Artificial Intelligence for Finance

Talks by Matt Taylor and Randy Goebel (Computing Science)

Opening remarks / emceeing by Stathi Avdis

Program

- Opening remarks — 15 min
  Stathi Avdis
- Reinforcement learning in stock trading — 30 min
  Matt Taylor
  - Q & A — 5 min
- Emergence of AI tools for regulatory compliance — 30 min
  Randy Goebel
  - Q & A — 5 min

Ground rules

Please hold questions until each Q&A

Two options to claim Q&A priority:

(Prioritized) Send me your question on **google chat**—you may have to install it on your phone

Raise your hand anytime, without asking, and you will get in the Q&A queue behind the chats

What is Artificial Intelligence (AI)?

A non-expert, non-objective view

Main goal: to understand the mind by **building it**

- Biological forms have inspired the very origins of AI (McCulloch and Pitts, *Bulletin of Mathematical Biophysics*, 1943)
- A broader goal: to understand **all possible** types of intelligence in a **synthetic manner**

By-products: methods for getting computers to do useful things

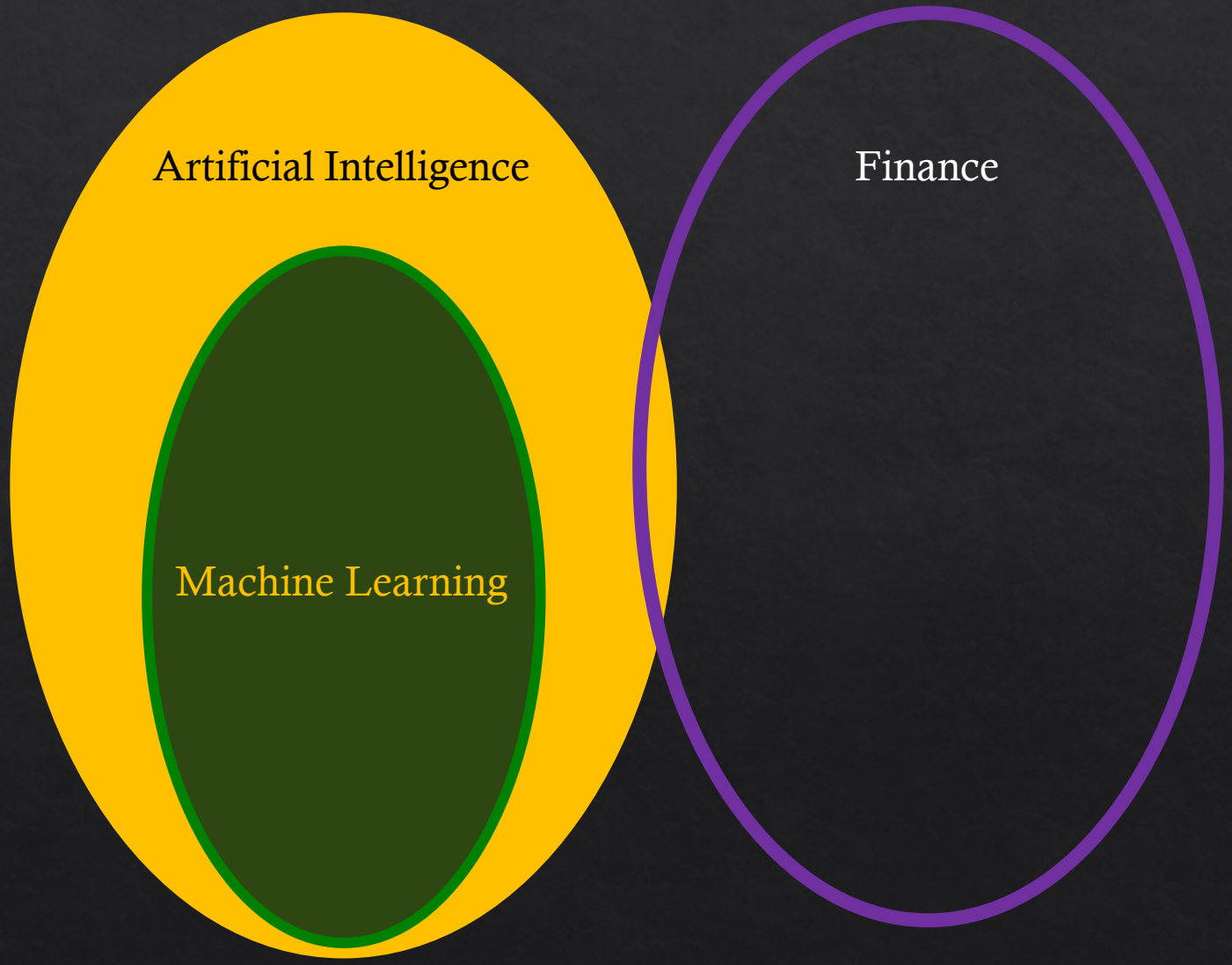
- Such methods can be very much unlike how actual minds work
- We can think of his goal as "technological," and not as "scientific" as above

Tricky question: suppose a machine **performs exactly like** the human mind, but **does not imitate** the physiology of the brain

- Does it matter? Isn't it enough that it performs similarly?

Why are we here?

Finance is witnessing an influx of AI! … or is it of ML?



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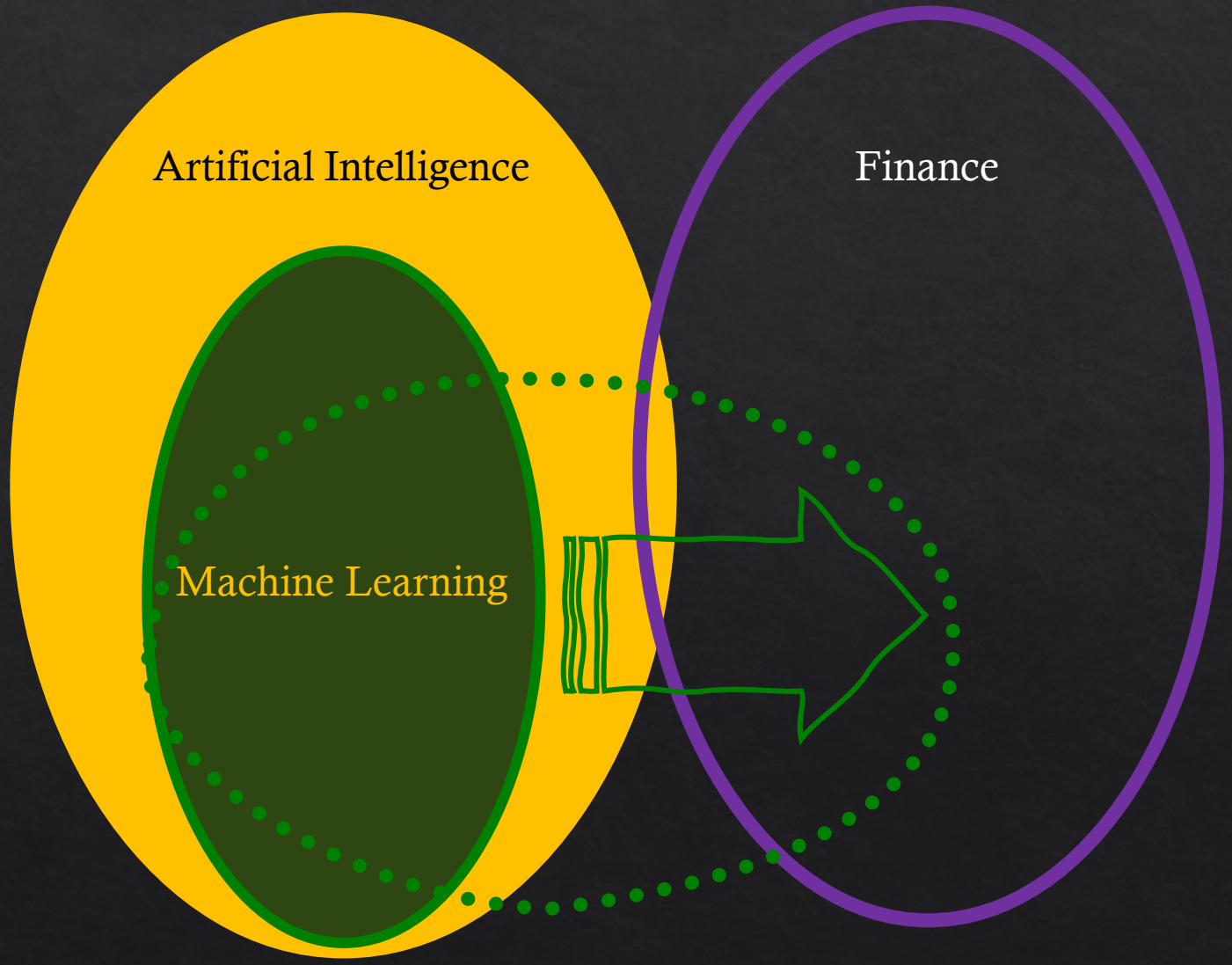

How did we get here?
A brief history of AI

1843: Ada Lovelace comments on Charles Babbage's work:

"'The Analytical Engine [does not] originate anything. It can do whatever we [..] order it to perform. It can follow analysis, but it [cannot anticipate] any analytical revelations or truths. [It makes] available what we are already acquainted with"

1900: David Hilbert declares that Mathematics must be rid of paradoxes and inconsistencies (program formalized in 1921)

1910-15: in their *Principia Mathematica*, Bertrand Russel and A.N. Whitehead attempt to reduce Mathematics to Formal Logic

1931: Kurt Gödel proves his Incompleteness Theorems, upending Hilbert's program

1937: Alan Turing proves that anything "computable" can be computed by a *Universal Machine*

- Turing later turns to how we could recognize artificial intelligence ("Computing Machinery and Intelligence", 1950)

How did we get here?
A brief history of AI, cont.

1952: Minsky and Edmonds build a neural computer with Hebb synapses (vacuum tubes)

1955: “Artificial Intelligence” coined in a proposal by McCarthy, Minsky, Rochester and Shannon

1956: a in Dartmouth at a workshop organized attendees include the above four, and McCulloch, Nash, Samuel, Simon, Newell, and others.

1970’s: Minsky and Papert point out that single-layer neural networks cannot compute XOR (“Perceptrons,” 1969). An AI Winter follows.

Mid 1980’s: halcyon days

Today: the AI Spring is in full swing—swallows arrived in the ’90s—due to three things:

- Multi-layer (thus “deep”) neural networks
- Better algorithms (e.g., deep learning)
- Ever-increasing computational power, best described by Moore’s law

Common context between AI and Finance

Ada Lovelace on Charles Babbage's Analytical Engine

- "The science of operations… is a science of itself, and has its own abstract truth and value"
- "This science constitutes the language through which alone we can adequately express the great facts of the natural world, and those unceasing changes of mutual relationship which… are interminably going on in the agencies of the creation we live amidst."
- "it is by [laborious] analysis that [we] must reach truth… guided by numbers; for without numbers [we cannot] raise the veil which envelopes the mysteries of nature…

  constructing an apparatus capable of aiding human weakness in such researches… would mark a glorious epoch in the history of the sciences."

Common context between AI and Finance, cont.

Charles Babbage and Adam Smith

1793-1801: After reading "*The Wealth of Nations,*" Gaspard de Prony builds a factory that produces mathematical tables, by replacing pin makers with unemployed hairdressers

1822: Inspired by de Prony's memoirs, Babbage designs a computer by replacing hairdressers with computational units ("*On the Economy of Machinery and Manufacturers,*" 1832, p.45)

[Connection pointed out by Allen Newell and Herbert Simon]

John von Neumann

1928: proves the minimax theorem of Game Theory (with two players: Nash equilibrium)

1944: writes "*Theory of Games and Economic Behavior*" with Oskar Morgenstern

1945: lays down the basics of today's computer architectures

[Connection pointed out by Prof. Wikipedia]