### CORSI E RICORSI: HERE WE GO AGAIN!

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Scientia Nova, De Antiquissima Italorum Sapientia G.B. Vico (1650)

# AI Craze... but what are the limitations?

- Novelty?
- Limitations
- Towards Verifiable AI

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Definitions (Oxford dictionary)

AI: The theory and development of computer systems able to perform tasks normally requiring human intelligence

**ML**: The use and development of computer systems that can learn and adapt without following explicit instructions, by using algorithms and statistical models to analyze and draw inferences from patterns in data.

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- 1958 Rosenblatt proposed perceptrons
- 1980 Neocognitron (Fukushima, 1980)
- 1982 Hopfield network, SOM (Kohonen, 1982), Neural PCA (Oja, 1982)
- 1985 Boltzmann machines (Ackley et al., 1985) 1986 Multilayer perceptrons and backpropagation (Rumelhart et al., 1986)
- 1988 RBF networks (Broomhead&Lowe, 1988)
- 1989 Autoencoders (Baldi&Hornik, 1989), Convolutional network (LeCun, 1989)
- 1992 Sigmoid belief network (Neal, 1992)
- 1993 Sparse coding (Field, 1993)

2000s Sparse, Probabilistic, and Energy models (Hinton, Bengio, LeCun, Ng)

Is deep learning 3, 30, or 60 years old? Berkeley



Rosenblatt's Perceptron



# Adeep learning architecture is a multilayer function with many parameters. Parameters are determined by fitting a training set and verified using a test set. Is there any guarantee that this function will approximate the «real» function?







### AI and EDA

Seminal work at IBM (1960s) on realizability of logic functions on a gate array: an empirical rule (the Rent's rule):

# T=tg<sup>p</sup>

Where T = number of pins on the periphery of the block, g = number of internal components, t and p = constant parameters to obtain by fitting data (0.5

The rule was based on regular layouts and rich statistical data.

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### Concerns around AI biases are mounting

Al transparency tech, also known as explainable Al, traces back outputs from Al algorithms to provide a way to understand what's happening in "human terms."

As Al is increasingly used for decision-making across industries, understanding how and why an algorithm makes its decisions can help mitigate inhorent biases associated with most Al systems in existence today.





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### **SCENIC:**

A Language for Scenario Specification and Data Generation





Scenic is an imperative, object-oriented, probabilistic, domain-specific language

Citation: Daniel Fremont, Edward Kim, ASV et al. "Scenic: A Language for Scenario Specification and Data Generation," Journal of Machine Learning Research, 2020

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PPL as a scenario specification language enables
1. Scenario-based evaluation
2. Comparison between synthetic and real sensor data at a scenario-level to validate simulation test results in the real world
3. Synthesis of scenarios as programs to automate modeling and generating realistic environment agent behaviors in simulation

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### Some Applications of Scenic

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- Data Generation, (Re)-Training - More controllable, interpretable
- Improves performance significantly
- Rare scenarios, controlled distributions, etc.
- Debugging Failures

   Vary scenarios systematical
- Explain failures of ML
- Besiden Space Exploration



Test Hypothesis: does the car model lead to a mis-detection?

























Create Simulated World	Image: Scenic Scenic Acceleration No Collision         Speed, Acceleration No Collision         Rules of the Road	-ooo
Safety Metrics	Speed, Acceleration, No Collision Rules of the Road 	









