Computing is changing:
What does that mean for innovative firms?

Neil C. Thompson

FutureTech
THE ECONOMIC AND TECHNICAL FOUNDATIONS
OF PROGRESS IN COMPUTING

MIT CSAIL

Massachusetts High Technology Council – May 2022

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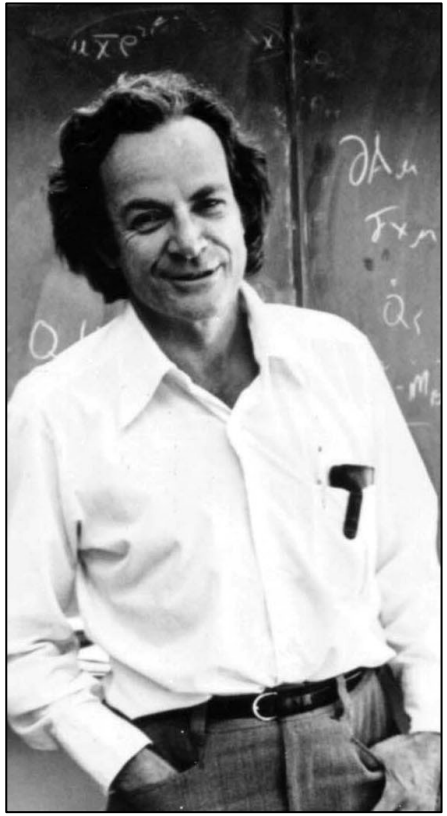
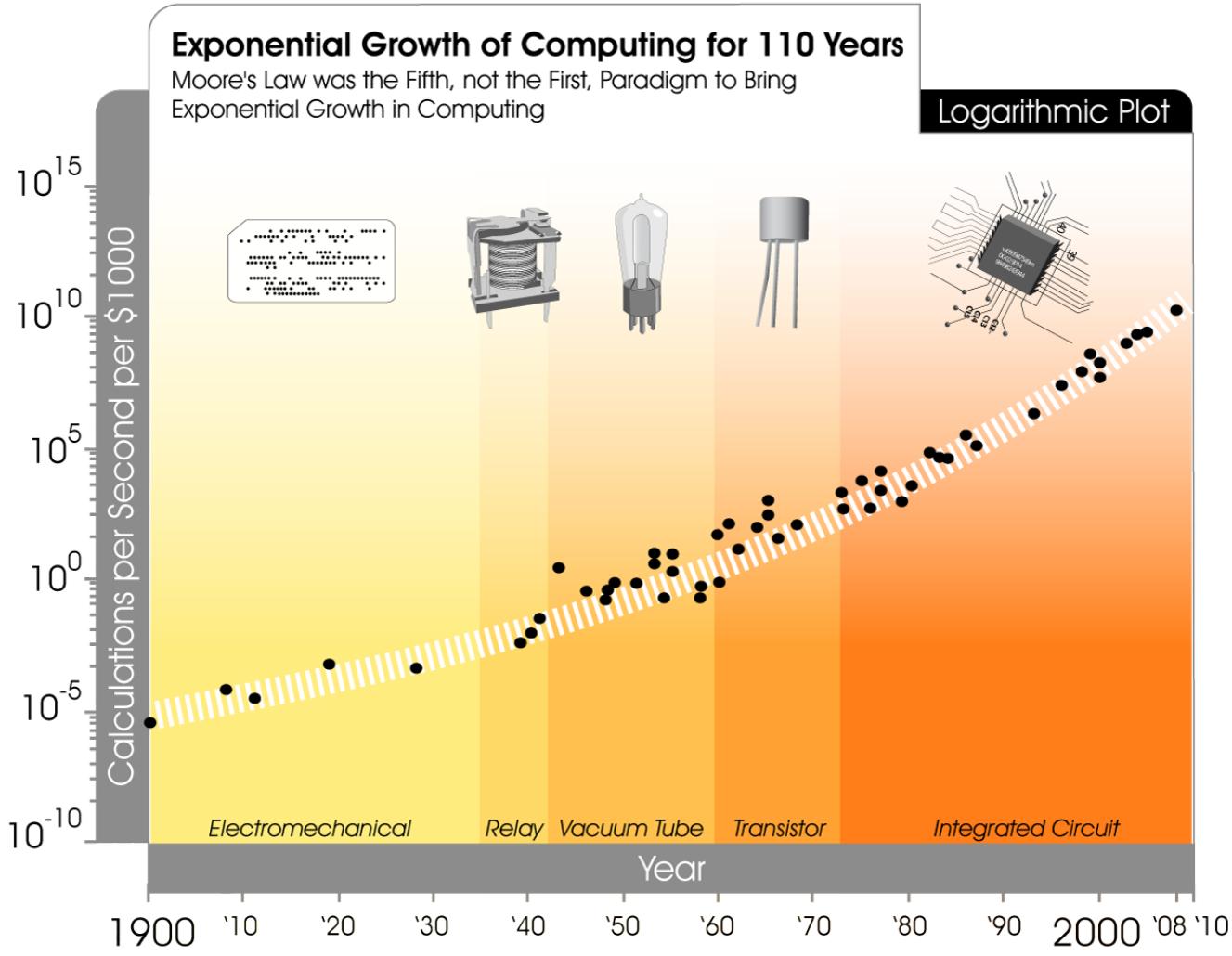
There's Plenty of Room at the Bottom

(American Physical Society, 1959)



Richard Feynman

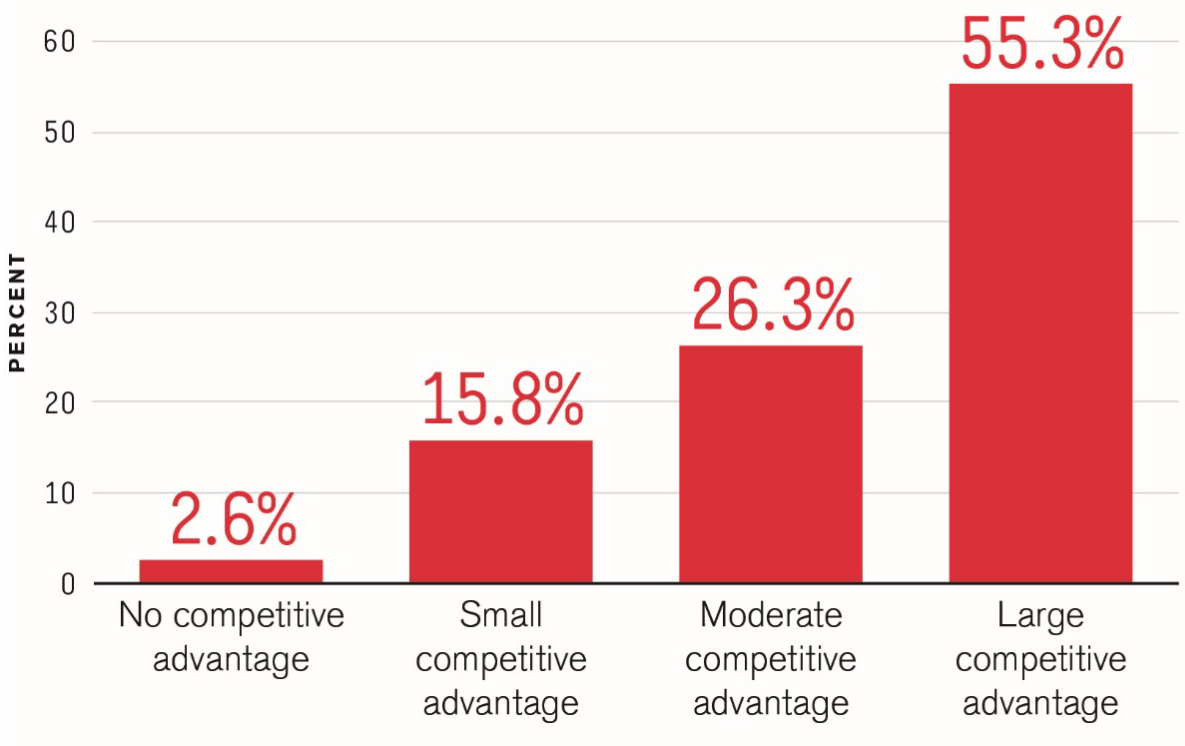
"Why can't we make them [computers] very small, make them of little wires, little elements—and by little, I mean little. For instance, the wires should be 10 or 100 atoms in diameter"



Source: Kurzweil

A Moderate Computing Advantage Yields…

Source: Advanced Computing Survey, undertaken by the Council on Competitiveness and Dr. Neil Thompson, MIT, Spring 2020.



1985
25 MHz

intel inside
pentium 4

2002
3 GHz

intel
CORE i7
10TH GEN

2020
10 cores @
4 GHz

intel
Only A
Dream Chip

2020
~480 GHz

Manual Tools circa 1900

Sew-E-Z
Hamilton-Beach, Racine
Labor Saving Home Motor

This Little Home Labor-Saver

Will sew for you without foot pumping—Will keep you cool on hot, sultry days of summer—Will grind and sharpen your carving knives—Will clean and polish your silverware and perform many other household duties—**Will work a week for you free.**

Simply place Sew-E-Z Motor on your sewing machine next to the hand wheel—no screws or bolts are needed. The little self-starter starts and stops it instantly—the slightest touch of your foot makes it sew fast or slow. Always starts right, never breaks the thread. Makes sewing easy—relieves all strain—saves your health.

The Fan attachment instantly changes this Home Labor Saver into a handsome, high class fan that will make brighter and happier hours in your home during the hot, sultry days of summer.

The Grinder and Sharpener keeps your carving knives sharp and ready for use. The Polisher and Buffer keeps your silver bright and shining and gives it that pleasing lustre that adds beauty and cheerfulness to your dining room.

One Week's Service Free

Sewing — Grinding — Polishing — Fanning

No Cost—No Obligation—simply phone your dealer "Send my wife this all-around electric motor." Do this today—right now.

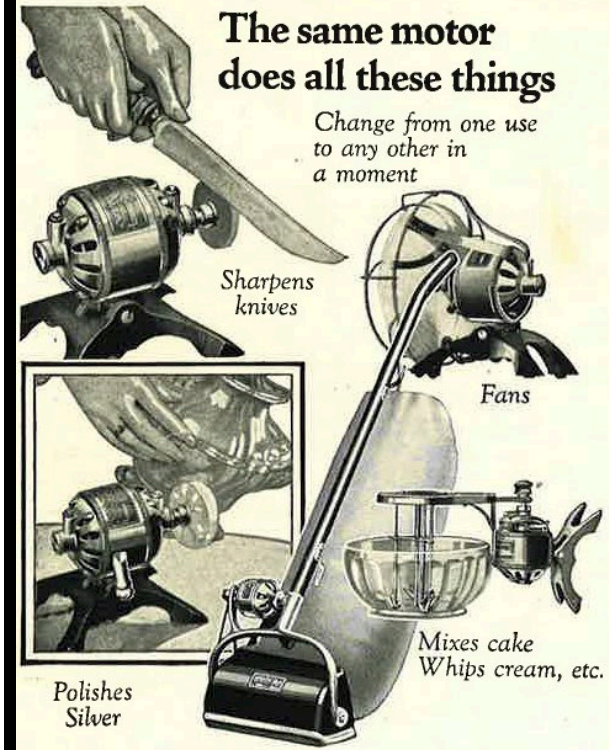
At the end of a week your dealer will take Sew-E-Z back if you do not want to keep it.

Six thousand dealers are ready to place this wonderful little motor on trial in homes everywhere. Have your dealer deliver YOURS today.

Hamilton-Beach Mfg. Co.
1005 Mate Street Racine, Wisconsin

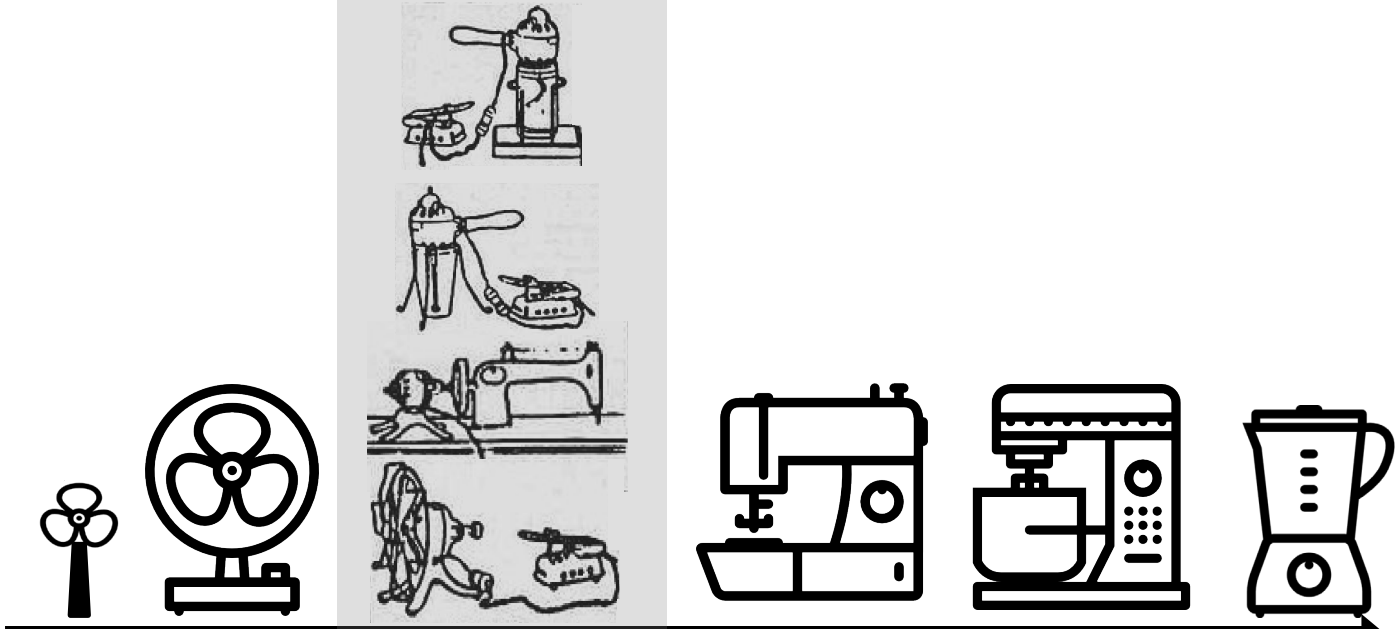
The same motor does all these things

Change from one use to any other in a moment



Phone for Free Trial

But there was a lot to be gained from specialization



4W
2017 Hand-held Fan

25W
2017 Large Fan

41-70W
1919 Home Motor Attachments

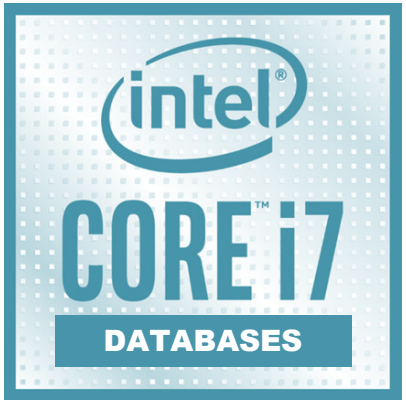
100W
2017 Sewing Machine

500W
2017 Stand Mixer

1400W
2017 Blender

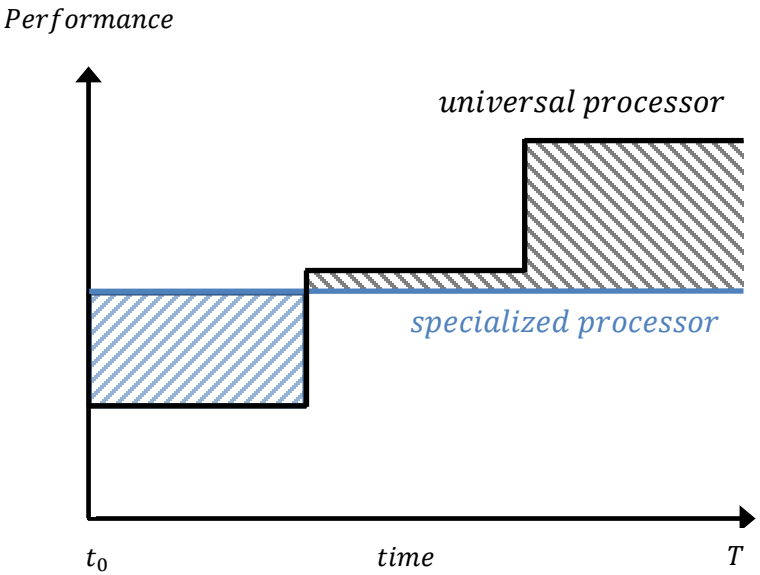
Image Source: https://www.flaticon.com/packs/electronics-and-appliances-2

But, for decades this didn't happen in computing

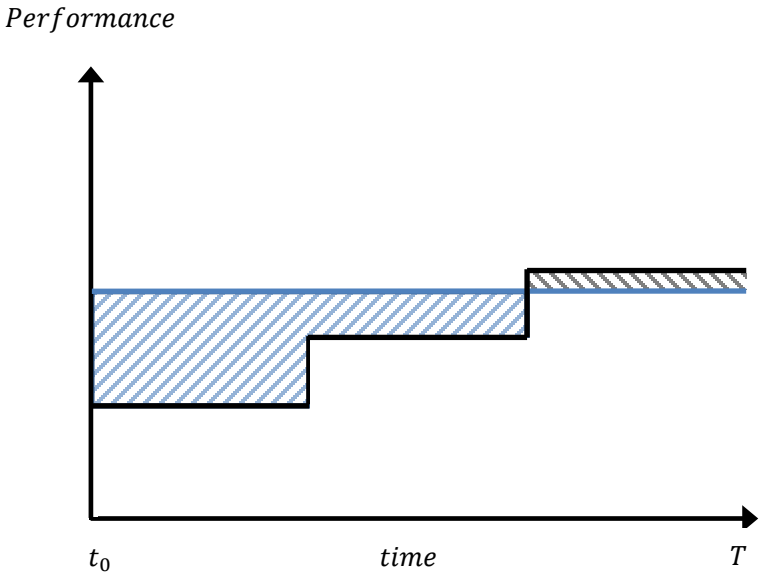


Specialization is unattractive if the universal technology is getting better quickly

Fast Improvement



Slow Improvement



Benefit from specializing

Benefit from not specializing

Source: Thompson & Spanuth (2021). The Decline of Computers as a general-purpose technology. Communications of the ACM.

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TECH

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Stung by delays and shortages, a growing number of businesses are bringing chip development in-house. But are the risks worth the effort?

John Edwards
Technology Journalist & Author

December 23, 2021

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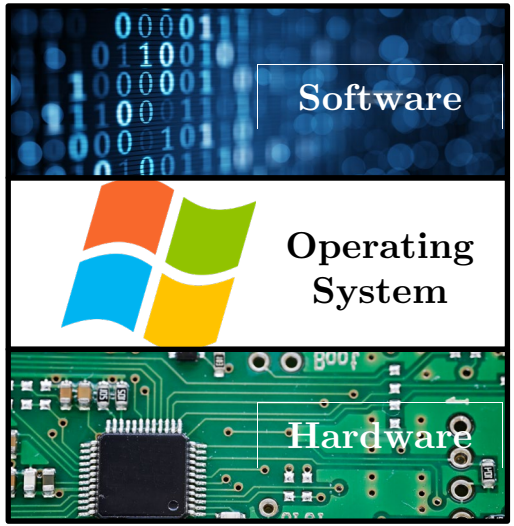
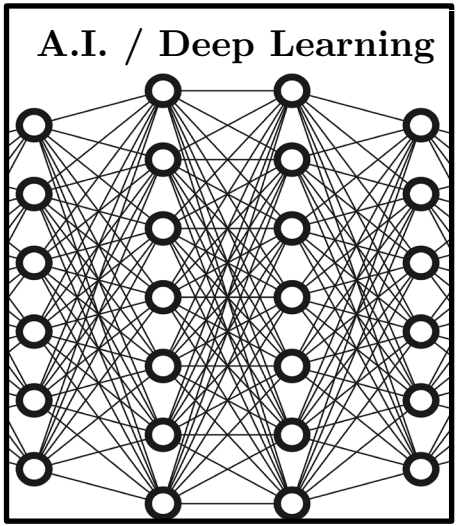
Implication 1:
Computing is becoming more integrated…and therefore siloed

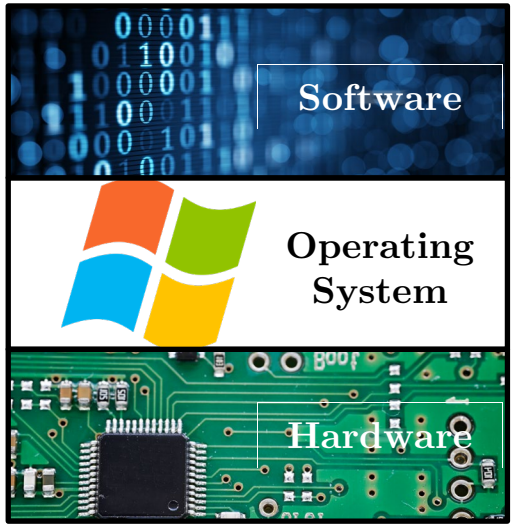
Old Model:
Modularity



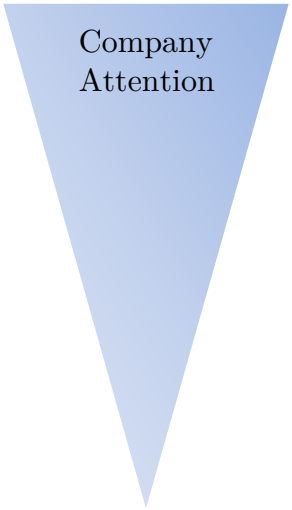
New Model:
Silos



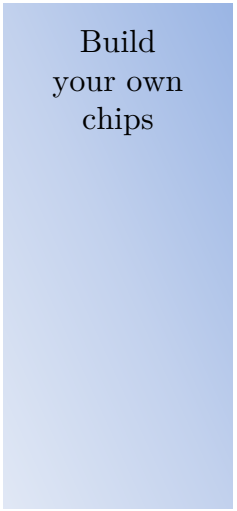
Implication 2:
Companies will either need more expertise or need to give up more control



Old Model:
Focus on Software



New Model:
Take control or give it up

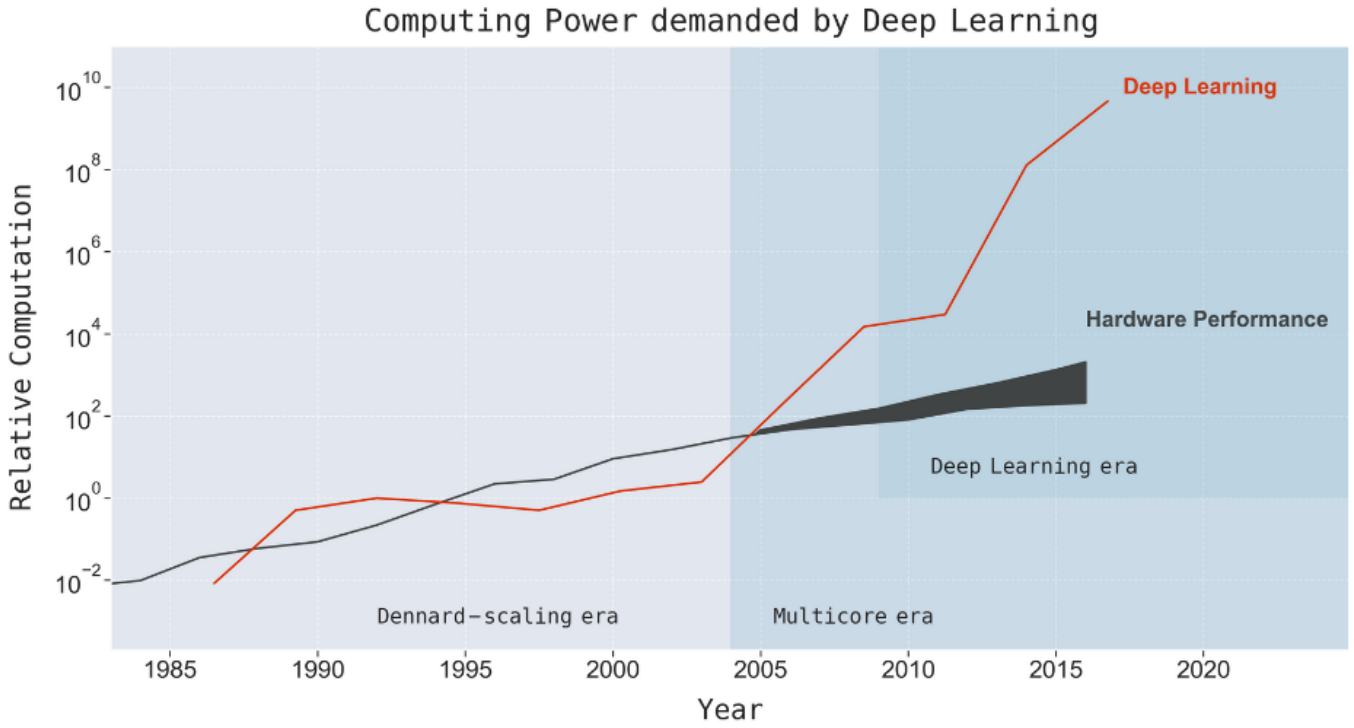


Implication 3:
Not everyone will get computing improvements

Old Model:
Rising Tide lifts all Boats

New Model:
Some rise, others do not

Growth in Computing Power in A.I.

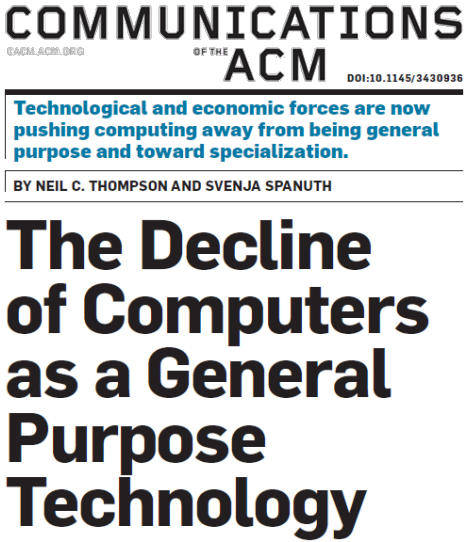


Note: Red line shows the biggest models in each period
Source: Thompson et al. (2020). The Computational Limits of Deep Learning. https://arxiv.org/abs/2007.05558
Based on data from OpenAI & Leiserson et al.

Summary

- Moore's Law drove enormous computing power improvements
  - Had a big impact on tech-focused firms
  - But is now slowing
- This is overturning the dynamics that kept chips "universal"
  - Increasingly firms are turning to specialization to get performance gains
- This is having big impacts on the shape of computing
  - Computing is becoming more siloed (as happened to home motors)
  - Companies will increasing need to integrate into hardware or give up control
  - There is an increasing risk of being "left behind" by computing progress

In case you want to know more



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