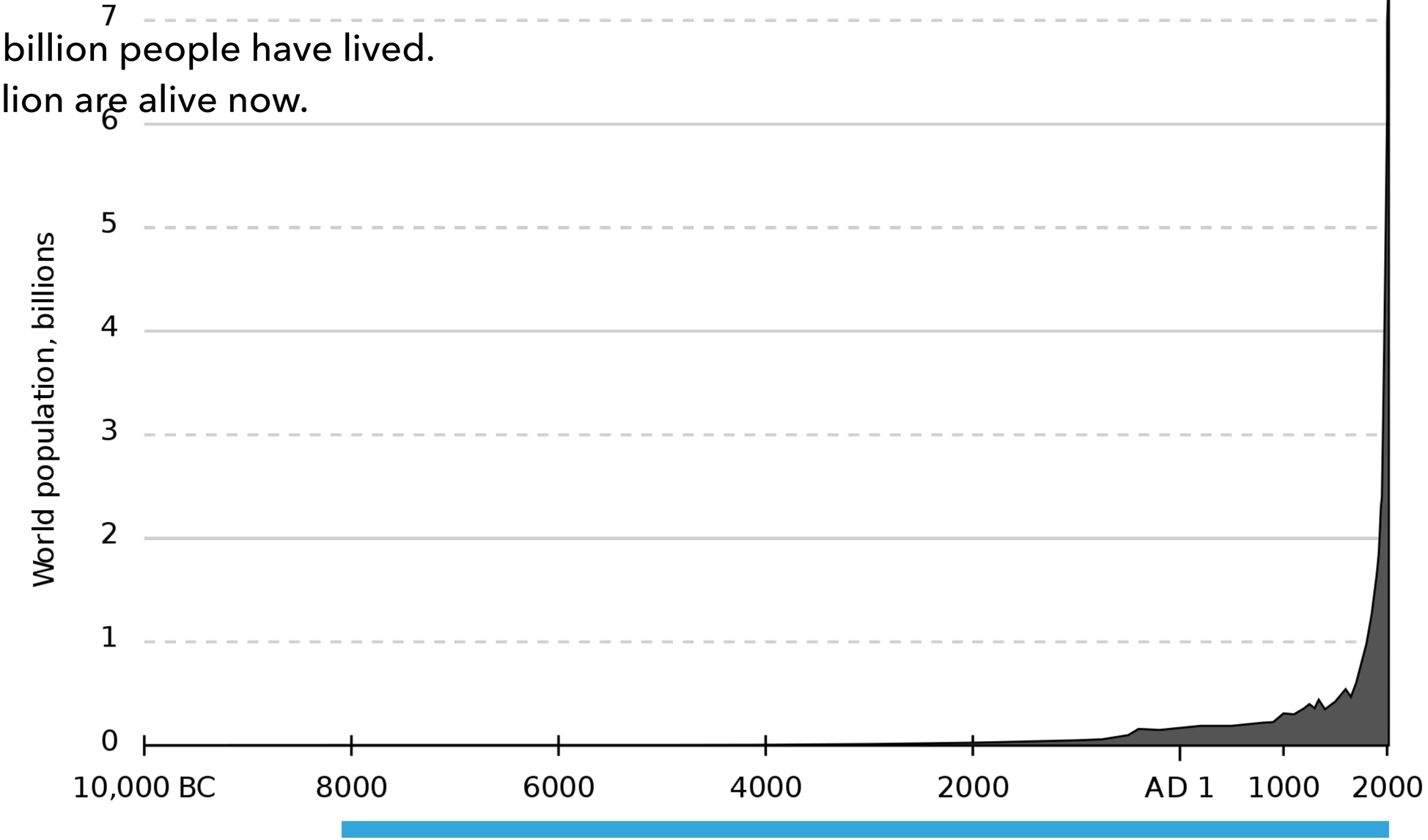
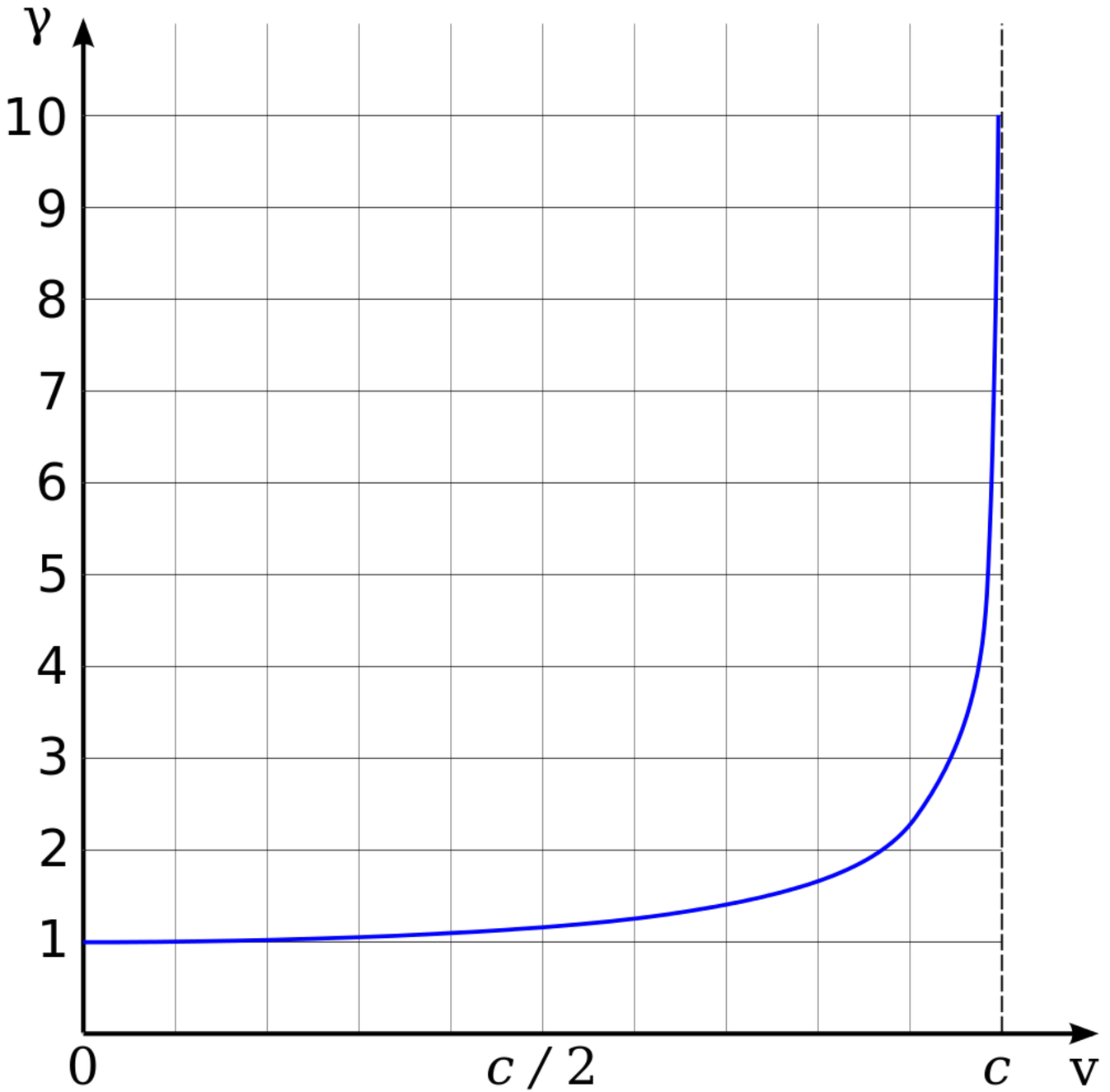


(10,000 YEARS IS APPROXIMATELY 400 GENERATIONS OF HUMANS)

Wikipedia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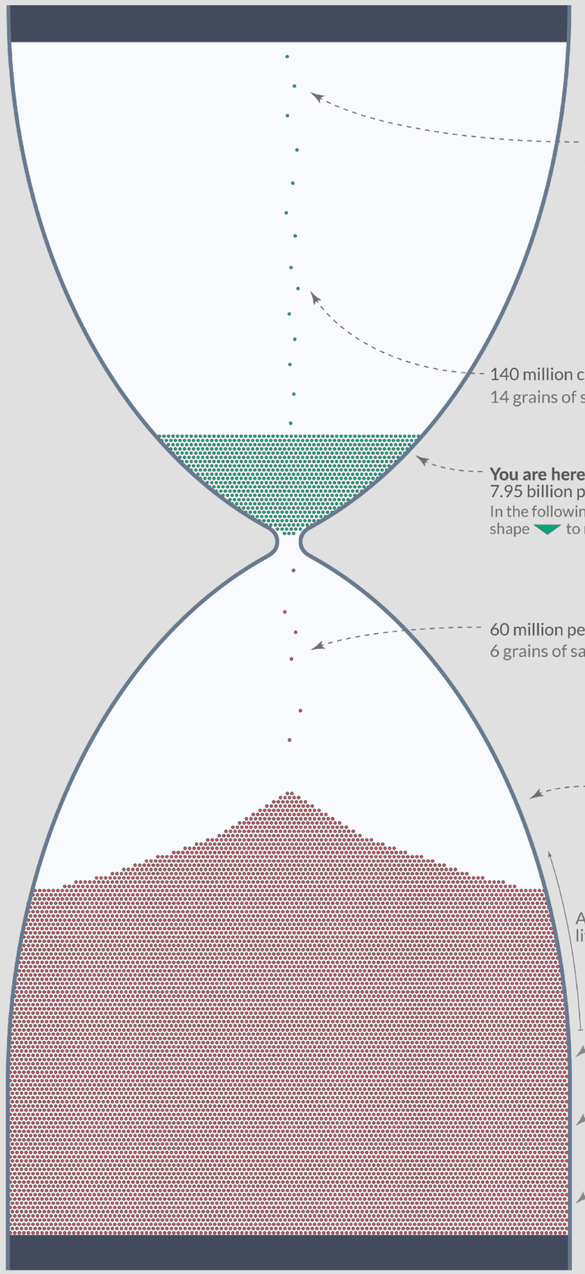
Humanity today and humanity's past

Our World in Data



Each grain of sand in this visualization represents 10 million people.

140 million children are born every year.
14 grains of sand enter the hourglass.

You are here. These 795 grains represent the 7.95 billion people who are alive today.
In the following chart I am using this triangle shape ▼ to represent 7.95 billion people.

60 million people die every year.
6 grains of sand pass through the hourglass.

About 109 billion people have lived and died.
10,900 grains of sand.

About half the people who ever lived lived in the last 2000 years.

Socrates, who was killed in 399 BCE, lies about here.

Half of the dead bodies here are the bodies of children.
[In pre-modern times half of all children died.]

The first agriculturalists lie here.
Only about 9 billion people lived before the Agricultural Revolution.

Based on the historical estimates from Toshiko Kaneda and Carl Haub (Population Reference Bureau) and the UN Population Division. Based on a design by Oliver Uberti.

https://ourworldindata.org/longtermism

Our potential future is *vast*

Our World in Data

Every triangle in this chart (▼) corresponds to 7.95 billion people, the number of people alive today.

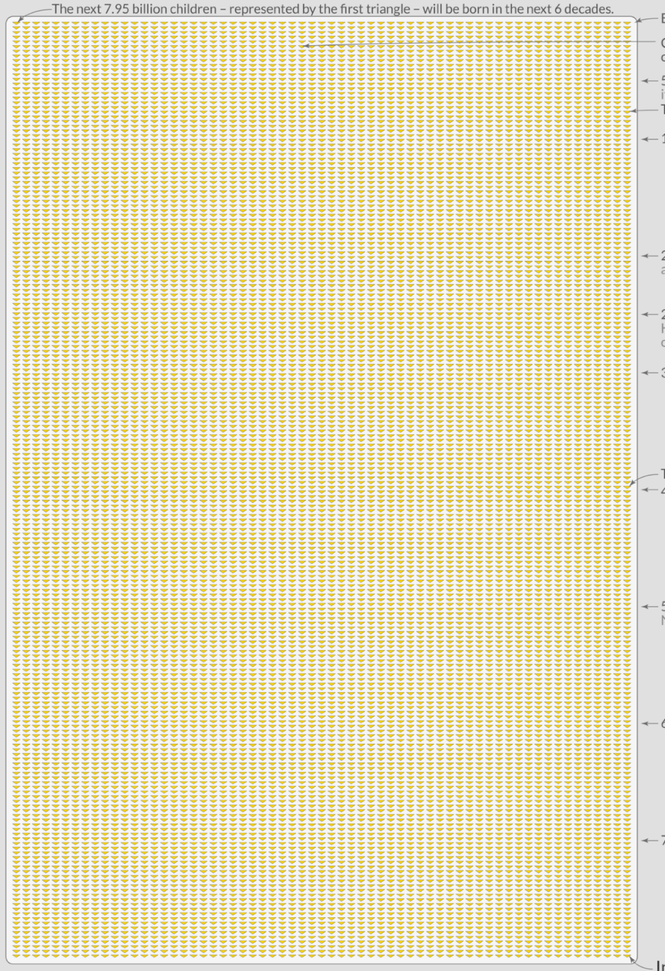
Humanity's past – All the people who have died, 109 billion. These are 14 triangles – the dead outnumber the living by a ratio of 14 to 1.

Humanity's present – All people who are alive today, 7.95 billion. Those of us who are alive now are about 6.8% of all people who ever lived.

Humanity's future?

The 12,572 triangles below represent all people who might be born in the future – from 2022 onwards.

This is a scenario in which humanity survives for another 800,000 years, in which the population stabilizes at 11 billion people and in which global life expectancy rises to 88 years.



The sun will exist for another 5 billion years. If we stay alive for all this time – and based on the scenario above – this would be a future in which 625 quadrillion children will be born.

How big would a chart be that shows this future? If you have a shelf with 30 books, each of which has 200 pages, then this same chart that you see here – showing the birth of 100 trillion future children – would be printed on each page of each book in your bookshelf.

And humanity could survive for even longer.

DOOMSDAY ARGUMENT

"To put it more simply: Out of all people who will ever live, we should probably assume we're somewhere in the middle; after all, most people are.

*If our population **levels out around 9 billion**, this suggests humans will probably go extinct in about 800 years, and not more than 16,000.*

This is the Doomsday Argument.

Yeah, but that's stupid

Almost everyone who hears this argument immediately sees something wrong with it.

The problem is, everyone thinks it's wrong for a different reason. And the more they study it, the more they tend to change their minds about what that reason is.

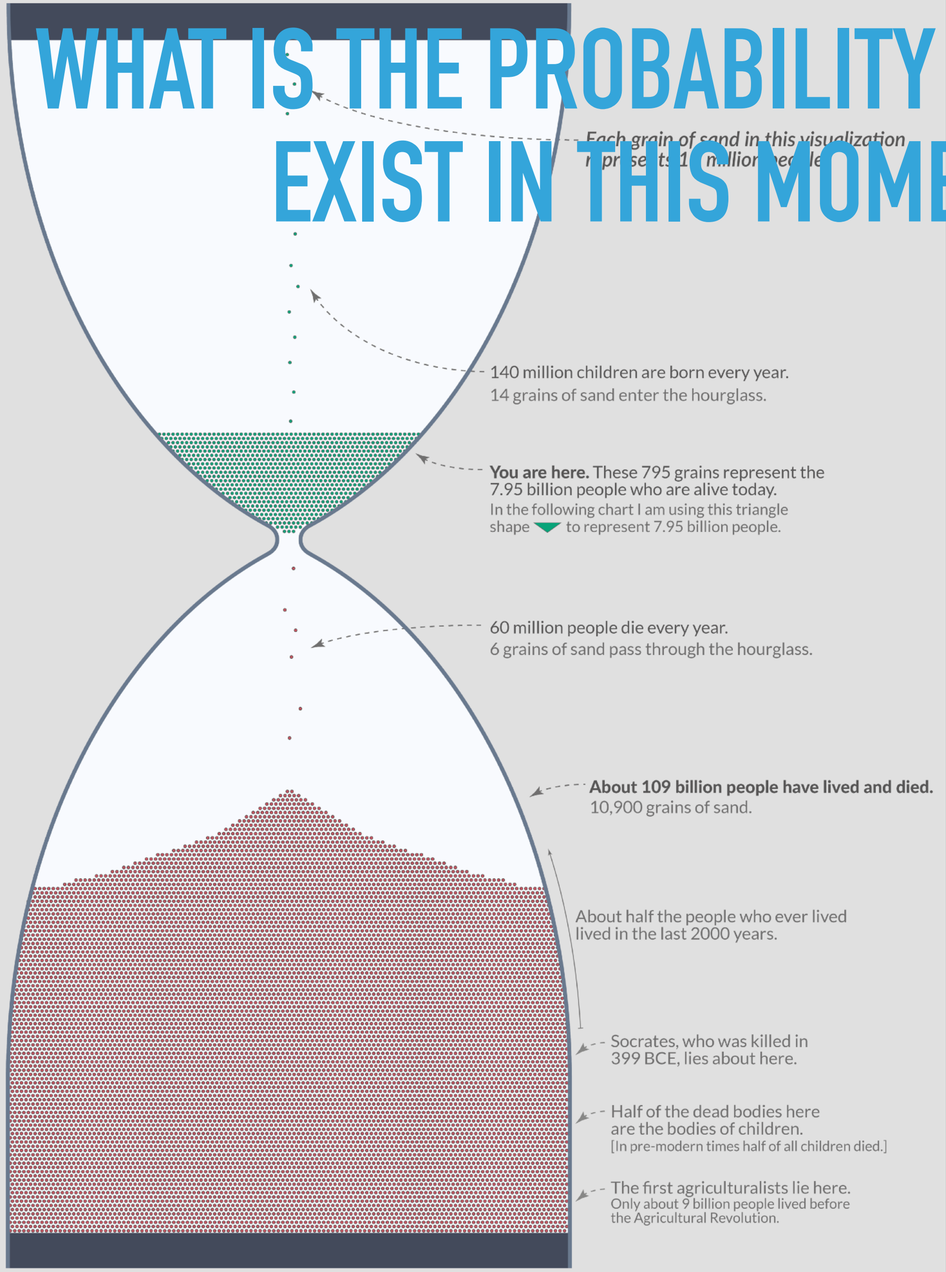
*Since it was proposed in 1983, it's been the subject of tons of papers refuting it, and tons of papers refuting those papers. There's no consensus about the answer; it's like the **airplane on a treadmill** problem, but worse."*

https://what-if.xkcd.com/65/

Humanity today and humanity's past

Our World in Data

WHAT IS THE PROBABILITY YOU EXIST IN THIS MOMENT?



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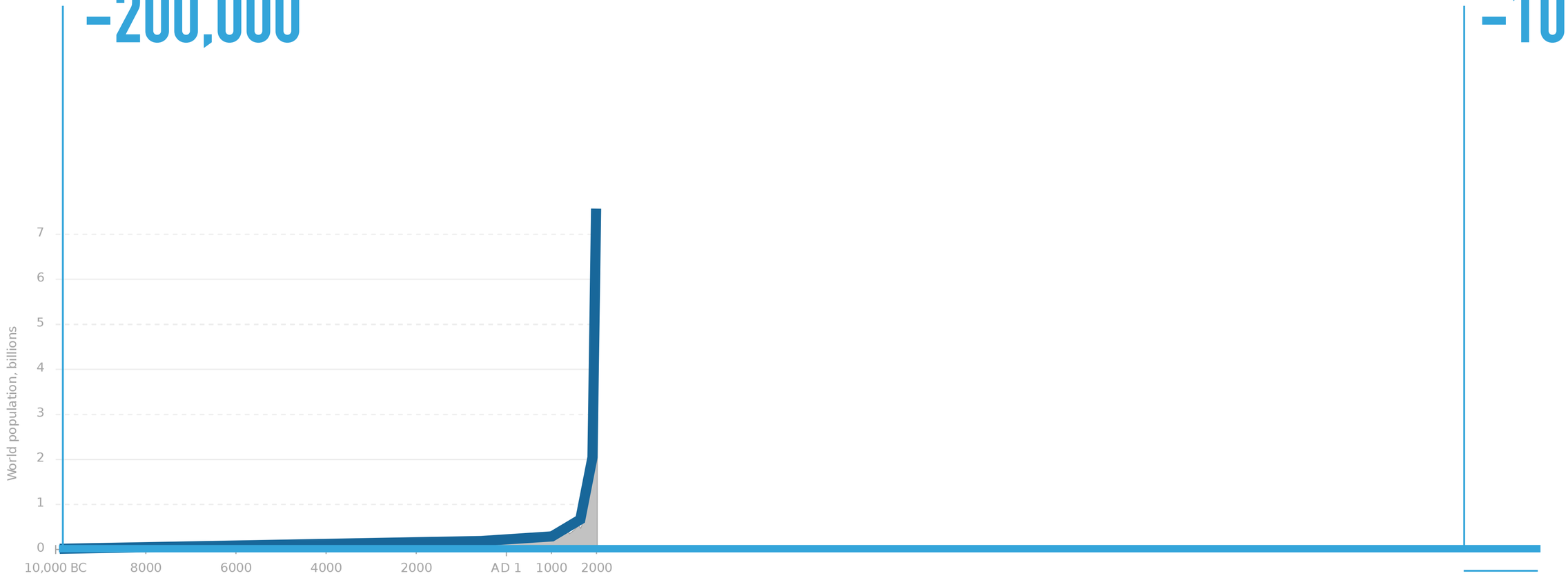
-200,000

-10,000



https://www.youtube.com/watch?v=dI7SbZx_Qiw

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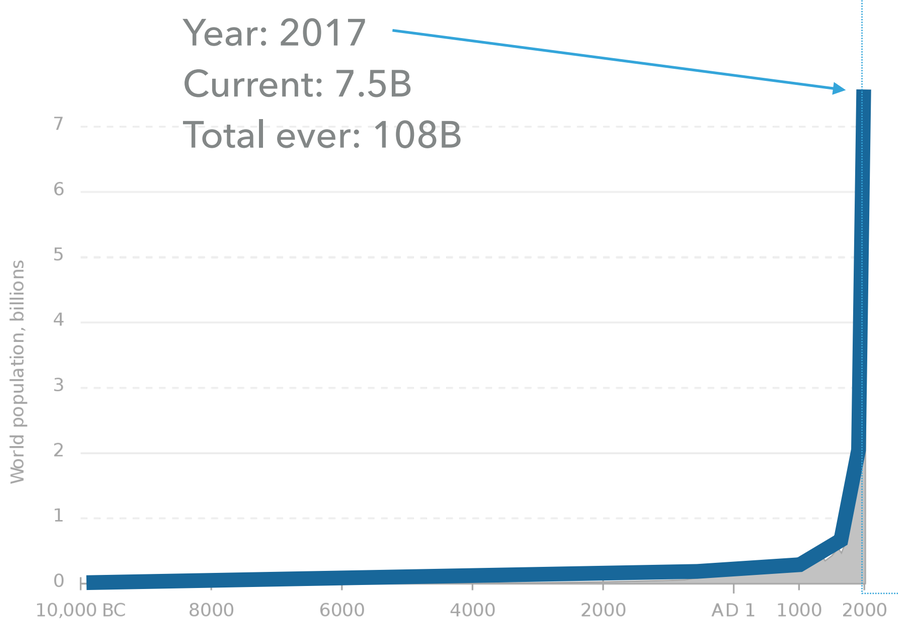
Draw something here. Use additional sheets if necessary



Pick a point in your drawing and estimate the following:

Year: _____

Current: _____

Total ever: _____