AI-Powered Algorithmic Trading with Python

Half-Day Training at ODSC London 2022

Dr. Yves J. Hilpisch









You find the Gist with the resources under https://bit.ly/odsc_ldn_2022 (will be updated during the session)

Agenda

- Introduction
- The Medium Article
- Trading Platform

- The AI Machine

• Data-Driven Finance • Case Study: Momentum Case Study: AI Strategy Case Study: Deployment

Introduction



SERVICES

for financial institutions globally





TRAINING

about Python for finance & algorithmic trading

PLATFORM

for browser-based data analytics

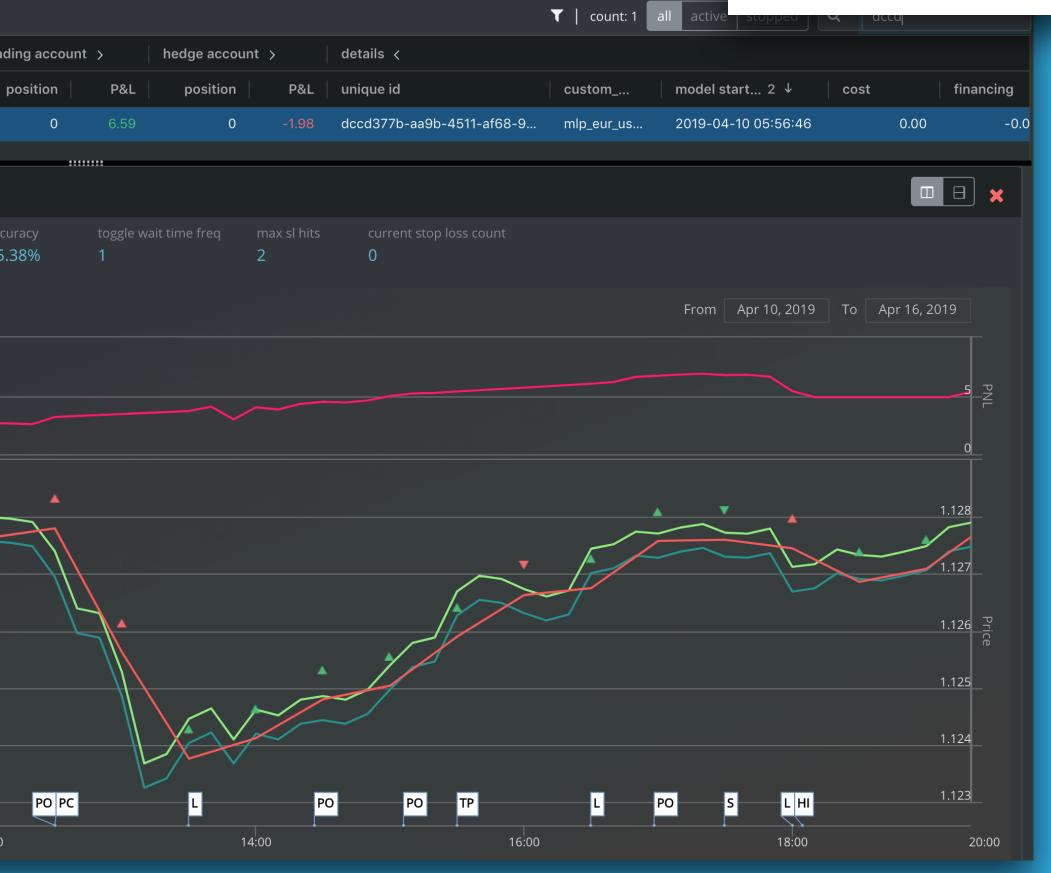
for financial analytics

EVENTS for Python quants & algorithmic traders **THE PYTHON** QUANTS CERTIFICATION QUANTS in cooperation with university BOOKS about Python and finance **OPEN SOURCE** Python library

http://tpq.io

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http://aimachine.io

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 six books (https://home.tpq.io/books):

* Financial Theory with Python (2021, O'Reilly) * Artificial Intelligence in Finance (2020, 0'Reilly) * Python for Algorithmic Trading (2020, 0'Reilly) * Python for Finance (2018, 2nd ed., 0'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





Financial Theory with Python – A Gentle Introduction



Financial Theory with Python

A Gentle Introduction



Yves Hilpisch

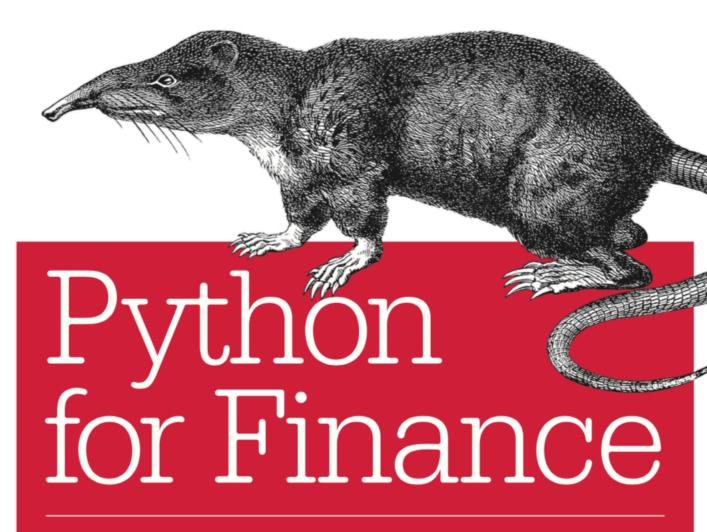
Yves Hilpisch

Finance with Python and Python environments Basic Finance Concepts and Models:

- Risk-Return
- Pricing of Instruments
- Expected Utility Theory
- Mean-Variance Portfolio Theory
- Capital Asset Pricing Model
- Portfolio Optimization
- Basic Python Concepts and
- Packages:
- Major Python Idioms
- NumPy Package
- SciPy & SymPy Packages

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MASTERING DATA-DRIVEN FINANCE

Yves Hilpisch

Python for Finance

OREILLY® オライリー・ジャパン

データ駆動型アプローチに向けて

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http://books.tpq.io

Quant Finance with Python

Wiley Finance Series

Derivatives Analytics with Python

Data Analysis, Models, Simulation, Calibration and Hedging

YVES HILPISCH

A ...

WILEY

Wiley Finance Series

Listed Volatility and Variance Derivatives

A Python-based Guide

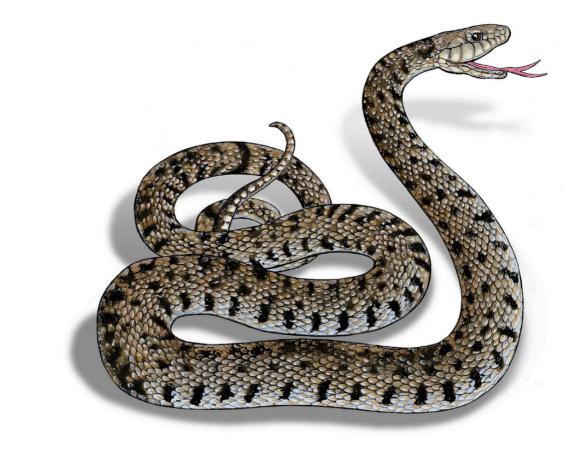
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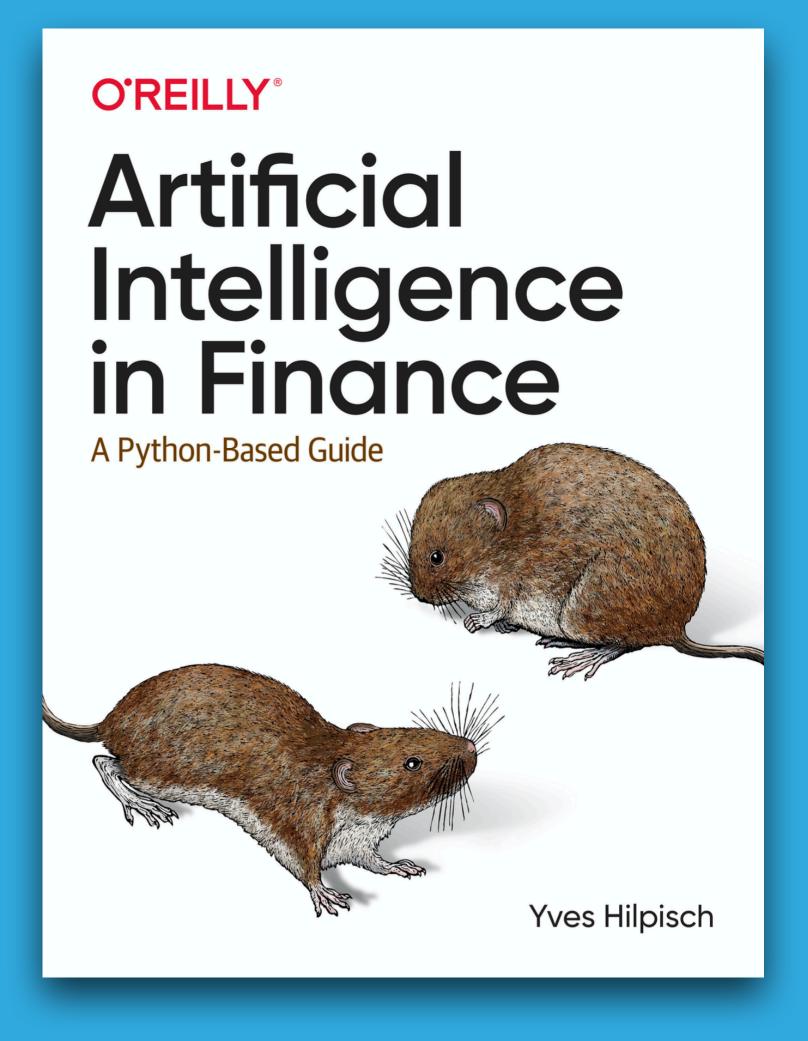
O'REILLY[®] **Python** for Algorithmic Trading

From Idea to Cloud Deployment



Yves Hilpisch

Python & AI for Finance & Trading



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Pythonからはじめる アルゴリズムトレード

自動売買の基礎と機械学習の本格導入に向けた Pythonプログラミング



Yves Hilpisch 著 村上振一郎 訳 YVES HILPISCH

Trading con Python



Creare algoritmi per la compravendita e l'analisi di mercato

APCEO





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Data-Driven Finance

FINANCIAL TIMES

COP clock runs down

Summit's 'blah blah blah' is welcomed -- GILLIAN TETH Business climate pledges' credibility gap — BIG READ, PA

rotest legacy

- NHS waiting list soars to almost 6m

» Wall St cashes in on GE's decline and fa

w price and the break-up of the group.- rat

+ Johnson Matthey cans battery chemical

» Uber chief flies in to fix London crisi

» Race to feed Afghans as winter looms

+ Lukashenko threatens EU gas supplies

unsit of gas and goods to Europe if the EU imp other subscribes on his regime over the migran

Foreign buyers triple home ownership

udde" and "shocking",- rate

ITTER. - PAGE 14, LEX. PAGE

Iran impasse Long wait for liberty goes on



Xi cements grip on China after vote puts him on par with Mao

Party says nation 'rejuvenated'
 Third five-year term likely
 New emphasis on socialism

BUT'S YER

De Klerk, last president of apartheid era, dies at 85

FW de Kherk, who shared the Nobel

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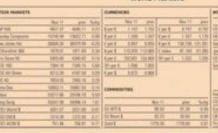
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Johnson's £4m outside earnings open him to charges of hypocrisy from MPs

ets Johnson, who this work ordered



World Markets



THE WALL STREET JOURN

DOW JONES News Corps ****

WEDNESDAY, NOVEMBER 10, 2021 ~ VOL. CCLXXVIII NO. 112 DJIA 36319.98 🔻 112.24 0.3% NASDAQ 15886.54 🔻 0.6% STOXX 600 482.71 👻 0.2% 10-YR. TREAS. 🛦 19/32, yield 1.431% OIL \$84.15 🛦 \$2.22 GOLD \$1,830.20 🛦 \$2.80 EURO \$1.1596 YEN 112.88

WSJ.com

John Flannery Larry Culp Aug. 2017 Oct. 2018

GE Breakup Marks End of an Era What's News

Sept. 2001 \$224.19B

and ebbed under four CEOs as it focused on

1980

Tax Bill

tax increase.

wary.....

Looms as

Business & Finance •

General Electric, the company that for more than century stood as a beacon of U.S. manufacturing might will split into three public ompanies, drawing the curin on an era of business the dominance of industrial conglomerates. A1, A12, A13

• U.S. stocks fell back, from record levels, with the Nasdaq, S&P 500 and Dow declining 0.6%, 0.4% and 0.3%, respectively. B12

• Rivian priced its highly anticipated IPO at \$78 a share, well above its raised expecta-tions, valuing the electric-vehicle maker at more than \$77 bil-lion on a fully diluted basis. **B1**

• Panera plans to go public nd has secured an uno onal investment from resta rateur Danny Mever's SPAC. B1

• Semiconductor makers ave earmarked less than 17% of the roughly \$146 billion the industry will devote to capital pending this year to legacy chips, Gartner estimates. **B1**

◆ Hertz, which emerged from bankruptcy this summer, listed on the Nasdaq, with shares losing down nearly 10% in the irst day of trading. **B1**

◆ DoorDash said it agreed to acquire European food-deliv-ery company Wolt in a deal valued at over \$8 billion. **B3**

• Presto is close to a deal to ombine with a SPAC and go public in a merger that would ogy firm at about \$1 billion. B3

• Videogame company Unity agreed to pay \$1.63 oillion for major parts of vi-

ual-effects studio Weta. **B4**

World-Wide +

Nicaragua, after a presiential election the U.S. called raudulent, is now widely en to have become Latin merica's third dictatorship and part of a broader trend of nocratic backsliding across he region, U.S. officials and olitical analysts said. A1

◆ Ports snarled with suply-chain problems will be ble to redirect money from other federally funded projects to help ease the logjams under a plan outlined by the Biden administration. A2

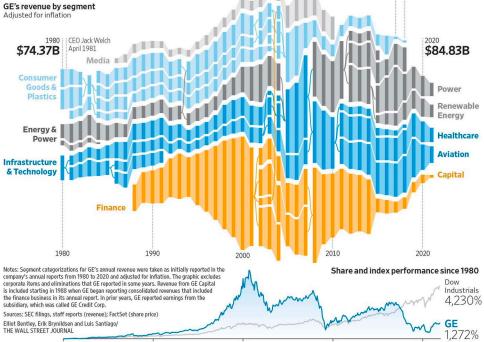
◆ The Oklahoma Supreme urt overturned a ruling that held J&J liable for tributing to the state's opioid-addiction crisis. A2

◆ Pfizer and partner BioN-Tech asked U.S. health reglators to expand the auorization of their Covid-19 booster to people as young as 18 years old. A3

◆ A federal judge said reords from the Trump White

louse can be turned over to

Over the past four decades, GE's revenue swelled CEO Jeff Immelt : 2004 different businesses, including a shift away from consumer goods and a bet on finance.



Company that symbolized U.S. manufacturing power to split into three parts

BY THOMAS GRYTA

General Electric Co., the ompany that for more than a century stood as a beacon of U.S. manufacturing might and management prowess, will spli nto three public companies drawing the curtain on an era of business—the dominance of industrial conglomerates.

The decision, announced Tuesday by Chief Executive Larry Culp, ends the myth that GE wielded a magic touch to run companies better, and make everyone richer, through its management of varied en terprises around the world. When Mr. Culp took over as CEO of a wounded GE three years ago, he faced calls from inside and outside to break it apart. He resisted the idea saying he wanted to fix GE and just needed more time. He re paired company finances, but ultimately concluded that investors wanted a simple structure. "It was clear this Please turn to page A13

◆ General Electric through the years in photos..... A12-13 Heard on the Street: GE sheds

ings simply had to ask one question of the content they

were considering recirculating

Please turn to page A

"Has it gone viral in the past"

Facebook Rife With Stolen Content

Latest in a series

By KEACH HAGEY the facebook files 🖭 AND JEFF HORWITZ

Musk Eyes Facebook has allowed pla-

Elon Musk's pledge to sell warned in internal memos. to disseminate content on the following year. "Step 1: 10% of his Tesla Inc. stock highlights the complex finan-facebook pages at one point in Facebook, while individual us Facebook, while individual us Facebook, while individual us Facebook, while individual us Facebook, stock Facebook

Share Sale gaining and recycled content to flourish on its platform de- viewed by The Wall Street effort) way to make a big Face- continues to be a formula for spite having policies against it, Journal. Pages are used by the tech giant's researchers businesses and organizations book Page?" Mr. Allen wrote in success on Facebook, accord-an internal slide presentation ing to data the company has cial web the world's richest man has spun around his per-sonal fortune. 2018 went to pages that stole or repurposed most of their content, according to a re-Facebook has been slow to

2020

in late 2019, wrote that Face

Mr. Allen, who left Facebook

Meta Curbs **Targeted Ads**

Personalized advertising o politics is dropped.....



BY LISA BANNON AND ANDREA FULLER

Over the past decade, the University of uthern California has used a for-profit ompany to help enroll thousands of students n its online social-work master's program. The nonprofit school used its status-symbol image to attract students across the lents it targeted for recruitment, often with U.S. Education Department data found. Com gressive tactics. Most students piled on debt to afford the tuition, which last year

pared with other master's-degree programs

reached \$115,000 for the two-year degree The majority never set foot on the posh Los Angeles campus but paid the same rate for online classes as in-person students. took out federal loans borrowed a median \$112,000. Half of them were earning \$52,000

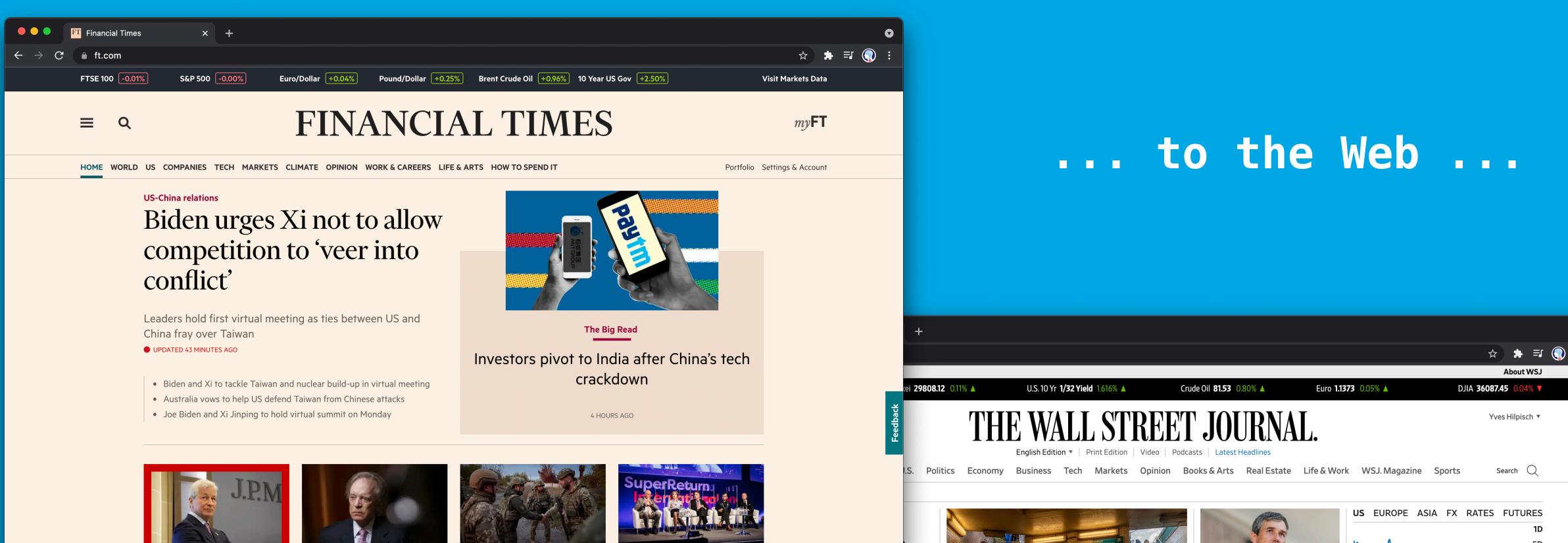
Please turn to page A14

Recent USC social-work graduates who or less annually two years later, a Wall

Democracy Loses Favor Is Santa

From print ...







Virtual Meeting

The White House said the U.S. and Chinese presidents discussed a variety of topics including Afghanistan, North Korea and Iran, as well as human rights, climate change and concerns over Taiwan. 🖓 492 🕘 7 min read

▶ How U.S. Plays Catch-Up on China's Push for Influence

President Signs Infrastructure Bill Into Law

The passage of the \$1 trillion bill to repair roads and bridges, upgrade the electrical grid and expand access to broadband



internet marks a rare bipartisan policy win for the White House. 🕘 6 min read

• What's in the Bill? From Amtrak to Roads to Water Systems



America's Infrastructure Struggles With New Weather Forecast

•

Historically anomalous heat and rain have overwhelmed systems designed to withstand old meteorological patterns, and climatologists expect still worse with climate change. "We've never seen destruction like this before." 🖵 523 🕘 Long read

Shell to Move Headquarters to London Amid



Beto O'Rourke Announces Bid for Texas Governor 4 min read



Kyle Rittenhouse Homicide Trial Wraps Up 2 5 min read



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America Will Be Number One—in Taxes By The Editorial Board | Review & Outlook

OPINION

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| variety of rel | esigns, manufactures and markets smartphones, personal computers, tablets, wearables and acc ated services. The Company's products include iPhone, Mac, iPad, and Wearables, Home and Ac y's line of smartphones based on its iOS operating system. Mac is the Company's line of persona | United States NASDAQ Glo | bal Select Consoli | idated Phones & Handheld Devices | | | | | | | | | | | | Valuat | ion VC |
| its macOS of Home and A | perating system. iPad is the Company's line of multi-purpose tablets based on its iPadOS operatin ccessories includes AirPods, Apple TV, Apple Watch, Beats products, HomePod, iPod touch and | Overview News & Reserve | arch Price & Ch | arts Estimates Financials ESG | Event Ov | wnership De | ebt & Credit | Peers & Valuati | on Derivatives | Filings | | | | | | ĺ | |
| and third-par line of smart | ty accessories. AirPods are the Company's wireless headphones that interact with Siri. Apple Wa watches. Its services include Advertising, AppleCare, Cloud Services, Digital Content and Payme | | | | STA | ARMINE MODE | ELS → | | High | lights | All Models | NEWS > | | News | Investor Briefs | s Globa | al Press |
| customers a | e primarily in the consumer, small and mid-sized business, education, enterprise and governmer | Open | | AAPL.O : 123.13 | 124.00 Bul | llish | | | Bearish | | | 03-Dec-2020 | | | | | |
| NEWS > | | Prev. Close | © 123.08 | | 123.50 Pric | ce Momentum | | 97 | Intrinsic Valuation | | 19 | 10:15:43 E | BUSINESS Apple sued o | ver old iPhones in E | urope Tech giaı | | TIME |
| 16-Nov-2021 | | | 123.24 / 123.35 | in the standard | | alyst Revisions | | | Relative Valuation | | 23 | | 《外企动向》苹果因旧款 | | | | ETNN |
| 08:51:09 | Refinitiv Newscasts - Evidence of Belarus providing migrants tourist visas | VWAP | | | 122.50 | art Holdings | | | Insider | | 27 | | 《外企動向》蘋果因舊款 | | | • | ETNN |
| 05:40:45 | S. Korea's new law on in-app payment is 'monumental': CAF chief | Turnover Volume | () 13,358 | | 122.00 | ort Interest nings Quality | | 95 95 | | | | | | | | | FEDE |
| 04:00:00 | KILL Singtel in Partnership with Apple Inc, Selects Nextech AR Solutions To Showcase Augme | | 0.500% | | | edit Risk - Com | bined | 96 | | | | | Analysts' Weekly Ratings Analysts' Weekly Ratings | | | | CREP /IEBAN |
| 01:48:19 | Apple Pty Ltd "Disney Melee Mania" coming this December exclusively on Apple Arcade | | G 67.66% | | | edit Risk - Smai | | 92 | | | | | 《A股焦点》欧菲光:被 | | | | |
| 01:10:00 | iPhone Black Friday Deals 2021: Best Early Apple iPhone Sales Reported by The Consumer P | Beta (5Y Monthly) | 1.272 | 2 12:00 15:00 | | edit Risk - Struc | ctural | 88 | | | | | 《A股焦點》歐菲光:被 | | | | ETNN |
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| 23:52:47 | EXCLUSIVE-Engine No. 1 partner leaves hedge fund after successful challenge of Exxon | | APL34.SA (1:0.1) | 52Wk: 53.153 | | | Global | Trailing 12 M | | Next 12 M | | 03-Dec-2020 | Equiti Global Arat | oic Smart Report | | Equit | |
| 23:39:51 | Jamf Announces Upcoming Conference Participation | DR Type | | Daily | 2-Sep n-2021 | | Rank | AAPL | Industry Median | AAPL | Industry Median | 02-Dec-2020 | Trefis Report: App | le - \$99.92 Trefis P | rice Estimate | Trefis | |
| 23:27:41 | Black Friday 2021 deals at Best Buy are here, with huge savings on Samsung, Apple and more | DR Bank | | | PE | | 32 | 36.284 | 8.368 | 30.782 | 13.425 | 02-Dec-2020 | | | | Equit | |
| 23:12:15 | How to connect any AirPods to your iPhone | | | | 1.000/ | /EBITDA | 24 | 26.610 | 8.037 | 22.303 | 8.094 | 01-Dec-2020 | | echnical and Funda | mental Analysis | | k Trade |
| EVENTS > | UPCOMING | | Share Class | | 0.70 | ' Yield | 31 | 0.653% | 1.808% | 0.666% | 3.242% | 01-Dec-2020 | | | | Equit | |
| 18-Nov-2021 | | IPO Date 12-Dec-1980 RECOMMENDATIONS | Lot Size | 100 ∆ 1 Week | | /Sales | 18 | 7.514 | 1.149 | 6.363 | 1.013 | 30-Nov-2020 29-Nov-2020 | | atters" Report for AA | Pl · the econo | Equit | |
| NTS | AAPL34.SA Final Cash Dividend of gross BRL 0.123473 paid on Nov 18, 2021 going | Mean | | Analysts Per Level | P/C | | 31 2 | 26.393 33.482 | 5.920 1.505 | 24.353 47.447 | 11.821 2.774 | EVENTS > | The Leonomy Ma | | Upcoming | | ast |
| 19-Nov-2021 | | AAPL | | Strong 11 | P/B ES1 | | | 33.482 | | | 2.774 Summary | 26-Jan-2021 | | | | | |
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021-11-15 15:00:00', 1-11-15 15:30:00', k',

total: 135 ms

15 15:00:00.004000 to 2021-11-15 15:29:59.936000

... to powerful APIs.

| | Apple Event on 18. C | October 2021 (https://www | w.apple.com/de/apple-e | vents/october-2021/). | |
|-------|----------------------------|-------------------------------------|--|--|------------|
| [9]: | headlines = ek.ge | et_news_headlines(que | ry='R:AAPL.0 macbook | | |
| | | | nt=5, | | |
| | | | e_from='2021-10-18', | | |
| | | date | e_to='2021-10-19') | | |
| [40] | | | | | |
| [10]: | headlines | | | | |
| [10]: | | versionCreated | text | storyld | sourceCode |
| | 2021-10-18 23:30:18.401 | 2021-10-18 23:30:18.401000+00:00 | Apple is finally fixing the things people hate | urn:newsml:reuters.com:20211018:nNRAh2psl1:1 | NS:WASHPO |
| | 2021-10-18 23:10:18.012 | 2021-10-18 23:10:18.012000+00:00 | Apple event – live: Macbook Pro and other new | urn:newsml:reuters.com:20211018:nNRAh2kj3a:1 | NS:INDEPE |
| | 2021-10-18 21:41:19.927 | 2021-10-18 21:41:19.927000+00:00 | New MacBook Pro features ultra-fast chips, ret | urn:newsml:reuters.com:20211018:nNRAh2u38b:1 | NS:EFEING |
| | 2021-10-18 21:33:50.860 | 2021-10-18 21:33:50.860000+00:00 | Apple Event: MacBook Pro 2021 alleged pictures | urn:newsml:reuters.com:20211018:nNRAh2u1wj:1 | NS:TIMIND |
| | 2021-10-18 21:33:50.623 | 2021-10-18 21:33:50.623000+00:00 | Apple launches new MacBook Pro: Price, specs a | urn:newsml:reuters.com:20211018:nNRAh2u1vv:1 | NS:TIMIND |

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| [11]: | <pre>story = headlines.iloc[0]</pre> |
|-------|---|
| | |
| [12]: | story |
| [10]. | 2021 10 10 |
| [12]: | versionCreated 2021-10-18 |
| | text Apple is finally fixing the |
| | storyId urn:newsml:reuters.com: |
| | sourceCode |
| | Name: 2021-10-18 23:30:18.401000, dtype: objec |
| [13]: | <pre>news_text = ek.get_news_story(story['storyId']</pre> |
| [=0]: | |
| [14]• | <pre>from IPython.display import HTML</pre> |
| [14]. | |
| [15]. | HTML(news_text) |
| [12]: | |
| [15]. | The demise of MagSafe charging. An inelegant Touch Ba |
| | |
| | Apple's laptops has steadily grown over the past five yea |
| | On Monday, the Cupartine Calif company unveiled a pr |
| | On Monday, the Cupertino, Calif., company unveiled a pa |
| | processors and free of the many limitations that plagued |
| | HomePod mini smart speakers. Riding high from record |
| | |
| | of its virtual event Monday. |
| | |

Still, computers that run Apple's MacOS software account for only a fraction of the overall PC landscape — just over 7 percent as of the end of the second quarter, according to market research firm IDC. Its market share has slipped from 8 percent in the first quarter and 7.6 percent a year earlier, IDC data showed. The changes on display Monday seem to be geared more toward

3 23:30:18.401000+00:00 e things people hate... n:20211018:nNRAh2psl1:1 NS:WASHP0

εςτ

])

Bar. Limited selection of ports. The laundry list of complaints about ears. Now, Apple is finally walking back those changes.

bair of new MacBook Pro laptops, powered by its latest homegrown ed earlier models. It also showed off a set of updated AirPods and colorful d Mac sales last year, Apple made sure to make its new MacBooks the star

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IPython



pandas





The Medium Article



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Algorithmic Trading in Less than 100 Lines of Python Code

O'Reilly Media Follow 0 Dec 17, 2020 · 9 min read

If You Know Trading and Python, this Is Easy

Editor's Note: The barriers to entry for algorithmic trading have never been lower. Not too long ago, only institutional investors with IT budgets in the millions of dollars could take part, but today even individuals equipped only with a notebook and an Internet connection can get started within minutes. In this piece from <u>Python for Algorithmic Trading</u>, author Yves Hilpisch shows you how to implement a complete algorithmic trading project, from backtesting the strategy to performing automated, real-time trading.

Algorithmic trading refers to the computerized, automated trading of financial instruments (based on some algorithm or rule) with little or no human intervention during trading hours. Almost any kind of financial instrument — be it stocks, currencies, commodities, credit products or volatility — can be traded in such a fashion. Not only that, in certain market segments, algorithms are responsible for the lion's share of the trading volume. The books *The Quants* by Scott Patterson, *More Money Than God* by Sebastian Mallaby, and, more recently, *The Man Who Solved the Market* by Gregory Zuckerman paint a vivid picture of the beginnings of algorithmic trading and the personalities behind its rise.

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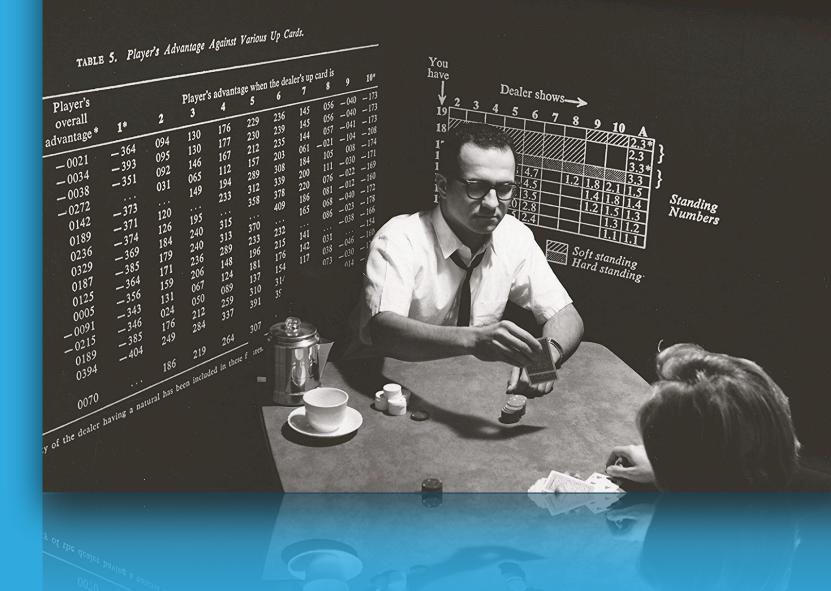
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EDWARD O. THOR A MAN FOR ALL MARKETS

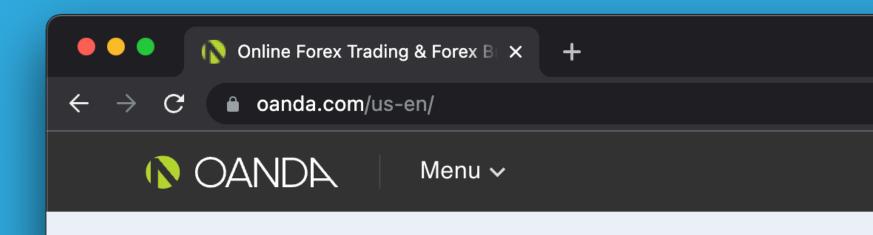
From LAS VEGAS to WALL STREET, HOW I BEAT THE DEALER and THE MARKET

FOREWORD BY NASSIM NICHOLAS TALEB



 $E = \frac{1}{2} MgL$ **NEW YORK TIMES BESTSELLER** $\frac{\partial \mathcal{O}}{\partial t} \left(\frac{q}{t}\right)^{\prime h} \left(\mathcal{O}_{0}^{2} - \mathcal{O}^{2}\right)^{\prime \prime 2}$ - Vn Snjn-1 000 00 (32) NA= (FrF), 2π - ML'O ML'O $\omega_{o}^{*} \chi = O \longrightarrow \omega_{o} = \left(\frac{c}{\Pi}\right)^{V_{o}}$ $\frac{\pi^{2}}{2m} \Delta \psi$ $\frac{\pi^{2}}{2m$ $(q_1 + \lambda_z^* < \mathsf{REVU})$ MEROOOD $E = \langle k \rangle = \langle u \rangle = \frac{1}{2} M W_{e}^{2} A^{2}$ f(x) = f(x) =





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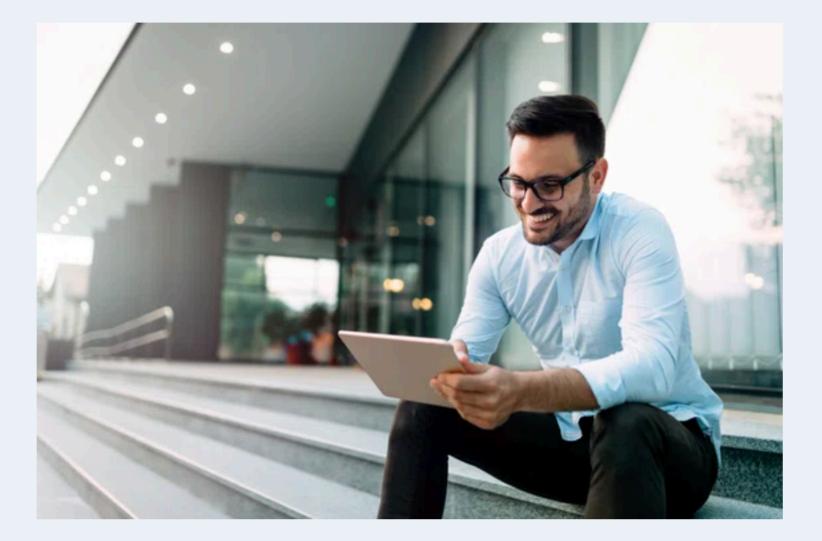
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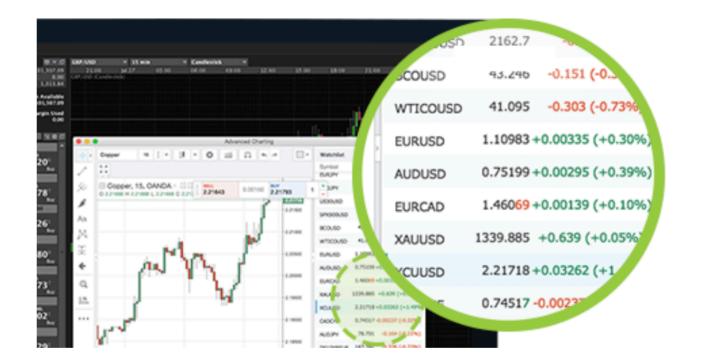
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pip install git+https://github.com/yhilpisch/tpgoa.git

access token = c71f59 YOURACCESSTOKEN 13da5b8f60fac1397232

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