

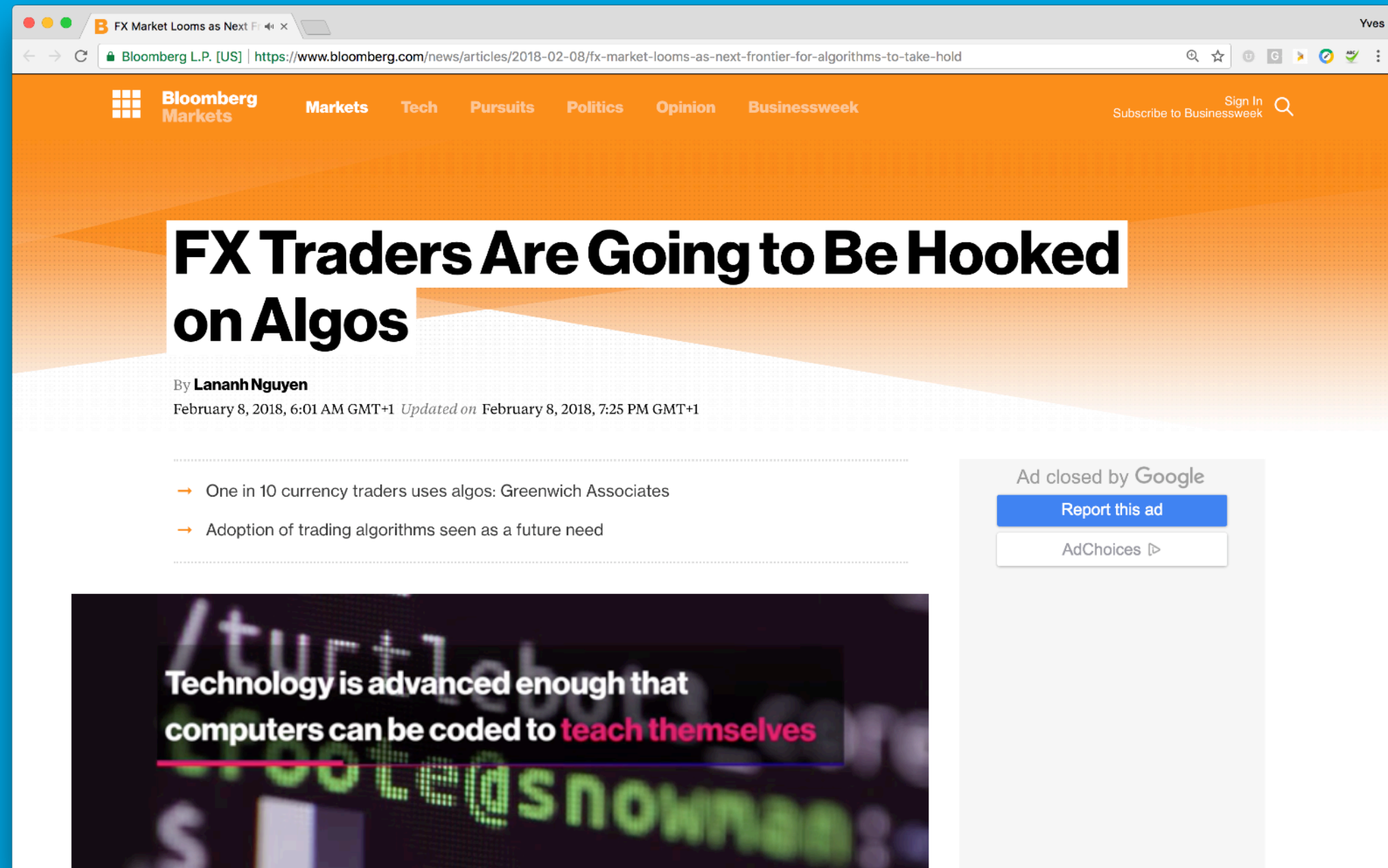
The AI Machine

— Standardized Deployment of AI-Based Trading Strategies

ODSC Kiev, 14. April 2018

Dr. Yves J. Hilpisch





In a few years, currency traders will be hooked on algos like their stock-market colleagues.

That's the view of David Stryker, a principal at consulting firm Greenwich Associates LLC, who sees foreign-exchange markets following equities in the widespread adoption of computerized trading.

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While only one in 10 FX traders currently uses algos to execute trades, the adoption rate is higher at the largest institutions, with one in four deploying the systems, according to a Greenwich study released Thursday. In comparison, in equities more than half of volume is done through an algorithm. The firm surveyed 79 currency-market participants at hedge funds, asset managers, corporations and other financial institutions in the U.S. and Europe.

“Given the myriad benefits that algos offer, FX traders currently not using algos (and not considering them) may soon have to determine whether they’re putting themselves at a disadvantage,” Stryker wrote in the study. “With all of the data available demonstrating the benefits/cost savings, the ability to execute a trade with an algo will soon become a ‘need’ as opposed to a ‘nice to have.’”

Almost 60 percent of respondents said algos had materially cut trading costs, according to the survey. The push to save money, combined with stricter regulation, will boost the appeal of trading software, Greenwich concluded.

AGENDA

- **Introduction**
- **Data-Driven Finance**
- **AI-First Finance**
- **Example Strategy**
- **The AI Machine**
- **Outlook**

Introduction

SERVICES

for financial institutions globally



EVENTS

for Python quants & algorithmic traders



THE PYTHON
QUANTS

TRAINING

about Python for finance
& algorithmic trading



CERTIFICATION

in cooperation with university



BOOKS

about Python and
finance



PLATFORM

for browser-based
data analytics

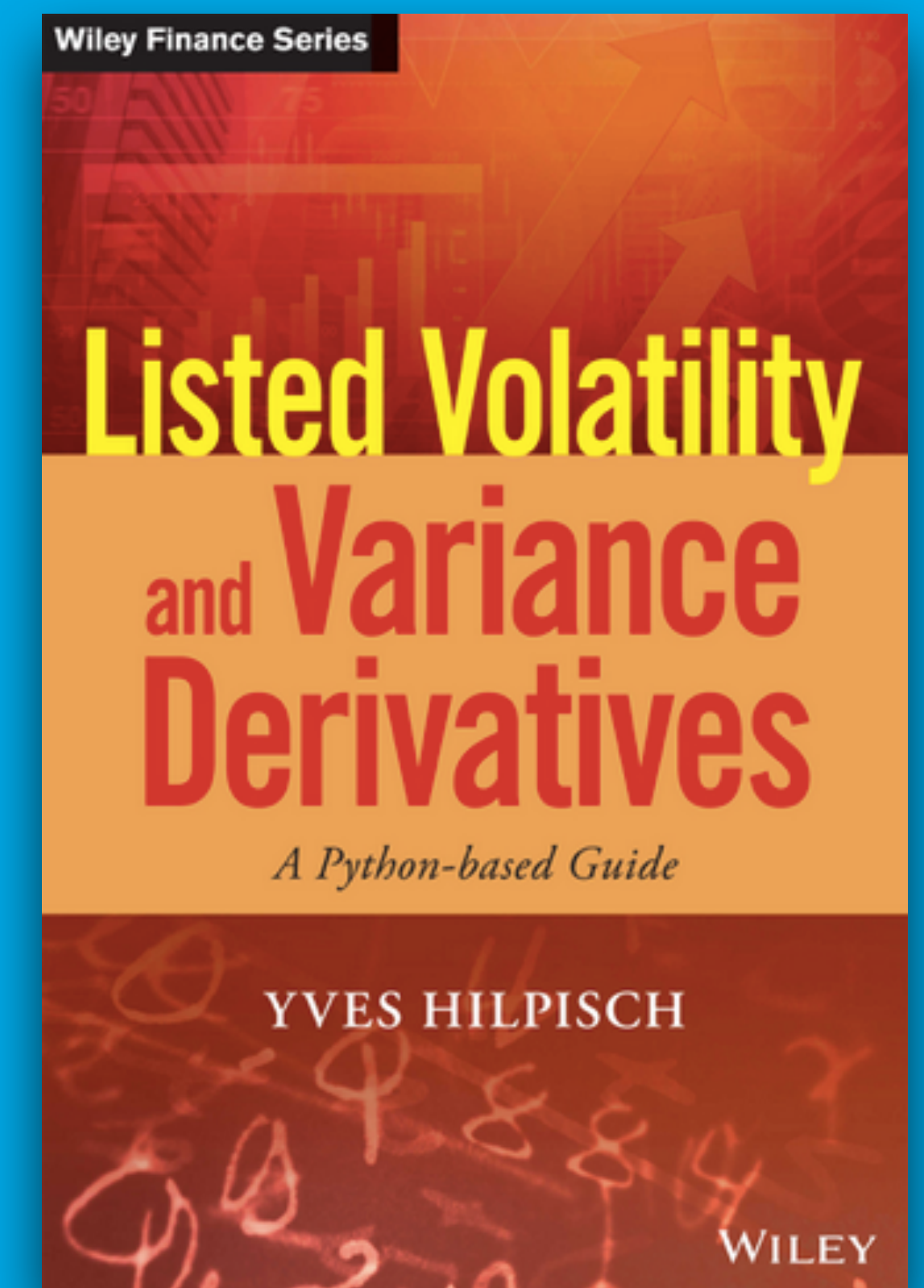
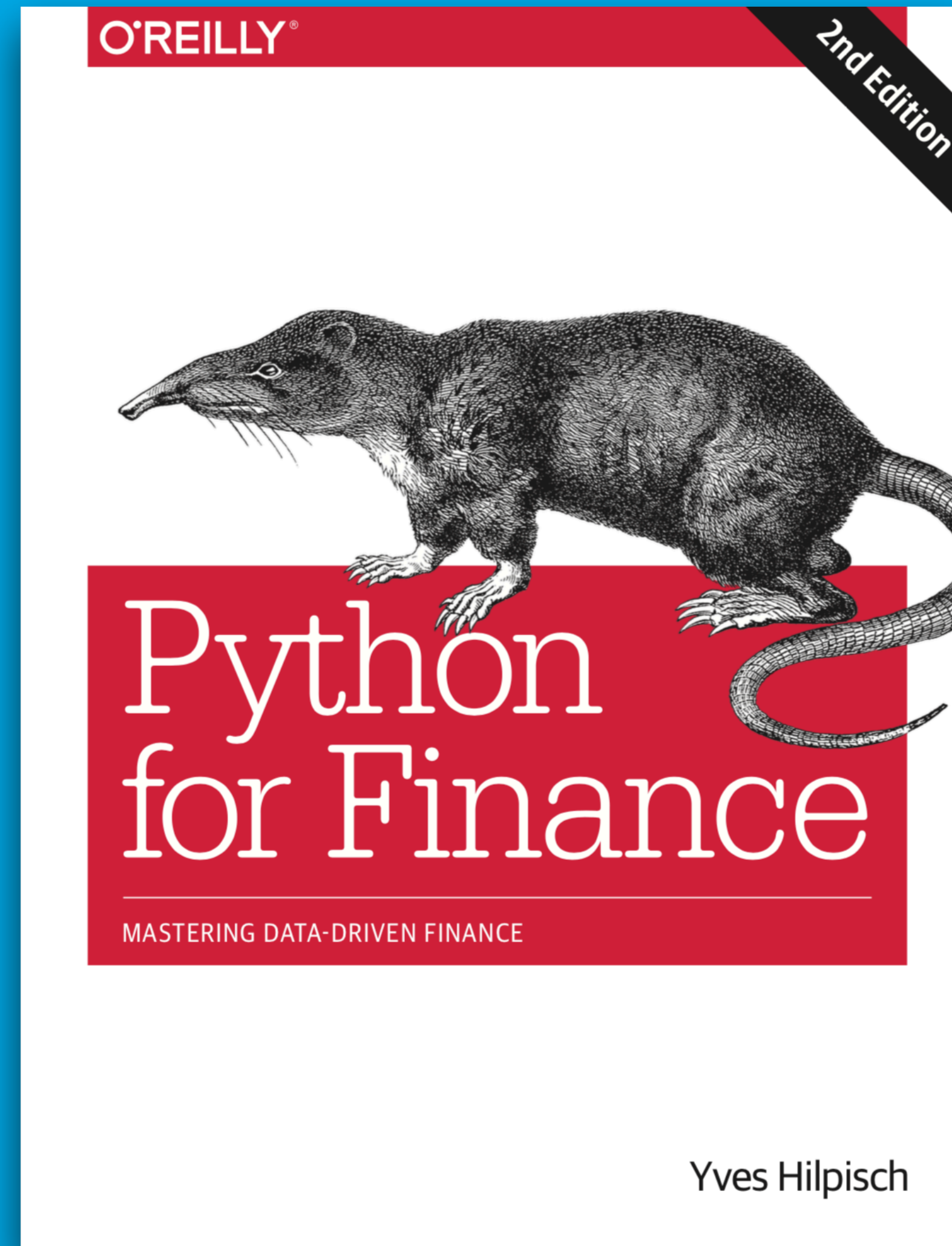
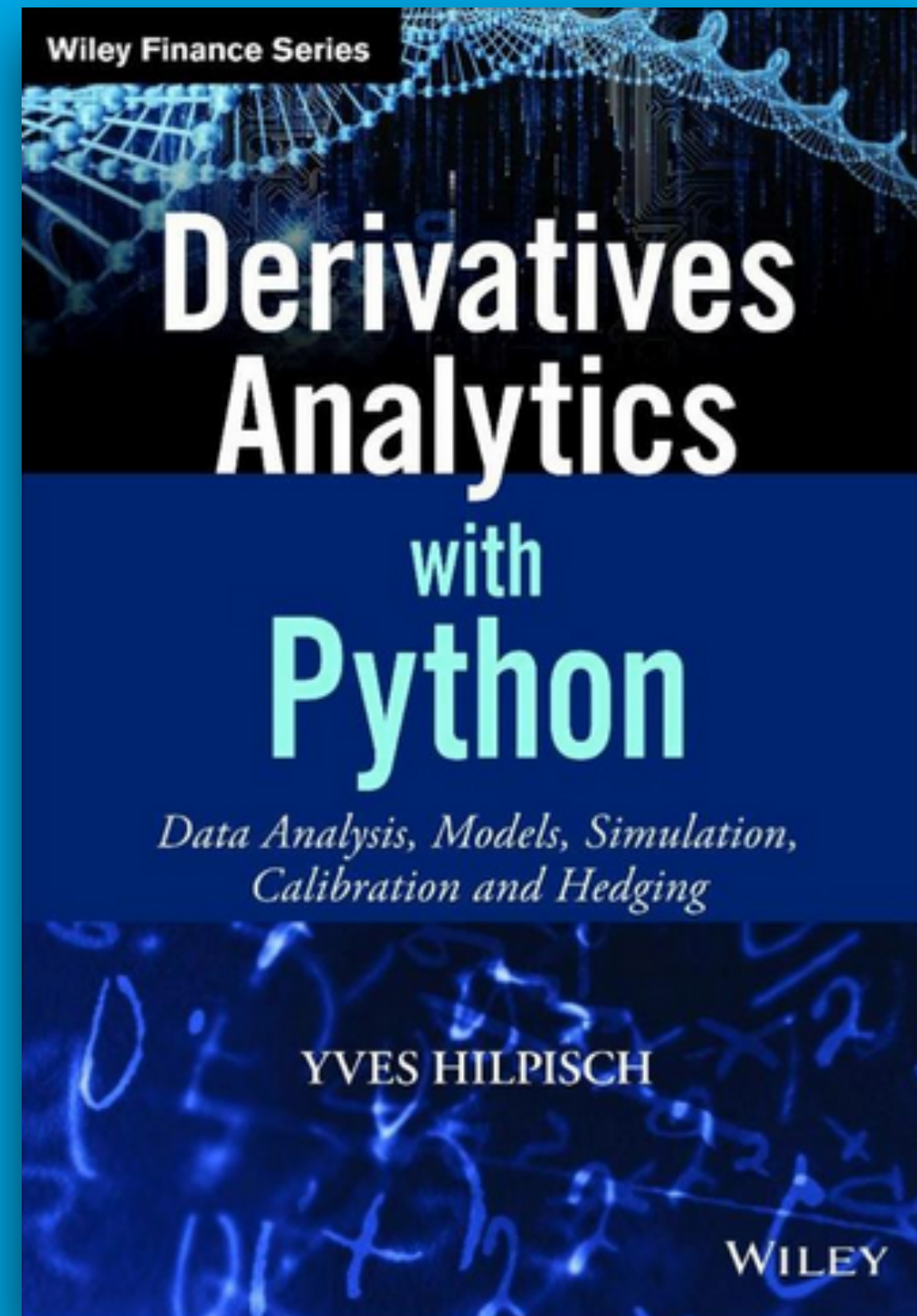


OPEN SOURCE

Python library
for financial analytics







16 week program

150+ hours
of instruction

5,000+ lines
of code

1,200 pages PDF

<http://certificate.tpq.io>



Data-Driven Finance

Yves

← → ↺ <https://emea1.apps.cp.thomsonreuters.com/web/Apps/Corp?s=AAPL.O&st=RIC&app=true#/Overview?s=AAPL.O&template=SOV> 🔍 ☆ U 📱 G ⋮

AAPL.O

AAPL.O ▲ 117.26

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AAPL.O ▼

APPLE INC ▼

United States | NASDAQ Global Select Consolidated | Computer Hardware

Overview

News & Research

Price & Charts

Estimates

Financials

Events

Ownership

Debt & Credit

Peers & Valuation

Derivatives

Filings

360 Menu

📄 ⚙️

BUSINESS SUMMARY >

Apple Inc. designs, manufactures and markets mobile communication and media devices, personal computers and portable digital music players. The Company sells a range of related software, services, accessories, networking solutions, and third-party digital content and applications. The Company's segments include the Americas, Europe, Greater China, Japan and Rest of Asia Pacific. The Americas segment includes both North and South America. The Europe segment includes European countries, India, the Middle East and Africa. The Greater China segment includes China, Hong Kong and Taiwan. The Rest of Asia Pacific segment includes Australia and the Asian countries not included in the Company's other operating segments. Its products and services include iPhone, iPad, Mac, iPod, Apple Watch, Apple TV, a portfolio of consumer and professional software applications, iPhone OS (iOS), OS X and watchOS operating systems, iCloud, Apple Pay and a range of accessory, service and support offerings.

NEWS >

28-Dec-2016

10:24:36	Apple dominerade julhandeln mätt i antalet aktiverade enheter	FNW
10:15:18	UPDATE 3-S.Korea fines Qualcomm \$854 mln for violating competition laws	RTRS
09:42:52	Corea del Sur multa a Qualcomm con 854 mlns dlr por violar leyes de competencia	RTRS
06:00:10	RPT-Wall Street cale une fois de plus au seuil des 20.000 points	RTRS
03:30:18	Aumento del gasto de último minuto impulsa a temporada de ventas de fin de año ...	RTRS
01:50:14	Last-minute spending surge lifts U.S. holiday shopping season	RTRS

27-Dec-2016

23:33:16	Reuters Insider - Tech stocks could take the Dow to 20k	CNBC
23:32:28	Reuters Insider - History suggests Dow could hit 20k by Friday: Technician	CNBC
22:55:29	LEAD 2-Wall Street cale une fois de plus au seuil des 20.000 points	RTRS
22:09:39	Apple, Cisco Lead DJIA Higher Tuesday	WALLST

EVENTS >

Upcoming

Past

24-Jan-2017 » 30-Jan-2017

NTS	Q1 2017 Apple Inc Earnings Release	📅
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24-Feb-2017 » 28-Feb-2017

PRICE PERFORMANCE >

Open

Prev. Close

Bid / Ask

VWAP

Turnover

Volume

Short Interest

YTD

Beta (5Y Monthly)

Mkt Cap

PE (LTM)

Div Yield

DR

DR Type

DR Bank

AAPL.O 115.190000

Price USD

117.260000

115.00

110.00

105.00

100.00

95.00

90.00

85.00

Dec-31

Mar-31

Jun-30

Sep-

14-Dec-2016

Today

5D

3M

6M

1Y

5Y

No Benchmark ▼

52Wk: 89.47

12-May

118.69

11-Oct

📅 Next Earn Report: 24-Jan-2017

Free Float

5.32B

Asset Type

Ordinary Share

📄 5 yr CDS

26.980 bps

Outstanding

5.33B

Share Class

--

Δ Today

-0.07%

IPO Date

12-Dec-1980

Lot Size

Δ 1 Week

-0.074

First Trade Da...

12-Dec-1980

Voting Rights

1

FUNDAMENTALS >

	AAPL (Sep-2016)	Growth	Industry
Gross Margin	38.02%	(4.71%) 4Q	38.91%
Operating Margin	25.10%	(11.59%) 4Q	5.75%

Tick Data

```
In [23]: tick = ek.get_timeseries(['AAPL.O'],  
                                fields='*',  
                                start_date='2017-07-11 16:00:0000',  
                                end_date='2017-07-11 16:15:0000',  
                                interval='tick')
```

```
In [24]: tick.info()
```

```
<class 'pandas.core.frame.DataFrame'>  
DatetimeIndex: 1898 entries, 2017-07-11 16:00:00.686000 to 2017-07-11 16:14:59.708000  
Data columns (total 2 columns):  
VALUE      1892 non-null float64  
VOLUME     1898 non-null float64  
dtypes: float64(2)  
memory usage: 44.5 KB
```

```
In [25]: tick.tail()
```

```
Out[25]:
```

	AAPL.O	VALUE	VOLUME
	Date		
	2017-07-11 16:14:59.693	144.9900	100.0
	2017-07-11 16:14:59.693	144.9900	100.0
	2017-07-11 16:14:59.693	144.9900	100.0
	2017-07-11 16:14:59.707	144.9899	400.0
	2017-07-11 16:14:59.708	144.9899	1305.0

News

```
In [29]: news = ek.get_news_headlines('R:.SPX AND "Trump" AND Language:LEN', count=5)
news
```

```
Out[29]:
```

	versionCreated	text	storyId	sourceCode
2017-08-18 16:46:19	2017-08-18 16:46:19	U.S. STOCKS EXTEND GAINS AFTER NEW YORK TIMES ...	urn:newsml:reuters.com:20170818:nL4N1L44L9:1	NS:RTRS
2017-08-18 15:53:08	2017-08-18 15:53:08	CORRECTED-U.S. STOCKS PARE LOSSES, TRADERS CIT...	urn:newsml:reuters.com:20170818:nL4N1L44IK:1	NS:RTRS
2017-08-18 15:16:27	2017-08-18 15:16:27	US STOCKS-Wall St lower on growing concerns ov...	urn:newsml:reuters.com:20170818:nL4N1L44F2:5	NS:RTRS
2017-08-18 11:24:30	2017-08-18 11:24:30	US STOCKS-Futures flat amid growing concerns o...	urn:newsml:reuters.com:20170818:nL4N1L43RR:5	NS:RTRS
2017-08-17 17:09:05	2017-08-17 17:09:05	US STOCKS-Wall St extends losses on Trump poli...	urn:newsml:reuters.com:20170817:nL4N1L34N1:5	NS:RTRS

```
In [30]: storyId = news.iloc[4, 2]
storyId
```

```
Out[30]: 'urn:newsml:reuters.com:20170817:nL4N1L34N1:5'
```

```
In [31]: from IPython.display import display, HTML
```

```
In [32]: display(HTML(ek.get_news_story(storyId)))
```

- Gary Cohn resignation rumors knocked down
- Wal-Mart drops after reporting margin fall
- Indexes down: Dow 0.81 pct, S&P 1.03 pct, Nasdaq 1.39 pct

Updates to early afternoon

By Sruthi Shankar and Tanya Agrawal

Aug 17 (Reuters) - U.S stocks hit session lows in early afternoon trading on Thursday as investors worried about President Donald Trump's ability to

AI-First Finance

MARCOS LOPEZ DE PRADO

ADVANCES
in
FINANCIAL
MACHINE
LEARNING



“The essential tool of econometrics is multivariate linear regression, an 18th-century technology that was already mastered by Gauss before 1794 ... It is hard to believe that something as complex as 21st-century finance could be grasped by something as simple as inverting a covariance matrix.”

“... what if economists finally started to consider non-linear functions?”

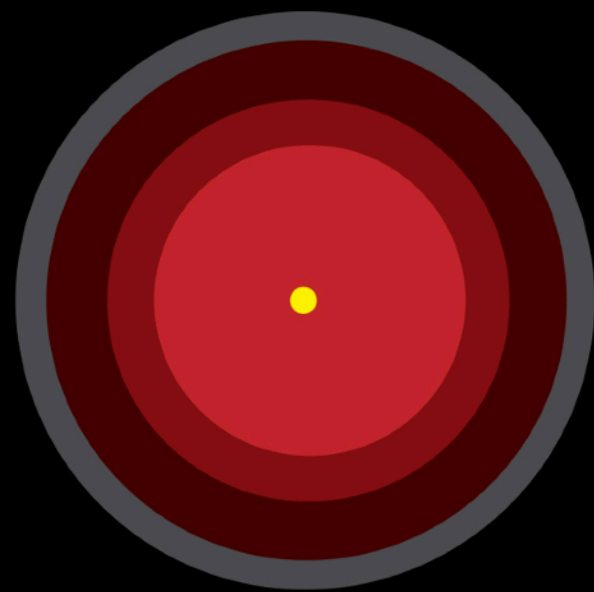
“An ML algorithm can spot patterns in a 100-dimensional world as easily as in our familiar 3-dimensional one.”

“Econometrics might be good enough to succeed in financial academia (for now), but succeeding in practice requires ML.”

Marcos López de Prado (2018)

THE TECHNOLOGICAL SINGULARITY

MURRAY SHANAHAN



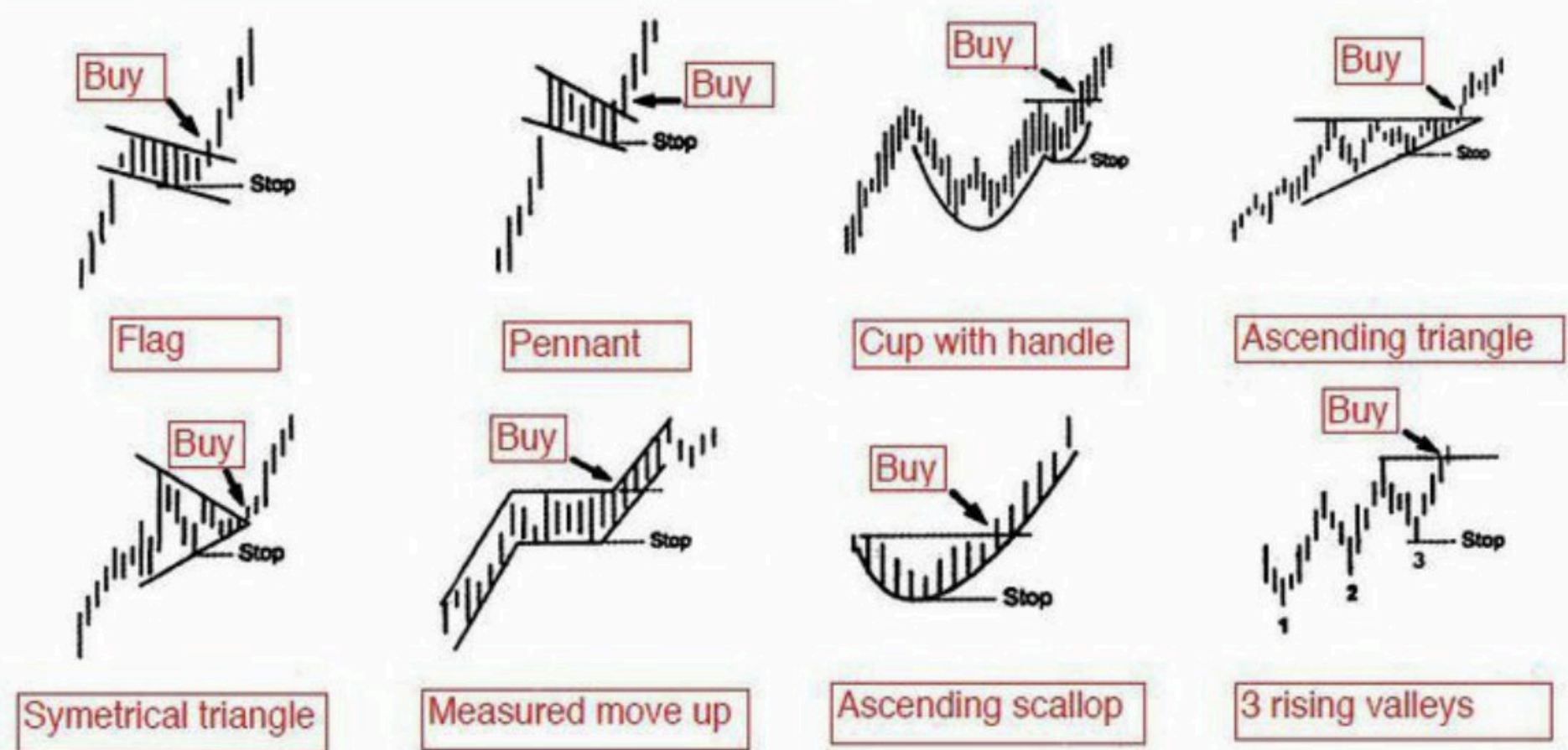
THE MIT PRESS ESSENTIAL KNOWLEDGE SERIES

THE MIT PRESS ESSENTIAL KNOWLEDGE SERIES

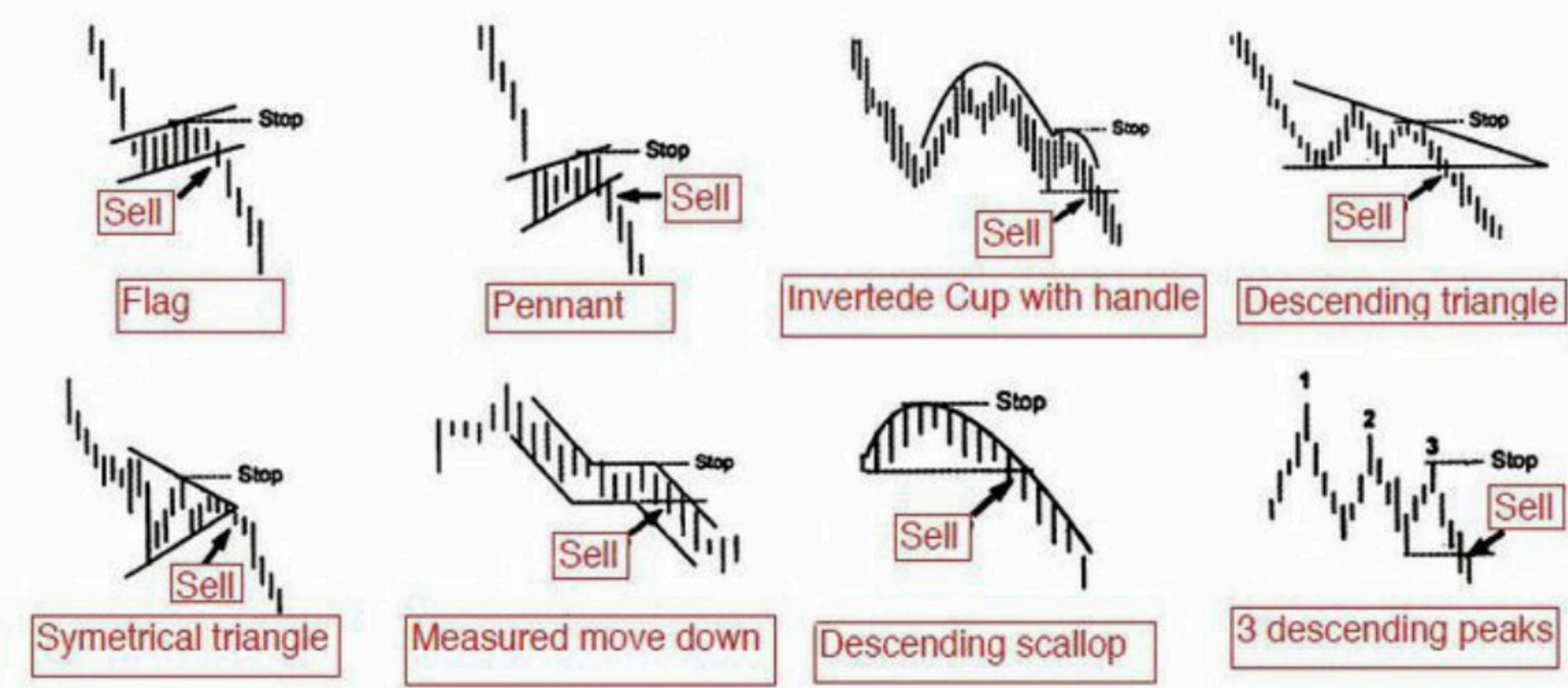
“Today’s algorithmic trading programs are relatively simple and make only limited use of AI. However, this is sure to change. Artificial intelligence is beneficial in any domain where patterns have to be found in large quantities of data and effective decisions have to be taken on the basis of those patterns, especially when the decisions have to be taken rapidly.”

Murray Shanahan (2015)

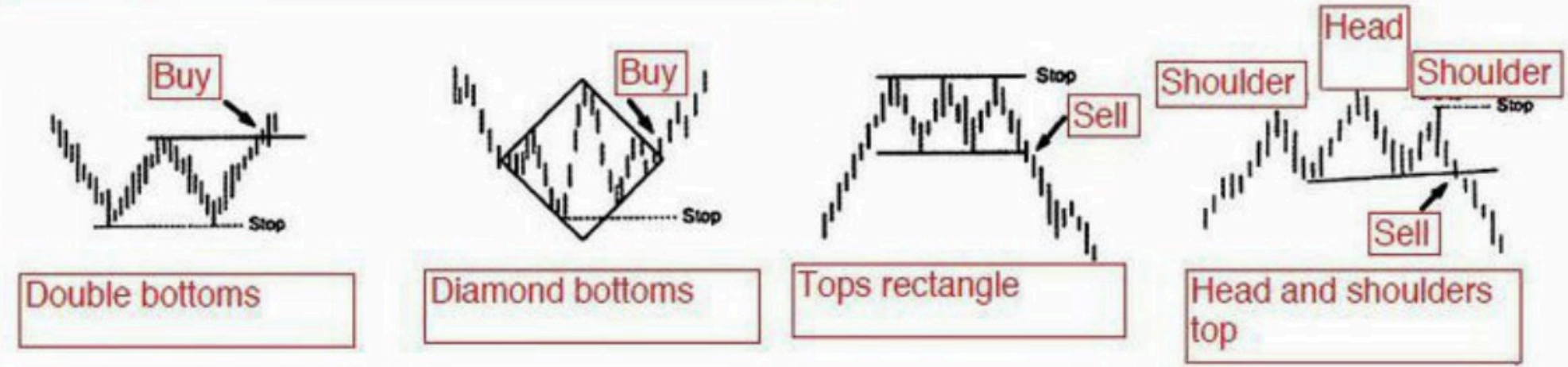
Bullish patterns (going up)



Bearish patterns (going down)



Reversal patterns

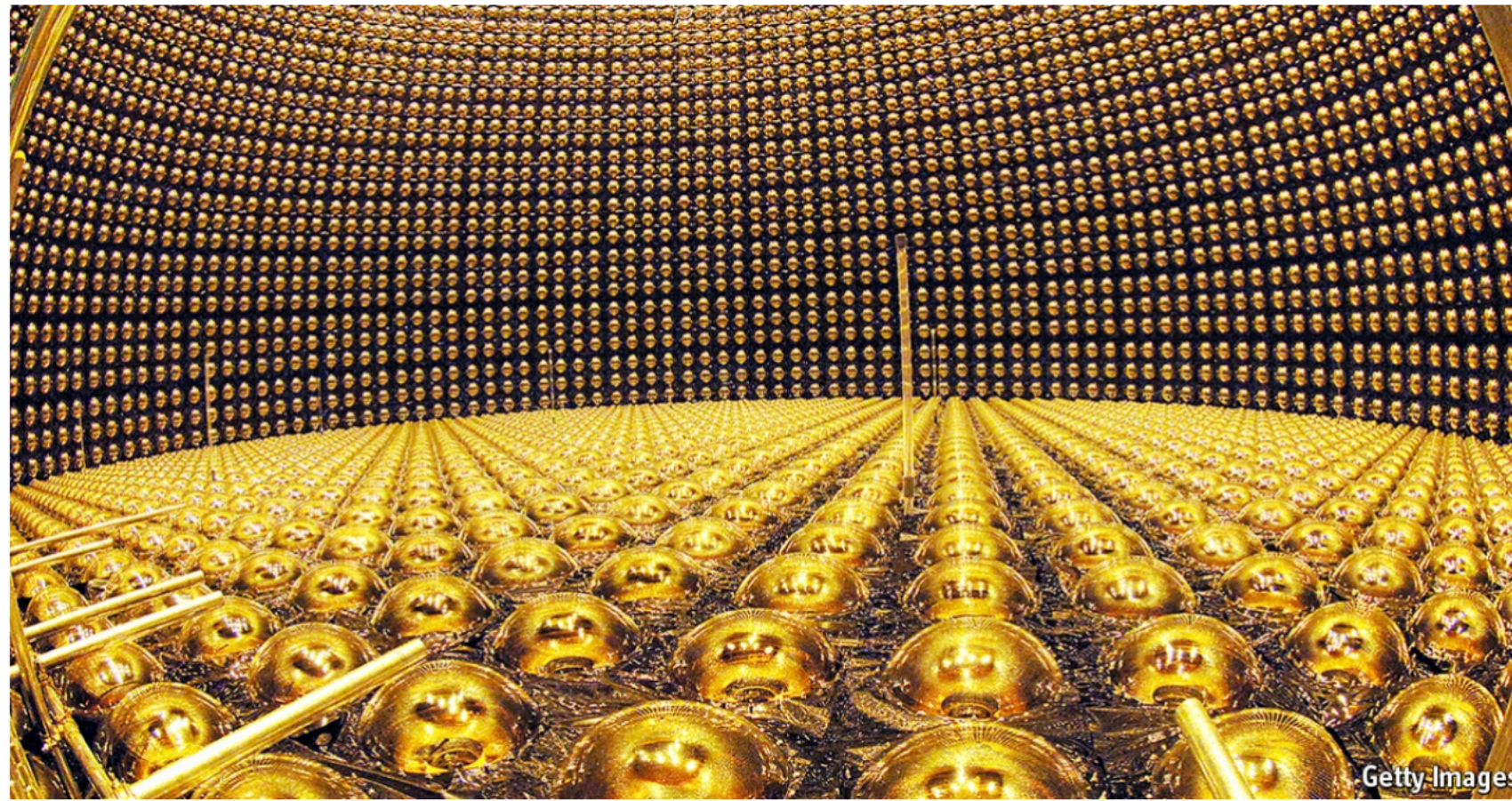


Particle physics

Fundamental physics is frustrating physicists

The Economist

No GUTs, no glory



Print edition | Science and technology >

Jan 13th 2018



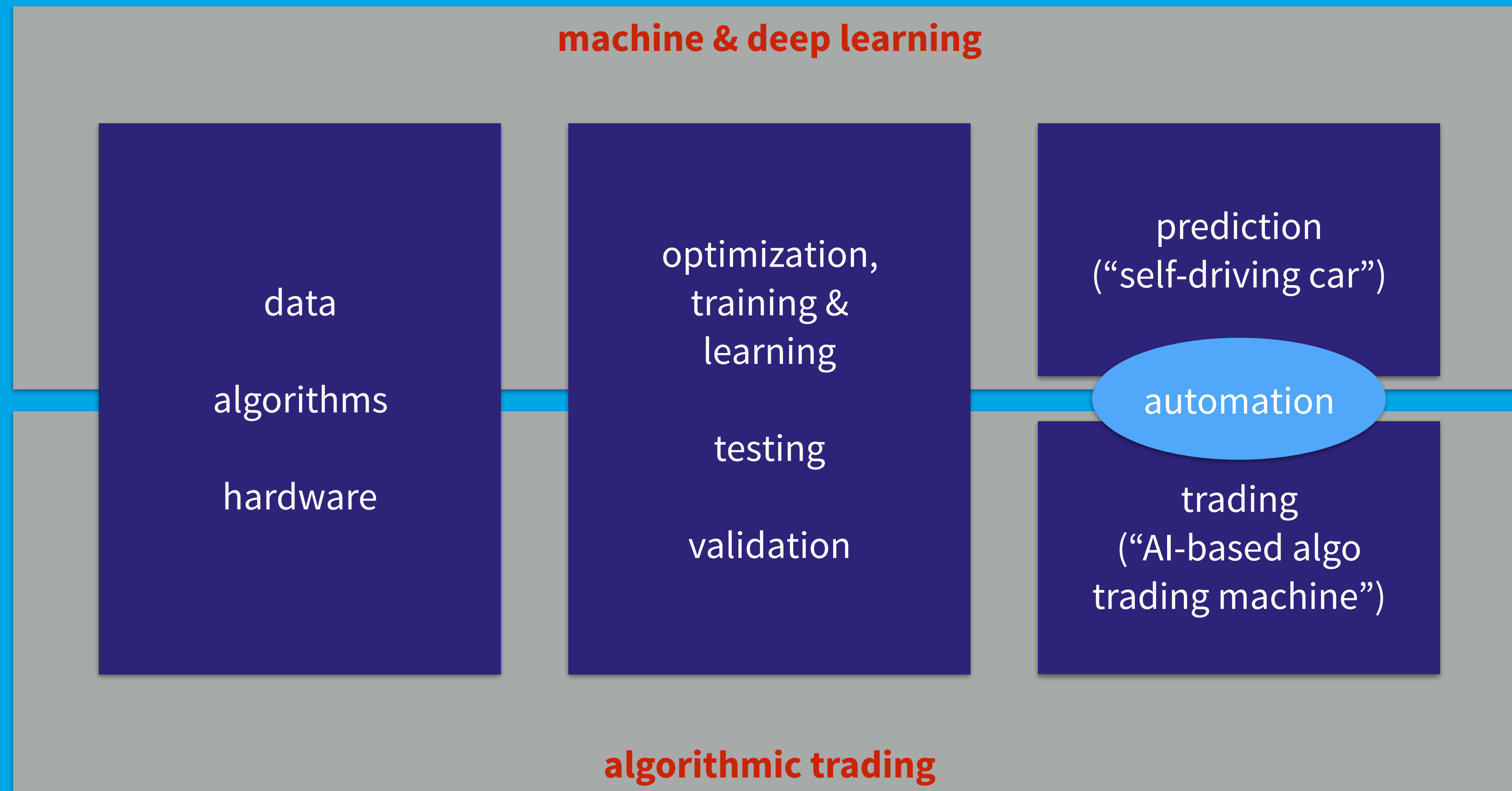
DEEP in a disused zinc mine in Japan, 50,000 tonnes of purified water held in a vast cylindrical stainless-steel tank are quietly killing theories long cherished by physicists. Since 1996, the photomultiplier-tube detectors (pictured above) at Super-Kamiokande, an experiment under way a

The beauty myth

One such is Sabine Hossenfelder of the Frankfurt Institute for Advanced Studies, in Germany. She argues that the appeal of GUTs, supersymmetry and the like rests on their ability to explain “numerological coincidences” that do not need to be explained. Perhaps, to take one example, the universe simply started out with more matter than antimatter in it, rather than this being a consequence of its subsequent evolution. As she points out, no theory precludes this possibility—it is just that it is not very elegant. Similarly, she says, “It’s not like anybody actually needs supersymmetry to explain anything. It’s an idea widely praised for its aesthetic appeal. Well, that’s nice, but it’s not science.”

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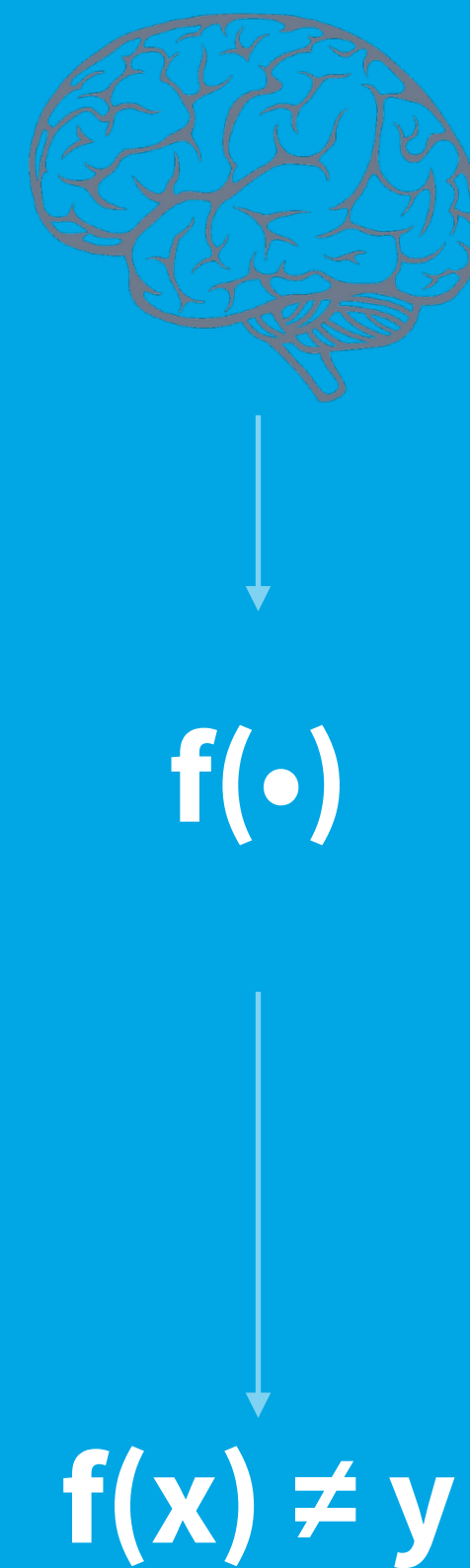


Financial Markets



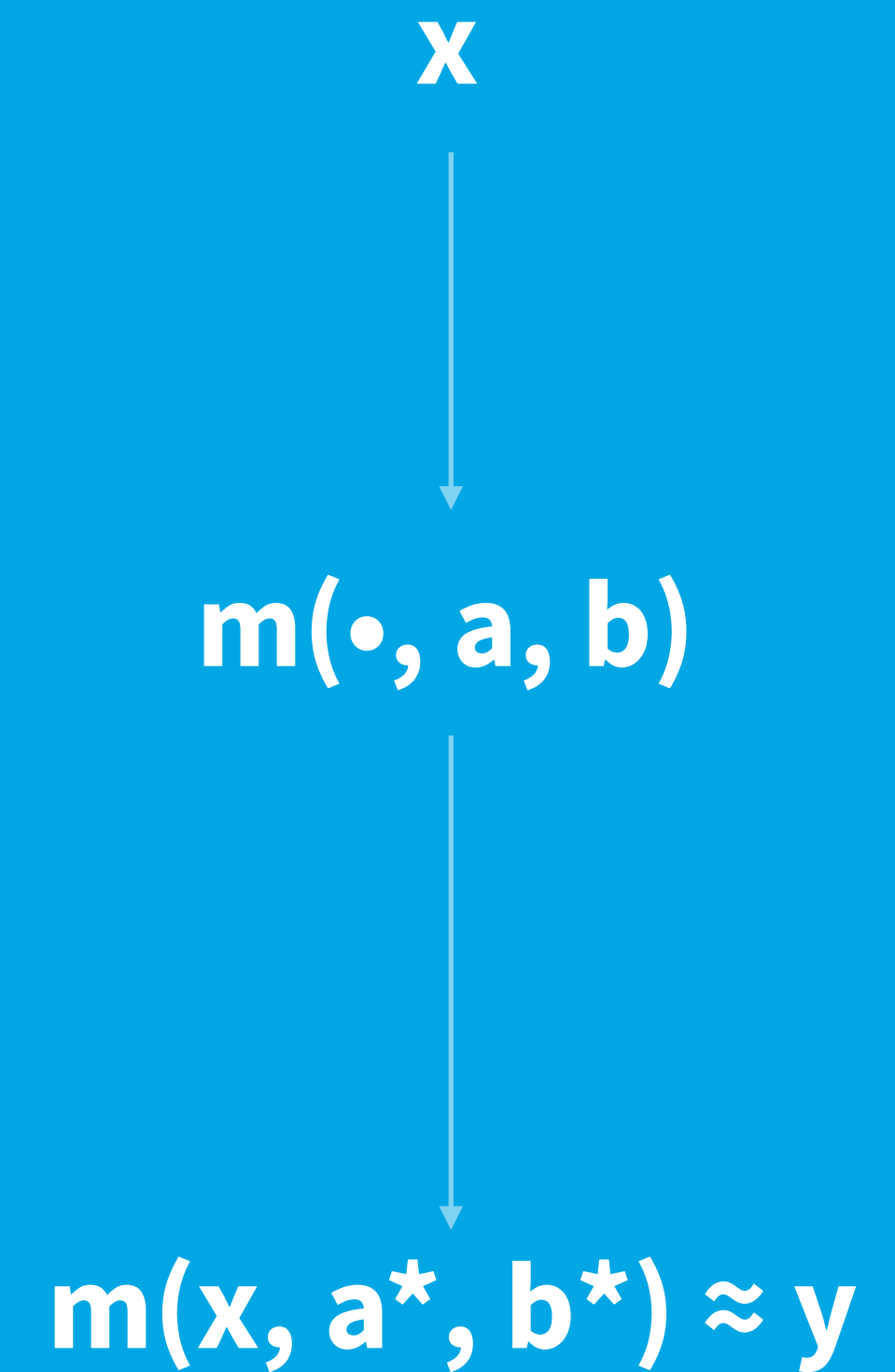
“non-linear, complex,
changing”

Finance History



“brain-driven &
beauty myth”

AI in Finance = finaince



“data-driven &
AI-first”

Example Strategy

STRATEGY IDEA

- **instruments:** single instrument (FX), leveraged
- **positions:** long and short
- **financial data:** mid-frequency (5 or 10 mins)
- **algorithm:** classification (Bayes, LR, LR and similar)
- **goal:** alpha = outperformance + positive return + low correlation
- **robustness:** acceptable performance independent of parameters
- **programming:** Python, NumPy, pandas, scikit-learn



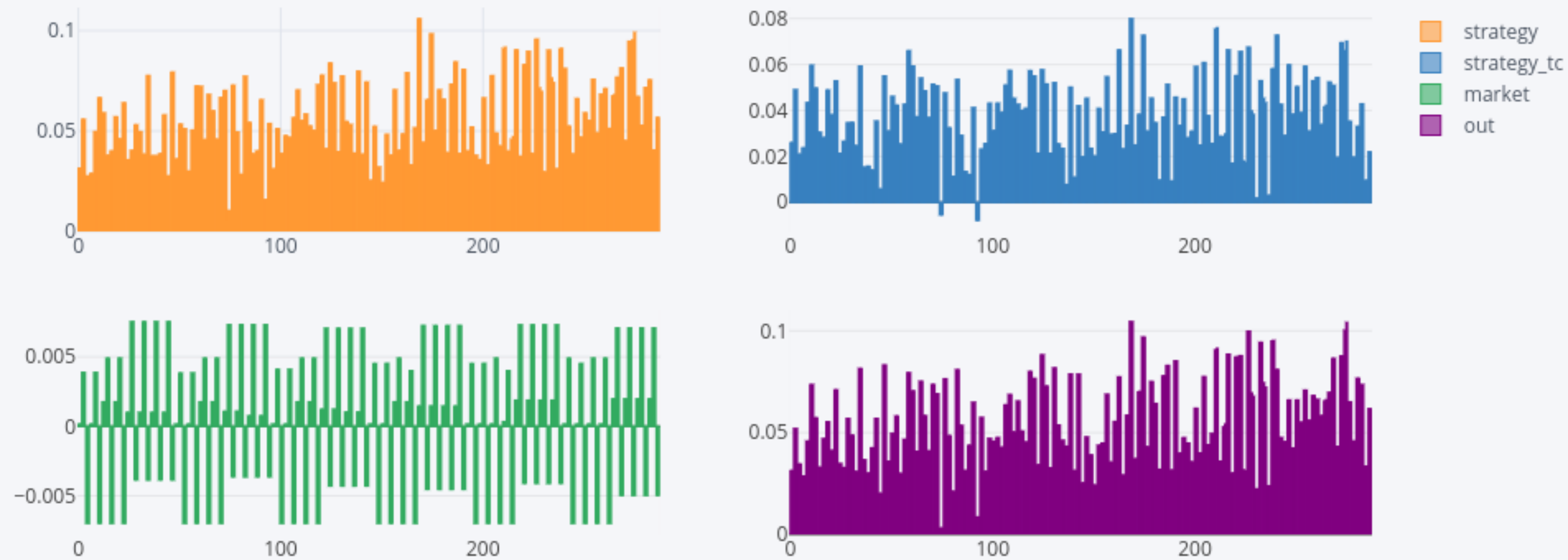
PARAMETERS

- EUR_USD, 5min bars
- sequential training/backtest
- 40% to 60% train-test split



PARAMETERS

- EUR_USD, 5min bars
- randomized training/backtest
- 40% to 60% train-test split



PARAMETERS

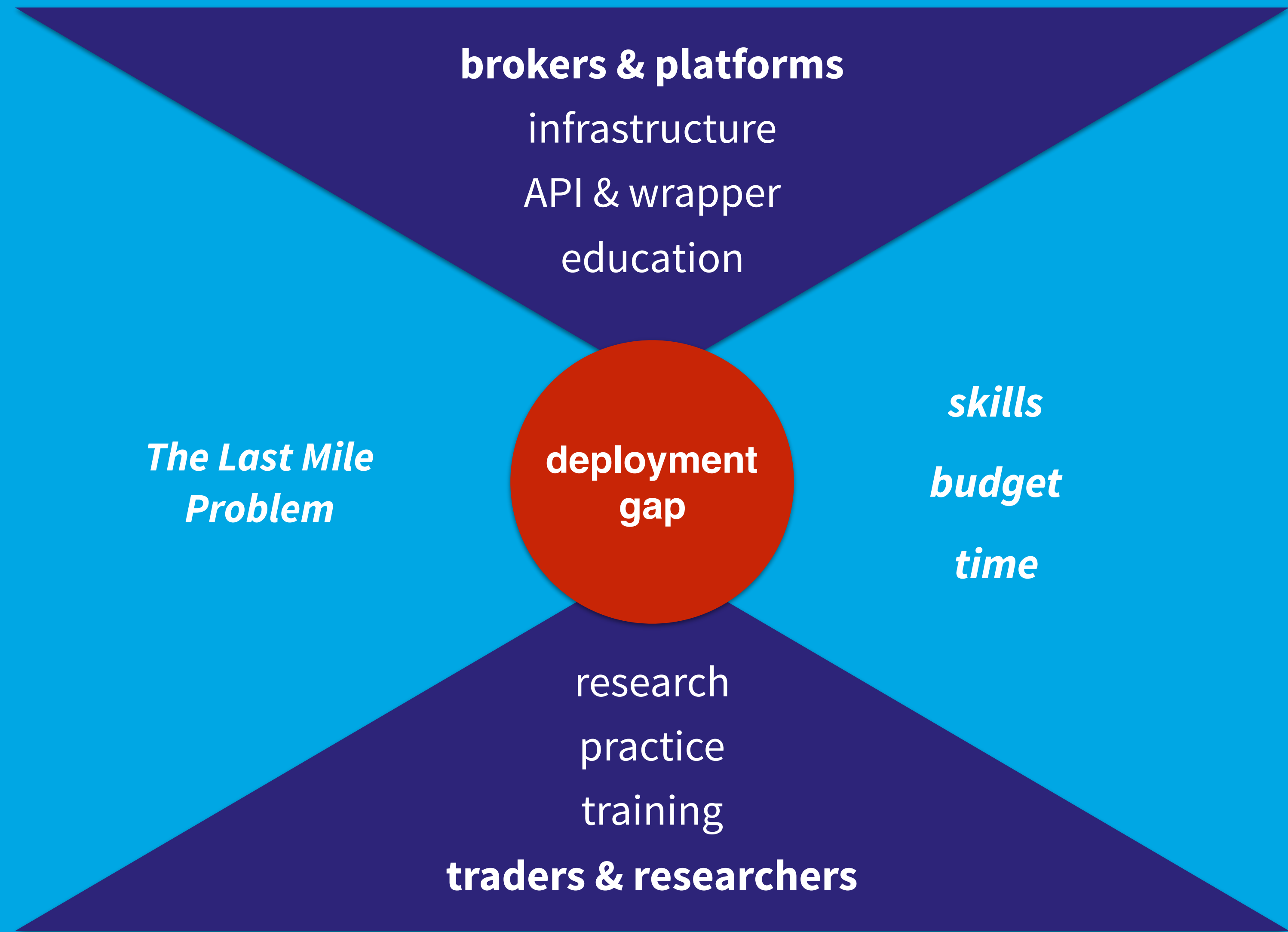
- EUR_USD, 10min bars
- randomized training/backtest
- 40% to 60% train-test split
- 288 algorithm configurations



PARAMETERS

- EUR_USD, 10min bars
- randomized training/backtest
- 40% to 60% train-test split
- 288 algorithm configurations

The AI Machine



The AI Machine

Tick Data Streamer
(retrieval, processing, storage, etc.)

Signal Generator
(prediction, positions, signals, etc.)

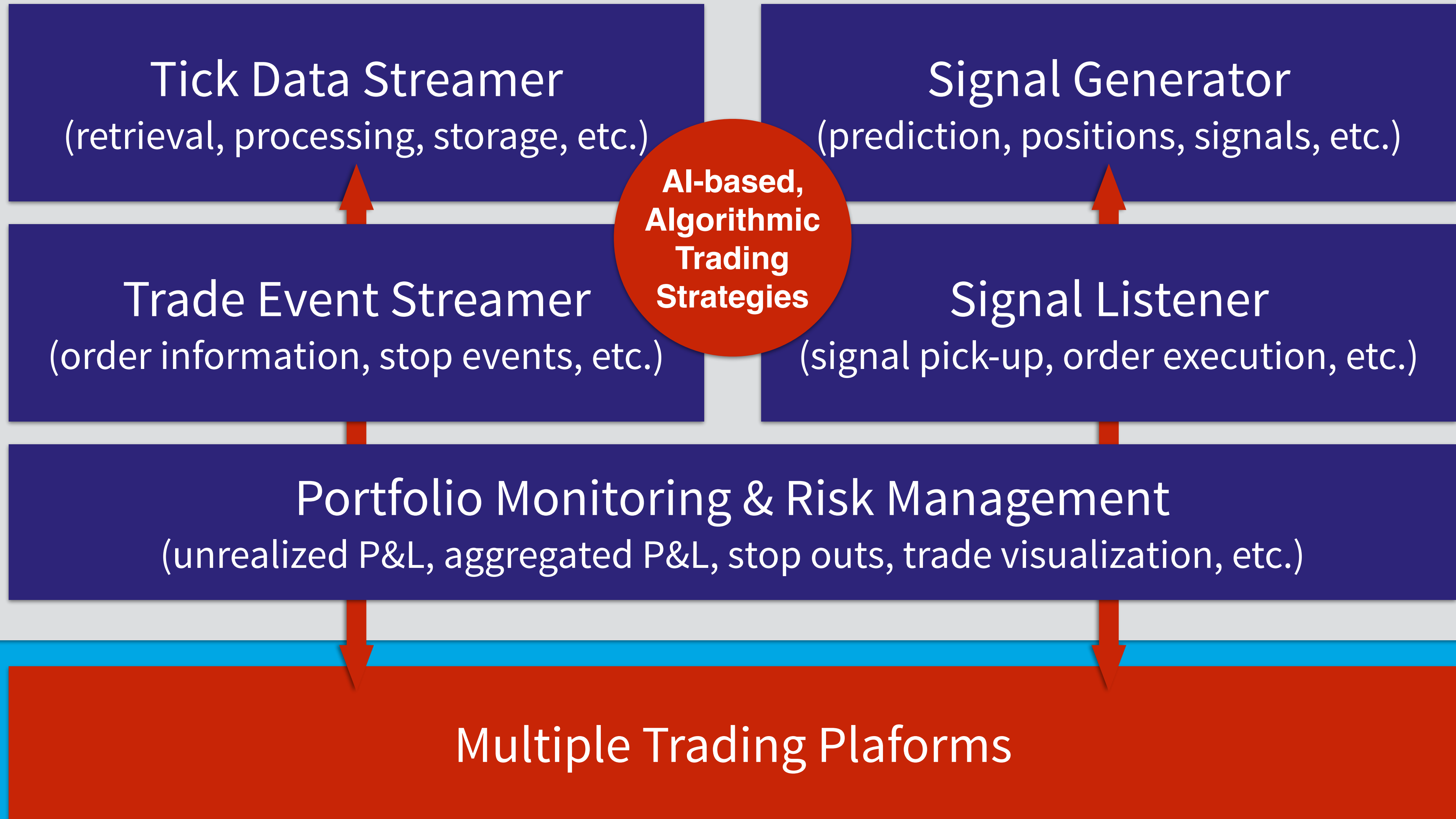
AI-based,
Algorithmic
Trading
Strategies

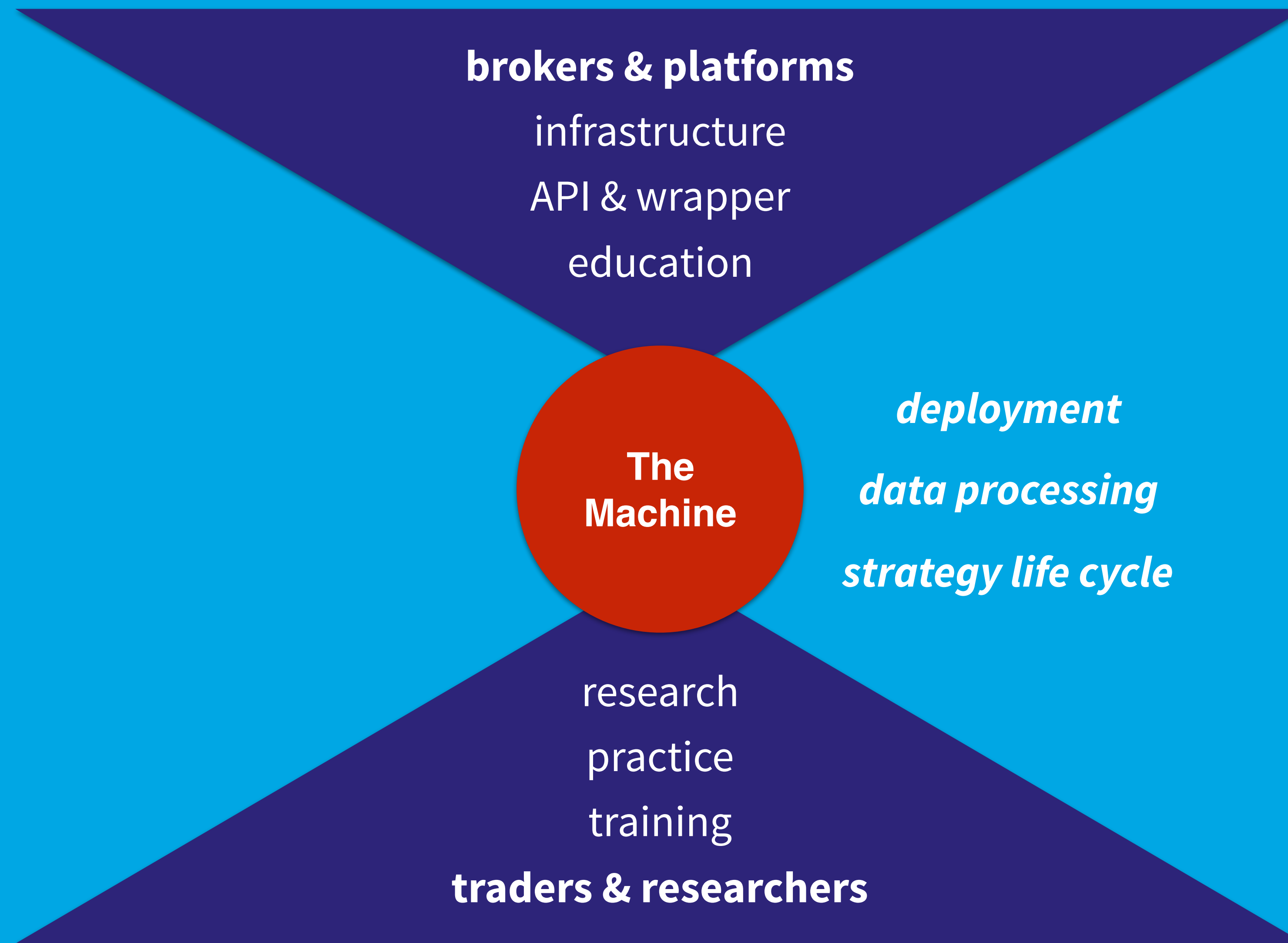
Trade Event Streamer
(order information, stop events, etc.)

Signal Listener
(signal pick-up, order execution, etc.)

Portfolio Monitoring & Risk Management
(unrealized P&L, aggregated P&L, stop outs, trade visualization, etc.)

Multiple Trading Platforms



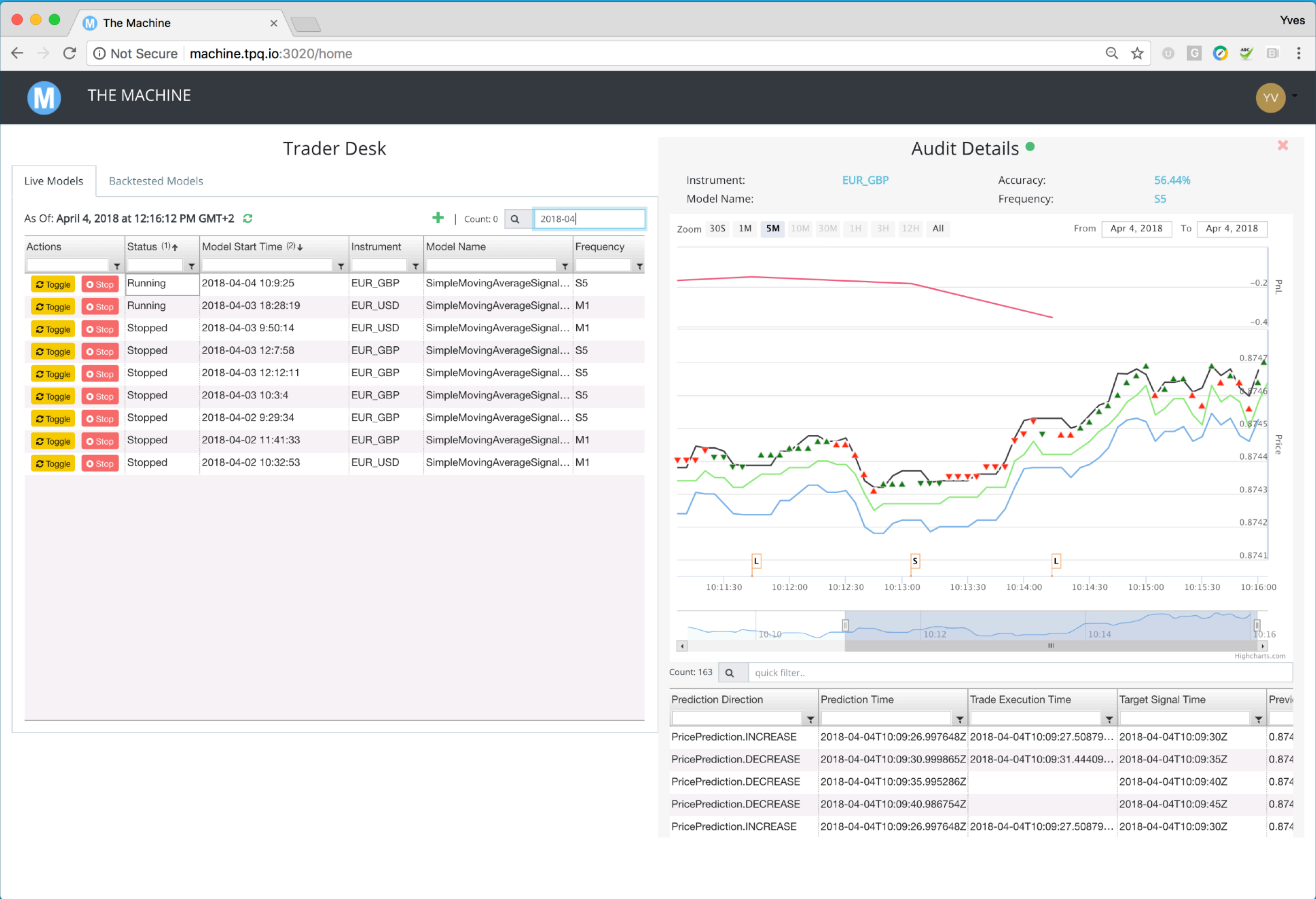




**AI-based,
Algorithmic
Trading
Strategies**

**The AI
Machine**

The AI Machine
standardized deployment
of AI-based algorithmic
trading strategies



INDUSTRIAL CHAIN

- **data sources:** platforms (Oanda, FXCM) and TR Eikon Data API
- **feature analysis:** any time series based features that are helpful
- **strategies:** long only, long and short
- **backtesting:** sequential, randomized, robust configuration
- **deployment:** The AI Machine, full automation, audit, report
- **portfolio oversight:** multiple configurations for multiple FX pairs & CFDs

**Skynet begins to learn at a geometric rate.
It becomes self-aware at 2:14 a.m. Eastern time, August 29th.**

—The Terminator (Terminator 2)

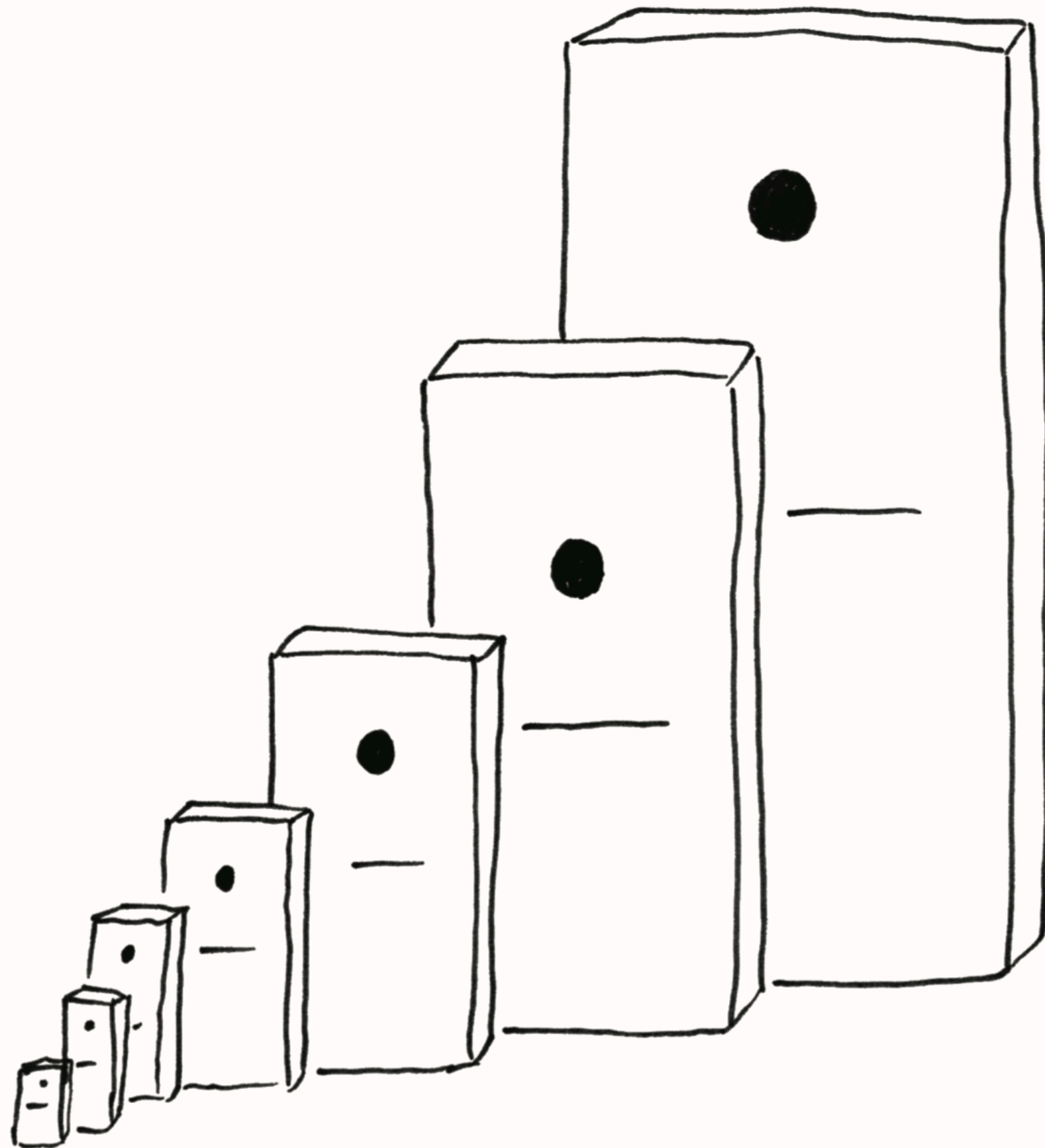
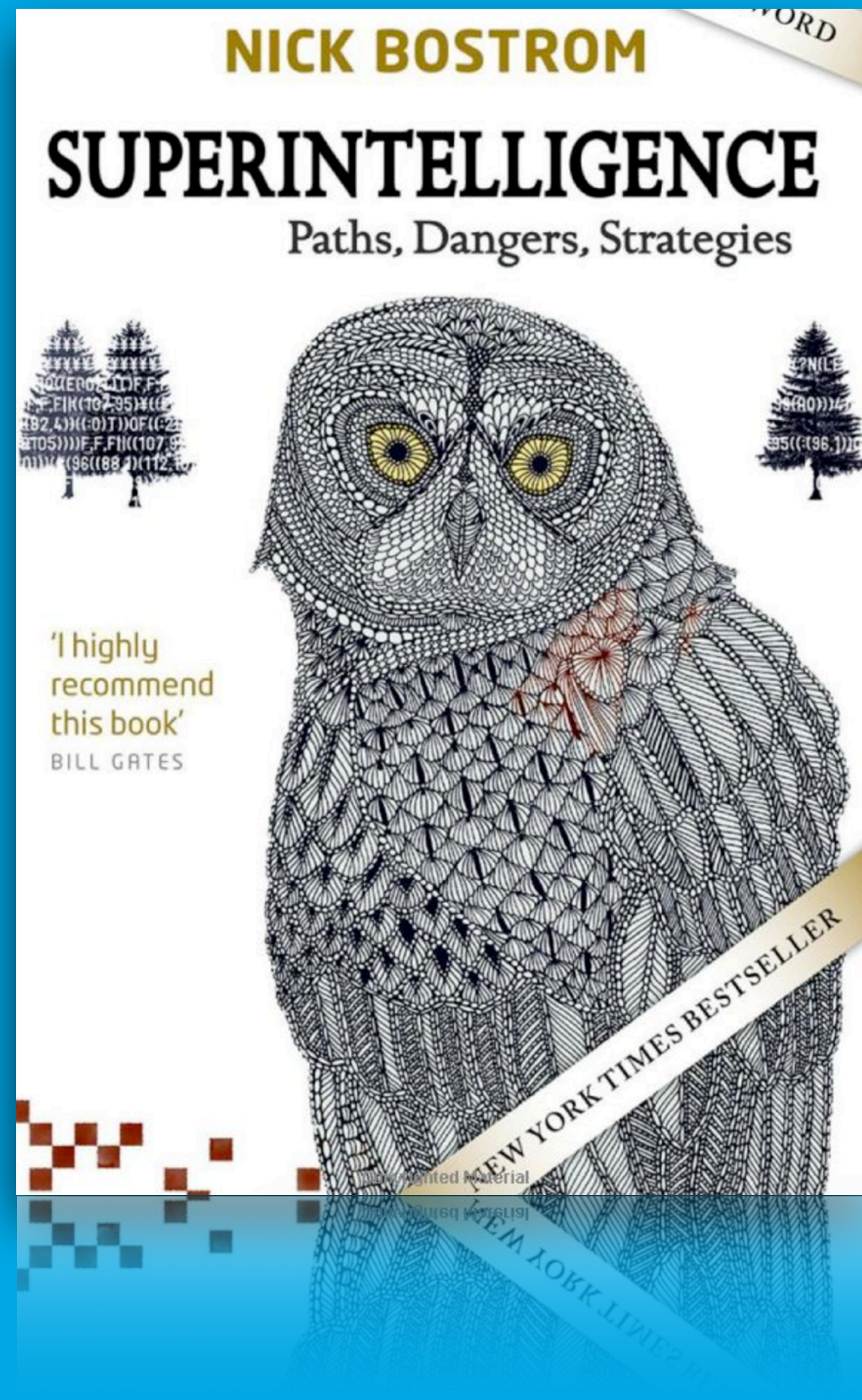


FIG 1 A geometric domino progression.

www.the1thing.com

exponential forces at work:

- technology improvements
- capital accumulation
- talent accumulation



“Go-playing programs have been improving at a rate of about 1 dan/year in recent years. If this rate of improvement continues, they might beat the human world champion in about a decade.”

Nick Bostrom (2014): Superintelligence.

The story of AlphaGo so far

AlphaGo is the first computer program to defeat a professional human Go player, the first program to defeat a Go world champion, and arguably the strongest Go player in history.

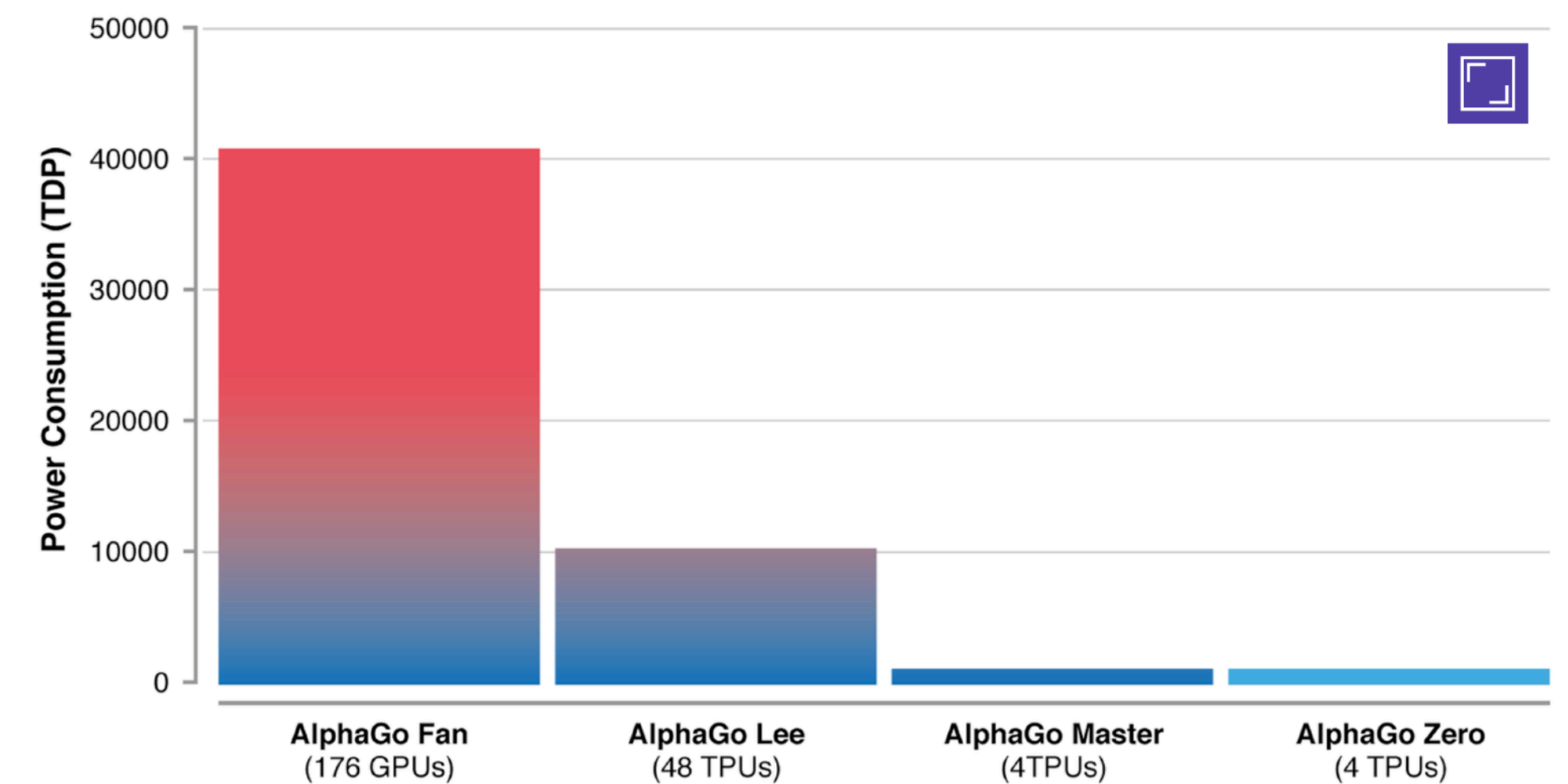
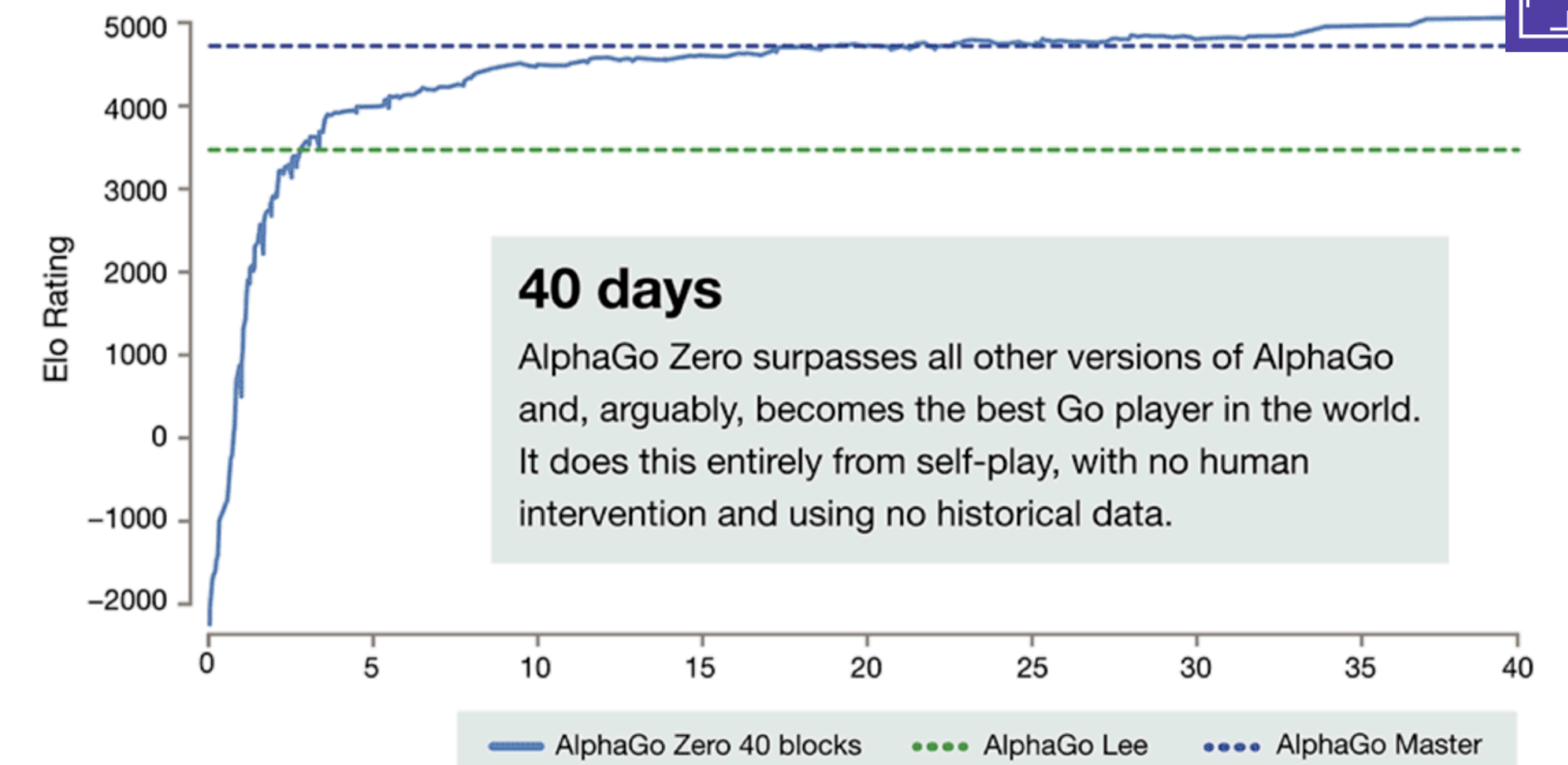
AlphaGo's first formal match was against the reigning 3-times European Champion, Mr Fan Hui, in October 2015. Its 5-0 win was the first ever against a Go professional, and the results were published in full technical detail in the international journal, [Nature](#). AlphaGo then went on to compete against legendary player Mr Lee Sedol, winner of 18 world titles and widely considered to be the greatest player of the past decade.

AlphaGo's 4-1 victory in Seoul, South Korea, in March 2016 was watched by over 200 million people worldwide. It was a landmark achievement that experts agreed was a decade ahead of its time, and earned AlphaGo a 9 dan professional ranking (the highest certification) - the first time a computer Go player had ever received the accolade.

During the games, AlphaGo played a handful of [highly inventive winning moves](#), several of which - including move 37 in game two - were so surprising they overturned hundreds of years of received wisdom, and have since been examined extensively by players of all levels. In the course of winning, AlphaGo somehow taught the world completely new knowledge about perhaps the most studied and contemplated game in history.

contemplated game in history

taught the world completely new knowledge about perhaps the most studied and extensively played games of all levels in the course of winning



AlphaGo has become progressively more efficient thanks to hardware gains and more recently algorithmic advances

The Python Quants GmbH

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