

# Financial Singularity — Paths, Dangers, Strategies

Dr. Yves J. Hilpisch

Machine Learning & AI in Quantitative Finance  
London | 17. November 2017



“Pichai said that as an ‘AI first’ company, this is a ‘unique moment in time’ for Google to combine hardware, software and artificial intelligence. ‘It's radically rethinking how computing should work’, he said.”

*Business Standard, “Google Ramps up Hardware Business”, 06. October 2017.*

This talk is about

**AI-first Finance**

and the potential for a

**Financial Singularity.**

# Introduction



## SERVICES

for financial institutions globally



## EVENTS

for Python quants & algorithmic traders



## TRAINING

about Python for finance  
& algorithmic trading



## CERTIFICATION

in cooperation with university



## BOOKS

about Python and  
finance



## PLATFORM

for browser-based  
data analytics



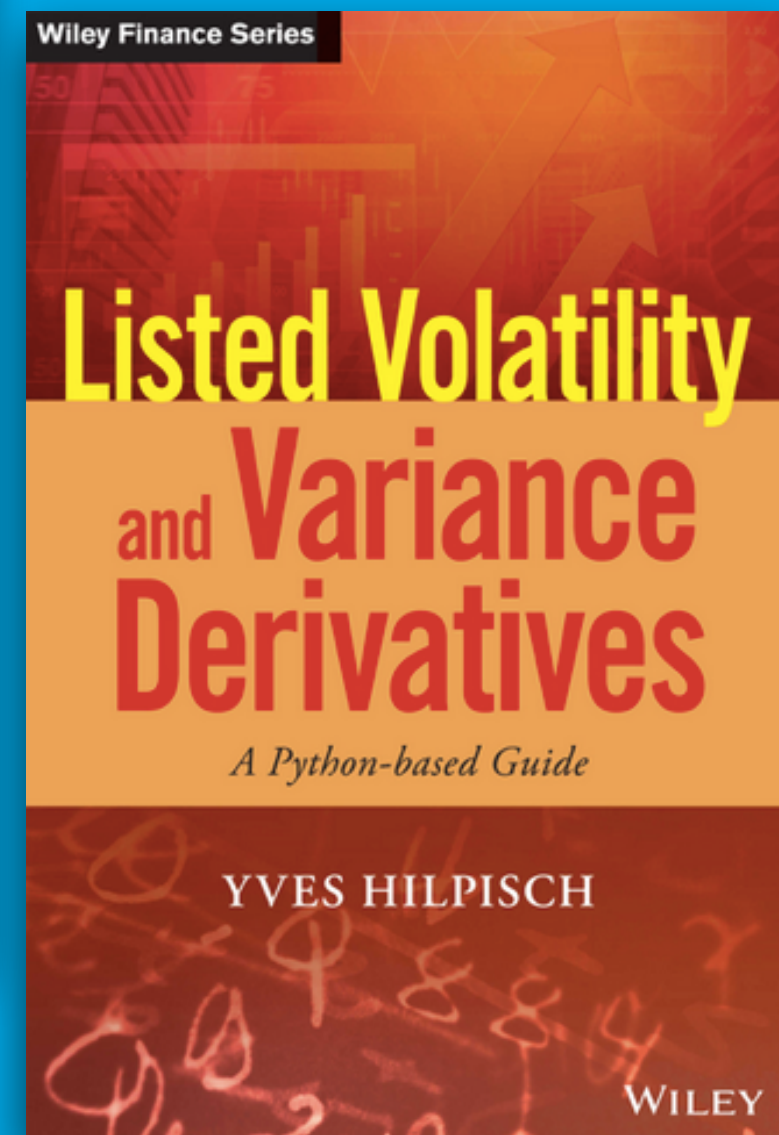
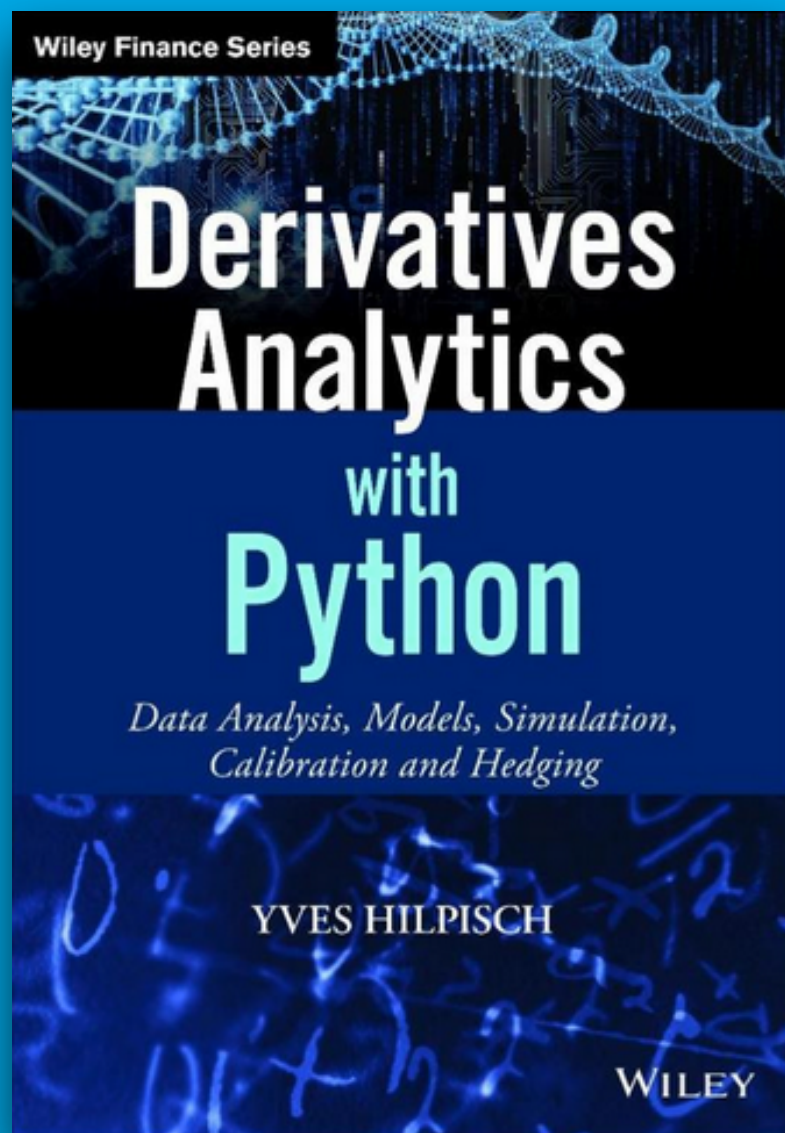
## OPEN SOURCE

Python library  
for financial analytics











125+ hours  
of pre-recorded  
video instruction

5,000+ lines of code



1,200+ pages of  
Python for Finance &  
Algorithmic Training

50+ Jupyter Notebooks

<http://certificate.tpq.io>

## **A Bit of Background**

## machine & deep learning

data  
algorithms  
hardware

optimization,  
training &  
learning

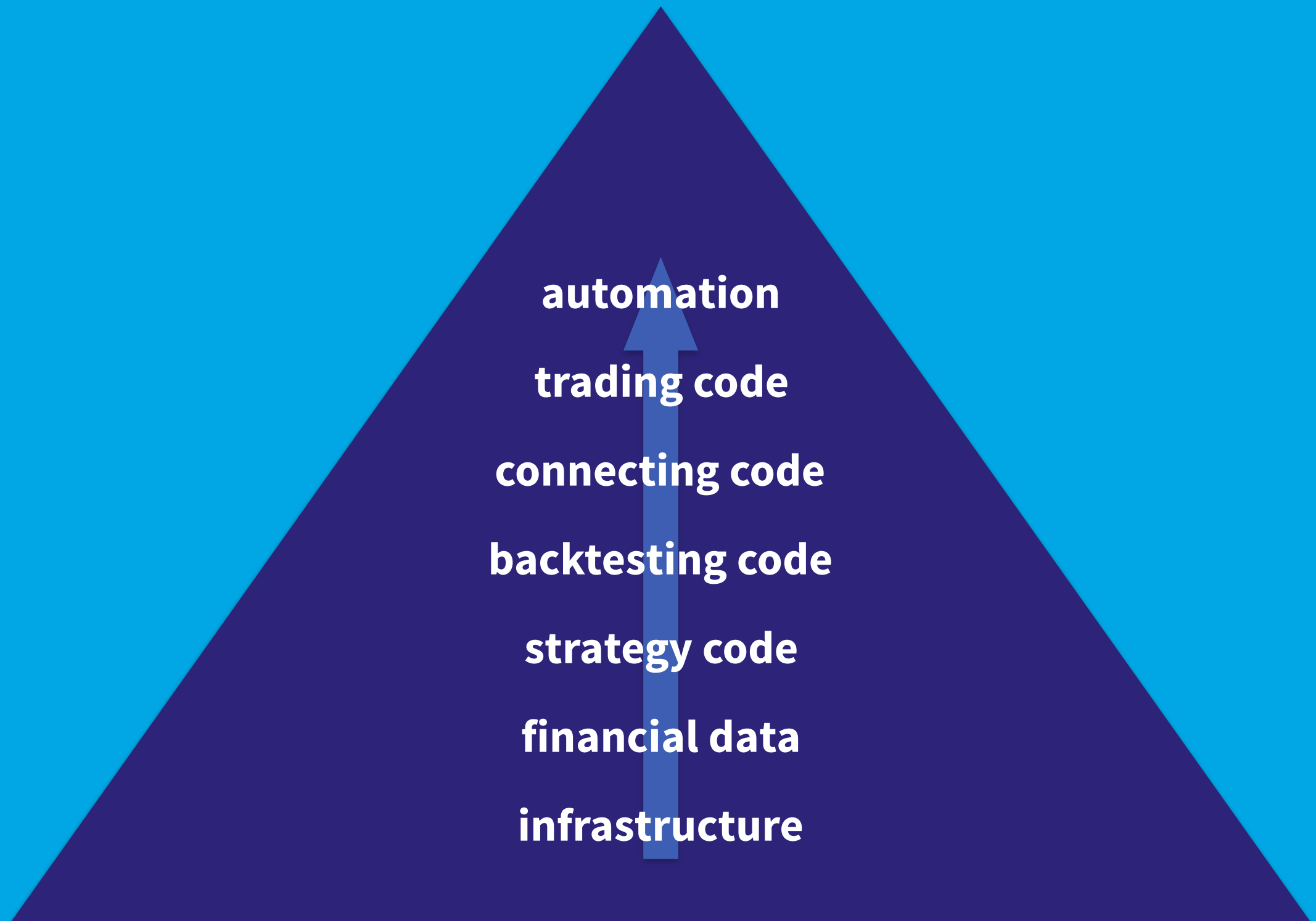
testing  
validation

prediction  
("self-driving car")

automation

trading  
("money making  
machine")

## algorithmic trading



# **The Benchmark Case of Random Walks**



### Bullish patterns (going up)



Flag



Pennant



Cup with handle



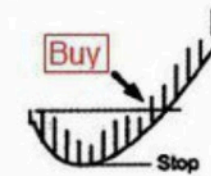
Ascending triangle



Symmetrical triangle



Measured move up



Ascending scallop



3 rising valleys

### Bearish patterns (going down)



Flag



Pennant



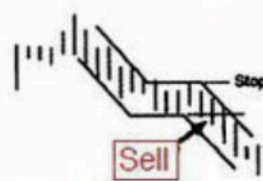
Inverted Cup with handle



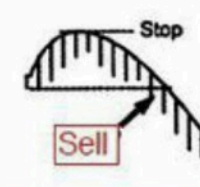
Descending triangle



Symmetrical triangle



Measured move down



Descending scallop



3 descending peaks

### Reversal patterns



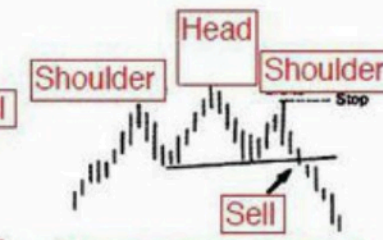
Double bottoms



Diamond bottoms



Tops rectangle



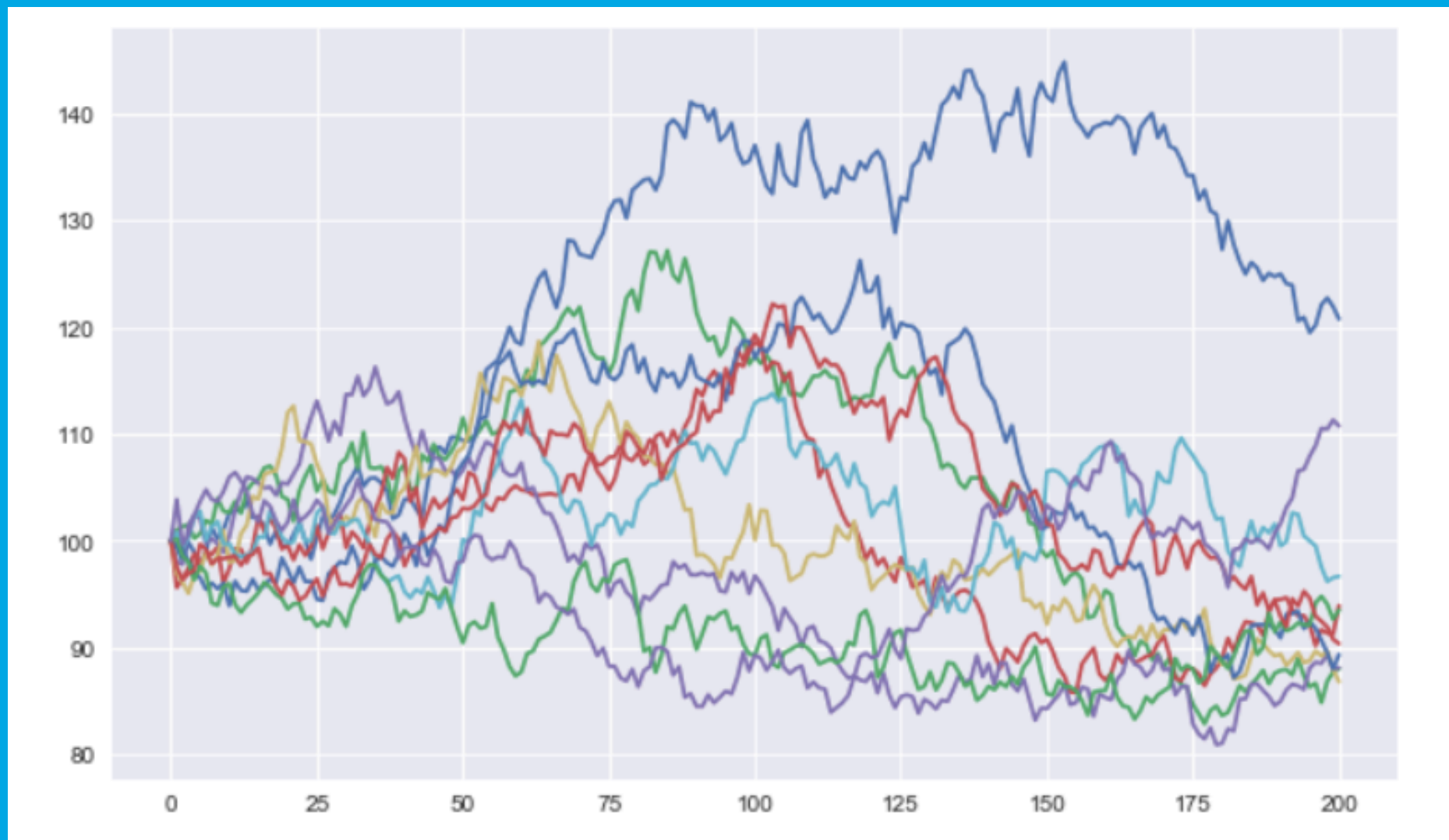
Head and shoulders top

“For many years, economists, statisticians, and teachers of finance have been interested in developing and testing models of stock price behavior. One important model that has evolved from this research is the theory of random walks. This theory casts serious doubt on many other methods for describing and predicting stock price behavior—methods that have considerable popularity outside the academic world. For example, we shall see later that, if the random-walk theory is an accurate description of reality, then the various “technical” or “chartist” procedures for predicting stock prices are completely without value.”

*Eugene F. Fama (1965): “Random Walks in Stock Market Prices”.*

If a stock price follows a (simple) **random walk** (no drift & normally distributed returns), then it rises and falls with the same probability of 50% (“toss of a coin”).

In such a case, the best predictor of tomorrow’s stock price —in a least-squares sense— is today’s stock price.



“A market is efficient with respect to an information set  $S$  if it is impossible to make economic profits by trading on the basis of information set  $S$ .”

*Michael Jensen (1978): “Some Anomalous Evidence Regarding Market Efficiency”.*

“Statistical research has shown that to a close approximation stock prices seem to follow a random walk with no discernible predictable patterns that investors can exploit. Such findings are now taken to be evidence of market efficiency, that is, evidence that market prices reflect all currently available information. Only new information will move stock prices, and this information is equally likely to be good news or bad news.”

“We have covered many of the so-called anomalies [eg small firms, January effect] cited in the literature, but our list could go on and on. Some wonder whether these anomalies are really unexplained puzzles in financial markets or whether they instead are an artefact of data mining.”

“By and large, the performance record of professionally managed funds lends little credence to claims that most professionals can consistently beat the market.”

*Bodie-Kane-Marcus (2013): Essentials of Investments. 9th ed.*

# Technological Singularity



NICK BOSTROM

# SUPERINTELLIGENCE

Paths, Dangers, Strategies



'I highly  
recommend  
this book'  
BILL GATES

Copyrighted Material  
"There are things in this book that could mess with your head."  
—VERNOR VINCE, computer scientist;  
essayist, "The Coming Technological Singularity"

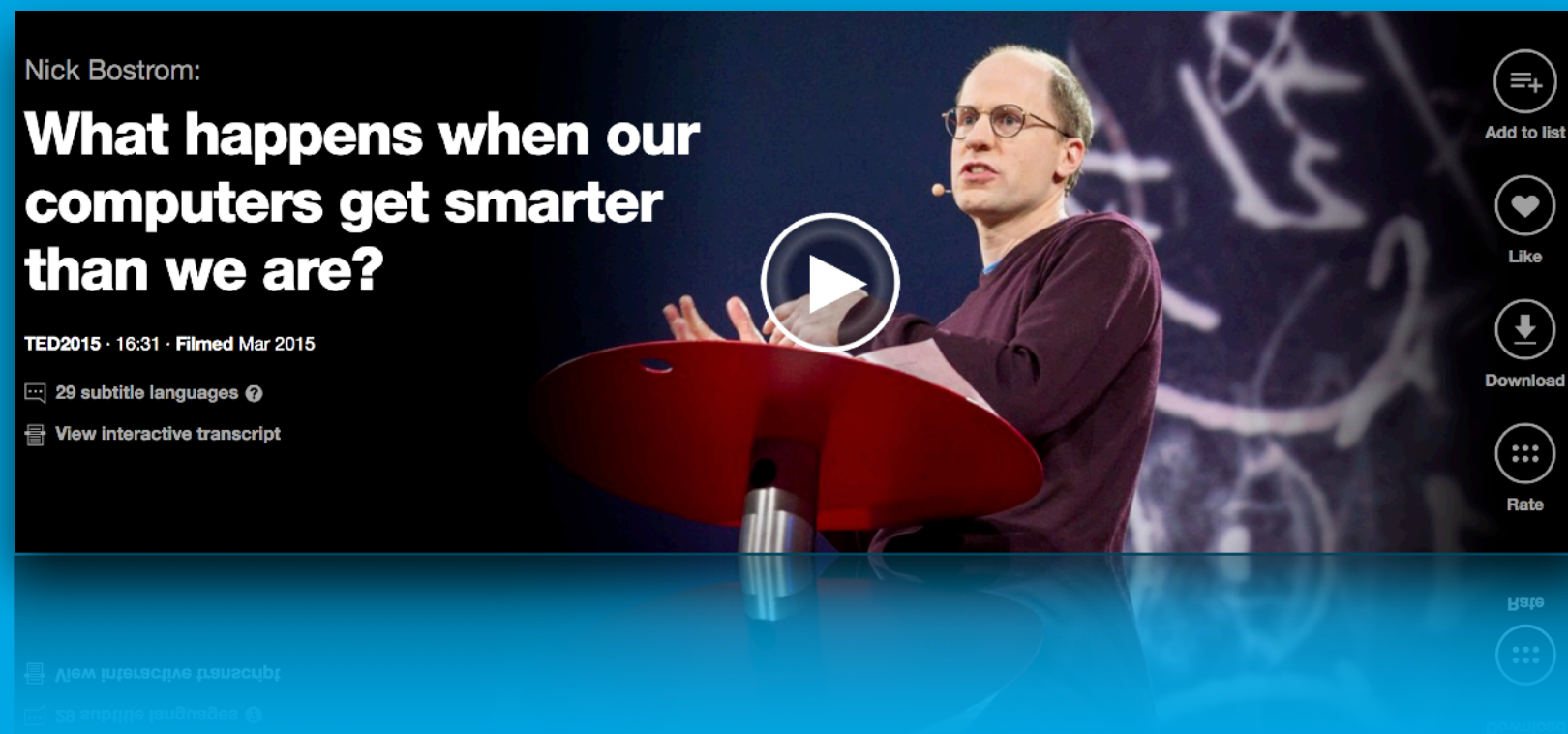
# SINGULARITY RISING



in a Smarter,  
gerous World

gerous World  
in a Smarter,

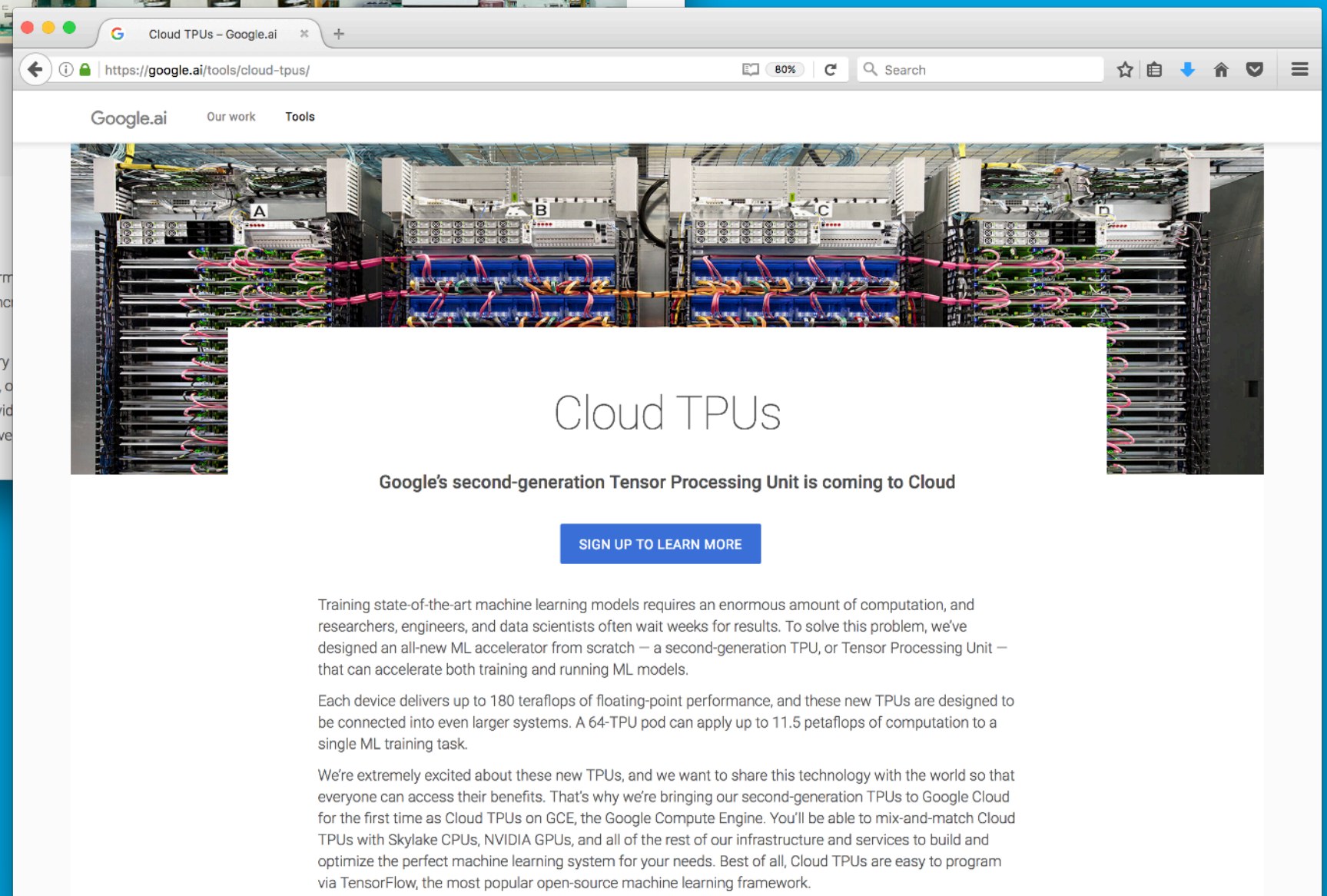
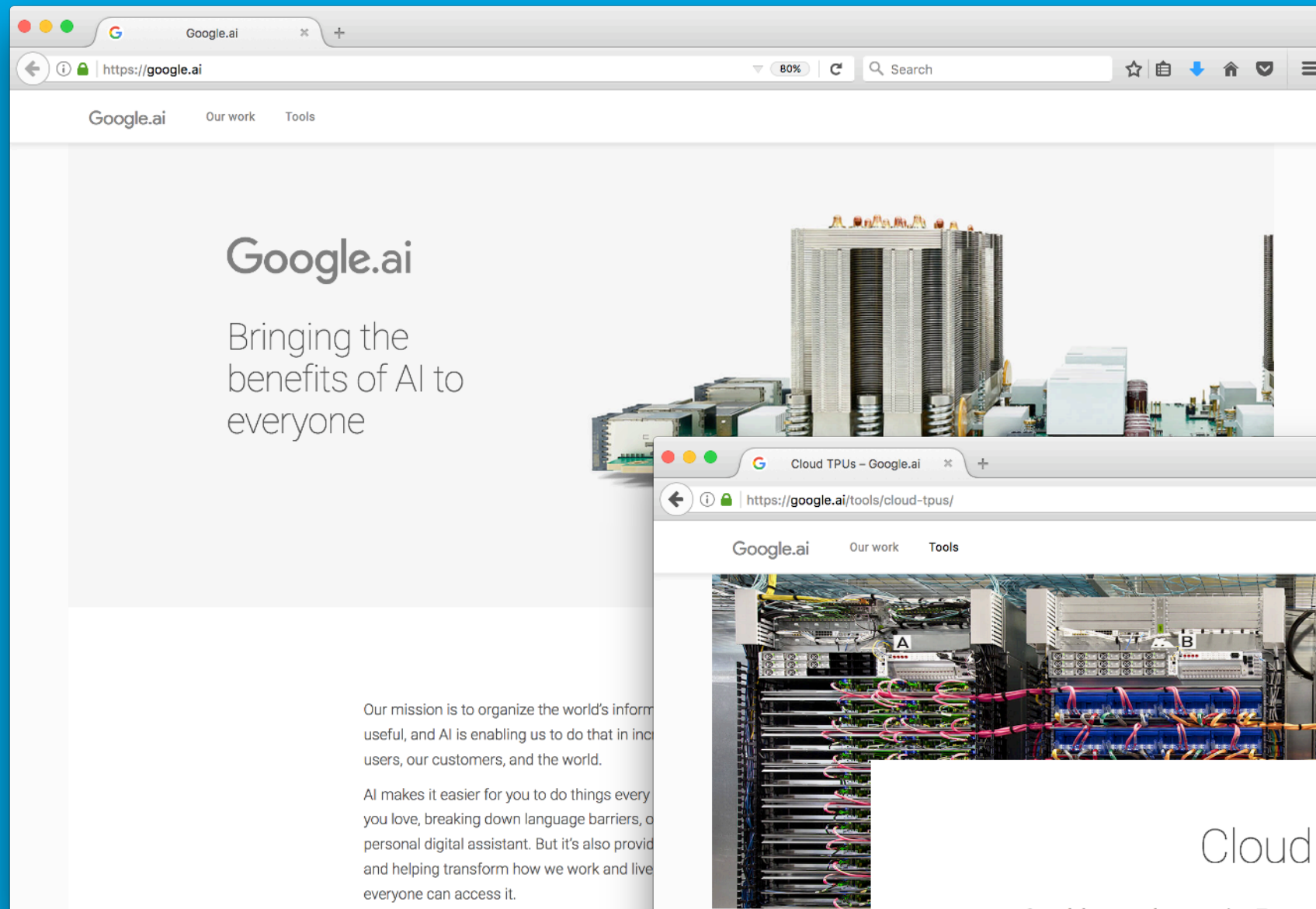




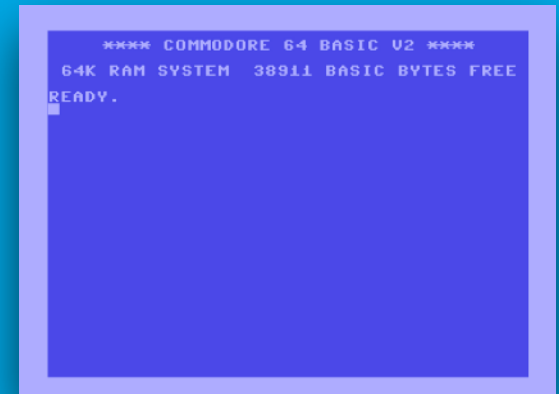
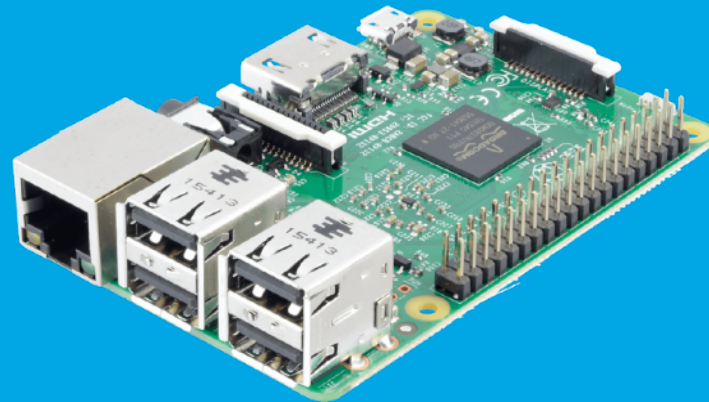
“Vast increases in biological and machine intelligences will create what’s being called the Singularity—a threshold of time at which AIs that are at least as smart as humans, and/or augmented human intelligence, radically remake civilization.”

*James Miller (2012): Singularity Rising. BenBella Books.*





# Emulation



**powerful  
hardware &  
software**

**human level  
AI**

# Humans

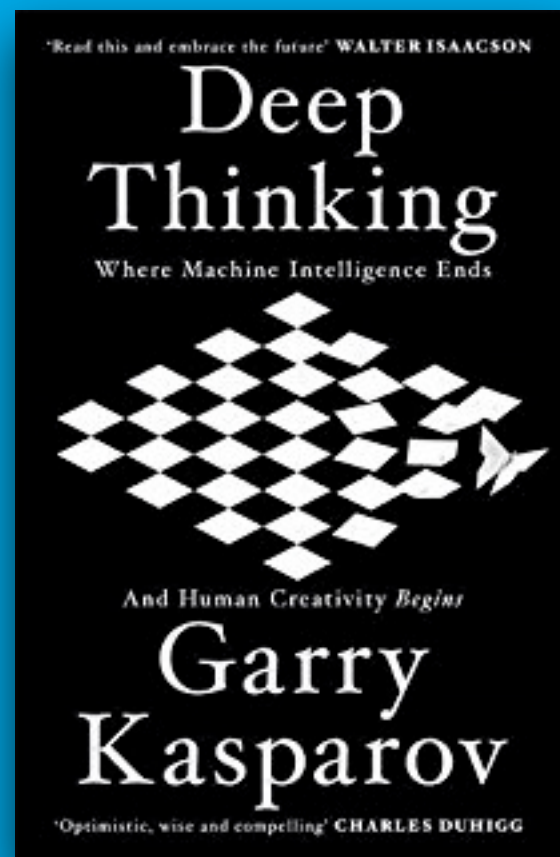


# Algorithms



# Chess Singularity

Chess singularity is a threshold of time  
from which on chess programs play better chess  
than any human being.

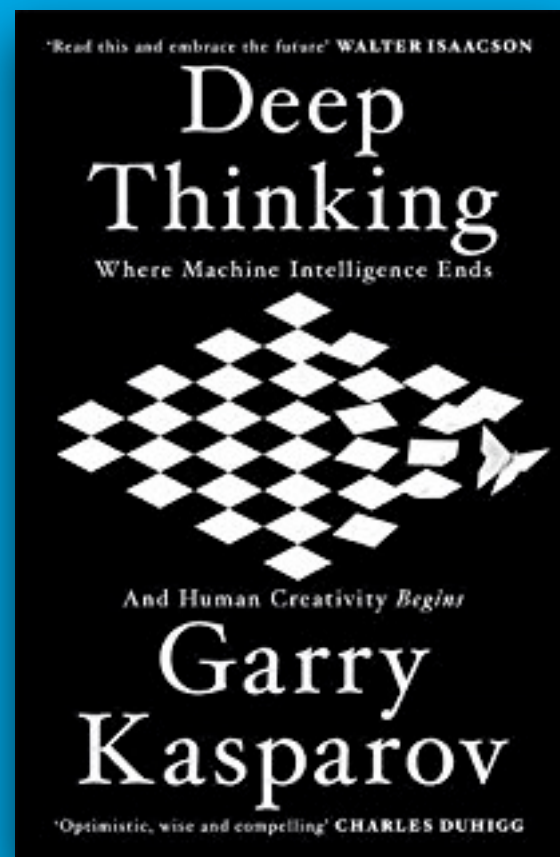


“It was a pleasant day in Hamburg in June 6, 1985, ... Each of my opponents, all thirty-two of them, was a computer. ... it didn't come as much of a surprise, ..., when I achieved a perfect 32—0 score.”

“Twelve years later I was in New York City fighting for my chess life. Against just one machine, a \$10 million IBM supercomputer nicknamed ‘Deep Blue’.”

“Jump forward another 20 years to today, to 2017, and you can download any number of free chess apps for your phone that rival any human Grandmaster.”

Did the human race resign  
and stop playing chess?

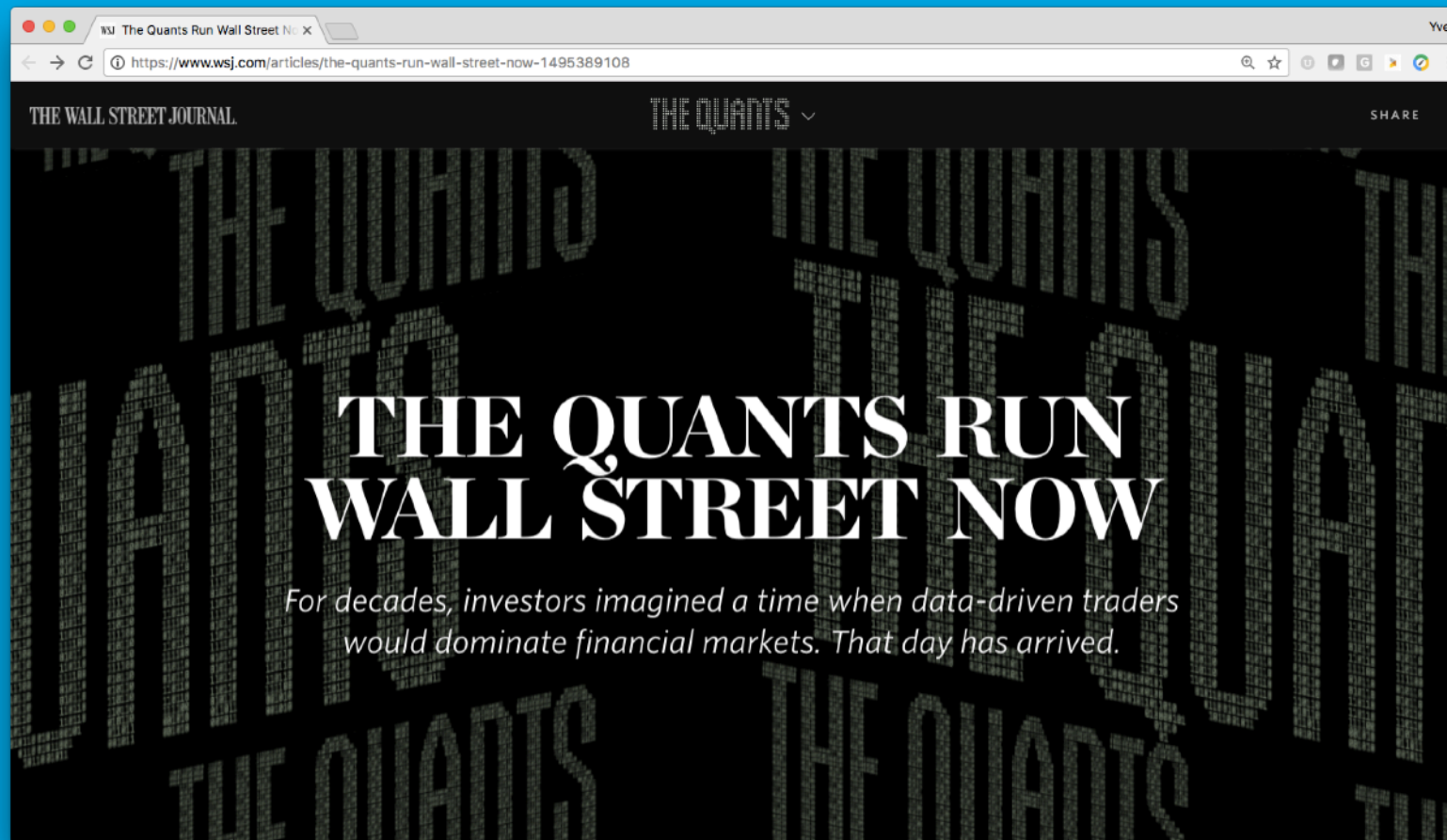


“The world is changing too quickly to teach kids everything they need to know; they must be given the methods and means to teach themselves. This means creative problem-solving, dynamic collaboration online and off, real-time research, and **the ability to modify and make their own digital tools.**”

“We are fantastic at teaching our machines how to do our tasks, and we will only get better at it. The only solution is to keep creating new tasks, new missions, new industries that even we don’t know how to do ourselves. We need new frontiers and the will to explore them.”



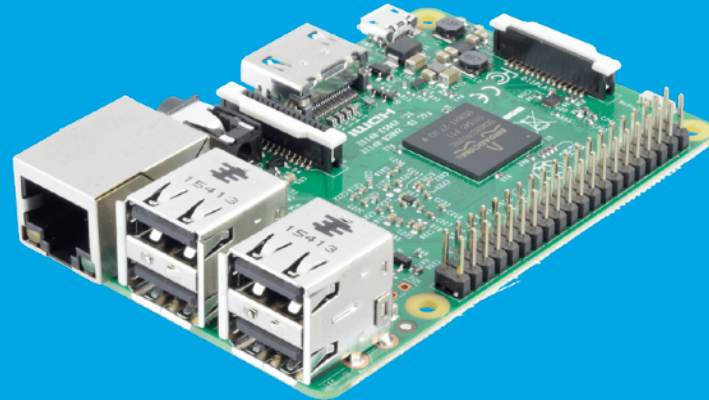
# Financial Singularity



“Financial singularity is the point at which all investment decisions are made by intelligent machines rather than human agents. ... When all human fallibility is eliminated from markets, efficient markets, which have only existed so far in theory, could become a reality.”

*Read more: Financial Singularity Definition | Investopedia*  
<http://www.investopedia.com/terms/f/financial-singularity.asp>

# Emulation



**powerful  
hardware &  
software**

**complete market  
emulation with  
all agents**

## Financial Markets

**x**



**y**

## Finance History



**f(•)**



**f(x) ≠ y**

“brain driven”

## AI in Finance = finaince

**x**

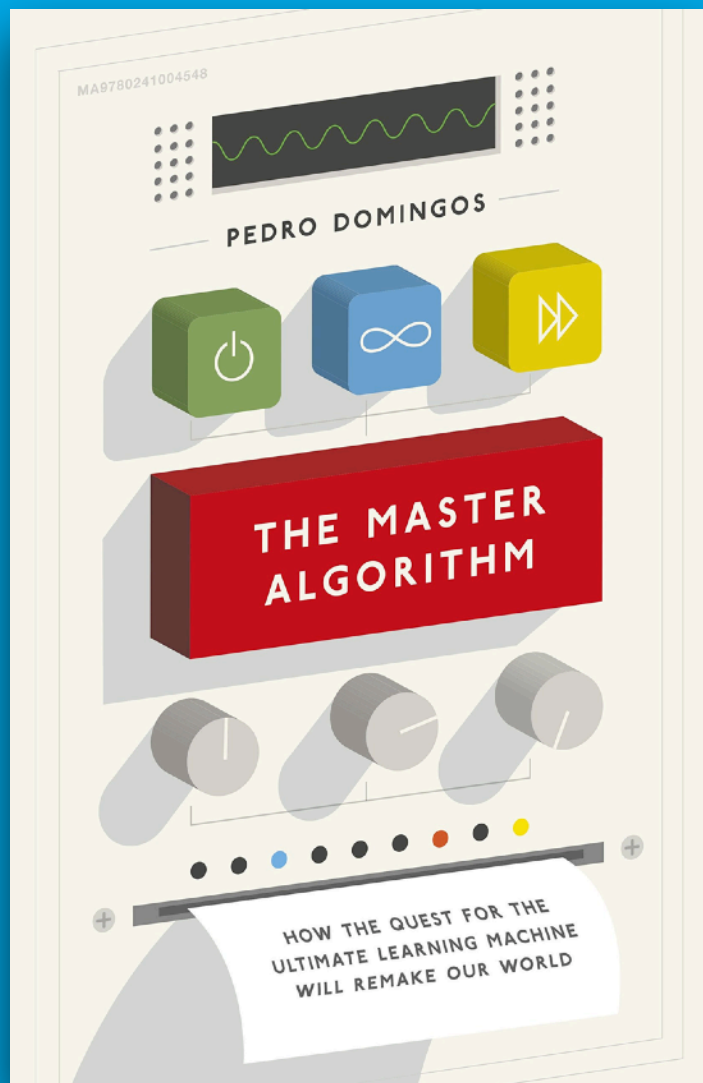


**m(•, a, b)**



**m(x, a\*, b\*) ≈ y**

“data driven”



“The grand aim of science is to cover the greatest number of experimental facts by logical deduction from the smallest number of hypotheses or axioms.”

— Albert Einstein

“Machine learning is the scientific method on steroids. It follows the same process of generating, testing, and discarding or refining hypotheses. But while a scientist may spend his or her whole life coming up with and testing a few hundred hypotheses, a machine-learning system can do the same in a second. Machine learning automates discovery. It’s no surprise, then that it’s revolutionizing science as much as it’s revolutionizing business.”

# Markets & Agents

# Algorithms

$x$



$y$



$x$



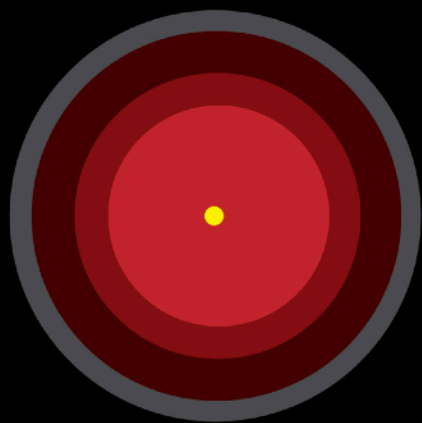
$f(x)$



$y$

# THE TECHNOLOGICAL SINGULARITY

MURRAY SHANAHAN



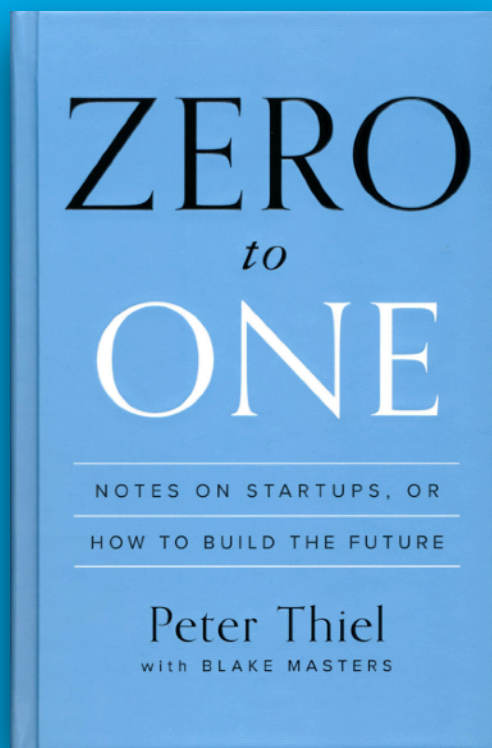
THE MIT PRESS ESSENTIAL KNOWLEDGE SERIES

“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)*

**Man + Machine**





“We are impressed by small feats accomplished by computers alone, but we ignore *big achievements from complementarity* because the human contribution makes them less uncanny.”

“Watson, Deep Blue and ever better machine learning algorithms are cool.”

“But the most valuable companies of the future won’t ask what problems can be solved with computers alone. Instead they’ll ask: *How can computers help humans solve hard problems?*”

# BlackRock cofounder: Artificial intelligence won't replace humans



Oscar Williams-Grut, Business Insider UK

🕒 3.11.2017, 08:03 📌 85

- **BlackRock has been betting big on artificial intelligence in finance in recent years.**
- **But President Rob Kapito said he believes the future "will be human and machines."**
- **A.I. is "just a way to make us much more efficient," Kapito said at a conference in London.**

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LONDON — The cofounder and president of asset management giant BlackRock believes artificial intelligence will never fully replace humans in the investment world.

in the investment world.

BlackRock believes artificial intelligence will never fully replace humans

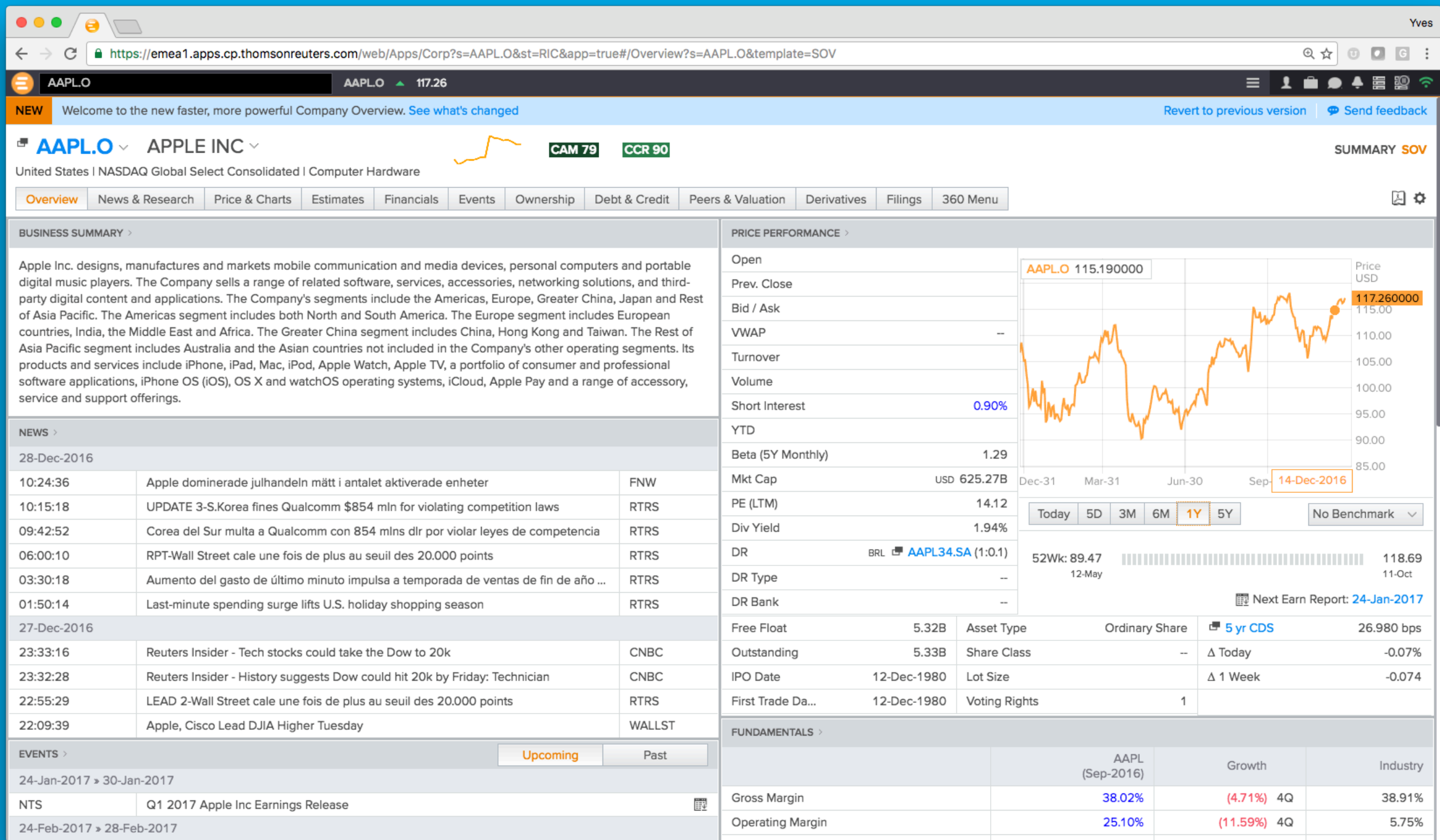
LONDON — The cofounder and president of asset management giant

# **Data as the Driving Force**









## 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

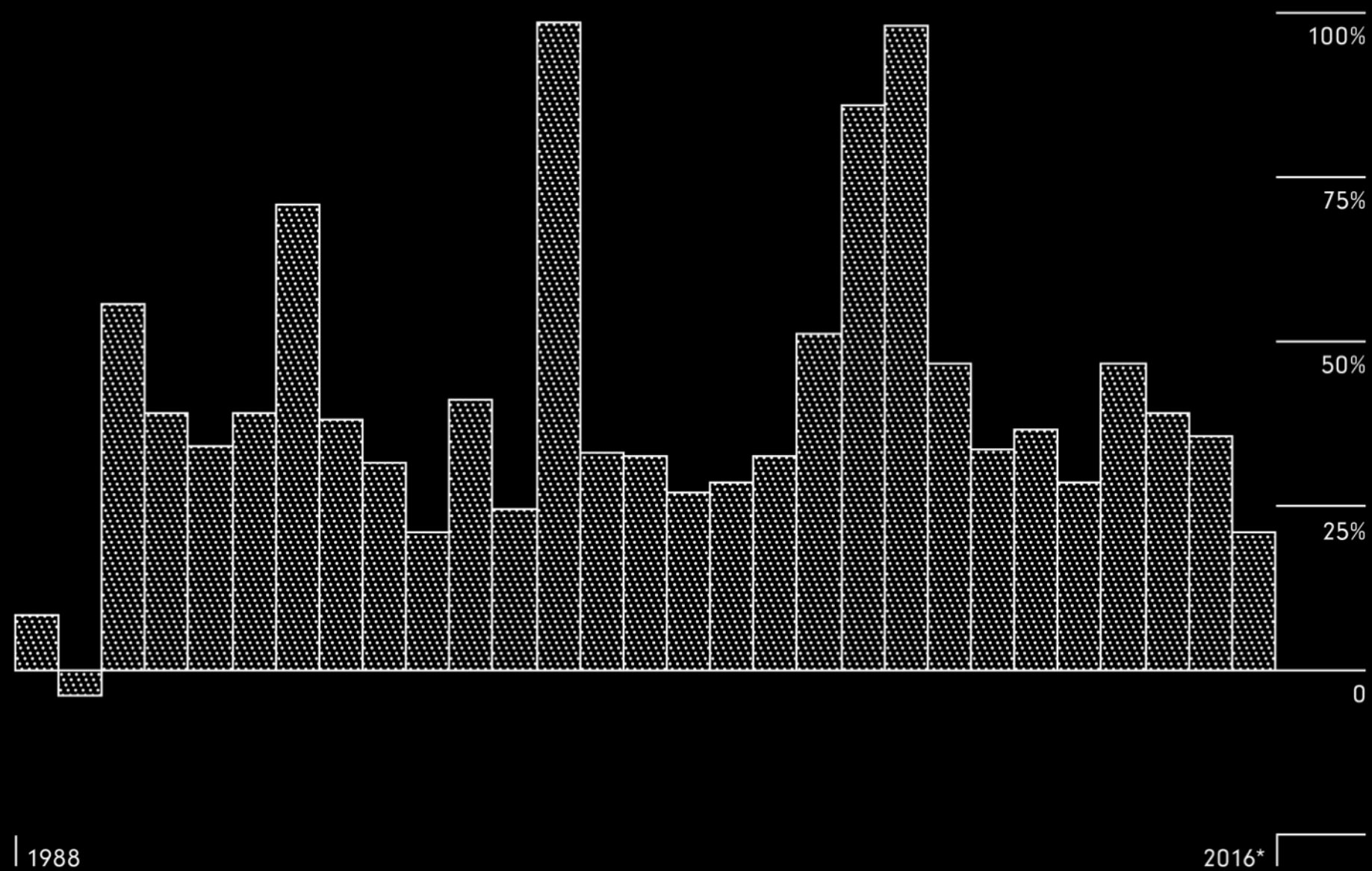
By Sruthi Shankar and Tanya Agrawal

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

**Is a Financial Singularity Possible?**

## MEDALLION FUND ANNUAL RETURNS SINCE INCEPTION

A beginning balance of \$1,000 would now be worth \$13,830,598.



\*Through June 30

source: <https://www.bloomberg.com/>

# Dutch Speed-Trader Turns to Currencies After Conquering ETFs

Flow Traders wants to colonize markets with its approach to trading, but its core business is coming under attack

by Will Hadfield

14 June 2017, 06:01 CEST

From **Bloomberg Markets**

The bottom shelf of the fridge is laden with Heineken and Corona. The Corona is on rotation, but the Heineken is a permanent fixture: This is Amsterdam. A few strides away there's a dark, well-stocked in-house pub.

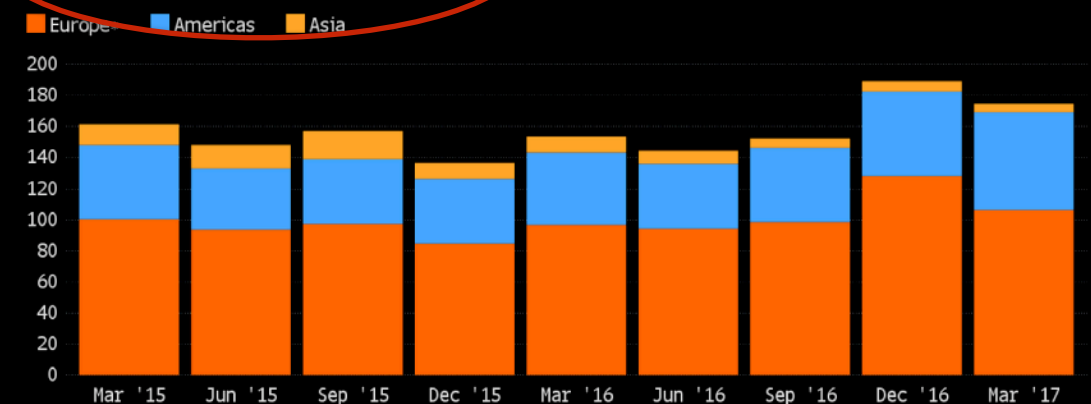
Up one flight of stairs, the atmosphere is very different. Behind a door that can only be opened with a security pass is by far the largest trading floor for exchange-traded funds in Europe. The 110 traders here, along with 30 colleagues in offices elsewhere, traded €640 billion (\$719 billion) in ETFs last year and at least that much in futures, commodities, bonds, stocks, and foreign exchange.

The trading volumes are those of a major Wall Street bank, but the refrigerator—and especially the pub, with its arcade games, pool table, and giant television—is pure startup. This isn't an investment bank; this is Flow Traders NV, one of the world's most successful algorithmic trading firms.

This year the firm will undergo its biggest transformation since it opened for business in 2004. Flow, which handles about a third of all ETF trades in Europe, is seeking to do to currency markets what it's already done to its core business. The firm's strategic calculation is that high-speed foreign exchange traders should be able to offer better prices than banks, which typically adjust their bids and offers based on their customers' creditworthiness and the amount of business they do with the lender.

## 34 Months Without a Loss

Flow Traders' value traded in exchange-traded funds, billion euros



Source: company  
\* Includes Middle East and Africa

Bloomberg

Rietberg and Dijkstra say the move into currency trading is a natural evolution of the business. That may be, but Flow also badly needs to find a new way to grow: Its shares languish below €32—the price when it went public almost two years ago. In the first three months of 2017, its profit dropped 41 percent as quiet markets reduced its ability to earn money from trading. What's more, Flow needs to adjust to a changing landscape. In some markets, the pool of income available to algo trading firms is shrinking as competition increases from established trading companies looking to expand into new asset classes.

source: <https://www.bloomberg.com/>

Flow is at a crossroads. Its distinctive approach to algorithmic trading could enable it to colonize other financial markets—or it could shrivel as rivals attack its core ETFs business. “Flow could be multiple times the size it currently is in 20 years,” says Joost de Rijk, an analyst who covers the company for Amsterdam-based merchant bank Kempen & Co. “But it could also be gone. I think they will reevaluate every year whether this is working. That’s the DNA of the company.”

**When you make only 0.028 percent on a trade, you need to make a lot of them.**

**Announcing its first-quarter results in May, Flow reported that it hadn’t lost money on a single trading day in the preceding 34 months.** It attributes the stellar run to its use of deterministic modeling, which produces definite outcomes, not probable ones. Most of its rivals calculate prices by means of statistical, or stochastic, modeling, producing hedges that probably (but not definitely) protect them from any downside.

definitely) protect them from any downside.

stochastic, modeling, producing hedges that probably (but not



# Outlook


The race to AI utilization in finance X

Yves

Bloomberg L.P. [US] | https://www.bloomberg.com/professional/blog/race-ai-utilization-finance-marathon-not-sprint/?utm\_source=Quandl+Communications&utm...





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Data Science

The race to AI utilization in finance is a marathon, not a sprint

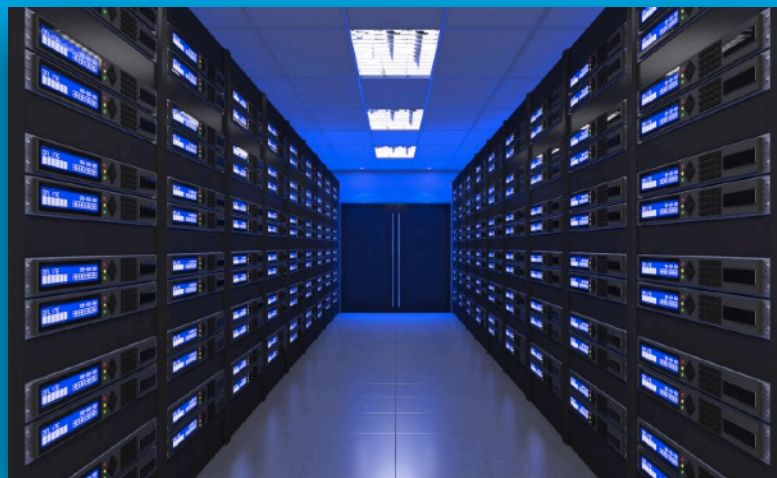


**Bloomberg Professional**

October 4, 2017

Development and deployment of artificial intelligence (AI) in financial services has accelerated. In particular, quantitative funds are increasingly applying programming and advanced statistical methods to generate alpha and automate trading strategies. Despite the hype and frequent headlines extolling the virtues

# Monopoly



*Deep Blue 1997  
("complete pie")*

# Oligopoly

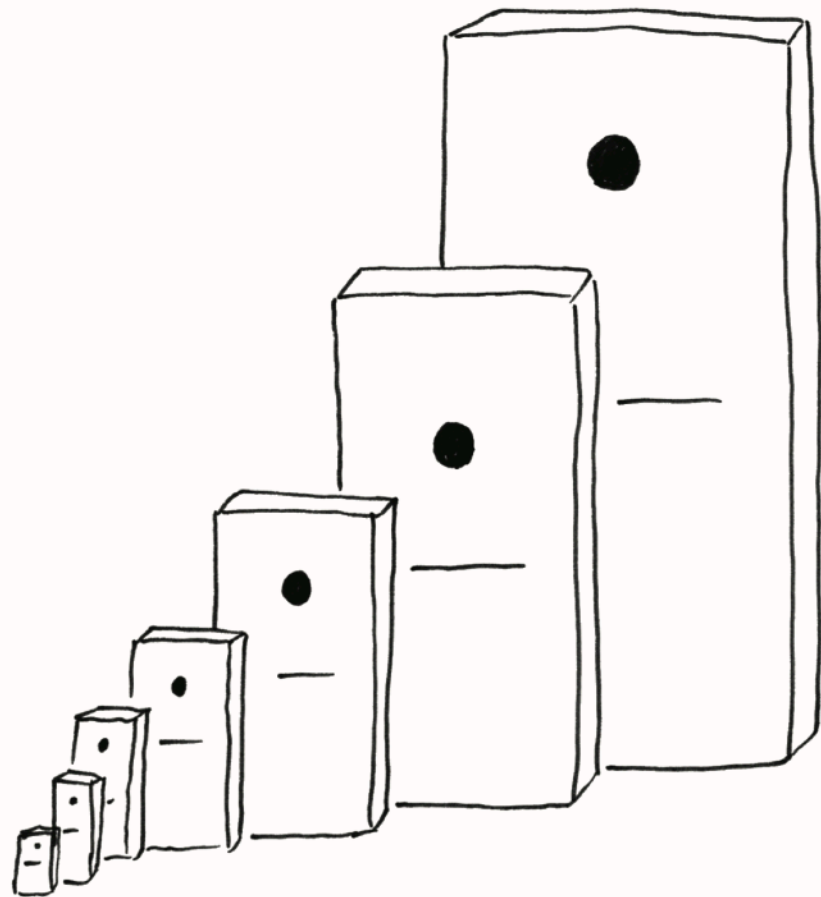


*Bitcoin Miners Today  
Hedge Fund Industry Today  
("piece of the pie")*

# Perfect Competition



*Chess Today  
("only crumbs")*



1 A geometric domino progression.

- exponential forces at work:
- technology improvements
  - capital accumulation
  - talent accumulation



finaince



# The Python Quants GmbH

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