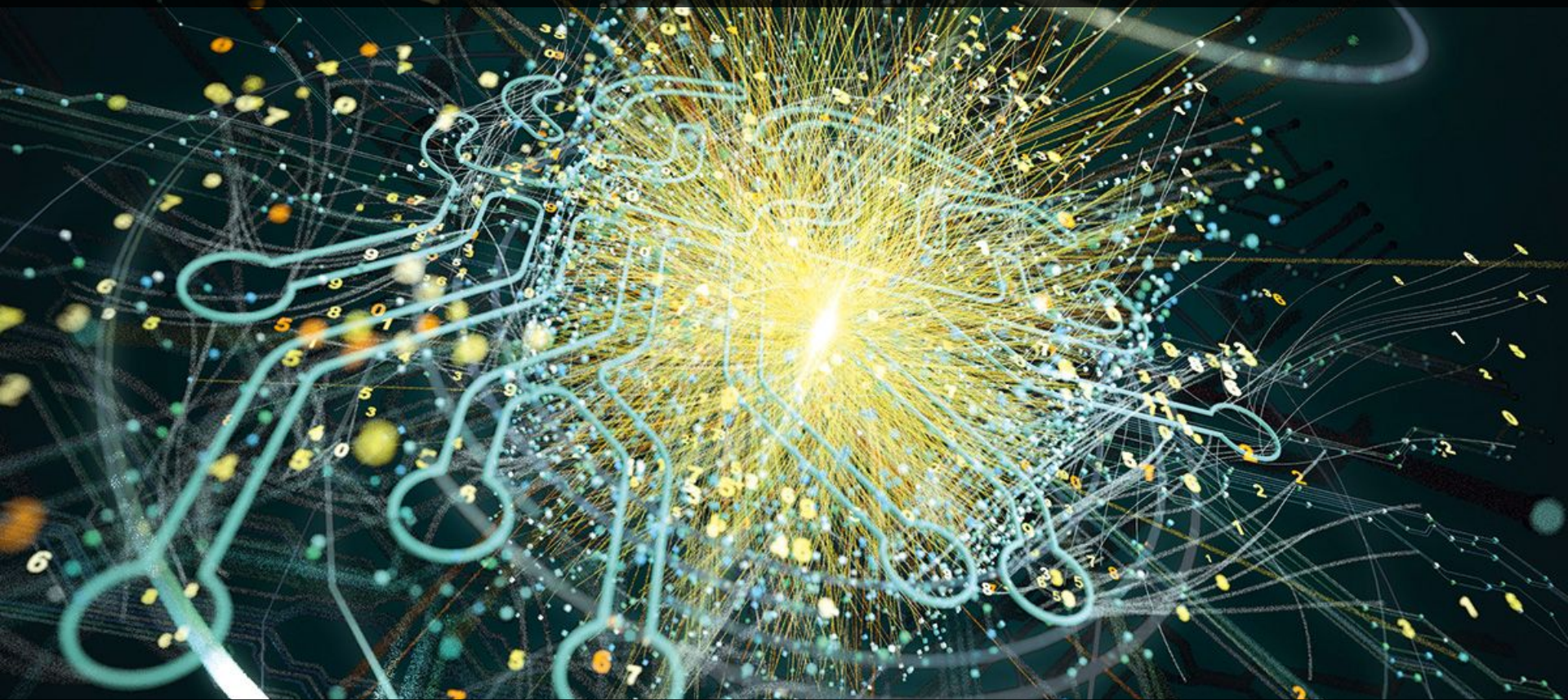# Artificial Intelligence & Machine Learning

Claire David | African School of Physics 2022 | Gqeberha, South Africa

Credit: D Dominguez/CERN

Anonymous Question Box

Artificial Intelligence
A.I.

Machine Learning
M.L.

What is AI? What is ML?

The Math Behind Machine Learning

How to learn on your own

Let's start with definitions

And annoyingly basic questions

What is intelligence?

Definition(s) of intelligence

Wikipedia (English)

- Capacity for abstraction, logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking, and problem-solving

- Ability to perceive or infer information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context.

Wikipedia (French)

- Faculty of adaptation ; learning to adapt to the environment

- Faculty of modifying the environment to adapt it to one's own needs

- Ability to process information to achieve goals

Definition(s) of intelligence (continued)

Etymology

from Latin *intelligere* → "to understand, comprehend, come to know"

A synthesis attempt

Intelligence measures an agent's ability to achieve goals

in a wide range of environments.

Shane Legg, Marcus Hutter arXiv:0712.3329

"A fundamental problem in artificial intelligence is that

nobody really knows what intelligence is."

What is artificial?

What is artificial?

Etymology

from Latin *artificiālis* → belonging to art, from artificium skill, artifice.

Artificial Intelligence

Dartmouth College, summer 1956

- "AI" attributed to John McCarthy of MIT
- Another founder Marvin Minsky (Carnegie-Mellon University) defines it as:

> "The construction of computer programs that engage in tasks that are currently more satisfactorily performed by human beings because they require high-level mental processes such as: perceptual learning, memory organization and critical reasoning."

"Artificial intelligence is not, by definition, simulation of human intelligence"

<div align="right">John McCarthy</div>

ARTIFICIAL INTELLIGENCE

MACHINE LEARNING
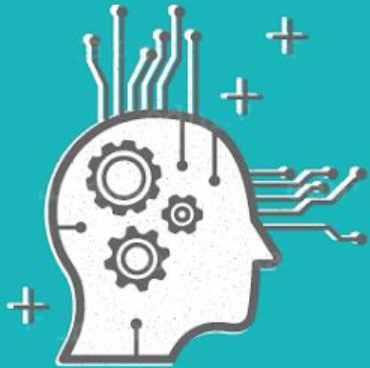
DEEP LEARNING

Science & engineering of making intelligent machines

"Field of study that gives computers the ability to <u>learn</u> without being explicitly programmed"
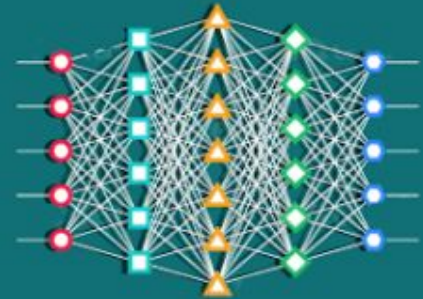
Learning based on Deep Neural Networks

Example: chatbots

Arthur Samuel

What is machine learning?

Machine Learning

Definition **Machine Learning**

A computer program is said to learn from **experience E** with respect to some **task T** and some **performance measure P**,
if its performance on T, as measured by P, improves with experience E.

Tom Mitchell, computer scientist, 1998

Your mission!

In groups, list several machine learning examples you know of.
What are the task T, the experience E and performance P?

Example: checker

Task: playing a checker game

Experience: repeated action of the program
to play against itself for thousands of different games

Performance: probability of winning
the next game of checker.
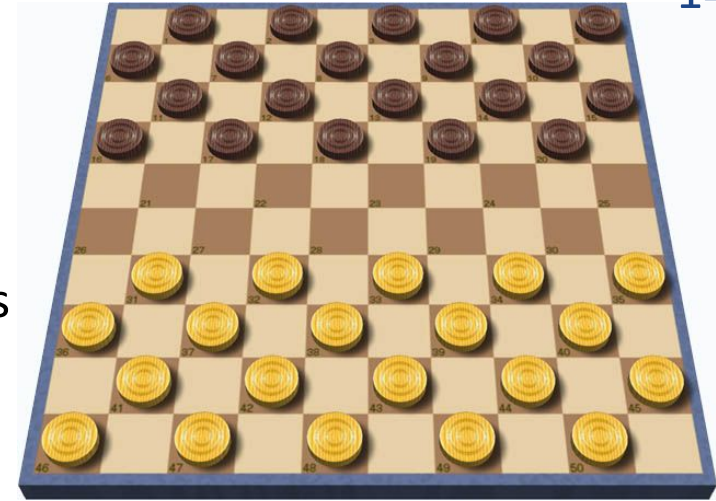
Probability increases → program has learned to play checkers

Important

- Assessment (win / lose) should be done on **new data**
- What counts in the experience is **novelty**

Example: zip code scan

Task: assignment from a picture to digits

Experience: expose the program to pictures of envelopes (input images) and answers (digits)

Performance: probability of guessing a new envelope with an unknown zip code.

Example: spam filter

Task: marking an email either spam or not-spam

Experience: repeating the task with a large collection of emails of known type

Performance: accuracy = percentage of correct decisions / all decisions

What is the difference between machine learning and statistical modeling?

Machine Learning vs Statistical Modeling

A Statistical Model is the use of statistics to build a representation of the data and then conduct analysis to infer any **relationships between variables** or discover insights.

Machine Learning is the use of mathematical or statistical models to obtain a general understanding of the data **to make predictions.**

Machine Learning is a <u>tool</u>

Types of Machine Learning

Credit: D Dominguez/CERN