Artificial Intelligence

Mustafa Bilgic

http://www.cs.iit.edu/~mbilgic

https://twitter.com/bilgicm

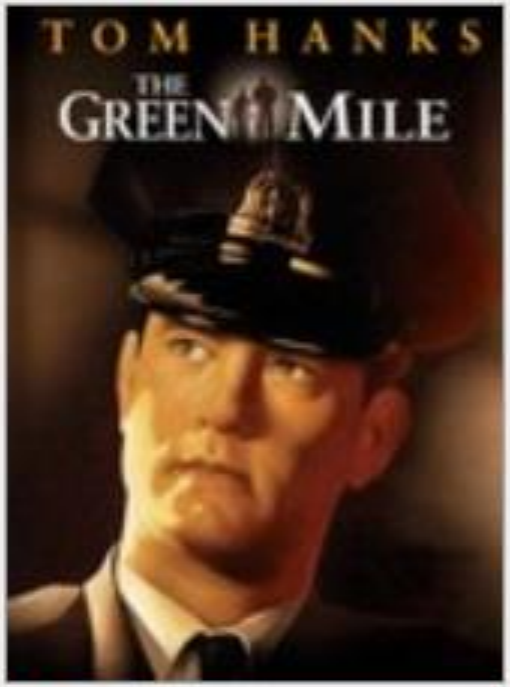
AI is Everywhere Now

Email Filtering

"Wow! I've got one from some

Search Engines

Recommender Systems



Add

Not Interested

The Green Mile

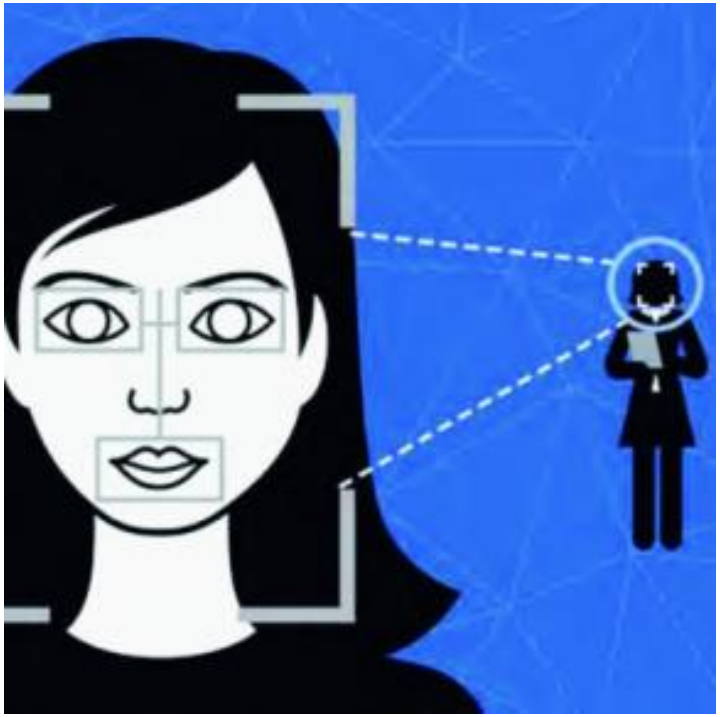
Because you enjoyed:

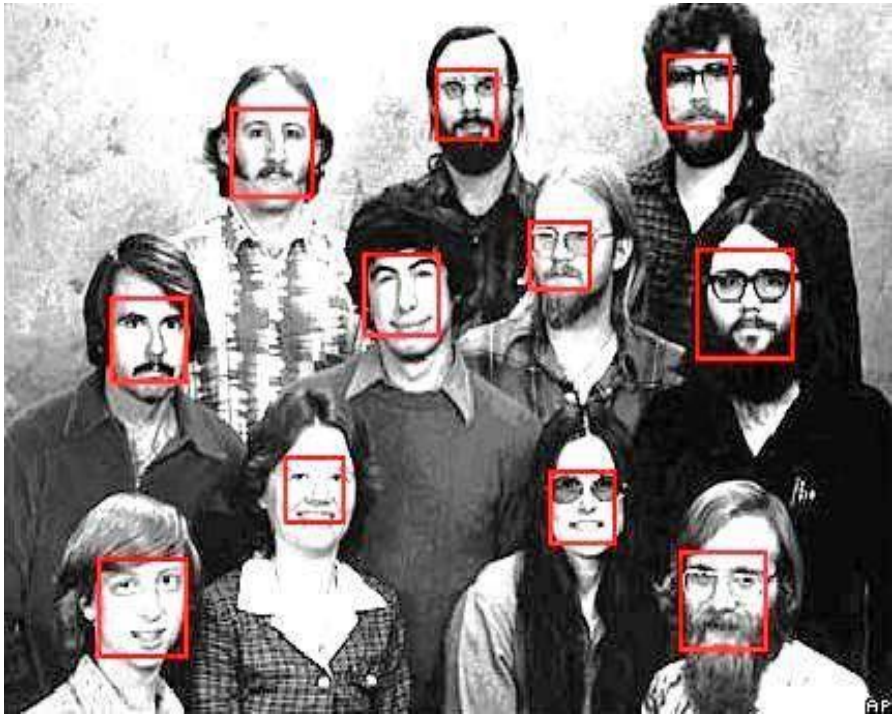
The Shawshank Redemption: Special Edition

Forrest Gump

Rain Man

Face Detection & Recognition

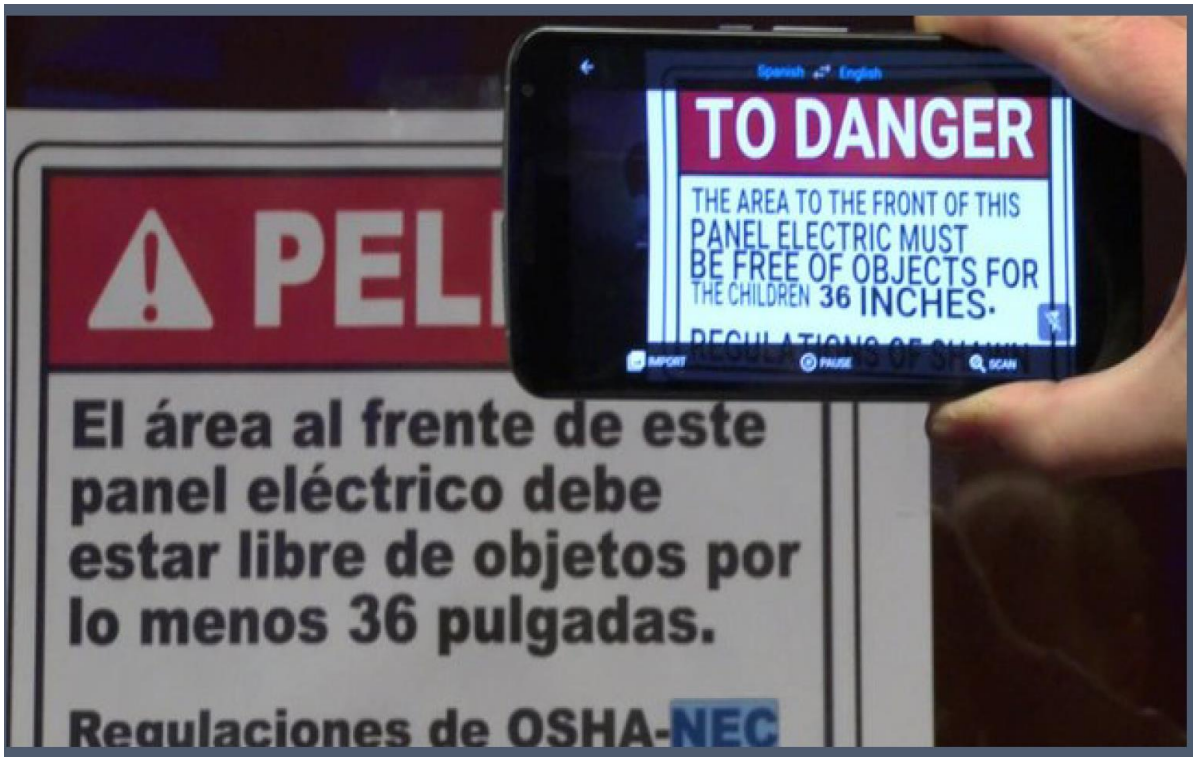




Medical Diagnosis

Intelligent Personal Assistants

Image Recognition + Translation



Self-driving Cars

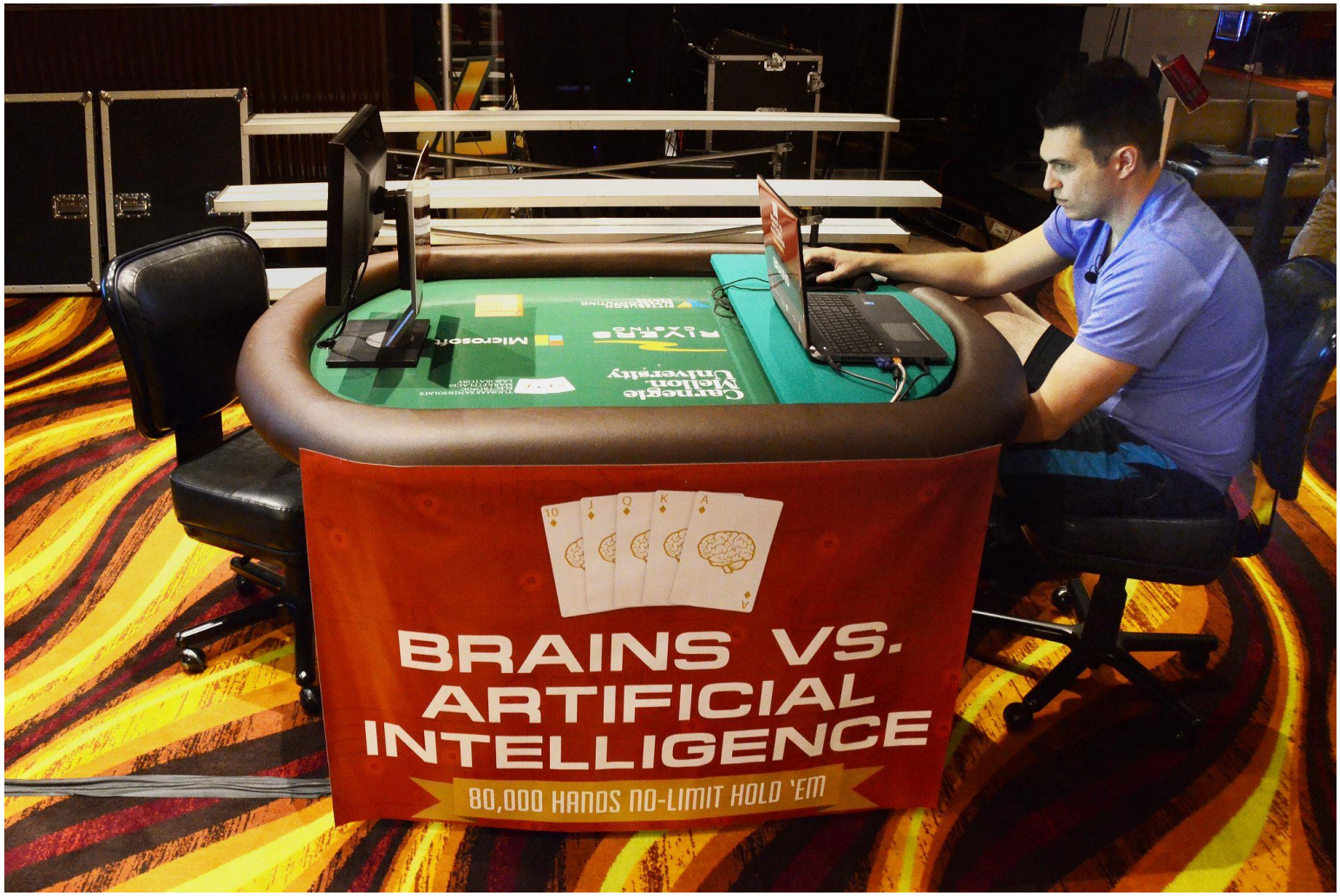
… and of course Games!

Kasparov vs Deep Blue –1997

IBM Watson – Jeopardy – 2011

Google DeepMind – Go – 2016

CMU – Poker – 2017



So, What is Artificial Intelligence?

- First, what is “intelligence”?
- Google
  - “The ability to acquire and apply knowledge and skills.”
- Dictionary
  - “Capacity for learning, reasoning, understanding, and similar forms of mental activity; aptitude in grasping truths, relationships, facts, meanings, etc.”

Imitate Humans?

- Would you call a robot that can perfectly imitate a human *intelligent*?

Intelligent?

- Humans?

Intelligent?

- Humans?

Intelligent?

- Animals?

Intelligent?

- Animals?

Intelligent?

- Plants?

Intelligent?

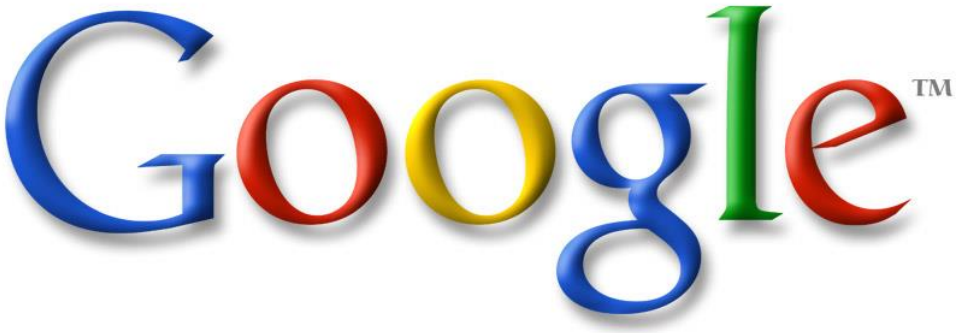
- Plants?

Intelligent?

- Calculators?

Intelligent?

- Search engines?



THE AI EFFECT

- “Every time we figure out a piece of it, it stops being magical; we say, 'Oh, that's just a computation.”
- “AI is whatever hasn't been done yet.”

Quotes from https://en.wikipedia.org/wiki/AI_effect

Intelligence and

- Consciousness
- Emotions
- Kindness
- Sense of humor
- Tell right from wrong
- Love
- Creativity
- Learning

Can machines think?

"The question of whether machines can think … is about as relevant as the question of whether submarines can swim."

Edsger Dijkstra (1984)

The foundations - I

- Philosophy
  - Logic, induction, rationalism, empiricism
- Mathematics
  - Probability, statistics
- Computing
  - Algorithms, data
- Engineering
  - Chips, sensors, robotics

The foundations - II

- Economics
  - Utility, decision theory, game theory
- Neuroscience
  - The study of the brain
- Psychology
  - Behaviorism, cognitive psychology, how humans and animals think and act
- Linguistics
  - Grammar, syntax, how language relates to thinking

Subfields of AI

1. Communication and Perception
   - Language, speech, vision, robotics
2. Knowledge representation and reasoning
   - Logic, probability, planning, decision making
3. Learning
   - Machine learning
4. Problem solving
   - Search, constraint satisfaction, game playing

AI vs ML vs DL

- A common misconception
  - AI = Machine Learning = Deep Learning
- Reality
  - Deep Learning $\subset$ Machine Learning $\subset$ AI

Machine Learning

Developing programs that improve their performance through experience at a given task

Tom Mitchell, Machine Learning

A few ML Examples

- Face recognition
- Speech recognition
- Game playing
- Medical diagnosis
- Scientific data analysis
- Behavior analysis
- Product recommendations
- Ad placements
- Personalization
- Credit scoring
- Fraud detection
- …

Weak vs Strong AI

- Weak AI
  - Build AI systems that are really good at one task
  - Most, if not all, of the current systems
- Strong AI
  - Build AI systems that are generally intelligent
  - Challenge: the whole is greater than the sum of its parts

AI Winter(s)?

- 1966
  - National Research Council report: “machine translation was more expensive, less accurate and slower than human translation”
- 1969
  - “Perceptrons” book; showed the limits of perceptrons, the building blocks of neural networks
- 1970s
  - The Lighthill report at UK; the problem of combinatorial explosion and intractability
  - Amendment to DARPA’s funding; required “mission-oriented” research rather than “basic” research
- 1987
  - The beginning of the collapse of the LIPS machine and expert systems
- 2020?

https://en.wikipedia.org/wiki/AI_winter

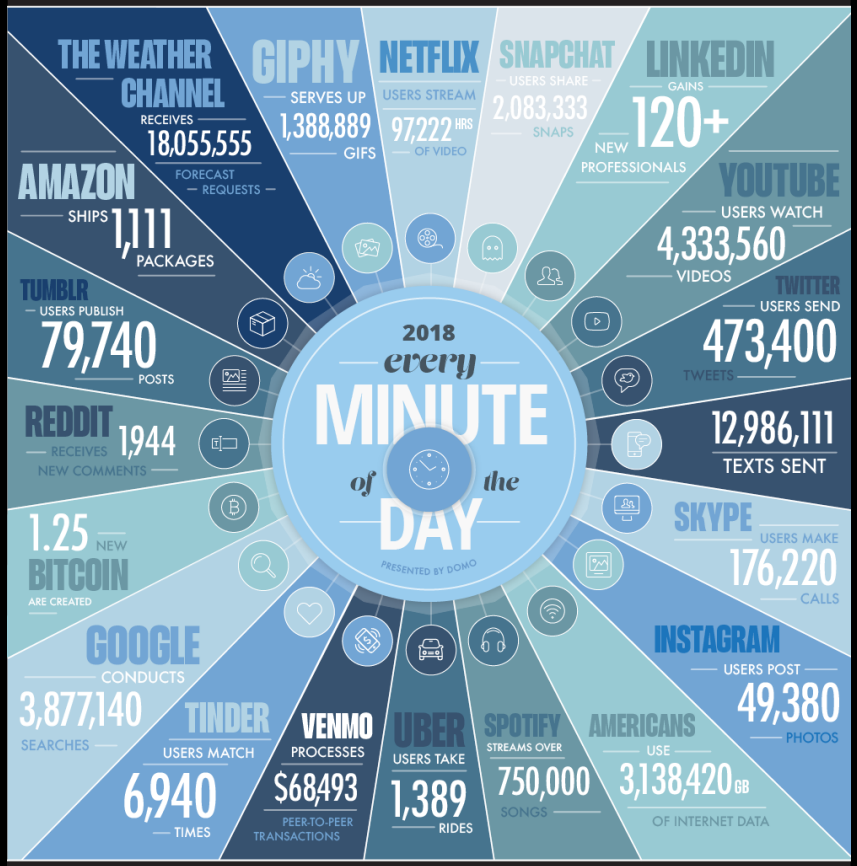
What is new?

1. Data
   - We generate **so** much data
   - We can and do store **all** of it
2. Computing power
   - Moore's law: "the number of transistors in a integrated dense circuit doubles about every two years"
   - GPU computation

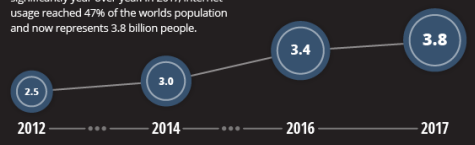
DATA NEVER SLEEPS 6.0

How much data is generated *every minute?*

There's no way around it: big data just keeps getting bigger. The numbers are staggering, but they're not slowing down. By 2020, it's estimated that for every person on earth, 1.7 MB of data will be created every second. In our 6th edition of Data Never Sleeps, we once again take a look at how much data is being created all around us every single minute of the day—and we have a feeling things are just getting started.



The world's internet population is growing significantly year-over-year. In 2017, internet usage reached 47% of the worlds population and now represents 3.8 billion people.



GLOBAL INTERNET POPULATION GROWTH 2012–2017
(IN BILLIONS)

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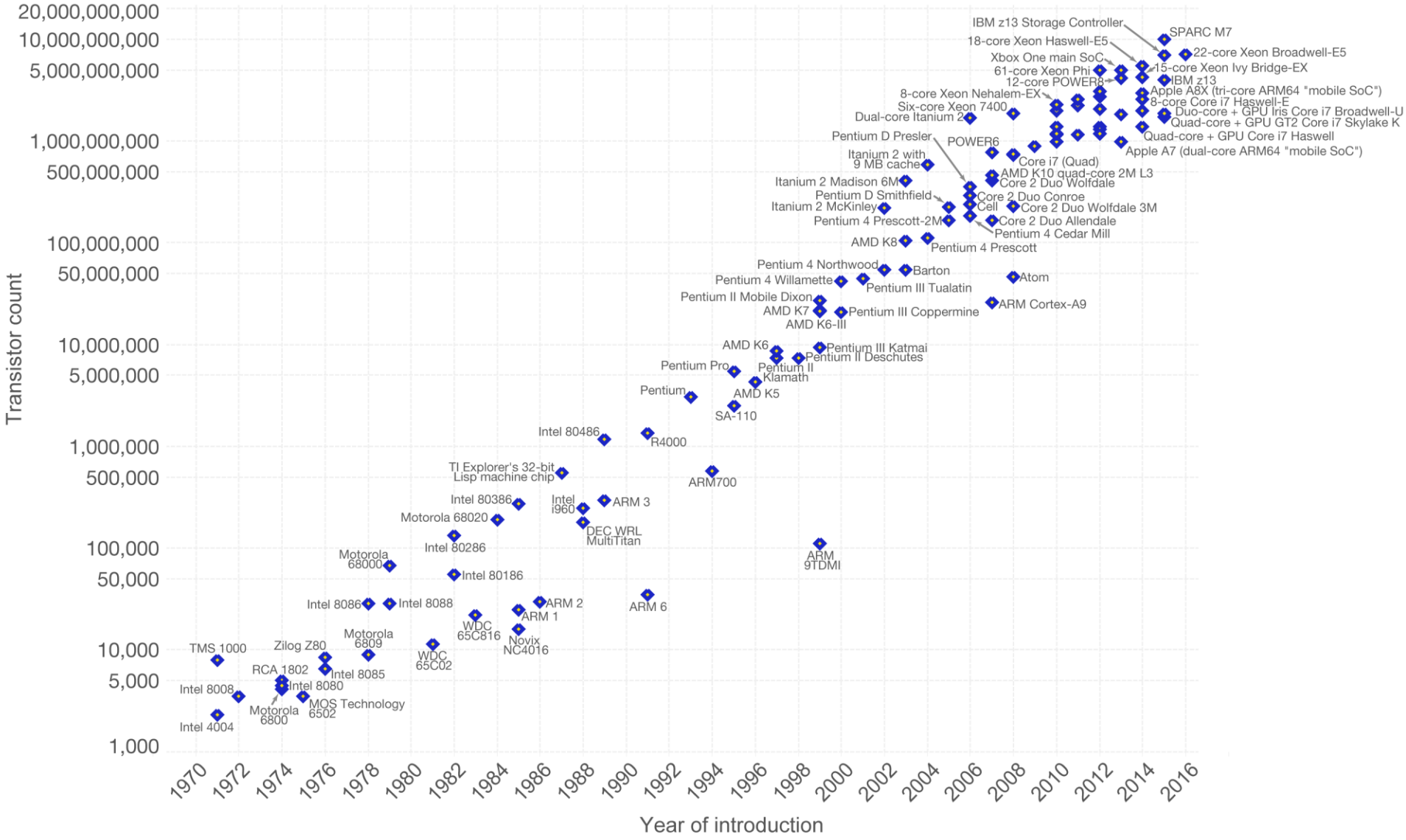
SOURCES: STATISTA, LINKEDIN, INTERNET LIVE STATS, EXPANDED RAMBLINGS, SLASH FILM, RIAA, BUSINESS OF APPS, INTERNATIONAL TELECOMMUNICATIONS UNION, INTERNATIONAL DATA CORPORATION

Moore's Law – The number of transistors on integrated circuit chips (1971-2016)

Our World in Data

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are strongly linked to Moore's law.



Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)

The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.

Some of the Current Challenges

- Privacy
- Fairness
- Accountability
- Transparency
- Social media
- Economics (e.g., job loss and creation)
- Regulations

Thank you!