

Setting a Date for the Singularity. A more modest but still profound threshold will be achieved much earlier. In the early 2030s one thousand dollars' worth of computation will buy about 10^{17} cps (probably around 10^{20} cps using ASICs and harvesting distributed computation via the Internet). Today we spend more than $\$10^{11}$ (\$100 billion) on computation in a year, which will conservatively rise to $\$10^{12}$ (\$1 trillion) by 2030. So we will be producing about 10^{26} to 10^{29} cps of nonbiological computation per year in the early 2030s. This is roughly equal to our estimate for the capacity of all living biological human intelligence.

Even if just equal in capacity to our own brains, this nonbiological portion of our intelligence will be more powerful because it will combine the pattern-recognition powers of human intelligence with the memory- and skill-sharing ability and memory accuracy of machines. The nonbiological portion will always operate at peak capacity, which is far from the case for biological humanity today; the 10^{26} cps represented by biological human civilization today is poorly utilized.

This state of computation in the early 2030s will not represent the Singularity, however, because it does not yet correspond to a profound expansion of our intelligence. By the mid-2040s, however, that one thousand dollars' worth of computation will be equal to 10^{26} cps, so the intelligence created per year (at a total cost of about $\$10^{12}$) will be about one billion times more powerful than all human intelligence today.⁶⁶

I set the date for the Singularity—representing a profound and disruptive transformation in human capability—as 2045.

The nonbiological intelligence created in that year will be one billion times more powerful than all human intelligence today.

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That *will* indeed represent a profound change, and it is for that reason that I set the date for the Singularity—representing a profound and disruptive transformation in human capability—as 2045.

Despite the clear predominance of nonbiological intelligence by the mid-2040s, ours will still be a human civilization. We will transcend biology, but not our humanity. I'll return to this issue in [chapter 7](#).

Returning to the limits of computation according to physics, the estimates above were expressed in terms of laptop-size computers because that is a familiar form factor today. By the second decade of this century, however, most computing will not be organized in such rectangular devices but will be highly distributed throughout the environment. Computing will be everywhere: in the walls, in our furniture, in our clothing, and in our bodies and brains.

And, of course, human civilization will not be limited to computing with just a few pounds of matter. In [chapter 6](#), we'll examine the computational potential of an Earth-size planet and computers on the scale of solar systems, of galaxies, and of the entire known universe. As we will see, the amount of time required for our human civilization to achieve scales of computation—and intelligence—that go beyond our planet and into the universe may be a lot shorter than you might think.