Python for Algorithmic Trading

—Vectorized Backtesting, Object-Oriented Programming, Event-Based Backtesting and Streaming Data with Python

Dr. Yves J. Hilpisch
Executive Program in Algorithmic Trading
March 2021

http://bit.ly/epat_mar_2021

Introduction

THE PYTHON QUANTS

SERVICES
for financial institutions globally

EVENTS
for Python quants & algorithmic traders

CERTIFICATION
in cooperation with university

TRAINING
about Python for finance & algorithmic trading

BOOKS
about Python and finance

PLATFORM
for browser-based data analytics

OPEN SOURCE
Python library for financial analytics

http://tpq.io

The AI Machine

http://aimachine.io

THE PYTHON QUANTS

recognized by Capital Markets CIO Outlook *magazine as*

TOP 10
ALGO TRADING
SOLUTION PROVIDERS - 2019

An annual listing of 10 companies that are at the forefront of providing Algo Trading solutions

http://certificate.tpq.io/tpq_top_algo_2019.pdf

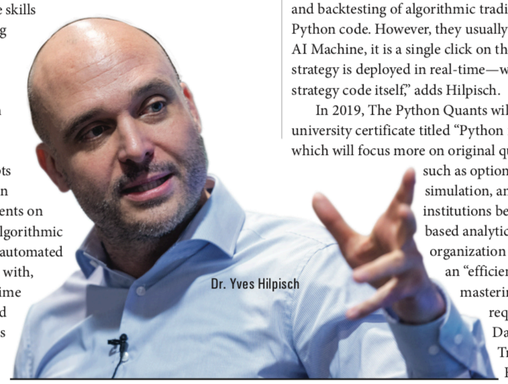
The Python Quants

First University Certificate in Python for Algorithmic Trading

Python programming has become a key skill in the financial industry. In areas such as financial data science, computational finance or algorithmic trading, Python has established itself as the primary technological platform. At the same time, the level of Python sophistication the industry is expecting from its employees and applicants is increasing steadily. The Python Quants Group is one of the leading providers of Python for Finance training programs.

Among others, The Python Quants have tailored a comprehensive online training program leading to the first University Certificate in Python for Algorithmic Trading. Be it an ambitious student with intrigue for algorithmic trading, or a major financial institution, The Python Quants, through this systematic training program, is equipping delegates with requisite skills and tools to formulate, backtest and deploy algorithmic trading strategies based on Python.

The topics covered in the training programs offered by The Python Quants are generally not found in the typical curriculum of financial engineering or quantitative finance Master programs. Dr. Yves Hilpisch, the firm's founder and managing partner, explains, "There are courses out there that show students how to apply machine learning for the formulation and backtesting of algorithmic trading strategies. However, none of them explains the difficulties or the skills required in deploying such algorithmic trading strategies in the real world. Besides providing an introductory course that teaches Python and financial concepts from scratch, we train our delegates and clients on how best to deploy algorithmic trading strategies in automated fashion in the cloud, with, among others, real-time risk management and monitoring," explains Hilpisch, an author of three books on the topic, with "Python for Finance" (2nd ed., O'Reilly) being the standard reference in the field.


Dr. Yves Hilpisch

The organization's "Python for Algorithmic Trading University Certificate" consists of 200 hours of instruction, 1,200 pages of documentation and 1,000s of lines of Python code. In addition to offering both online and offline Python training, Hilpisch and his team also organize bespoke training events for financial institutions, hedge funds, banks, and asset management companies. "Most of the training is online since we have students and delegates from about 65 different countries in general. Most recently, we noticed that it's not just financial firms and students who want to deepen their algorithmic trading knowledge, but even professors of finance who want to get more involved in this popular topic," says Hilpisch.

While the Quant Platform is the most popular choice, especially for users in the financial sector who don't have access to a full-fledged, interactive, financial analytics environment, the team at The Python Quants is currently developing The AI Machine—a new platform which leverages artificial intelligence to formulate and deploy algorithmic trading strategies in a standardized manner. Hilpisch explains that it's relatively easy to write Python code for an algorithmic trading strategy, but the same can't be said about the deployment of such a strategy. "There are a few platforms out there that allow the formulation and backtesting of algorithmic trading strategies by the use of Python code. However, they usually stop exactly there. With The AI Machine, it is a single click on the 'GO LIVE' button and the strategy is deployed in real-time—without any changes to the strategy code itself," adds Hilpisch.

In 2019, The Python Quants will be introducing a new university certificate titled "Python for Computational Finance," which will focus more on original quantitative finance topics, such as option pricing, Monte Carlo simulation, and hedging. As financial institutions begin to perceive Python-based analytics as a prerequisite skill, the organization will continue to provide an "efficient and structured way of mastering all the tools and skills required in Python for Financial Data Science, Algorithmic Trading, and Computational Finance."CM

Dr. Yves J. Hilpisch is founder and CEO of **The Python Quants** (http://tpq.io), a group focusing on the use of open source technologies for financial data science, artificial intelligence, algorithmic trading, and computational finance. He is also the founder and CEO of **The AI Machine** (http://aimachine.io), a company focused on AI-powered algorithmic trading based on a proprietary strategy execution platform.

Yves has a Diploma in Business Administration, a Ph.D. in Mathematical Finance and is Adjunct Professor for Computational Finance.

Yves is the author of five books (https://home.tpq.io/books):

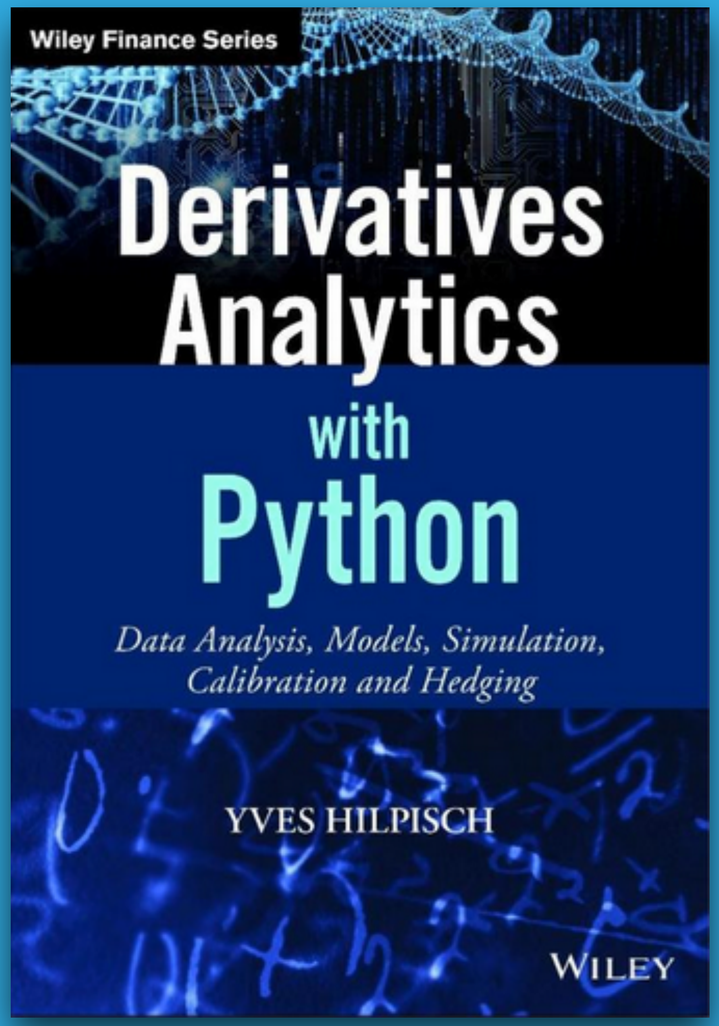
* Artificial Intelligence in Finance (2020, O'Reilly)
* Python for Algorithmic Trading (2020, O'Reilly)
* Python for Finance (2018, 2nd ed., O'Reilly)
* Listed Volatility and Variance Derivatives (2017, Wiley Finance)
* Derivatives Analytics with Python (2015, Wiley Finance)

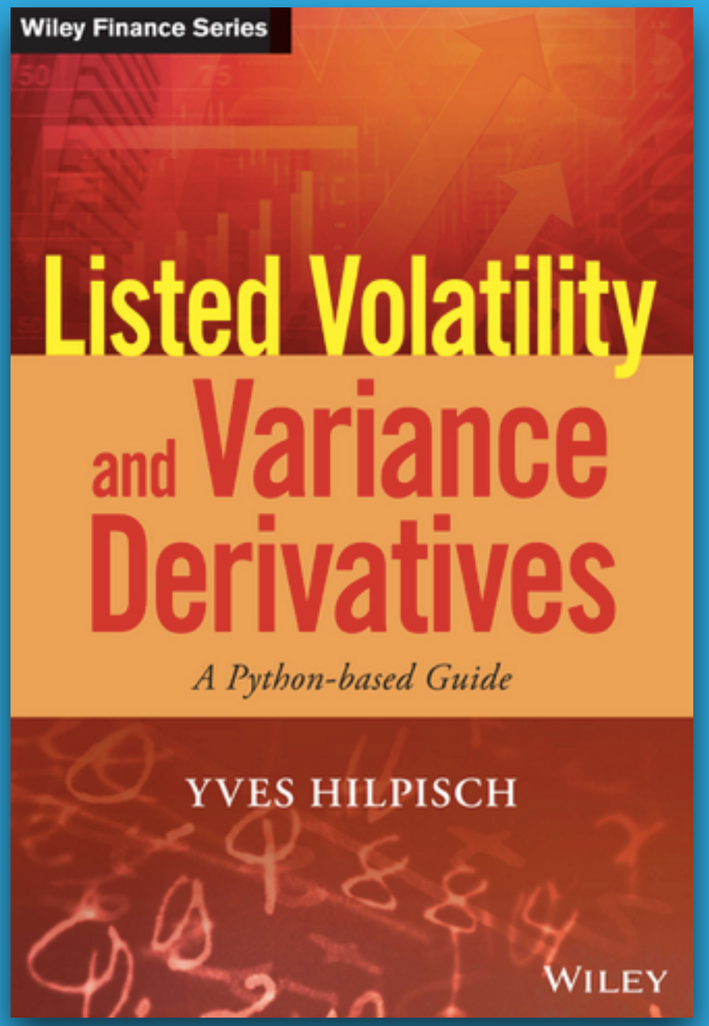
Yves is the director of the first online training program leading to **University Certificates in Python for Algorithmic Trading** (https://home.tpq.io/certificates/pyalgo) and **Computational Finance** (https://home.tpq.io/certificates/compfin). He also lectures on computational finance, machine learning, and algorithmic trading at the **CQF Program** (http://cqf.com).

Yves is the originator of the financial analytics library **DX Analytics** (http://dx-analytics.com) and organizes Meetup group **events**, **conferences**, **and bootcamps** about Python, artificial intelligence and algorithmic trading in London (http://pqf.tpq.io), New York (http://aifat.tpq.io), Frankfurt, Berlin, and Paris. He has given **keynote speeches** at technology conferences in the United States, Europe, and Asia.

http://hilpisch.com

Quant Finance with Python





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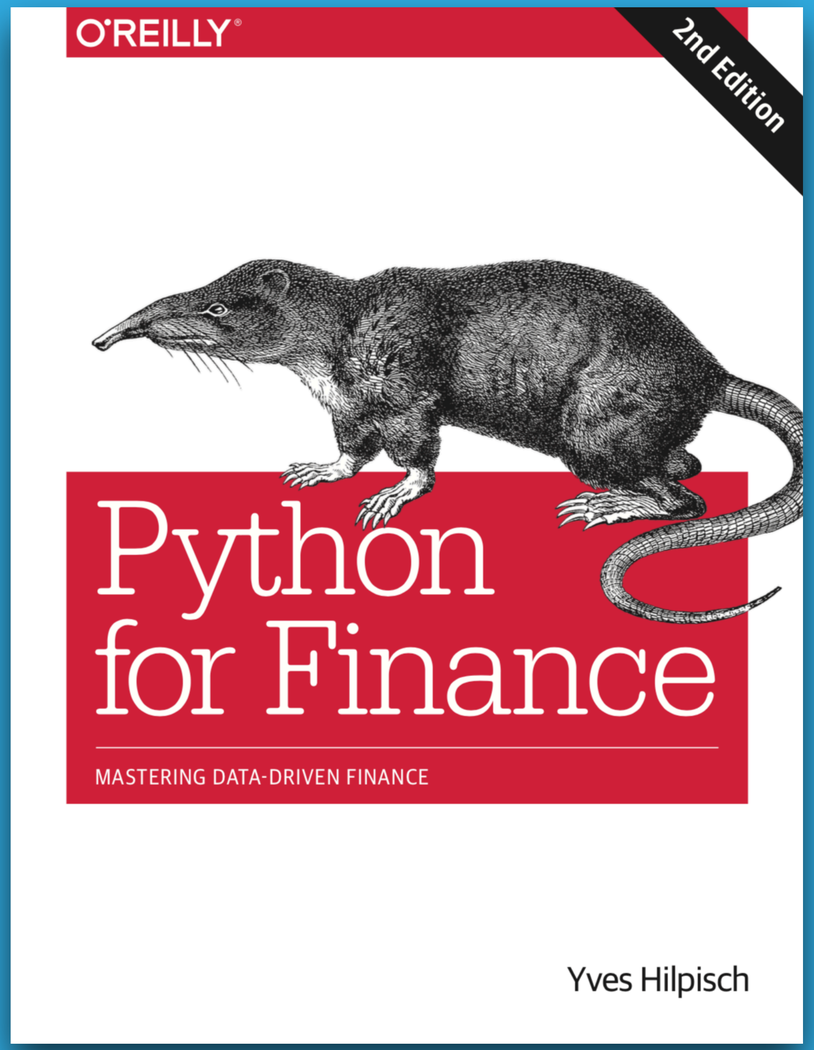
Python for Finance



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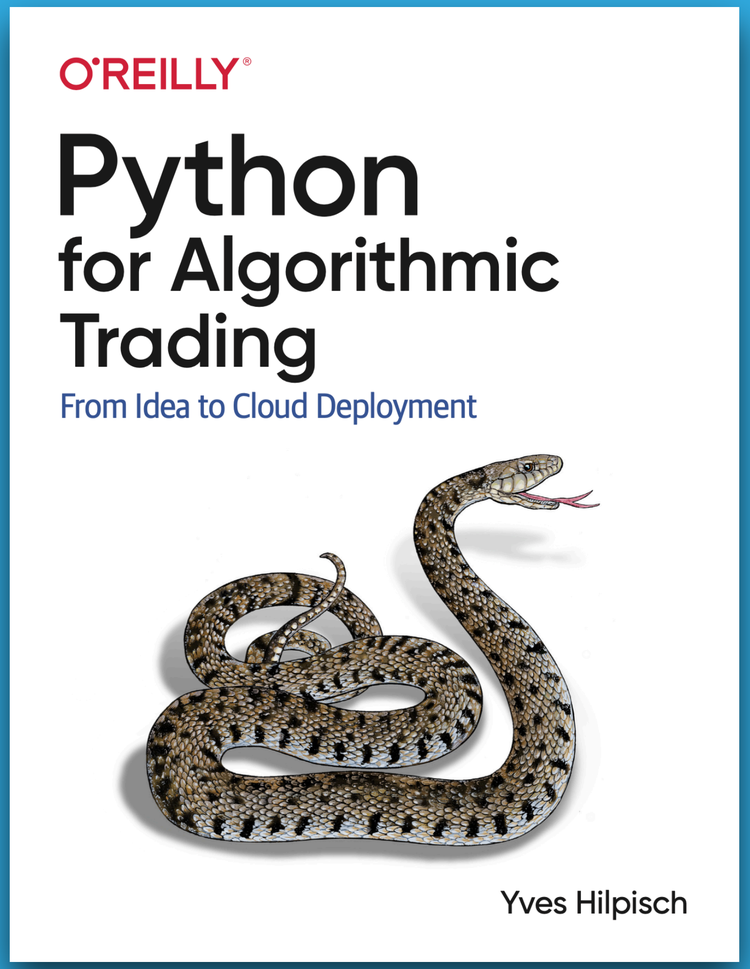
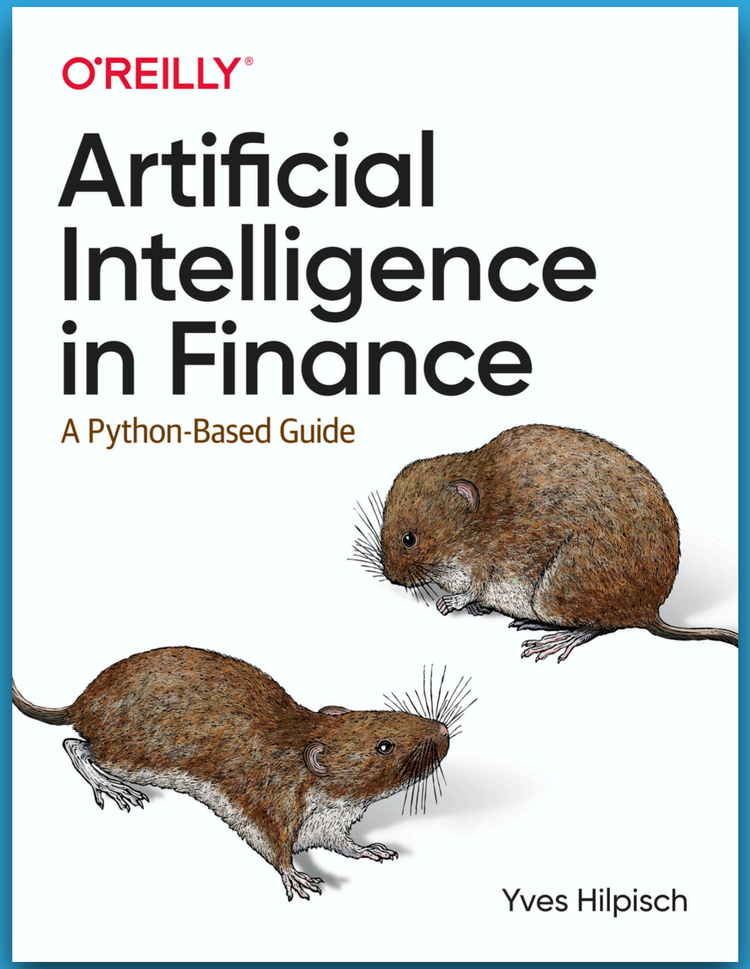
Python & AI for Finance & Trading





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Dr. Yves J. Hilpisch is founder and managing partner of The Python Quants (http://tpq.io), a group focusing on the use of open source technologies for financial data science, algorithmic trading and computational finance. He is the author of the books

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UNIVERSITY CERTIFICATE IN PYTHON FOR ALGORITHMIC TRADING

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April 2017

10,000+ lines of code

1,750+ pages PDF

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Finance with Python,
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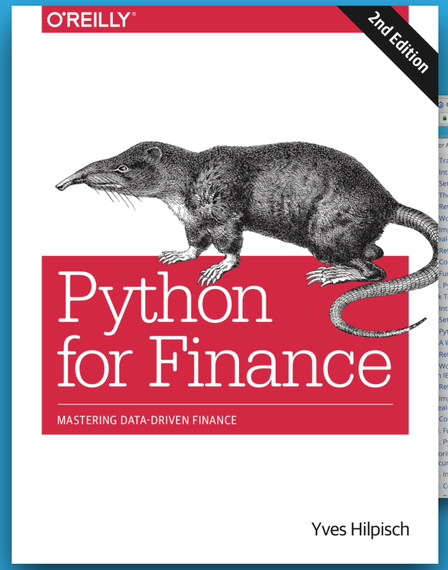
Derivatives Analytics



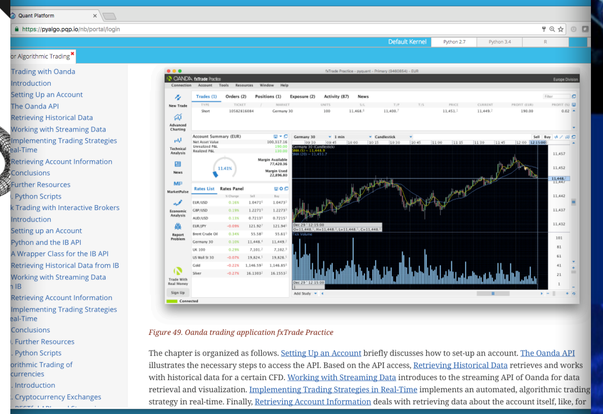
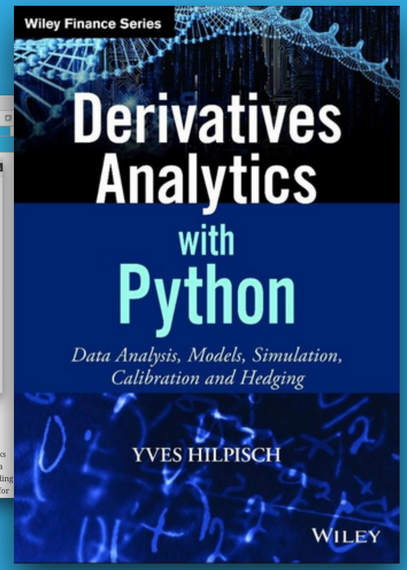
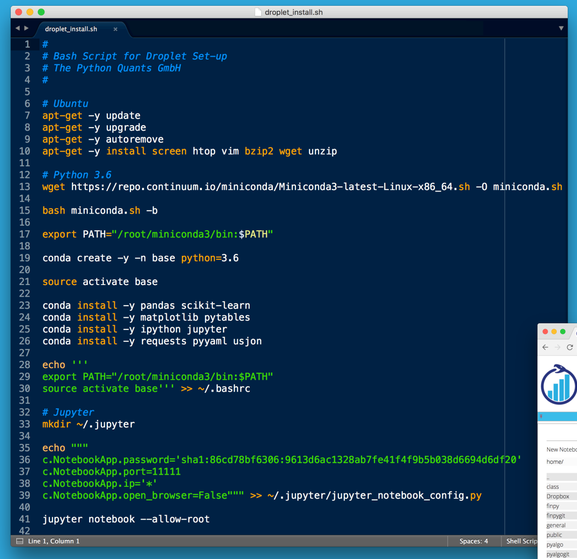


Figure 49. Oanda trading application fcTrade Practice

The chapter is organized as follows. Setting Up an Account briefly discusses how to set-up an account. The Oanda API illustrates the necessary steps to access the API. Based on the API access, Retrieving Historical Data retrieves and works with historical data for a certain CFD. Working with Streaming Data introduces to the streaming API of Oanda for data retrieval and visualization. Implementing Trading Strategies in Real-Time implements an automated, algorithmic trading strategy in real-time. Finally, Retrieving Account Information deals with retrieving data about the account itself, like, for

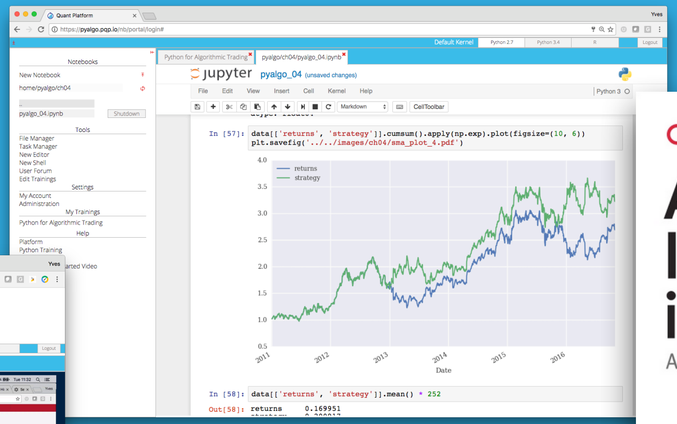


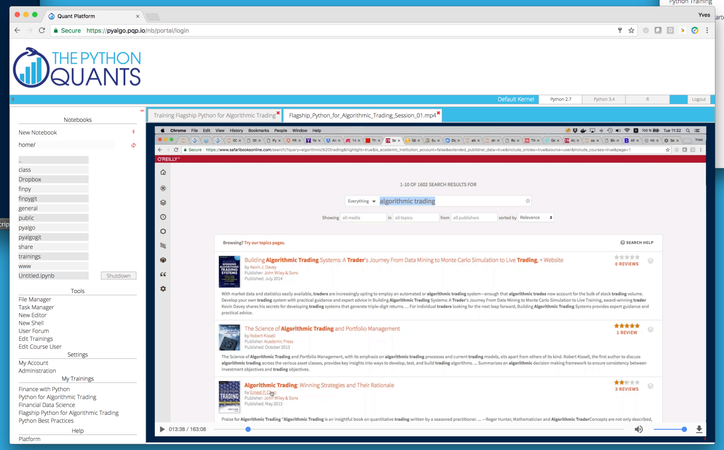
10,000+ lines of code



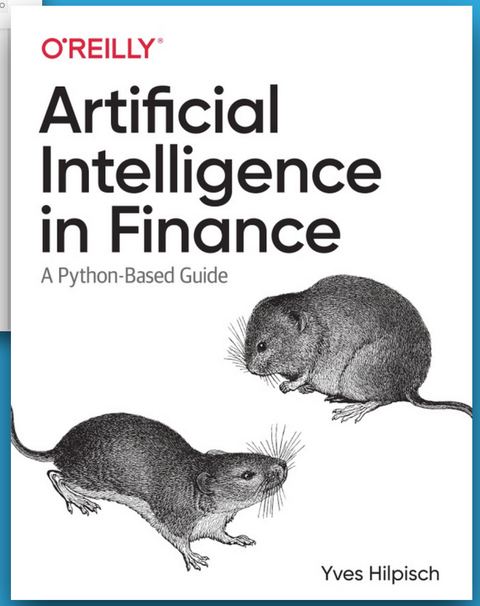
200+ hours
of pre-recorded
video instruction

150+ Jupyter Notebooks





many hours of
additional
live sessions



Data-Driven Finance

FINANCIAL TIMES

TUESDAY 3 OCTOBER 2017 — WORLD BUSINESS NEWSPAPER — MIDDLE EAST

Mohamed El-Erian
Reasons to worry about the Fed's 'beautiful normalisation' — PAGE 20

Torturing Theresa
Boris Johnson's bid to dictate May's Brexit strategy — JANAN GANESH, PAGE 11

Confined in a circle
The myths that hold back women in Indian society — AMY KAZMIN, PAGE 10

Las Vegas reels from worst US mass shooting

A casualty is carried from the scene after a gunman opened fire on concert-goers in Las Vegas on Sunday night. More than 58 people were killed and over 515 wounded, making it the deadliest mass shooting in US history.

Las Vegas police said the suspected gunman, 64-year-old Stephen Paddock, fired shots from his 32nd floor room in the Mandalay Bay Hotel and Casino into the crowd of 22,000 people attending the Route 91 Harvest Festival.

In televised remarks, Donald Trump, the US president, called the shooting "an act of pure evil" but made no reference to guns. He plans to visit the city on Wednesday to meet the families of the victims and law enforcement officials.

Report page 2

David Becker/Getty Images

Catalan president urges Brussels to mediate in independence clash

Region seeks to avoid 'traumatic split' from Spain ● EU says dispute is 'internal matter'

MICHAEL STOTHARD — BARCELONA

He added: "We don't want a traumatic split from Spain. Today's referendum, while ille- necessary the suspension of Catalonia's

Briefing

Puerto Rico calls for billions in aid
Raúl Maldonado Gautier, Puerto Rico's treasury secretary, says the island will need "tens of billions" of dollars in aid from the US as it struggles to recover after Hurricane Maria.— PAGE 2

Portugal's Socialists reap benefits
Portugal's ruling Socialists reaped the rewards of a recovering economy by winning a decisive victory in local elections midway through the first term of an anti-austerity government.— PAGE 3

Uber's UK head quits as chief flies in
Jo Bertram, Uber's UK boss, has quit the company a day before a visit to London by Dara Khosrowshahi, chief executive, to meet regulators over a threat to revoke the ride-hailing app's licence in the capital.— PAGE 13

Koike faces Japan election dilemma
Tokyo governor Yuriko Koike is under pressure to stand in Japan's general election later this month, amid fears she and her party lack the resources to beat Shinzo Abe, the prime minister.— PAGE 4

Equifax defends silence over hack
Credit reference agency Equifax has claimed ahead of a hearing at the US Congress later today that disclosing that it had been hacked would have encouraged "copycat" cyber attacks.— PAGE 13

Western envoys warn on Kenya re-run
Western ambassadors have condemned President Uhuru Kenyatta and Raila Odinga, opposition leader, for undermining the electoral commission's ability to restage its election this month.— PAGE 4

Huawei beats Apple as top China choice
Huawei has for the first time beaten Apple to top spot for intended smartphone purchases in China, according to a survey of 1,000 consumers.— PAGE 14

Datawatch

US manufacturing purchasing managers' index
Above 50 = growth

US manufacturing activity as measured by the Institute of Supply Management was at its highest level in September since the summer of 2004

Sources: Thomson Reuters Datastream; ISM

Printed in London, Liverpool, Glasgow, Dublin, Frankfurt, Milan, Madrid, New York, Chicago, San Francisco, Washington DC, Orlando, Tokyo, Hong Kong, Singapore, Seoul, Dubai, Doha

FTSE 100	7430.04	7372.70	0.80	4 mths	94.256	93.905	3 mths	99.285	99.435	See Geo 2 yr		101.97	0.71	0.00
FTSE All Share	4051.95	4041.09	0.87	5th qtr E	1.142	1.144	5th qtr F	1.292	1.298			pm pr	prev	chg
CAC 40	5302.44	5329.01	0.30	COMMODITIES						Fed Funds FT		1.07	1.07	0.00
Xetra Dax	12822.65	12828.86	0.00			Oct 2		prev	%chg	WE 3m Eris		1.05	1.05	0.00
Nikkei	20402.78	20398.28	0.22	Oil WTI $		50.48		51.87	-2.81	Euro Libor 3m		0.38	-0.38	0.00
Hang Seng	27554.80	27421.85	1.48	Gl Brent $		56.05		56.79	-1.30	$R 3m		0.34	0.33	0.00
FTSE All World $	301.85	301.88	0.00	Gold $		1273.70		1269.10	-0.73	Price as latest for edition			Data provided by Morningstar	

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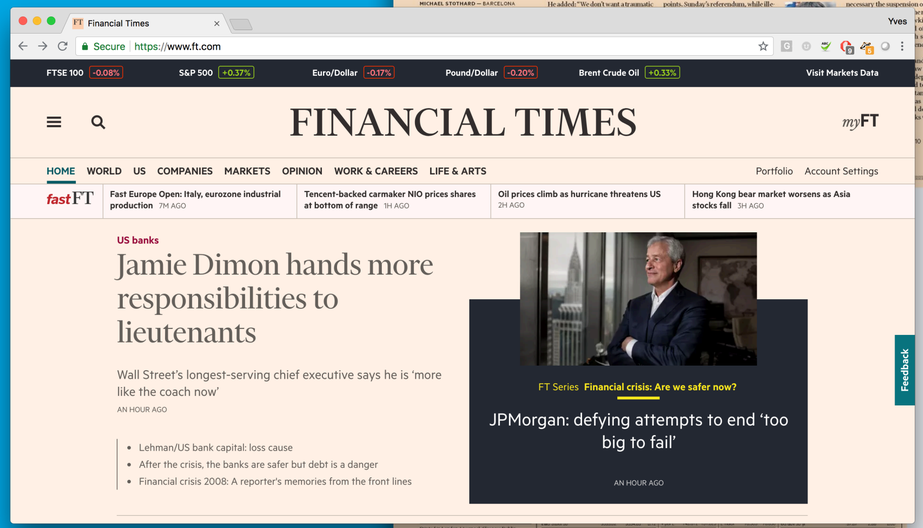

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THE WALL STREET JOURNAL.

DOW JONES

WEDNESDAY, DECEMBER 11, 2013 - VOL. CCLXII NO. 138 — WSJ.com — ★★★★ $2.00

DJIA 15973.13 ▼ 52.40 0.3% NASDAQ 4060.49 ▼ 0.2% NIKKEI 15611.31 ▼ 0.25% STOXX 600 314.91 ▼ 0.7% 10-YR. TREAS. ▲ 16/32, yield 2.797% OIL $98.51 ▲ $1.17 GOLD $1,262.40 ▲ $27.10 EURO $1.3761 YEN 102.84

TODAY IN PERSONAL JOURNAL

A Celebrity Selfie Machine

PLUS Secondhand Stress at Work

What's News

Business & Finance

GM named its first female CEO, tapping company veteran and product chief Mary Barra to run the auto maker. **A1**

■ **Financial regulators** approved the Volcker rule, which curbs banks' risk-taking and could slash their profits. **A1**

■ **The FDIC board** approved a draft plan to keep parts of a failing financial firm open without a taxpayer bailout. **C3**

■ **Finance ministers** from big euro-zone nations reached an understanding on winding down failing banks. **C3**

■ **Discovery is considering** a bid for Food Network majority owner Scripps, presaging a possible wave of TV deals. **B1**

■ **Stocks declined** as investors weighed the potential impact of reduced Fed stimulus. The Dow dropped 52.40 points. **C4**

■ **OTC stock trading** was halted for about an hour because of a hardware error. **C4**

■ **Smith & Wesson said** profit slid 20% and revenue rose just 2%, as gun sales slow from their recent torrid pace. **B2**

■ **Pacific trade talks** adjourned without a deal amid discord between the U.S. and Japan. **A17**

■ **Italy pulled out** of a two-year contraction in the third quarter, posting flat GDP. **A13**

■ **Three Swiss banks** agreed to participate in a U.S. tax-evasion-disclosure program. **C5**

■ **LightSquared can proceed** with a suit against Dish over a debt purchase, a judge ruled. **B3**

■ **Monsanto is teaming up** with a Danish firm to develop useful microbes for plants. **B4**

World-Wide

■ **Congressional negotiators** struck a budget deal that would allow more domestic and military spending and include deficit-cutting measures. **A1, A8**

■ **Ukrainian forces** stormed a protesters' encampment in Kiev, hours after Western diplomats called for a nonviolent end to the political crisis. **A13**

■ **Obama's disapproval rate** hit 54%, the high for his presidency, amid the flawed health-law rollout, a Wall Street Journal/NBC poll found. **A4**

■ **World leaders gathered** to honor Mandela. In a rare encounter, Obama shook hands with Cuba's Raúl Castro. **A12**

■ **Senate Democrats** confirmed an Obama appeals-court pick and the head of Fannie and Freddie's overseer. **A4**

■ **A key Senate Democrat** said he would back the Obama administration's request to delay new Iran sanctions. **A17**

■ **Supreme Court justices** expressed sympathy for the EPA approach to air pollution that crosses state lines. **A2**

■ **An AIDS group called** for a probe to see if HIV-infected patients were discouraged from enrolling in health plans. **A6**

■ **Uruguay's Senate** voted to legalize marijuana. The president plans to sign the bill. **A15**

■ **France's leader** flew to the Central African Republic after two French troops died. **A13**

■ **Singapore police** charged 24 Indian citizens in connection with a night of rioting. **A13**

■ **Died: Jim Hall**, 83, acclaimed jazz guitarist.

Deal Brings Stability to U.S. Budget

Congressional Negotiators Avert January Shutdown and Soften Sequester Cuts; Airline Fees to Climb

By Janet Hook

House and Senate negotiators, in a rare bipartisan act, announced a budget agreement Tuesday designed to avert another economy-rattling government shutdown and to bring a dose of stability to Congress's fiscal policy-making over the next two years.

Sen. Patty Murray (D., Wash.) and Rep. Paul Ryan (R., Wis.), who struck the deal after weeks of private talks, said it would allow more spending for domestic and defense programs in the near term, while adopting deficit-reduction measures over a decade to offset the costs.

Revenues to fund the higher spending would come from changes to federal employee and military pension programs, and higher fees for airline passengers, among other sources. An extension of long-term jobless benefits wasn't included.

The plan is modest in scope, compared with past budget deals and to once-grand ambitions in Congress to craft a "grand bargain" to restructure the tax code and federal entitlement programs. But in a year and an institution characterized by gridlock, lawmakers were relieved they could reach even a minimal agreement.

"In divided government, you don't always get what you want," said Mr. Ryan.

Ms. Murray joined him in welcoming the prospect that lawmakers would steer away from a crisis-driven budget process. "We have lurched from crisis to crisis, from one cliff to the next," she said. "That uncertainty was devastating to our fragile economic recovery."

The deal, which goes to the House and Senate for approval in the coming days, marks a major change in the 2011 budget-cutting law, which set in motion 10 years of fiscal austerity, including across-the-board spending cuts known as sequestration.

The annual discretionary spending target will be raised to

Please turn to page A8

◆ Farm groups fight limits..... A6
◆ Pension-change pushback?... A8

Thousands Honor Memory of South Africa's Liberator

REST IN PEACE: A boy attended the memorial service for former South African President Nelson Mandela at a soccer stadium in Johannesburg on Tuesday that drew celebrities and dozens of heads of state, including President Obama, along with thousands of other mourners. **A12**

Longtime Insider Is GM's First Female CEO

By Jeff Bennett And Sara Murray

DETROIT—General Motors Co. tapped product chief Mary Barra as its next chief executive, smashing a century-old gender barrier while choosing a longtime insider who grew up steeped in Detroit's car culture.

Ms. Barra will succeed Dan Akerson as CEO next month and become the first woman to run a major global auto maker. The 51-year-old joined GM 33 years ago as a college intern, eventually becoming an engineering manager before running one of its big U.S. assembly plants. She got global experience managing human resources and, more recently, the company's world-wide product development group.

She will become the 22nd woman currently running a For-

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◆ Milestone is hailed, but women continue to face obstacles..... B7
◆ Heard on the Street..... C14

Ukrainian Forces Confront Protesters

Government security forces cracked down on protesters in Kiev hours after U.S. and EU diplomats called for a nonviolent resolution. **A13**

Reuters

PARTY DISCIPLINE

China Spins New Lesson From Soviet Fall

By Jeremy Page

BEIJING—The Communist Party boss in eastern China's Jiangsu province summoned local officials recently to a compulsory study session. Their task was to watch a six-part documentary on the Soviet Union's collapse.

The film begins with images of the Soviet Union in its heyday, but quickly cuts to graphic footage of unrest in China's northern neighbor in the 1990s, set to ominous music and punctuated by Russian communists lamenting their nation's fate.

When the screening in Jiangsu ended, state media reported, local party chief Luo Zhijun exhorted the assembled officials to "correctly understand the lessons of history." The film's message: The Soviet Union didn't fall apart because of the communist system itself, but because of individuals who betrayed it, especially Mikhail Gorbachev.

The film is part of an ideological campaign launched by China's new leader, Xi Jinping, to re-energize the party and enforce discipline among its members. It has been shown at dozens of political meetings since September.

The frequent showings suggest Mr. Xi believes China needs to reinforce its Leninist political system rather than limit the party's powers. Party insiders and academics say it is part of an effort to combat what is portrayed as an American conspiracy to overthrow the party through "peaceful evolution"—the spread of Western ideas via media, academia and popular culture.

The office in charge of Mr. Xi's campaign didn't respond to questions about the film, called "20th Anniversary of the Death of the Soviet Party and State: As the Russians Relate," but said the campaign drew on experiences from China and the rest of the world.

The film, which was produced by a retired Chinese major general, has drawn criticism from some Chinese scholars of Soviet history, including some within the party. They argue that Moscow's mistake was to overlook deep flaws in the Soviet political and economic systems that emerged long before Mr. Gorbachev.

The film "lacks rational analysis, is mainly aimed at defending the Stalinist system and is illogical in many places," wrote Zuo Fen-

Please turn to page A18

Bank Rule Challenges Wall Street

By Justin Baer And Julie Steinberg

A broad new government rule to limit risk-taking by Wall Street will force banks to rethink virtually every aspect of their trading activities, setting the stage for more tumult at the largest U.S. financial institutions.

The so-called Volcker rule, approved by five financial regulatory agencies on Tuesday, could top as much as $10 billion total in yearly pretax profit from the eight largest U.S. banks through lower revenue and higher compliance costs, according to estimates from Standard & Poor's.

The 953-page edict, part of the 2010 Dodd-Frank financial overhaul, codifies and restricts the way banks trade securities. It curbs banks' ability to bet with their own capital and forces

Please turn to page A6

◆ Plan for ailing banks detailed... C3
◆ Heard on the Street: Rule is a means to an end..... C14

Here's Your Holiday Bonus, Now Start Running

Workers Win All-They-Can-Grab Sprees From Companies; 'Supermarket Sweep'

By Rachel Feintzeig

On Thursday, Alan Comley will get the holiday gift he never knew he always wanted: two minutes at a Texas Costco.

The 27-year-old wasn't even a member of the wholesale warehouse store until a few days ago. But his employer, coupon website RetailMeNot Inc., takes a cue from the game show "Supermarket Sweep" when it comes to rewarding employees. As a prize for his work as a software engineer, Mr. Comley will have 120 seconds to run unbridled through the big-box store's aisles, grabbing a plasma television, a videogame console and almost anything else that he can hoist onto his cart. "I'm looking to break a record," he says.

At a time of year when many workers anticipate a Christmas bonus check or a holiday ham, some companies say one of the best ways to reward outstanding performance and inspire employee loyalty is a chance to shop 'til they drop.

Jordan, Nicholas, Elliott Inc., a Florida company that runs several restaurants, unleashes high performers on a Lakeland, Fla., Winn-Dixie, where they get two to four minutes to fill their carts as co-workers race alongside. Still other companies hit the mall—one gives workers $150 and an hour to buy what they like, while an Ohio health-care system awards 20-year employees a $300 trip to a shopping center, after which they strut down a

Please turn to page A18

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AAPL.O VOV

APPLIB

MARKETS | COMPANY | NEWS | CHARTING | PORTFOLIOS & MONITORS | SEARCH TOOLS | DEVELOPMENT AND ADMIN TOOLS | MY LAYOUTS

AAPL.O APPLE INC

123.08 c USD Vol 13,358 CAM 72 CCR 96

Updated: 03-Dec-2020 11:00:20
Valuation VOV

United States | NASDAQ Global Select Consolidated | Phones & Handheld Devices

Overview | News & Research | Price & Charts | Estimates | Financials | ESG | Event | Ownership | Debt & Credit | Peers & Valuation | Derivatives | Filings

PRICE PERFORMANCE

Open	
Prev. Close	123.08
Bid / Ask	123.24 / 123.35
VWAP	
Turnover	--
Volume	13,358
Short Interest	0.500%
YTD	67.66%
Beta (5Y Monthly)	1.272
Mkt Cap - Default	USD 2.093T
PE (LTM)	37.676
Div Yield	0.666%
DR	BRL AAPL34.SA (1:0.1)
DR Type	--
DR Bank	--

Today | 5D | 3M | 6M | 1Y | 5Y | YTD

No Benchmark

52Wk: 53.153 (23-Mar) — Last — 137.980 (02-Sep) — Daily

Next Earn Report: 26-Jan-2021

Free Float	16.99B	Asset Ty...	Ordinary Share	5 yr CDS	28.35 bps
Outstanding	17.00B	Share Class	--	Δ Today	1.00%
IPO Date	12-Dec-1980	Lot Size	100	Δ 1 Week	2.72

RECOMMENDATIONS

Mean

AAPL

Phones & Handheld Devices

Analysts Per Level

Strong Buy	11
Buy	19
Hold	8
Sell	1
Strong Sell	1

Price Target (Mean) USD 125.92 Upside 2%

STARMINE MODELS

Highlights | All Models

Bullish		Bearish	
Price Momentum	97	Intrinsic Valuation	19
Analyst Revisions	79	Relative Valuation	23
Smart Holdings	77	Insider	27
Short Interest	95		
Earnings Quality	95		
Credit Risk - Combined	96		
Credit Risk - Smart Ratios	92		
Credit Risk - Structural	88		
Credit Risk - Text Mining	85		
Combined Alpha Model	72		

RELATIVE VALUATION

	Global Rank	Trailing 12 Months AAPL	Trailing 12 Months Industry Median	Next 12 Months AAPL	Next 12 Months Industry Median
PE	32	36.284	8.368	30.782	13.425
EV/EBITDA	24	26.610	8.037	22.303	8.094
Div Yield	31	0.653%	1.808%	0.666%	3.242%
EV/Sales	18	7.514	1.149	6.363	1.013
P/CF	31	26.393	5.920	24.353	11.821
P/B	2	33.482	1.505	47.447	2.774

ESTIMATES

Guidance | Summary

	QTR Dec-2020 EPS	QTR Dec-2020 Rev	FY Sep-2021 EPS	FY Sep-2021 Rev
Mean Estimate	1.39	102.00B	3.96	315.25B
Smart Estimate	1.39	101.94B	3.95	314.43B
Predicted Surprise	0.00%	-0.06%	-0.32%	-0.26%
Mean Chg %	0.62%	0.29%	0.95%	0.33%

NEWS

News | Investor Briefs | Global Press

03-Dec-2020

10:15:43	BUSINESS Apple sued over old iPhones in Europe Tech giant i...	LATIME
10:13:01	《外企动向》苹果因旧款手机电池问题在欧洲多国面临诉讼	HKETNN
10:12:11	《外企動向》蘋果因舊款手機電池問題在歐洲多國面臨訴訟	HKETNN
09:49:33	USPTO ISSUES TRADEMARK: WORKS WITH APPLE IBEACON	USFEDE
09:16:24	Analysts' Weekly Ratings Updates for Apple (AAPL)	TICREP
09:11:02	Analysts' Weekly Ratings Updates for Apple (AAPL)	AMEBAN
09:00:25	《A股焦点》欧菲光：被苹果移出相机模块供应链消息不属实	HKETNN
08:59:39	《A股焦點》歐菲光：被蘋果移出相機模塊供應鏈消息不屬實	HKETNN
07:13:26	Dow Jones Selected Stocks 1710 - December 03	AAP
06:47:44	RPT-Hong Kong-Le magnat Jimmy Lai détenu pour des accusa...	RTRS

RESEARCH

Contributor | Internal

03-Dec-2020	Equiti Global Arabic Smart Report	Equiti
02-Dec-2020	Trefis Report: Apple - $99.92 Trefis Price Estimate	Trefis
02-Dec-2020	Equiti Global Arabic Smart Report	Equiti
01-Dec-2020	Comprehensive Technical and Fundamental Analysis...	Stock Trade...
01-Dec-2020	Equiti Global Arabic Smart Report	Equiti
30-Nov-2020	Equiti Global Arabic Smart Report	Equiti
29-Nov-2020	"The Economy Matters" Report for AAPL: the econo...	MacroRisk ...

EVENTS

Upcoming | Past

26-Jan-2021

NTS	Q1 2021 Apple Inc Earnings Release

25-Feb-2021

18:00:00	Apple Inc Annual Shareholders Meeting

PEERS

Company Name	Mkt Cap	% Chan...	Reven...	EBITD...	EV/ ...
Apple Inc	2.09T		274.52B	28.17%	23.39
HP Inc	31.34B	1.97%	56.64B	8.40%	6.63

[4]:
```
%%time
data = ek.get_timeseries('AAPL.O', fields='*',
                         start_date='2020-12-02 16:00:00',
                         end_date='2020-12-02 16:30:00',
                         interval='tick')
```

```
CPU times: user 115 ms, sys: 6.49 ms, total: 122 ms
Wall time: 4.65 s
```

[5]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 32239 entries, 2020-12-02 16:00:00.010000 to 2020-12-02 16:29:59.914000
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   VALUE   32191 non-null  float64
 1   VOLUME  32239 non-null  Int64
dtypes: Int64(1), float64(1)
memory usage: 787.1 KB
```

[6]:
```
data.head()
```

[6]:

	AAPL.O	VALUE	VOLUME
	Date		
2020-12-02 16:00:00.010		122.00	37
2020-12-02 16:00:00.010		122.00	2
2020-12-02 16:00:00.010		122.01	600
2020-12-02 16:00:00.010		122.01	300
2020-12-02 16:00:00.010		122.00	20

[7]:
```
news = ek.get_news_headlines('R:AAPL.O',
                             date_from='2020-10-13',
                             date_to='2020-10-14',
                             count=5
                            )
```

[8]:
```
news
```

[8]:

	versionCreated	text	storyId	sourceCode
2020-10-13 21:40:03.235	2020-10-13 23:55:17.584000+00:00	Refinitiv Newscasts - Post-Market Wrap: Octobe...	urn:newsml:reuters.com:20201013:nRTV99mSrx:4	NS:CNBC
2020-10-13 21:07:10.816	2020-10-13 23:17:28.661000+00:00	Refinitiv Newscasts - Apple enters 5G race wit...	urn:newsml:reuters.com:20201013:nRTV8h4JYx:4	NS:RTRS
2020-10-13 21:05:12.773	2020-10-13 23:14:26.185000+00:00	Refinitiv Newscasts - T-Mobile CEO on 5G servi...	urn:newsml:reuters.com:20201013:nRTV3ghlDN:2	NS:CNBC
2020-10-13 23:12:27.333	2020-10-13 23:12:27.333000+00:00	Prime Day 2020: The best deals from Apple, Mic...	urn:newsml:reuters.com:20201013:nNRAd6qnfu:1	NS:INDEPE
2020-10-13 20:58:43.544	2020-10-13 23:10:15.457000+00:00	Refinitiv Newscasts - I feel more bullish afte...	urn:newsml:reuters.com:20201013:nRTV6vSQ8N:5	NS:CNBC

[9]:
```
from IPython.display import HTML
```

[10]:
```
HTML(ek.get_news_story(news['storyId'].iloc[1]))
```

[10]:

Click the following link to watch video: https://share.insider.thomsonreuters.com/link?entryId=1_eg1wg2n1&referenceId=tag:reuters.com,2020:newsml_OVCZYVZPN_K15&pageId=ReutersNews

Source: Thomson Reuters

Description: Apple on Tuesday launched four versions of its new flagship iPhone 12 with faster 5G connectivity in hopes of sparking an upgrade cycle that will keep sales booming through the end of the year. Conway G.Gittens has more on what's coming.

Infrastructure

IP[y]:
IPython

NumPy

matplotlib

pandas

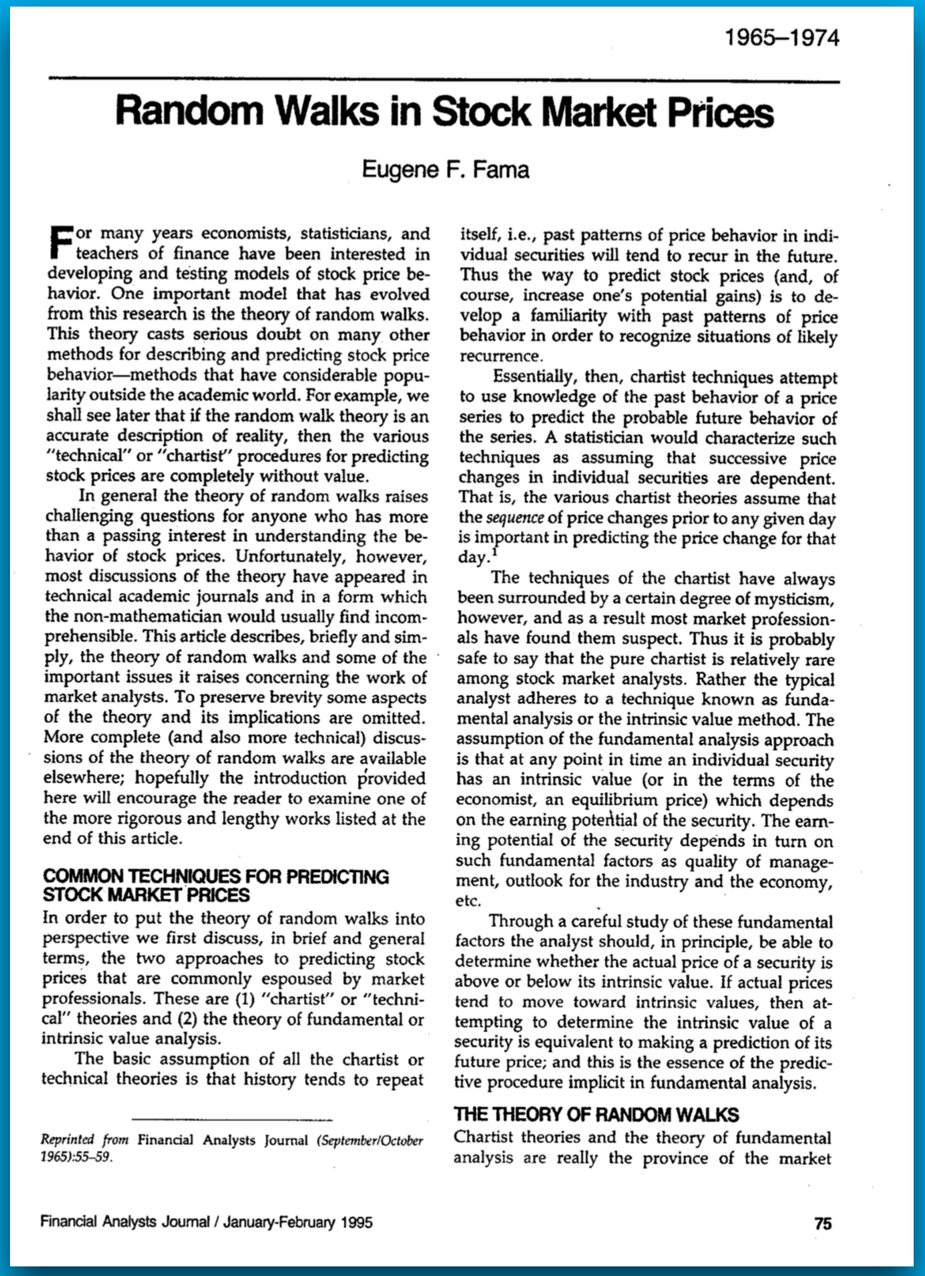
$$y_i t = \beta' x_{it} + \mu_i + \epsilon_{it}$$

Keras

Resources & Links

http://bit.ly/epat_mar_2021

Efficient Markets



1965–1974

Random Walks in Stock Market Prices

Eugene F. Fama

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.

In general the theory of random walks raises challenging questions for anyone who has more than a passing interest in understanding the behavior of stock prices. Unfortunately, however, most discussions of the theory have appeared in technical academic journals and in a form which the non-mathematician would usually find incomprehensible. This article describes, briefly and simply, the theory of random walks and some of the important issues it raises concerning the work of market analysts. To preserve brevity some aspects of the theory and its implications are omitted. More complete (and also more technical) discussions of the theory of random walks are available elsewhere; hopefully the introduction provided here will encourage the reader to examine one of the more rigorous and lengthy works listed at the end of this article.

COMMON TECHNIQUES FOR PREDICTING STOCK MARKET PRICES

In order to put the theory of random walks into perspective we first discuss, in brief and general terms, the two approaches to predicting stock prices that are commonly espoused by market professionals. These are (1) "chartist" or "technical" theories and (2) the theory of fundamental or intrinsic value analysis.

The basic assumption of all the chartist or technical theories is that history tends to repeat itself, i.e., past patterns of price behavior in individual securities will tend to recur in the future. Thus the way to predict stock prices (and, of course, increase one's potential gains) is to develop a familiarity with past patterns of price behavior in order to recognize situations of likely recurrence.

Essentially, then, chartist techniques attempt to use knowledge of the past behavior of a price series to predict the probable future behavior of the series. A statistician would characterize such techniques as assuming that successive price changes in individual securities are dependent. That is, the various chartist theories assume that the *sequence* of price changes prior to any given day is important in predicting the price change for that day.[1]

The techniques of the chartist have always been surrounded by a certain degree of mysticism, however, and as a result most market professionals have found them suspect. Thus it is probably safe to say that the pure chartist is relatively rare among stock market analysts. Rather the typical analyst adheres to a technique known as fundamental analysis or the intrinsic value method. The assumption of the fundamental analysis approach is that at any point in time an individual security has an intrinsic value (or in the terms of the economist, an equilibrium price) which depends on the earning potential of the security. The earning potential of the security depends in turn on such fundamental factors as quality of management, outlook for the industry and the economy, etc.

Through a careful study of these fundamental factors the analyst should, in principle, be able to determine whether the actual price of a security is above or below its intrinsic value. If actual prices tend to move toward intrinsic values, then attempting to determine the intrinsic value of a security is equivalent to making a prediction of its future price; and this is the essence of the predictive procedure implicit in fundamental analysis.

THE THEORY OF RANDOM WALKS

Chartist theories and the theory of fundamental analysis are really the province of the market

Reprinted from Financial Analysts Journal *(September/October 1965):55–59.*

Eugene F. Fama (1965):

"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"

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

“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.”

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”).

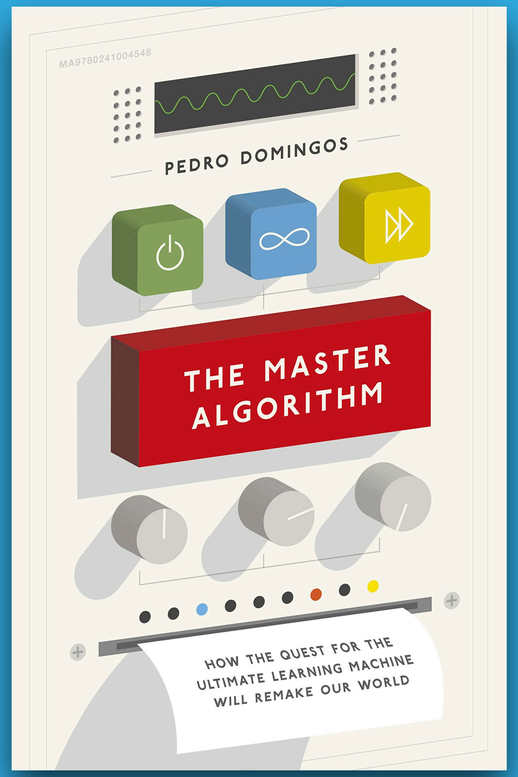
In such a case, the best predictor of tomorrow’s stock price — in a least-squares sense — is today’s stock price.

AI-First Finance

scientific method

noun

a method of procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses.
"criticism is the backbone of **the scientific method**"



"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."

Bullish patterns (going up)

Flag

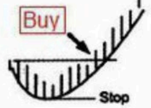
Pennant

Cup with handle

Ascending triangle

Symetrical triangle

Measured move up



Ascending scallop

3 rising valleys

Bearish patterns (going down)

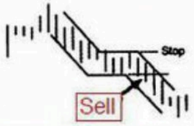
Flag

Pennant

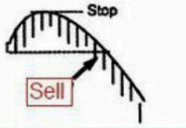
Invertede Cup with handle

Descending triangle

Symetrical triangle



Measured move down



Descending scallop

3 descending peaks

Reversal patterns

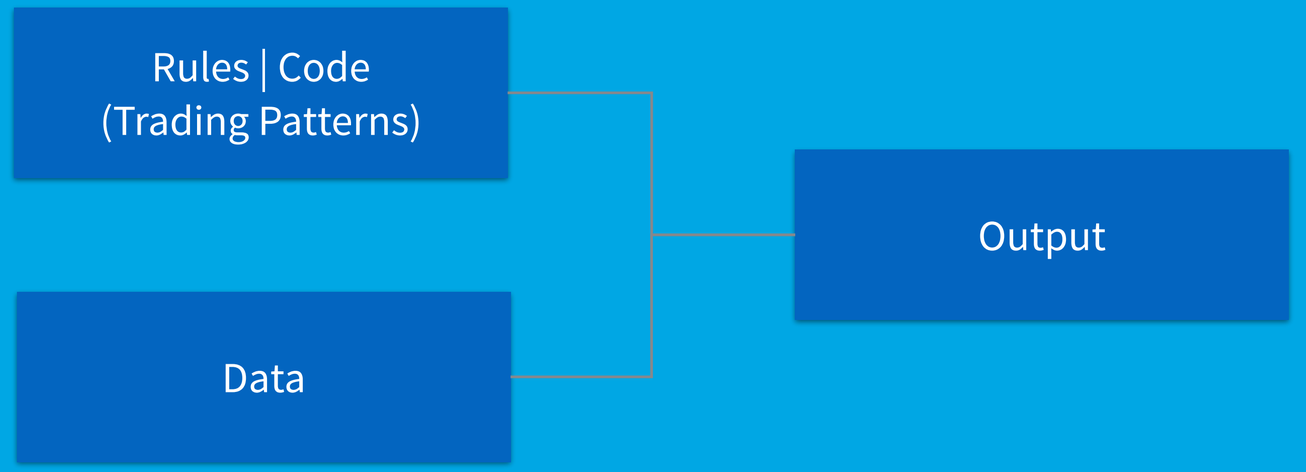
Double bottoms

Diamond bottoms

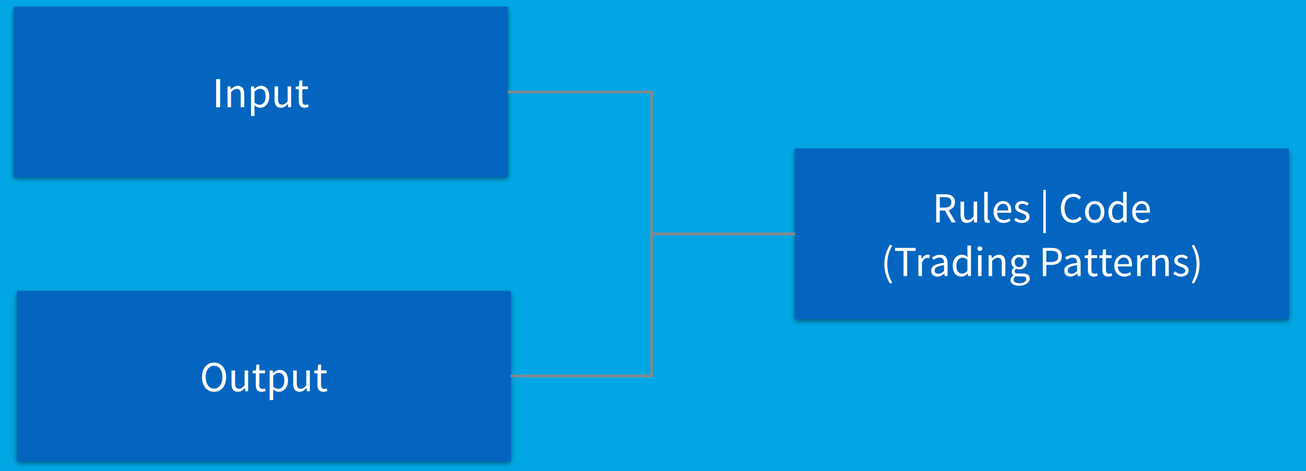
Tops rectangle

Head and shoulders top

Programming.



Machine Learning.



Financial Markets

Finance History

AI in Finance = finaince

“normative economics = assumptions, axioms, etc.”

“positive economics = data, relationships, etc.”

x

x

(too) “simple and elegant theories”

“general, parametrizable, trainable algorithms”

f(•)

m(•, a, b)

“hardly any supporting empirical evidence”

“might show good performance, but black box”

y

f(x) ≠ y

m(x, a*, b*) ≈ y

“non-linear, complex, changing”

“brain-driven & beauty myth”

“data-driven & AI-first”

How investment analysts became data miners

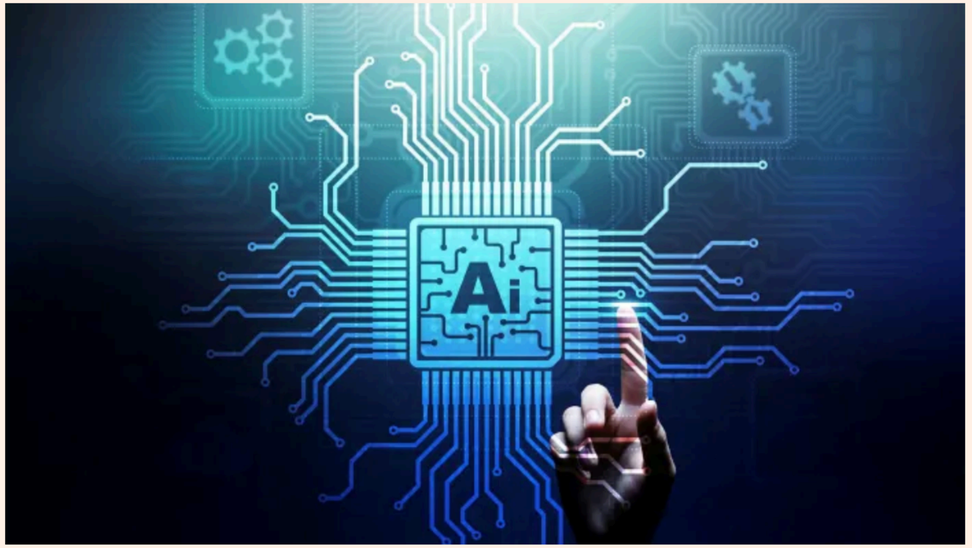
Banks battle for audiences with new information sets, ‘charticles’ and podcasts

© AP

Will bots replace humans in active equity investment?

Machine learning will implement quant analysis to find the right stocks

ROBERT POZEN + Add to myFT



ML can identify outperforming equities based on patterns that would have not been selected by humans © Dreamstime

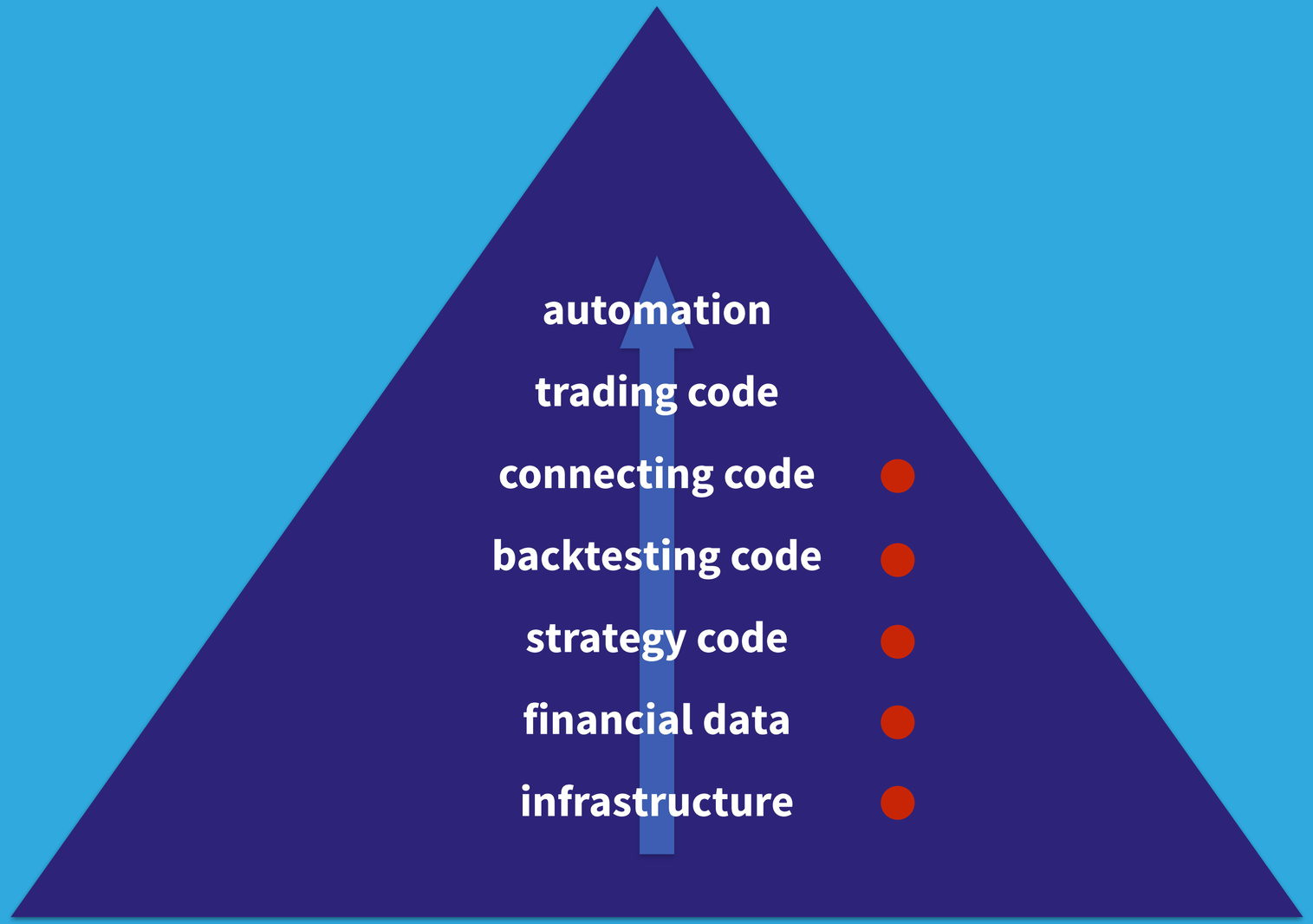
Overview

INFRASTRUCTURE
Python environment, Jupyter Notebook,
first steps, vectorized backtesting

VECTORIZED BACKTESTING
interactive code,
OOP and Python classes

EVENT-BASED BACKTESTING
base backtesting class,
strategy backtesting class

REAL-TIME DATA
simulated streaming (“real-time”) data,
data processing, online algorithms


automation
trading code
connecting code
backtesting code
strategy code
financial data
infrastructure

Why Object Orientation?

Some human aspects:

- natural way of thinking
  - a “house”
  - a “person”
  - a “person” in a “house”
- mastering complexity
- nicer user interfaces
- pythonic way …

Some technical aspects:

- abstraction
- modularity
- re-usability
  - inheritance
  - composition
  - aggregation
  - polymorphism
- non-redundancy

Free e-book about OOP in general

Lecture Notes on Object-Oriented Programming

Free e-book about Python programming & OOP

http://python-textbok.readthedocs.io/en/1.0/

Fluent Python (O'Reilly)

https://learning.oreilly.com/library/view/fluent-python-2nd/9781492056348/

The Python Quants GmbH

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