

ARTIFICIAL INTELLIGENCE



Mustafa Bilgic

✉ <http://www.cs.iit.edu/~mbilgic>

WHO AM I?

- Associate Professor of Computer Science
- Director of the
 - MAS-AI program
 - Machine Learning Laboratory

AI is Everywhere Now

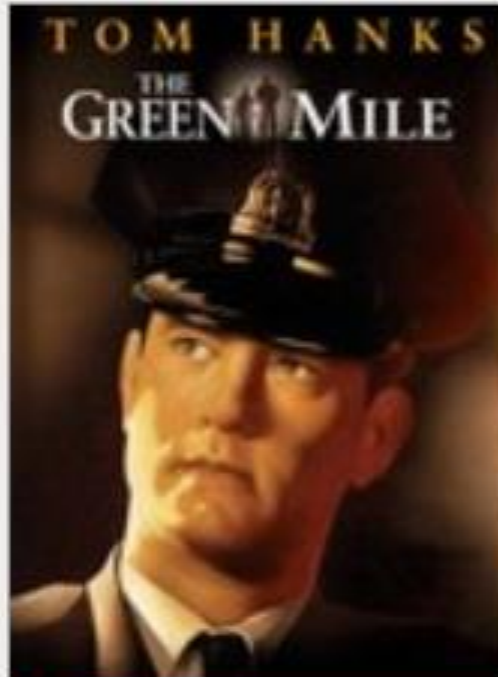
EMAIL FILTERING



SEARCH ENGINES



RECOMMENDER SYSTEMS



Add



☐ Not Interested

The Green Mile

Because you enjoyed:

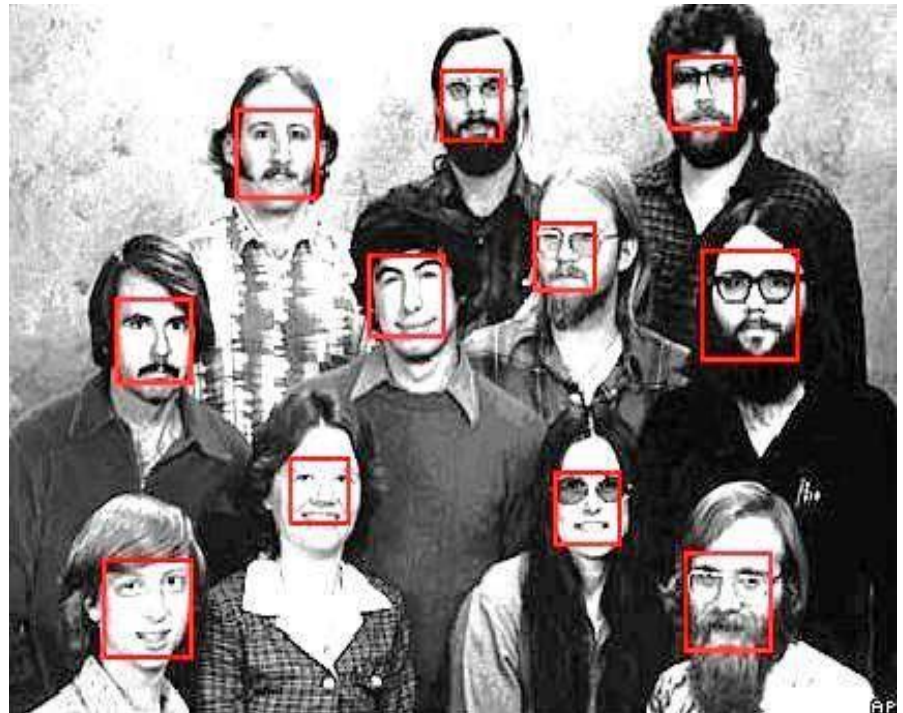
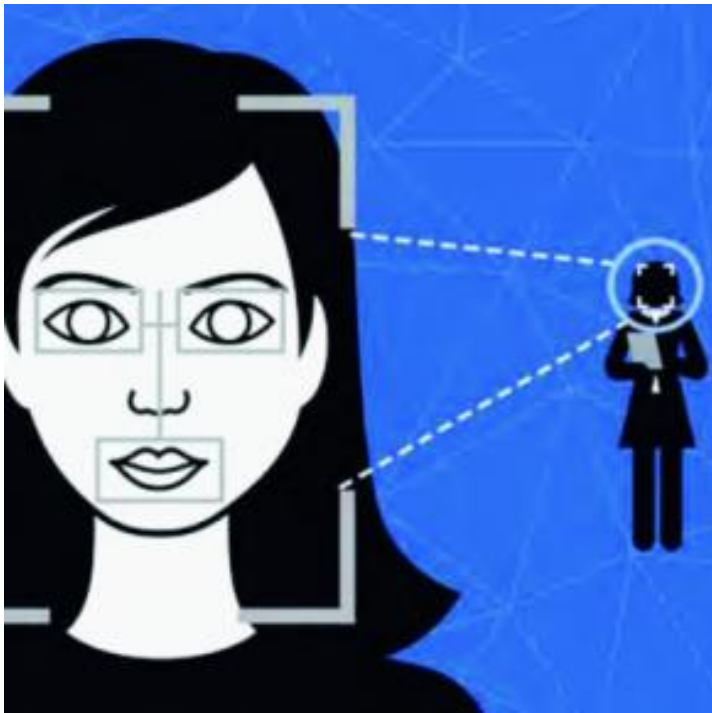
The Shawshank

Redemption: Special
Edition

Forrest Gump

Rain Man

FACE DETECTION & RECOGNITION



MEDICAL DIAGNOSIS



INTELLIGENT PERSONAL ASSISTANTS

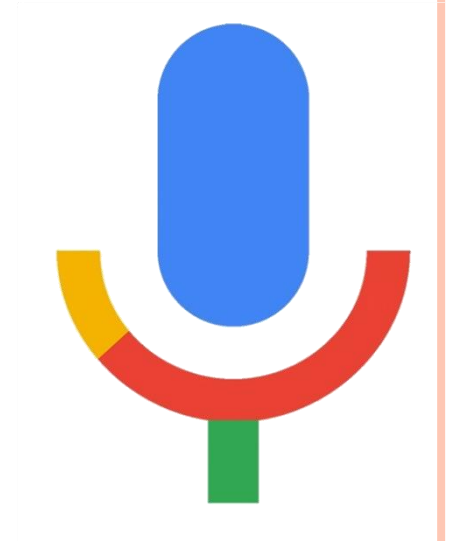
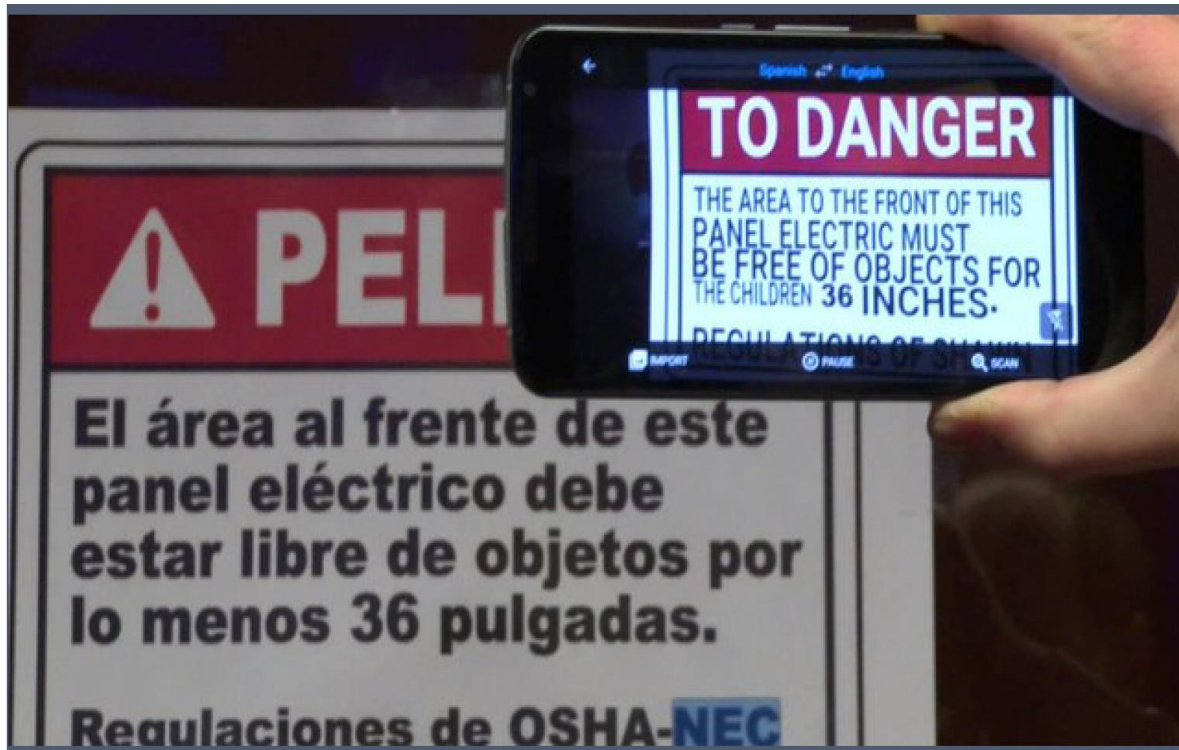


IMAGE RECOGNITION + TRANSLATION



SELF-DRIVING CARS



... and of course Games!

KASPAROV VS DEEP BLUE –1997



IBM WATSON – JEOPARDY! – 2011



GOOGLE DEEPMIND – Go – 2016



CMU – POKER – 2017



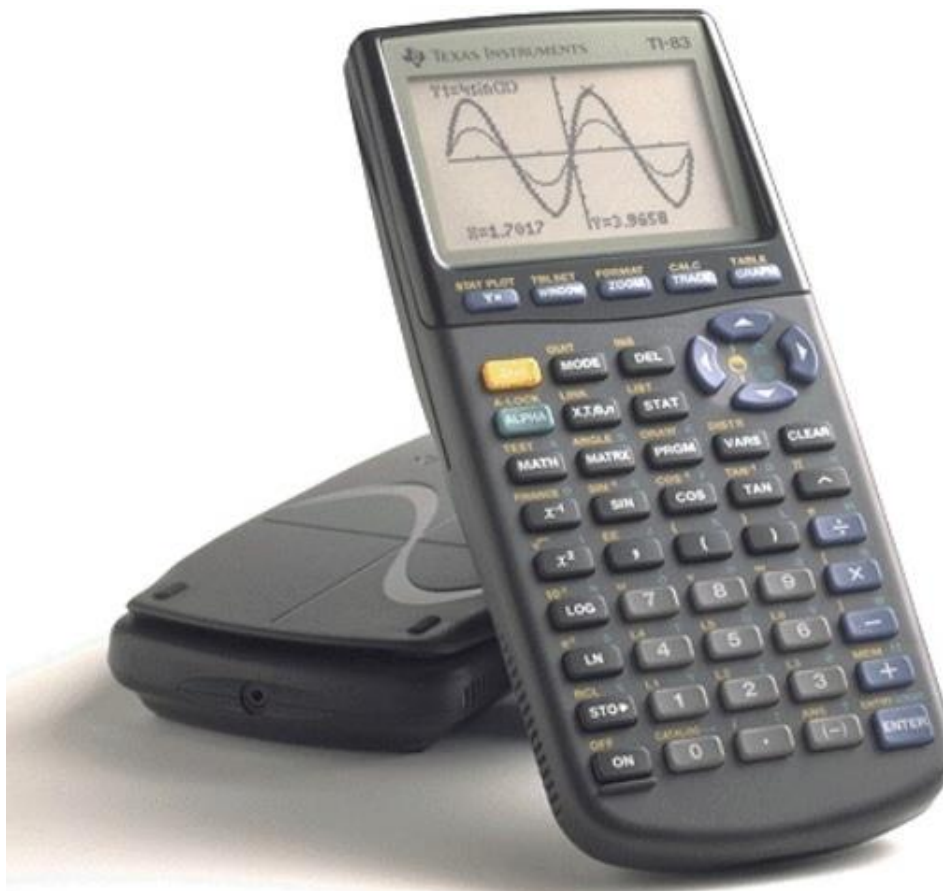
What's your favorite application of AI?

WHAT IS AI?

- https://www.lexico.com/en/definition/artificial_intelligence
 - “The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.”
- <https://www.merriam-webster.com/dictionary/artificial%20intelligence>
 - “an area of computer science that deals with giving machines the ability to seem like they have human intelligence”
 - “the power of a machine to copy intelligent human behavior”
- <https://www.britannica.com/technology/artificial-intelligence>
 - “the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.”
- https://en.wikipedia.org/wiki/Artificial_intelligence
 - “is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals including humans”

INTELLIGENT?

- Calculators?



INTELLIGENT?

- Search engines?

The Google logo is displayed in its characteristic multi-colored font: blue 'G', red 'o', yellow 'o', blue 'g', green 'l', and red 'e'. A small 'TM' trademark symbol is located to the upper right of the 'e'.The bing logo is shown in a blue, lowercase, sans-serif font. A small yellow dot is positioned above the 'i'. A small 'TM' trademark symbol is located to the upper right of the 'g'.

INTELLIGENT?

- Trees?



INTELLIGENT?

- Ants?



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INTELLIGENT?

- Human babies?



INTELLIGENCE AND

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

A GREAT READ

- Turing, A. (1950). Computing machinery and intelligence. *Mind*, 59, 433-460.

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

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 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.”

HUMANLY VS. RATIONALLY & THINKING VS. ACTING

	Humanly	Rationally
Think	Thinking humanly	Thinking rationally
Act	Acting humanly	Acting rationally

WEAK VS STRONG AI

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

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
- ...

HISTORY

- 1943 – first neural network
- 1945 – ENIAC
- 1950 – first neural network computer
- 1950 – Turing test
- 1956 – Dartmouth workshop – the term AI is coined
- ...

THE STATE OF THE ART

- Whatever I put in this slide has the potential to become stale in a few years
- Check out aiindex.org
- AI has met or exceeded human benchmarks on
 - Chess, Go, Poker, Pac-Man, Jeopardy, ImageNet object detection, speech recognition in limited domains, Chinese to English translation in limited domains, Quake III, Dota 2, Starcraft II, various Atari games, skin cancer detection, prostate cancer detection, protein folding, and diabetic retinopathy diagnosis

WHAT IS NEW?

1. Data

- We generate **so** much data
- We can and do store **all** of it

2. Computing power

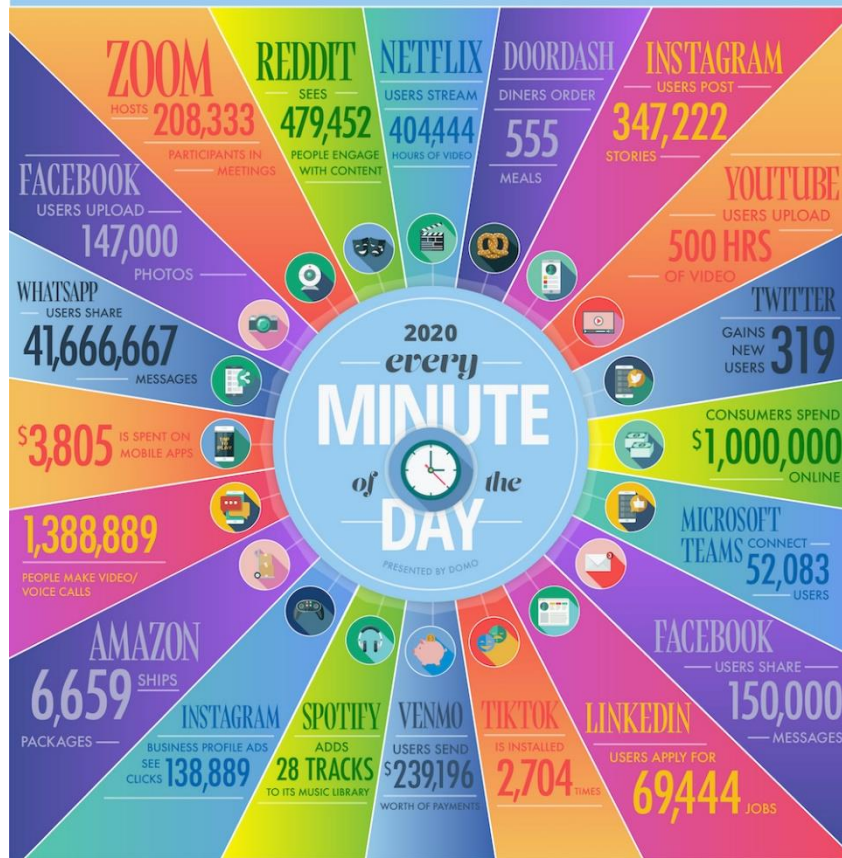
- Moore's law: "the number of transistors in a integrated dense circuit doubles about every two years"
- GPU computation

DOMO

DATA NEVER SLEEPS 8.0

How much data is generated *every minute*?

In 2020, the world changed fundamentally—and so did the data that makes the world go round. As COVID-19 swept the globe, nearly every aspect of life—from work to working out—moved online, and people depended more and more on apps and the Internet to socialize, educate and entertain ourselves. Before quarantine, just 15% of Americans worked from home. Now over half do. And that's not the only big shift. In our 8th edition of Data Never Sleeps, we bring you the latest stats on how much data is being created in every digital minute—a trend that shows no sign of stopping.



The world's Internet population is growing significantly year over year. As of April 2020, the Internet reaches 59% of the world's population and now represents 4.57 billion people — a 6% increase from January 2019.



GLOBAL INTERNET POPULATION GROWTH 2014–2020
(IN BILLIONS)

As the world changes, businesses need to change with the times—and that requires data. Every click, swipe, share or like tells you something about your customers and what they want, and Domo is here to help your business make sense of all of it. Domo gives you the power to make data-driven decisions at any moment, on any device, so you can make smart choices in a rapidly changing world.

Learn more at domo.com

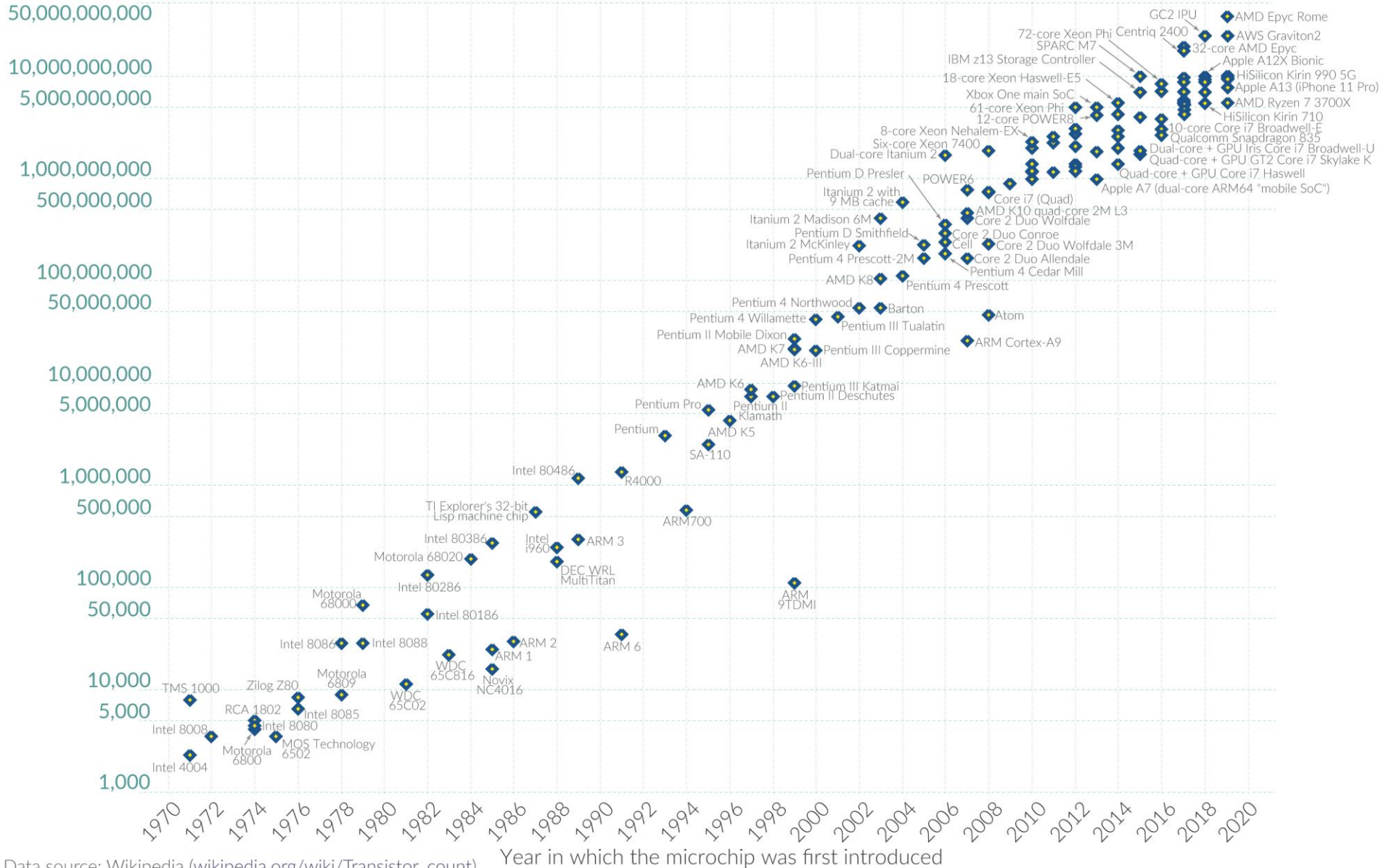
SOURCE: STATISTA, VITAL CAPITALIST, BUSINESS INSIDER, GAME/SPOT, TECHCRUNCH, OMNICORE AGENCY, DOORDASH, BUSINESS OF APPS, NEW YORK TIMES, MUSIC BUSINESS WORLDWIDE, INC., THE VERGE, INC., HOOTSUIT, BUSTIN STOUT, REDCUT, LEBES, AMAZON, VOR



Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

Transistor count



RISKS AND BENEFITS

○ Benefits

- Solve challenging problems (diseases, climate change, resource shortages, ...)

○ Risks

- Lethal autonomous weapons
- Surveillance
- Manipulation
- Biased decision making
- Unemployment
- Safety
- Security
- ...

AI COURSES

- AI Courses

- CS 480 – Artificial intelligence
- CS 581 – Advanced artificial intelligence

- AI-related courses

- Data mining, information retrieval, natural language processing, introduction to machine learning, ...
 - CS 422, CS 429, CS 481, CS 482, CS 484
- Machine learning, computer vision, deep learning, online social network analysis, probabilistic graphical models, natural language processing, ...
 - CS 512, CS 522, CS 529, CS 577, CS 578, CS 579, CS 580, CS 582, CS 583, CS 584, CS 585

AI FACULTY IN CS

- Gady Agam
 - Computer vision, machine learning
 - <https://www.iit.edu/directory/people/gady-agam>
- Shlomo Argamon
 - NLP, machine learning
 - <https://www.iit.edu/directory/people/shlomo-argamon>
- Mustafa Bilgic
 - Machine learning
 - <https://www.iit.edu/directory/people/mustafa-bilgic>
- Kai Shu
 - Data mining
 - <https://www.iit.edu/directory/people/kai-shu>
- Binghui Wan
 - Robust machine learning
 - <https://www.iit.edu/directory/people/binghui-wang>
- Yan Yan
 - Video analysis, machine learning
 - <https://www.iit.edu/directory/people/yan-yan>



GADY AGAM



- ❖ Computer vision
- ❖ Medical imaging
- ❖ Deep learning
- ❖ Machine learning



SHLOMO ARGAMON



- ❖ Natural language processing
- ❖ Forensic linguistics
- ❖ Biomedical informatics
- ❖ Machine learning



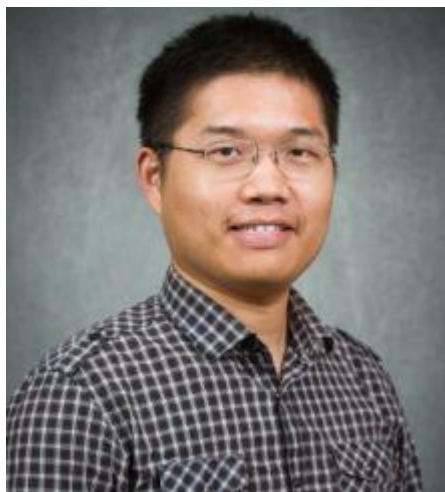
MUSTAFA BILGIC



- ❖ Machine learning
- ❖ Active learning
- ❖ Explainable AI
- ❖ Probabilistic modeling



KAI SHU



- ❖ Data mining
- ❖ Social computing
- ❖ Natural language processing
- ❖ Machine learning



BINGHUI WAN



- ❖ Machine learning
- ❖ Privacy
- ❖ Security
- ❖ Robustness



YAN YAN



- ❖ Computer vision
- ❖ Image and video analysis
- ❖ Deep learning
- ❖ Multimedia



SOME OF MY PROJECTS

- **Filter bubbles:** study filter bubble formation and evolution in news recommender systems
- **Interpretable text classification:** develop interpretable text classifiers that generate concise and meaningful explanations that make sense to humans
- **Learning with rationales:** develop machine learning algorithms that can elicit rich feedback from annotators and utilize it for more efficient learning
- **Test-time interpretability:** investigate how predictive model behavior differs from source data to target data

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DANKSCHEEN

GRACIAS

ARIGATO

SHUKRIA

TEŞEKKÜR

TASHAKKUR ATU

GRAZIE

MEHRBANI

BOLZİN

MERCI

THANK

YOU

BİYAN

SHUKRIA

TINGKI

YAQHANYELAY

SUKSAMA

EKHMET

GOZAIMASHITA

EFCHARISTO

KOMAPSUMNIDA

MAAKE

PALDIES

SHUKRIA