人工智慧財務金融應用
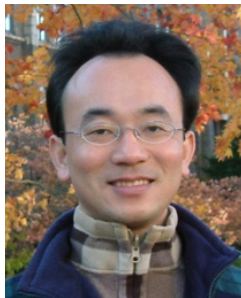## AI in Financial Application

人工智慧投資分析與機器人理財顧問
(Artificial Intelligence for Investment Analysis and Robo-Advisors)

Min-Yuh Day
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Dept. of Information Management, Tamkang University
淡江大學 資訊管理學系

http://mail. tku.edu.tw/myday/
2019-09-27

Tamkang
Universit
淡江大學

課程大綱 (Syllabus)

週次 (Week)　日期 (Date)　內容 (Subject/Topics)

1　2019/09/13　中秋節 (Mid-Autumn Festival) 放假一天 (Day off)

2　2019/09/20　人工智慧財務金融應用課程介紹
(Course Orientation for AI in Financial Application)

3　2019/09/27　人工智慧投資分析與機器人理財顧問
(Artificial Intelligence for Investment Analysis and Robo-Advisors)

4　2019/10/04　金融科技對話式商務與智慧型交談機器人
(Conversational Commerce and Intelligent Chatbots for Fintech)

5　2019/10/11　國慶日補假 (Bridge Holiday for National Day, Extra Day Off)

6　2019/10/18　財務金融事件研究法 (Event Studies in Finance)

課程大綱 (Syllabus)

週次 (Week)　　日期 (Date)　　內容 (Subject/Topics)

7　2019/10/25　人工智慧財務金融應用個案研究 I
(Case Study on AI in Financial Application I)

8　2019/11/01　Python AI智慧金融分析基礎
(Foundations of AI in Finance Big Data Analytics with Python)

9　2019/11/08　Python Pandas 量化投資分析
(Quantitative Investing with Pandas in Python)

10　2019/11/15　期中報告 (Midterm Project Report)

11　2019/11/22　Python Scikit-Learn 機器學習財務金融應用
(Machine Learning in Finance Application with Scikit-Learn In Python)

12　2019/11/29　TensorFlow 深度學習財務金融應用I
(Deep Learning for Finance Application with TensorFlow I)

課程大綱 (Syllabus)

週次 (Week)　日期 (Date)　內容 (Subject/Topics)

13　2019/12/06　人工智慧財務金融應用個案研究 II
　　　　　　　　(Case Study on AI in Financial Application II)

14　2019/12/13　TensorFlow 深度學習財務金融應用 II
　　　　　　　　(Deep Learning for Finance Application with TensorFlow II)

15　2019/12/20　TensorFlow 深度學習財務金融應用 III
　　　　　　　　(Deep Learning for Finance Application with TensorFlow III)

16　2019/12/27　社會網絡分析財務金融應用
　　　　　　　　(Social Network Analysis for Finance Application)

17　2020/01/03　期末報告 I (Final Project Presentation I)

18　2020/01/10　期末報告 II (Final Project Presentation II)

Artificial Intelligence for Investment Analysis and Robo-Advisors

Robotic Process Automation (RPA)

AI
Robo-Advisor
in
FinTech

AIWISFIN
AI Conversational Robo-Advisor
(人工智慧對話式理財機器人)
First Place, InnoServe Awards 2018

https://www.youtube.com/watch?v=sEhmyoTXmGk

2018 The 23th International ICT Innovative Services Awards (InnoServe Awards 2018)

- Annual ICT application competition held for university and college students

- The largest and the most significant contest in Taiwan.

- More than ten thousand teachers and students from over one hundred universities and colleges have participated in the Contest.

https://innoserve.tca.org.tw/award.aspx

9

2018 International ICT Innovative Services Awards (InnoServe Awards 2018)
(2018第23屆大專校院資訊應用服務創新競賽)

FinTech Innovation:
From Robo-Advisors to Goal Based Investing and Gamification,
Paolo Sironi, Wiley, 2016
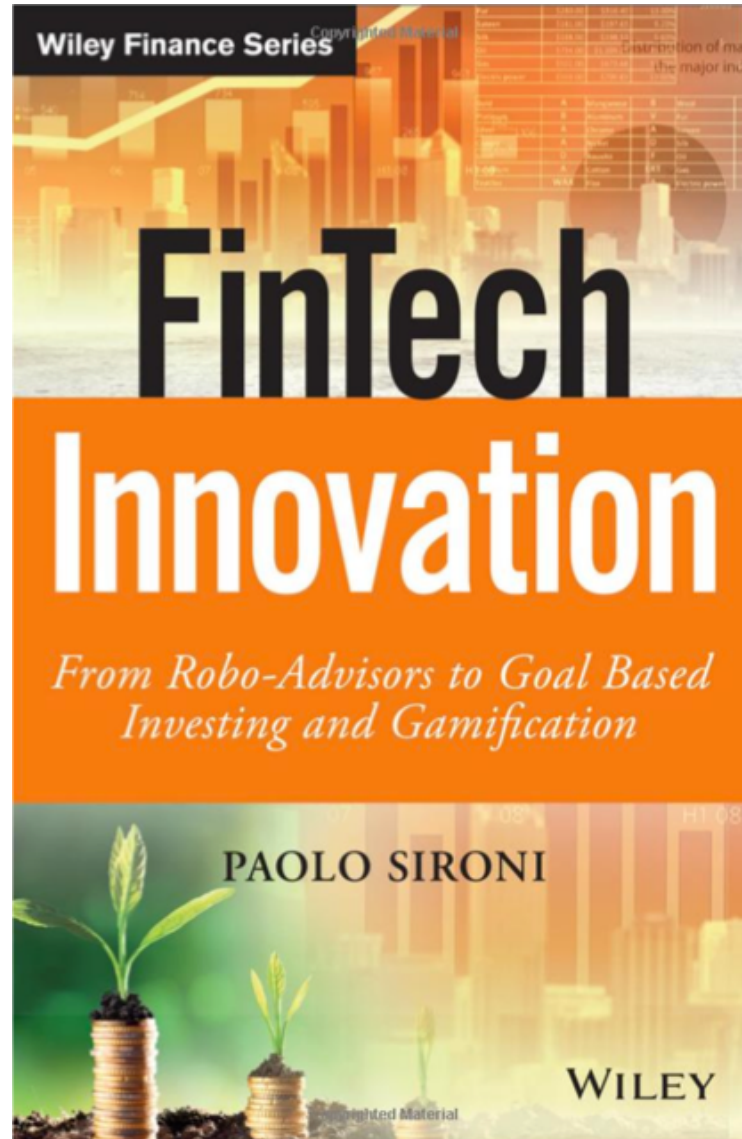
Edwin J. Elton, Martin J. Gruber, Stephen J. Brown, and William N. Goetzmann (2014),
Modern Portfolio Theory and Investment Analysis,
9th Edition, Wiley.
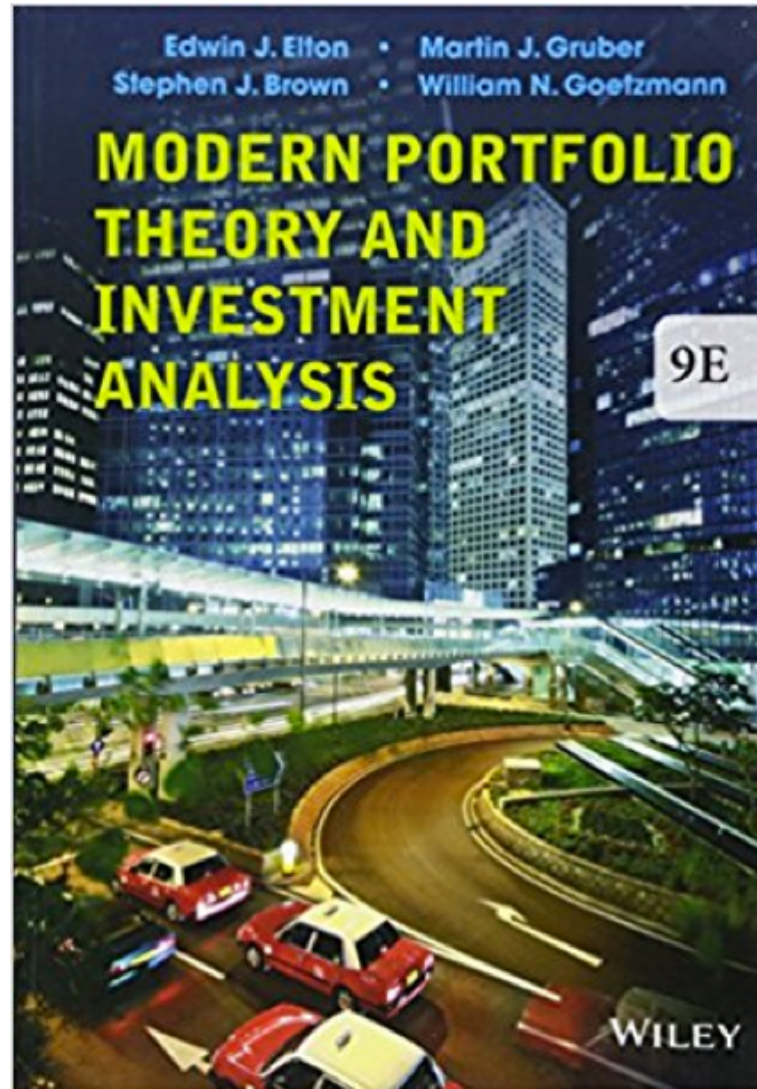
Charles P. Jones (2012),

Investments: Analysis and Management,

12th Edition, Wiley

Artificial Intelligence (AI)

Investment Analysis

Robo-Advisors

Artificial Intelligence and
Deep Learning for
Fintech

From **Algorithmic Trading** to **Personal Finance Bots:** 41 Startups Bringing **AI to Fintech**

From Algorithmic Trading To Personal Finance Bots: 41 Startups Bringing AI To Fintech

AI in Fintech

41 Startups Bringing Artificial Intelligence To Fintech

General Purpose/ Predictive Analytics
- AYASDI
- Digital Reasoning
- context relevant
- H₂O
- KENSHO
- cortical.io
- Numenta
- turi
- DataRobot
- nervana SYSTEMS

Market Research & Sentiment Analysis
- indico
- acuity TRADING
- Lucena Quantitative Analytics
- NUMERAI
- Dataminr

Search Engine
- alphasense

Quantitative Trading
- sentient technologies
- CLONE ALGO
- Alpaca
- WALNUT ALGORITHMS

Blockchain
- Skry
- EUKLID

Debt Collection
- TrueAccord

AI Assistants/Bots
- KASISTO
- TRIM
- Penny
- INSURIFY
- SURE.
- Cleo
- FinGenius

Fraud Detection
- feedzai
- BIOCATCH — Less Friction. Less Fraud.

Credit Scoring
- TypeScore
- aire
- credit vidya
- zest finance
- ADF APPLIED DATA FINANCE
- Wecash 闪银奇异
- CREAM FINANCE

Personal Banking
- personetics® TAKING DIGITAL BANKING PERSONAL
- SBDA group

Artificial Intelligence (AI) in Fintech

General Purpose/ Predictive Analytics

AYASDI · Digital Reasoning · context relevant · H$_2$O

KENSHO · cortical.io · Numenta · turi

DataRobot · nervana SYSTEMS

Market Research & Sentiment Analysis

indico · acuity TRADING · Lucena Quantitative Analytics · NUMERAI

Dataminr

Search Engine

alphasense

Artificial Intelligence (AI) in Fintech

Quantitative Trading: sentient technologies, CLONE ALGO, Alpaca, WALNUT ALGORITHMS

AI Assistants/Bots: KASISTO, TRIM, Penny, INSURIFY, SURE., Cleo, FinGenius

Credit Scoring: TypeScore, aire, creditvidya, zest finance, ADF APPLIED DATA FINANCE, Wecash 闪银奇异, CREAM FINANCE

Blockchain: Skry, EUKLID

Fraud Detection: feedzai, BIOCATCH Less Friction. Less Fraud.

Personal Banking: personetics TAKING DIGITAL BANKING PERSONAL, SBDA group

Debt Collection: TrueAccord

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/

Definition
of
Artificial Intelligence
(A.I.)

Artificial Intelligence

"... the **science** and

engineering

of

making

intelligent machines"
(John McCarthy, 1955)

Artificial Intelligence

"... technology that thinks and acts like humans"

Artificial Intelligence

"... intelligence exhibited by machines or software"

Artificial Intelligence (A.I.) Timeline

A.I. TIMELINE

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955
A.I. BORN
Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

1966
SHAKEY
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998
KISMET
Cynthia Breazeal at MIT introduces KISmet, an emotionally intelligent robot insofar as it detects and responds to people's feelings

1999
AIBO
Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time
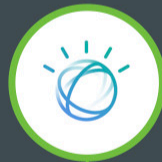
2002
ROOMBA
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S
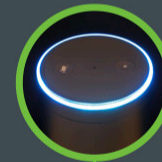
2011
WATSON
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show *Jeopardy*
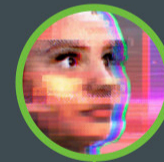
2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human

2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks

2016
TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments
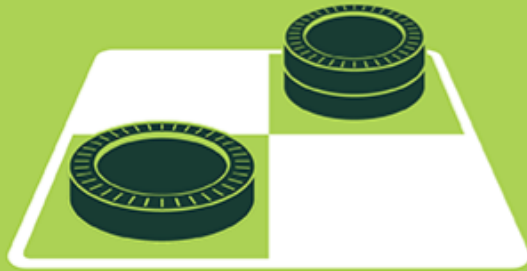
2017
ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

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Artificial Intelligence
Machine Learning & Deep Learning

ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.

MACHINE LEARNING
Machine learning begins to flourish.

DEEP LEARNING
Deep learning breakthroughs drive AI boom.

1950's   1960's   1970's   1980's   1990's   2000's   2010's

Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

AI

and

Cognitive Computing

Financial Technology
FinTech

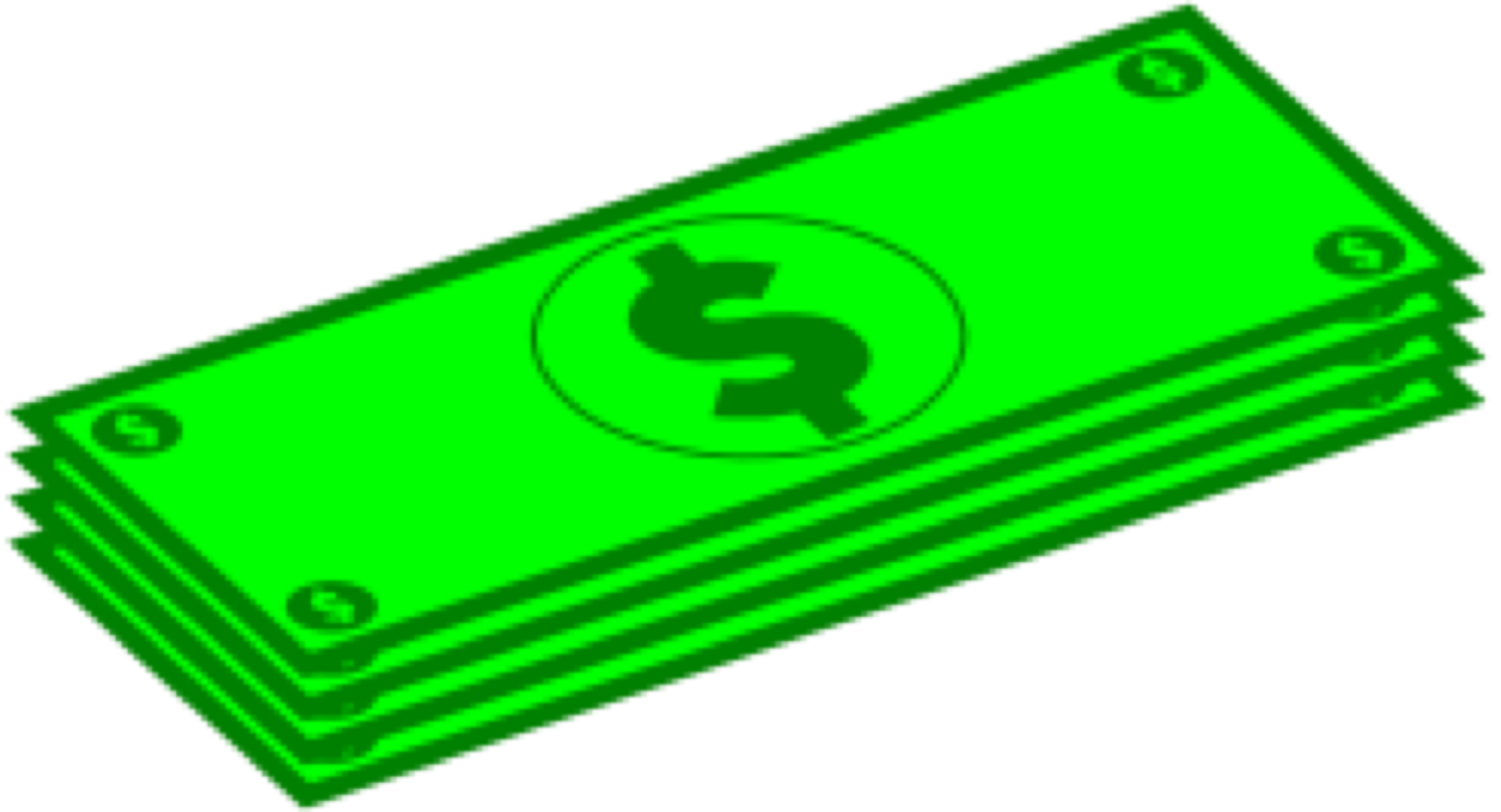"providing financial services by making use of software and modern technology"

Financial Services

Financial Services

Money

Money

Money

Makes

Money

Treasure

Wealth
Management
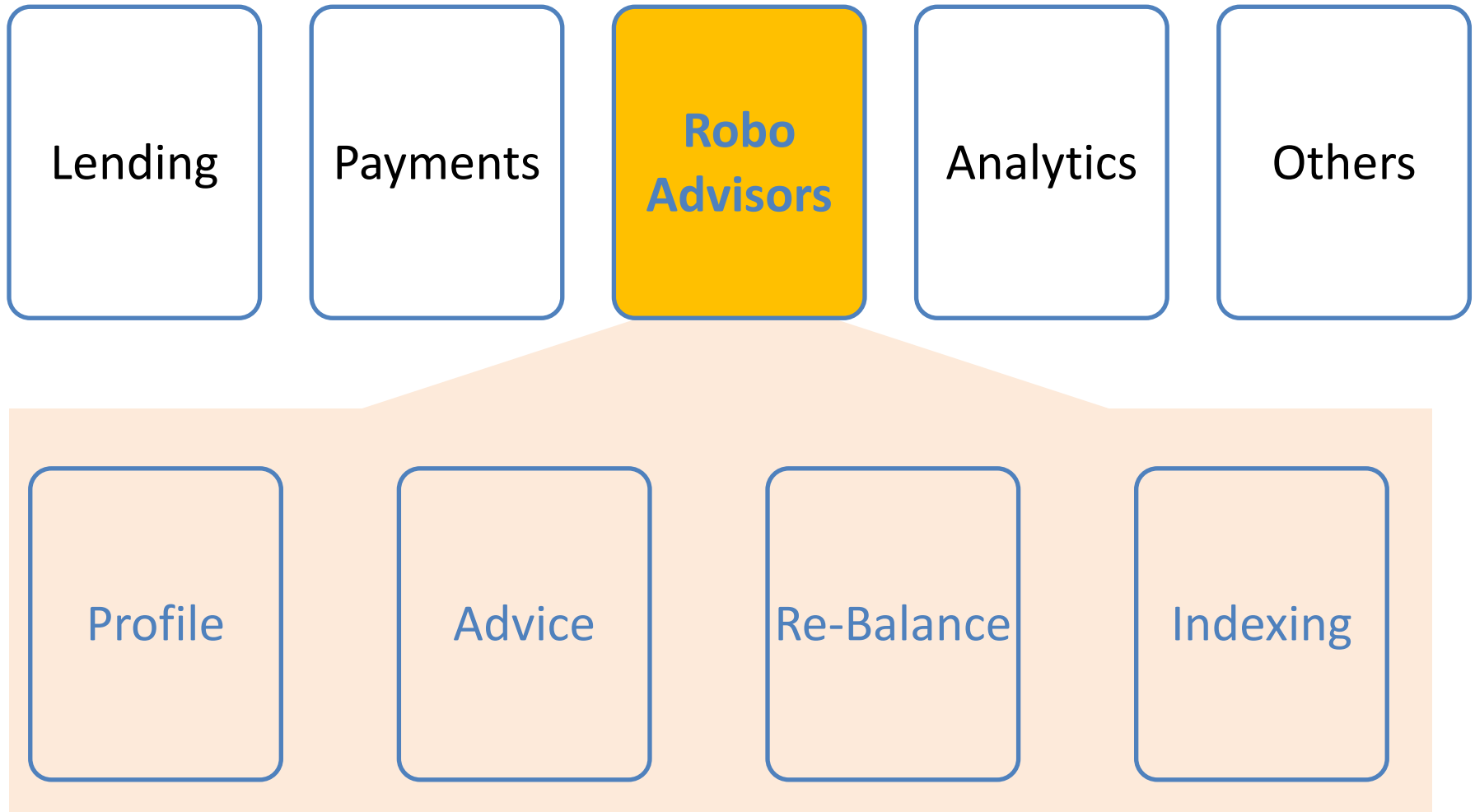
Investment Analysis

Time Value of Money

Risk

Return

Fintech Robo Advisors

Big Data Driven Disruption: Robo-Advisor

FinTech high-level classification

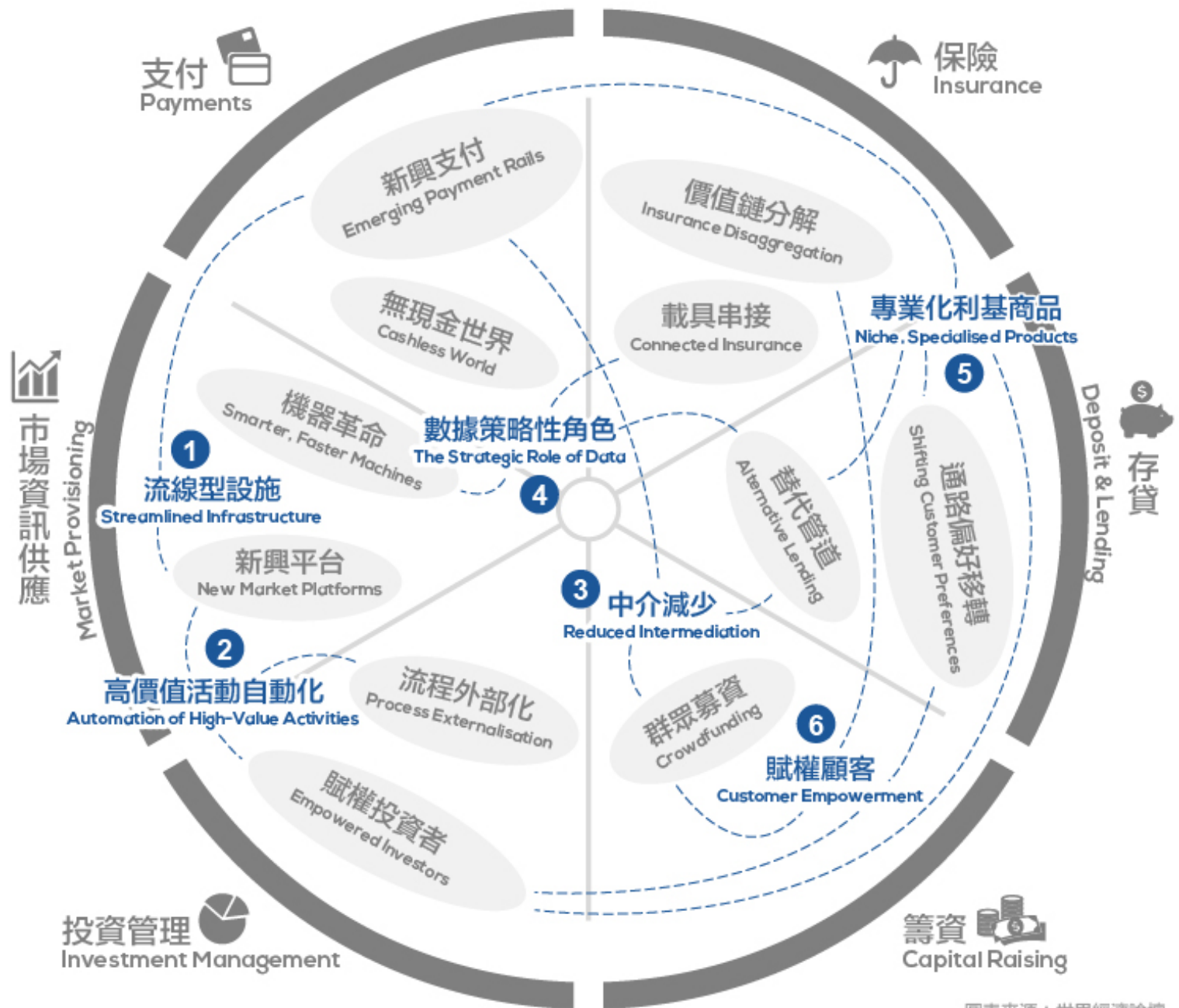| Lending | Payments | **Robo Advisors** | Analytics | Others |

| Profile | Advice | Re-Balance | Indexing |

FinTech: Financial Services Innovation

FinTech:
Financial Services Innovation

1. Payments
2. Insurance
3. Deposits & Lending
4. Capital Raising
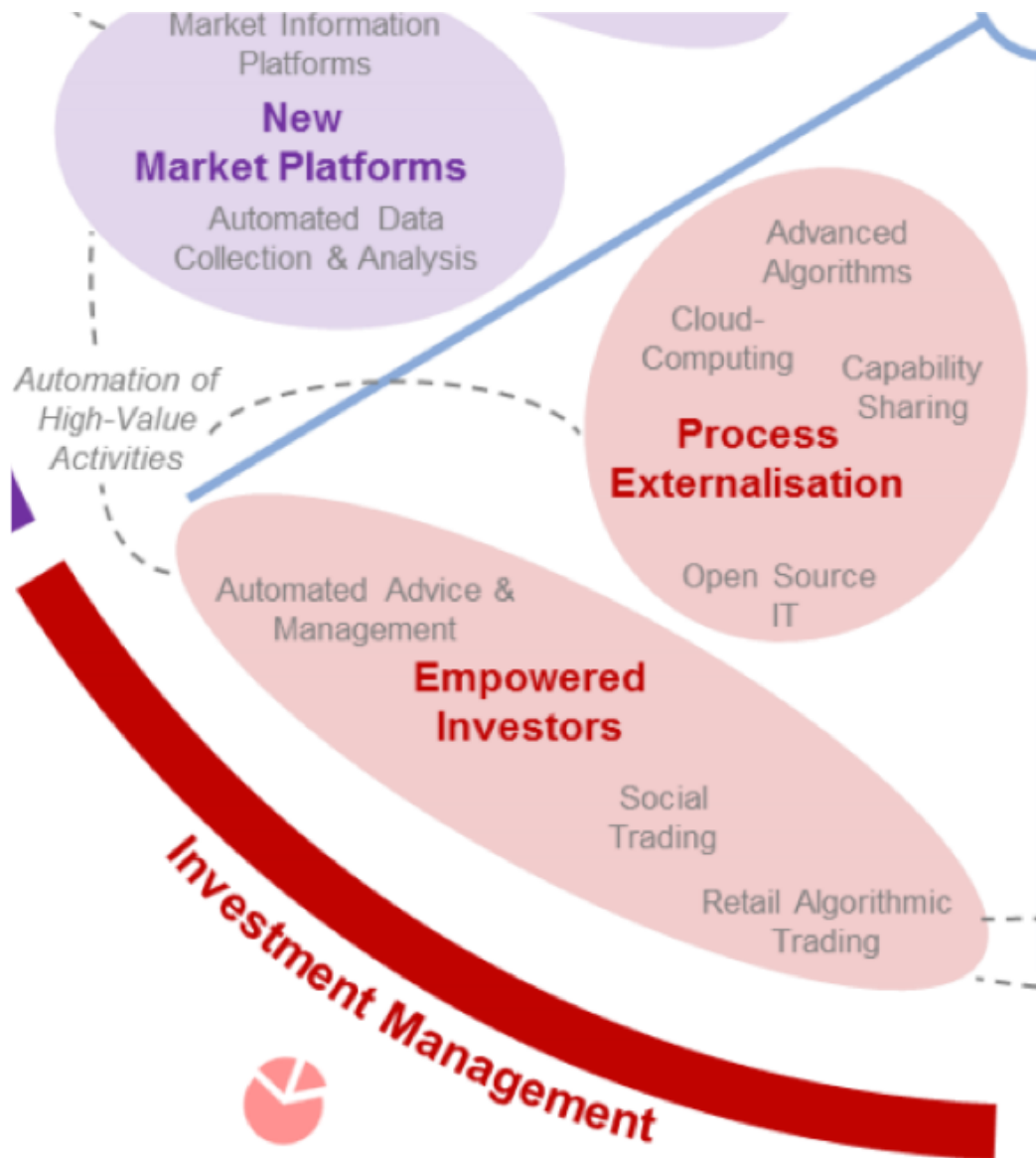5. **Investment Management**
6. Market Provisioning

支付
Payments

保險
Insurance

市場資訊供應
Market Provisioning

存貸
Deposit & Lending

投資管理
Investment Management

籌資
Capital Raising

新興支付
Emerging Payment Rails

價值鏈分解
Insurance Disaggregation

無現金世界
Cashless World

載具串接
Connected Insurance

專業化利基商品
Niche, Specialised Products

5

機器革命
Smarter, Faster Machines

數據策略性角色
The Strategic Role of Data

1
流線型設施
Streamlined Infrastructure

新興平台
New Market Platforms

替代管道
Alternative Lending

通路偏好移轉
Shifting Customer Preferences

4

3 中介減少
Reduced Intermediation

2
高價值活動自動化
Automation of High-Value Activities

流程外部化
Process Externalisation

群眾募資
Crowdfunding

6
賦權顧客
Customer Empowerment

賦權投資者
Empowered Investors

圖表來源：世界經濟論壇

FinTech: Financial Services Innovation

功能	創新項目
支付 Payments	無現金世界 (Cashless World) 新興支付 (Emerging Payment Rails)
保險 Insurance	價值鏈裂解 (Insurance Disaggregation) 保險串接裝置 (Connected Insurance)
存貸 Deposit & Lending	替代管道 (Alternative Lending) 通路偏好移轉 (Shifting Customer Preferences)
籌資 Capital Raising	群眾募資 (Crowdfunding)
投資管理 Investment Management	賦權投資者 (Empowered Investors) 流程外部化 (Process Externalisation)
市場資訊供應 Market Provisioning	機器革命 (Smarter, Faster Machines) 新興平台 (New Market Platforms)

圖表來源：Fugle團隊整理

New Market Platforms
- Market Information Platforms
- Automated Data Collection & Analysis

Process Externalisation
- Advanced Algorithms
- Cloud-Computing
- Capability Sharing
- Open Source IT

Empowered Investors
- Automation of High-Value Activities
- Automated Advice & Management
- Social Trading
- Retail Algorithmic Trading

Investment Management

5 FinTech: Investment Management Empowered Investors Process Externalization

	創新	關鍵趨勢
投資管理	賦權投資者 Empowered Investors	社群交易、機器推薦與財富管理、零售演算法交易 (Retail Algorithmic Trading)
	流程外部化 Process Externalisation	流程即服務 (Process-as-a-Service, PaaS)、能力共享 (Capability Sharing)、進階分析、自然語言

圖表來源：Fugle團隊整理

FinTech: Market Provisioning

6
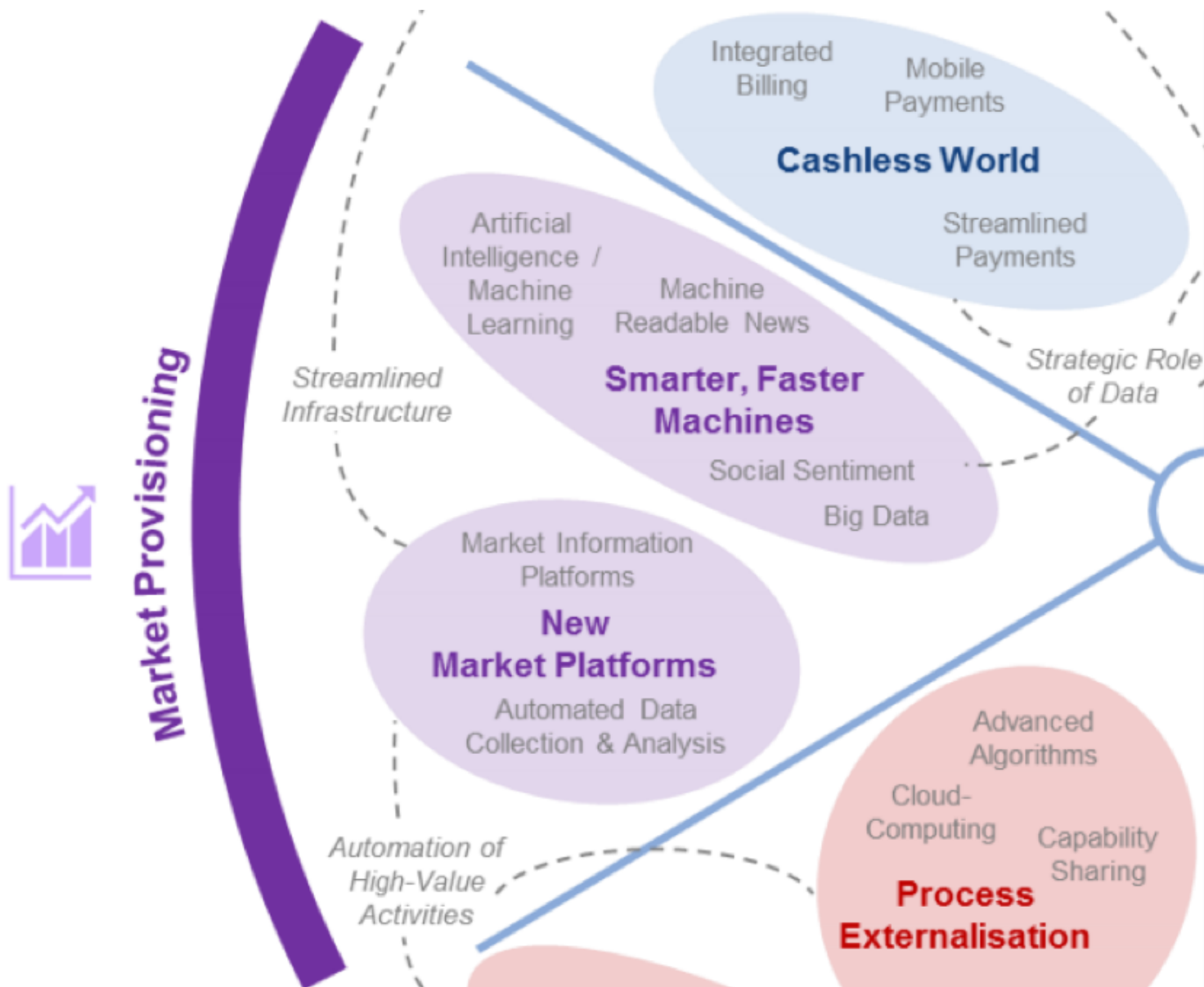
FinTech: Market Provisioning
Smarter, Faster Machines
New Market Platforms

市場資訊供應

創新	關鍵趨勢
機器革命 Smarter, Faster Machines	機器易用數據 (Machine Accessible Data)、人工智慧 / 機器學習、大數據
新興平台 New Market Platforms	固定收益商品平台 ALGOMI、基金 / 組合型基金平台 NOVUS、私募 / 創投平台 BISON、未公發股權平台 LIQUITY、原物料商品與衍生性合約平台 ClauseMatch

圖表來源：Fugle團隊整理

Fintech: Financial Technology

Disrupting Banking: The Fintech Startups That Are Unbundling Wells Fargo, Citi and Bank of America

Fintech: Unbunding the Bank

Unbundling of a Bank

Fintech: Unbunding the Bank

Wealth Management: Wealthfront

Unbundling of a Bank

Wealthfront: Fintech Robo Advisor

Financial Advisor FinTech Solutions

Financial Advisor FinTech Solutions Map

December 2018 | Latest version available at: kitces.com/fintechmap

= Category Newcomer

Nerd's Eye View | kitces.com

A classic workflow for financial recommendations

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Process of Robo Advisors

Process of Robo Advisory

- Knowing customer needs
- Processing Customer Information
- Customized Solution in matter of seconds

AdviseSure.com

Benefits of Robo Advisors

Benefits of Robo Advisors

—— Unbiased Advice ——
—— No minimum Investment required ——
—— Low Charges ——
——Transparency ——
—— Customised Solutions ——

AdviseSure.com

Robo-Advisor Business Models

- **Full service online Robo-advisor**
  - 100% automated without any human element

- **Hybrid Robo-advisor model**
  - being pioneered by firms like Vanguard & Charles Schwab

- **Pure online advisor**
  - primarily human in nature

Robo-Advisor Business Models

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Usecases of Robo-Advisors

1. Determine individual Client profiles & preferences

2. Identify appropriate financial products

3. Establish correct Investment Mix for the client's profile

4. Using a algorithmic approach, choose the appropriate securities for each client account

5. Continuously monitor the portfolio & transactions within it to tune performance

6. Provide value added services

7. Ensure the best user experience by handling a whole range of financial services

Business Requirements for a Robo-Advisor (RA)

1. Collect Individual Client Data

2. Client Segmentation

3. Algorithm Based Investment Allocation

4. Portfolio Rebalancing

5. Tax Loss Harvesting

6. A Single View of a Client's Financial History

Algorithms for a Robo-Advisor (RA)

- Leverage data science & statistical modeling to automatically allocate client wealth across different asset classes (such as domestic/foreign stocks, bonds & real estate related securities) to automatically rebalance portfolio positions based on changing market conditions or client preferences.

  - These investment decisions are also made based on detailed behavioral understanding of a client's financial journey metrics

    - Age, Risk Appetite & other related information.

Algorithms for a Robo-Advisor (RA)

- RA platforms also provide
  24×7 tracking of market movements
  to use that to track rebalancing decisions
  from not just a portfolio standpoint
  but also from a taxation standpoint.

Algorithms for a Robo-Advisor (RA)

- A mixture of different algorithms
  can be used such as
  Modern Portfolio Theory (MPT),
  Capital Asset Pricing Model (CAPM),
  the Black Litterman Model,
  the Fama-French etc.

  – These are used to allocate assets as well as to adjust positions based on market movements and conditions.

Robo-Advisor (RA) Sample Portfolios

Sample Portfolios – for an aggressive investor

1. Equity – 85%

A) US Domestic Stock (50%)

– Large Cap – 30%, Medium Cap – 10% , Small Cap – 10%, Dividend Stocks – 0%

B) Foreign Stock – (35%)

– Emerging Markets – 18%, Developed Markets – 17%

2. Fixed Income – 5%

A) Developed Market Bonds – 2%

B) US Bonds – 1%

C) International Bonds – 1%

D) Emerging Markets Bonds – 1%

3. Other – 5%

A) Real Estate – 3%

B) Currencies – 0%

C) Gold and Precious Metals – 0%

D) Commodities – 2%

4. Cash – 5%

Architecture of a Robo-Advisor (RA)
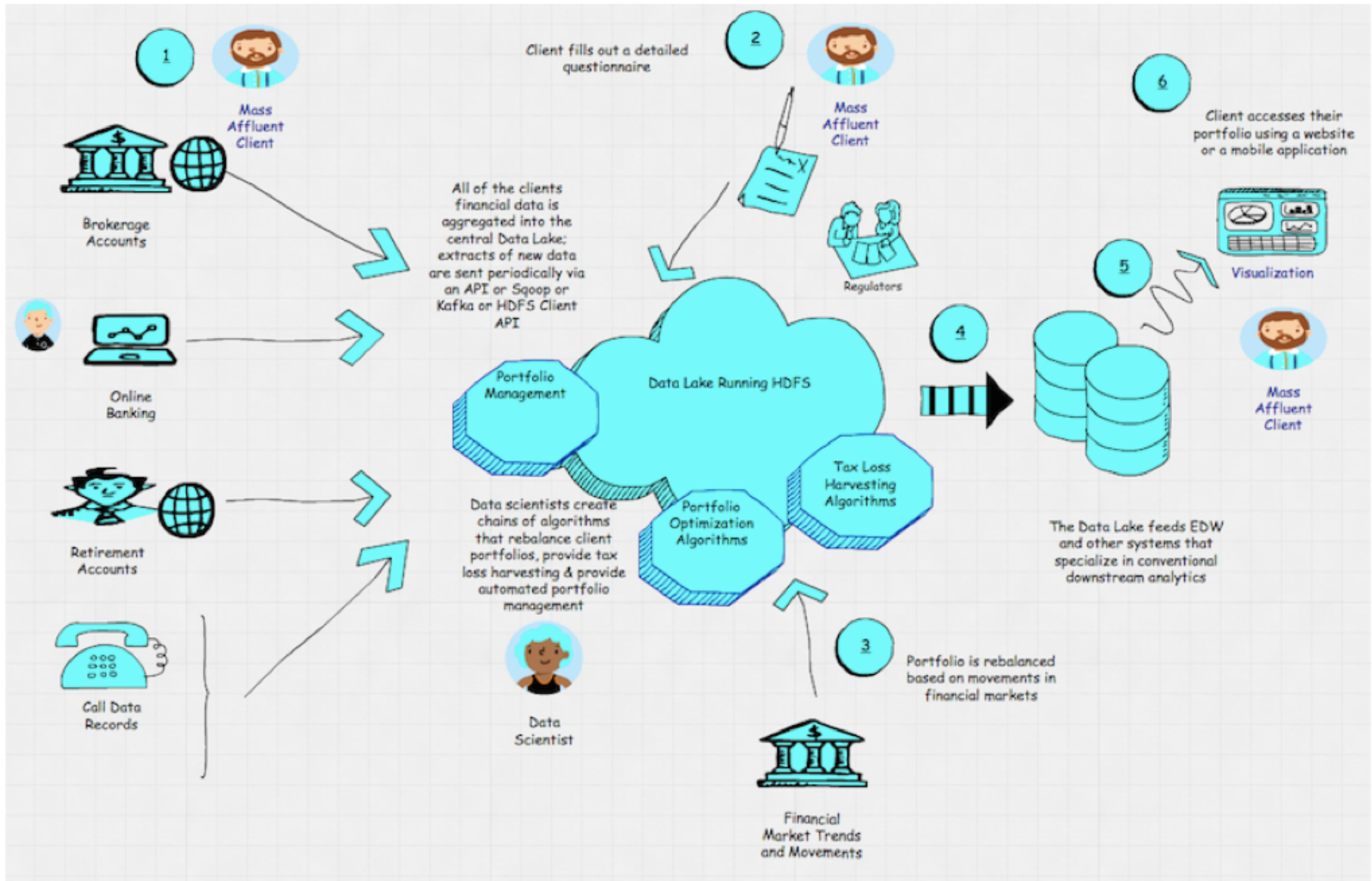
Robo-Advisor

Wealthfront

Financial Planning & Robo-Investing for Millennials

WEALTHFRONT

Meet your financial copilot

We'll build a free financial plan for the life you want and automate your investments at a low cost.

Our all-in-one solution gives you the financial expertise you need, right in your pocket. No spreadsheets, no annoying sales calls, no judgment.

GET STARTED

Wealthfront: Fintech Robo Advisor

Betterment
Online Financial Advisor

https://www.betterment.com/

Betterment: Fintech Robo Advisor

Betterment

WHY BETTERMENT   SERVICES   RESOURCES   PRICING   FAQS   FOR BUSINESS   LOG IN   SIGN UP
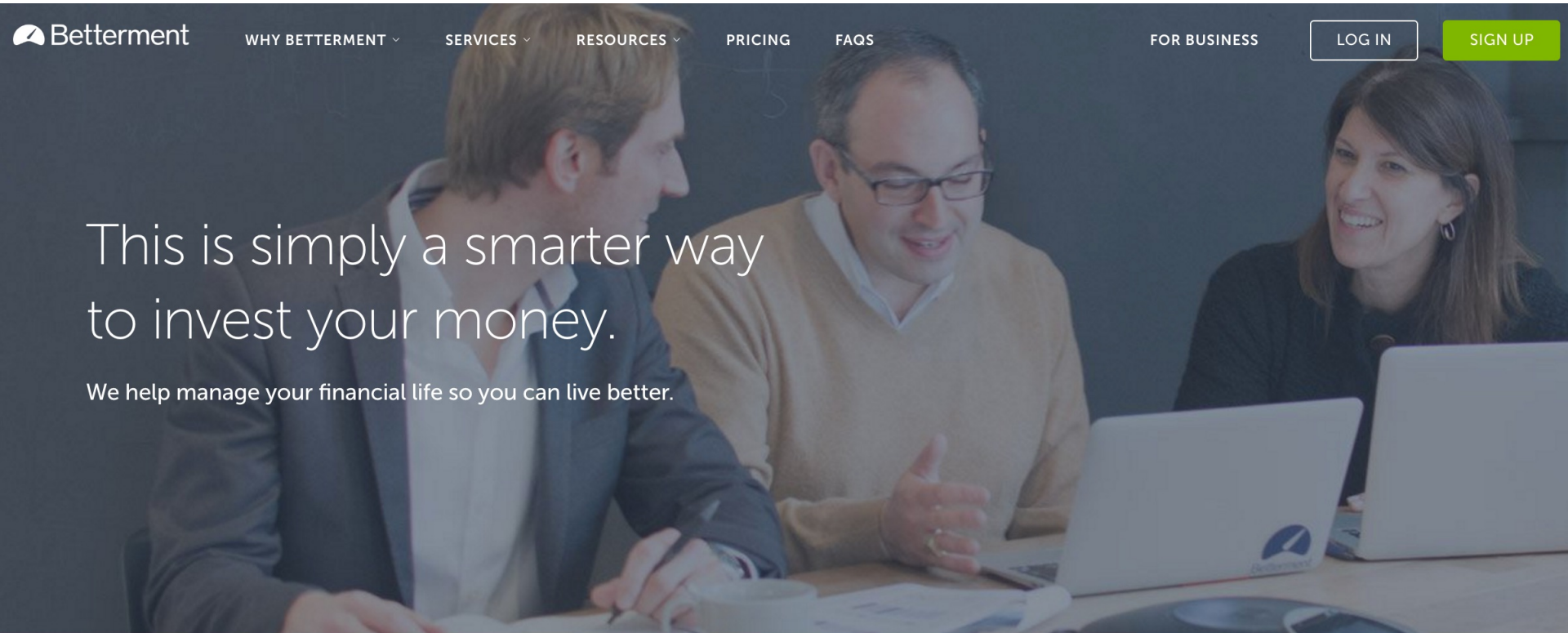
This is simply a smarter way to invest your money.

We help manage your financial life so you can live better.

We can help you get started. Schedule your free 15 minute call today. Schedule a call >

Increase after-tax returns.   No hidden fees.   Satisfaction guaranteed.   Access to licensed experts.

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Betterment vs. Wealthfront

Robo-Advisor	Betterment	wealthfront
Investor Junkie Rating	4.5 star	5 star
Promotions	One Month Free	First $15k for Free
Fees	0.25%/yr	None first $10k; 0.25%/yr for more
Minimum Deposit	None	$500
Human Advisors	Yes — Additional Fee	No
Automatic Rebalancing	Yes	Yes
Tax Loss Harvesting	Yes	Yes
Direct Indexing	No	Yes
Fractional Shares	Yes	No
Assets Under Management	$8.0B	$5.0B

Wealthfront:
0.25%
Flat annual advisory fee

- No trading commissions or hidden fees

- Portfolio of low-cost ETFs

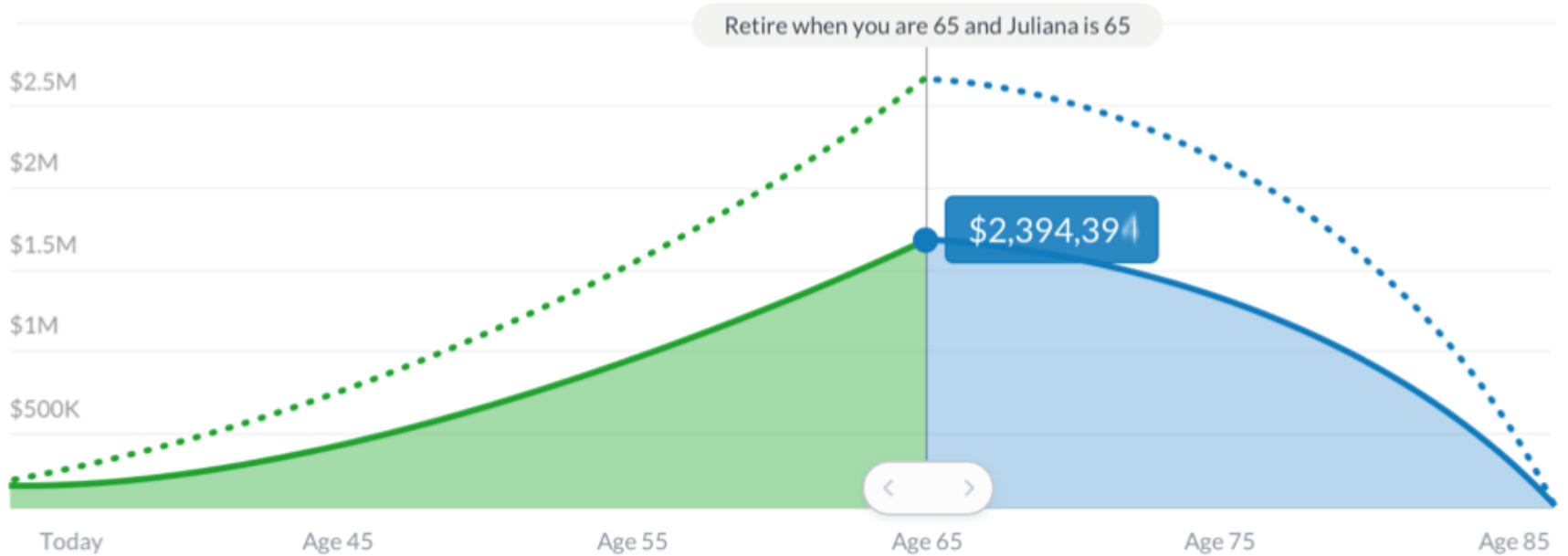- Your first $10,000 managed free

Wealthfront

Powering your financial life with technology

Wealthfront Robo Advisor

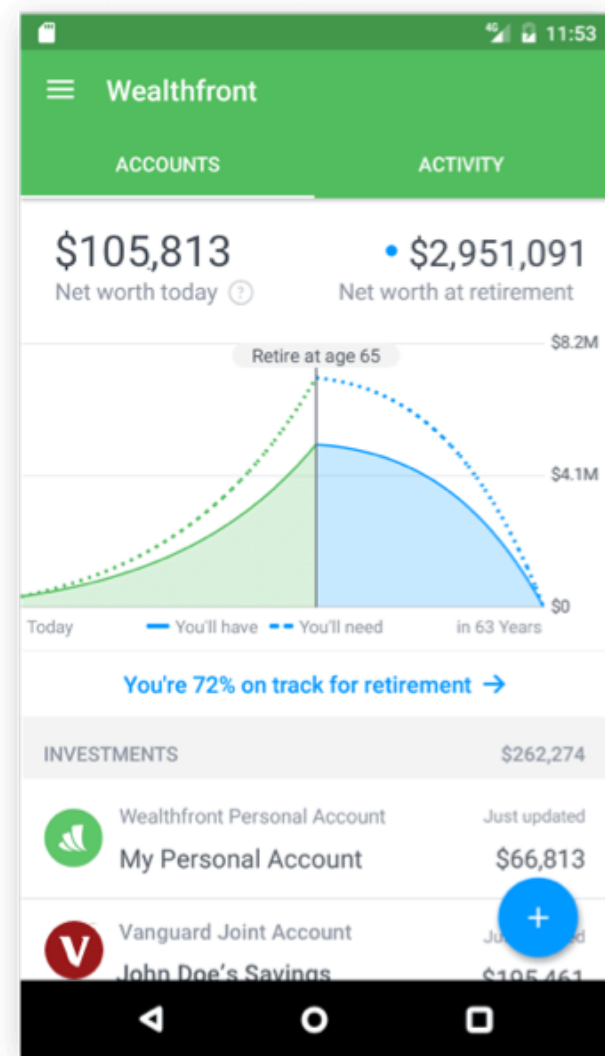
You're on track to have $8,000 per month to spend in retirement. That's 76% of your target.

Retire when you are 65 and Juliana is 65

$2,394,39[

My assumptions

— What you'll have   ••• What you'll need

Wealthfront Robo Advisor
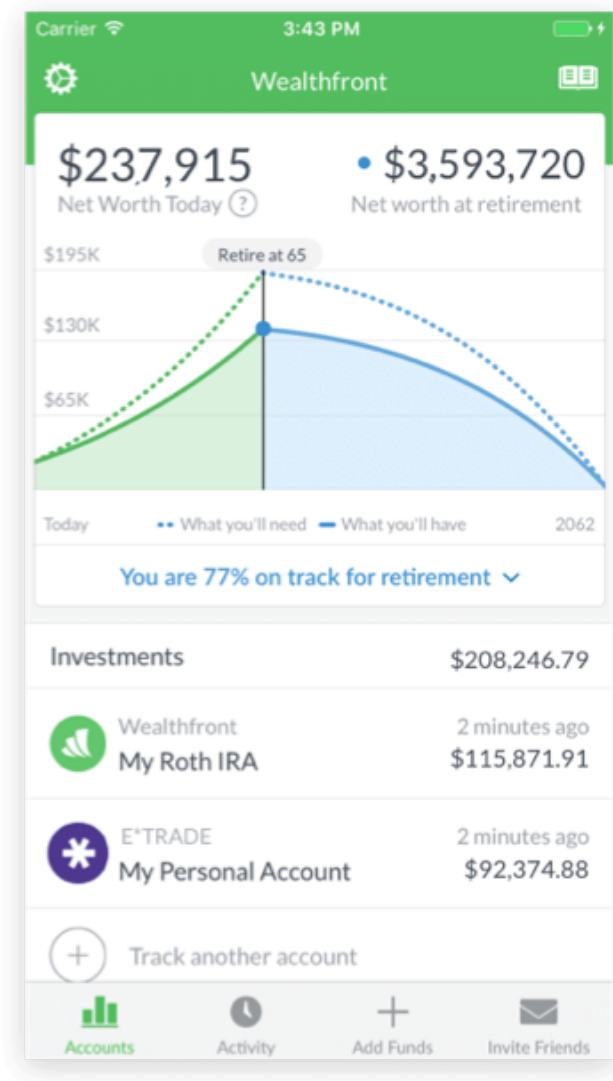
Financial Revolution with Fintech

A financial services revolution

Consumer Trends

1. Simplification 2. Transparency 3. Analytics 4. Reduced Friction

Millennial Personal Finance: 63 Fintech Startups Targeting Millennials

Fin Tech Startups for Millennials

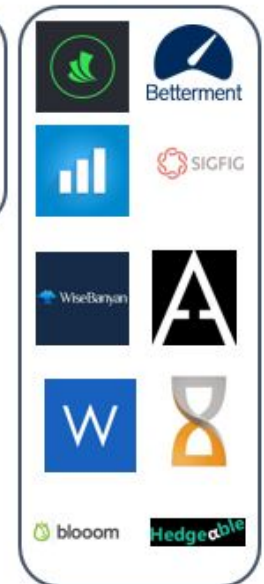Source: https://www.cbinsights.com/blog/fin-tech-startups-millennials/
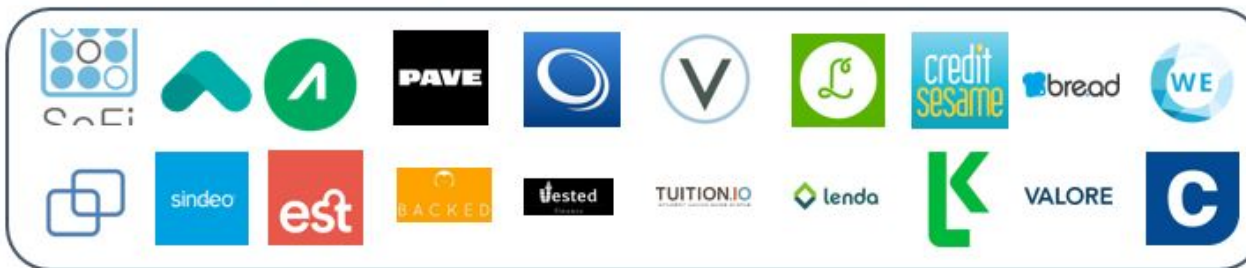
Marketing to Millenials

GENERATIONS OVERVIEW

MILLENNIALS
18 — 29 YEARS OLD
87.5M AMERICANS

GENERATION X
30 — 49 YEARS OLD
83.7M AMERICANS

BABY BOOMERS
50 — 65+ YEARS OLD
66.4M AMERICANS
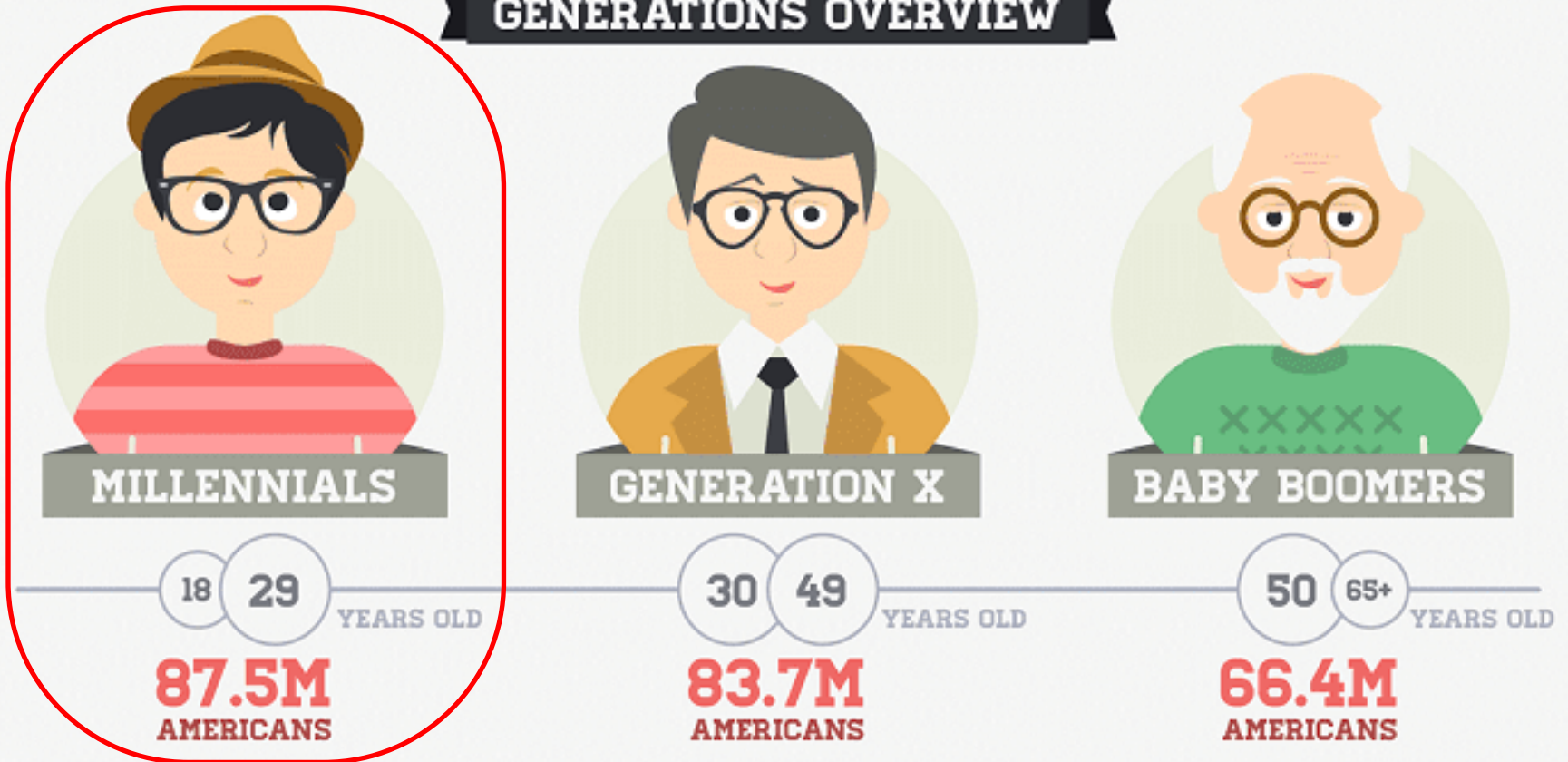
Marketing to Millenials

MILLENNIAL PERSONAS

DIGITAL WINDOW SHOPPERS
Less engaged online than other millennials
23%
of the millennial population
42% | 58%
female majority

DIGITAL SOCIALITES
Highly social and engaged online
26%
of the millennial population
45% | 55%
female majority

DYNAMIC MEDIA JUNKIES
Extremely tech savvy and engaged with online video and streamed content
23%
of the millennial population
64% | 36%
male majority

CASUALLY ENGAGED
Least engaged in digital world, more likely to be unemployed
17%
of the millennial population
53% | 47%
male majority

EMERGING TECHNOCRACY
Strongly engaged digitally and highly influential
15%
of the millennial population
57% | 43%
male majority

Marketing to Millenials

BEST PRACTICES FOR MARKETING TO MILLENNIALS

OPTIMIZED MOBILE

Mobile is the **BEST WAY TO REACH MILLENNIALS -** they have the highest rates of ownership of smartphones of all generations

MULTI-PLATFORM

Millennials **CONSUME CONTENT ACROSS MULTIPLE DEVICES,** so marketers need to create content with a multi-platform strategy. For example, **55%** are watching videos several times a day on multiple devices

PERSONALIZATION

85% of Millennials are **MORE LIKELY TO MAKE A PURCHASE IF IT IS PERSONALIZED** to their interests, both in-store and with digital displays

SOCIAL MEDIA PRESENCE

Millennials are **MORE LIKELY TO USE SOCIAL MEDIA DAILY** with 62% reporting that brand engagement is more likely to make them a loyal customer

BE AUTHENTIC

Millennials are willing to share good advertising, but **DISLIKE WHEN ADVERTISING FEELS DECEPTIVE**

44%   36%   33%
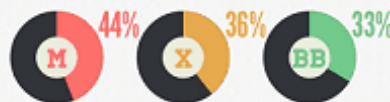
believe brands say something about who they are, their values and where they fit

INFORMATIONAL BLOGS

one in three millennials choose **BLOGS** as the top media source **BEFORE MAKING A PURCHASE.** Traditional media sources like TV and magazines have less impact on this generation

Fintech for Millennials

Fintech Category	#Company
Crowdfunding	2
Insurance (Non-Health)	4
Loans & Credit Risk	20
Mobile Banking & Payments	8
Personal Investing	10
Savings & Finances Tracking	10
Wealth Management	9
Total	63

Fintech: Wealth Management

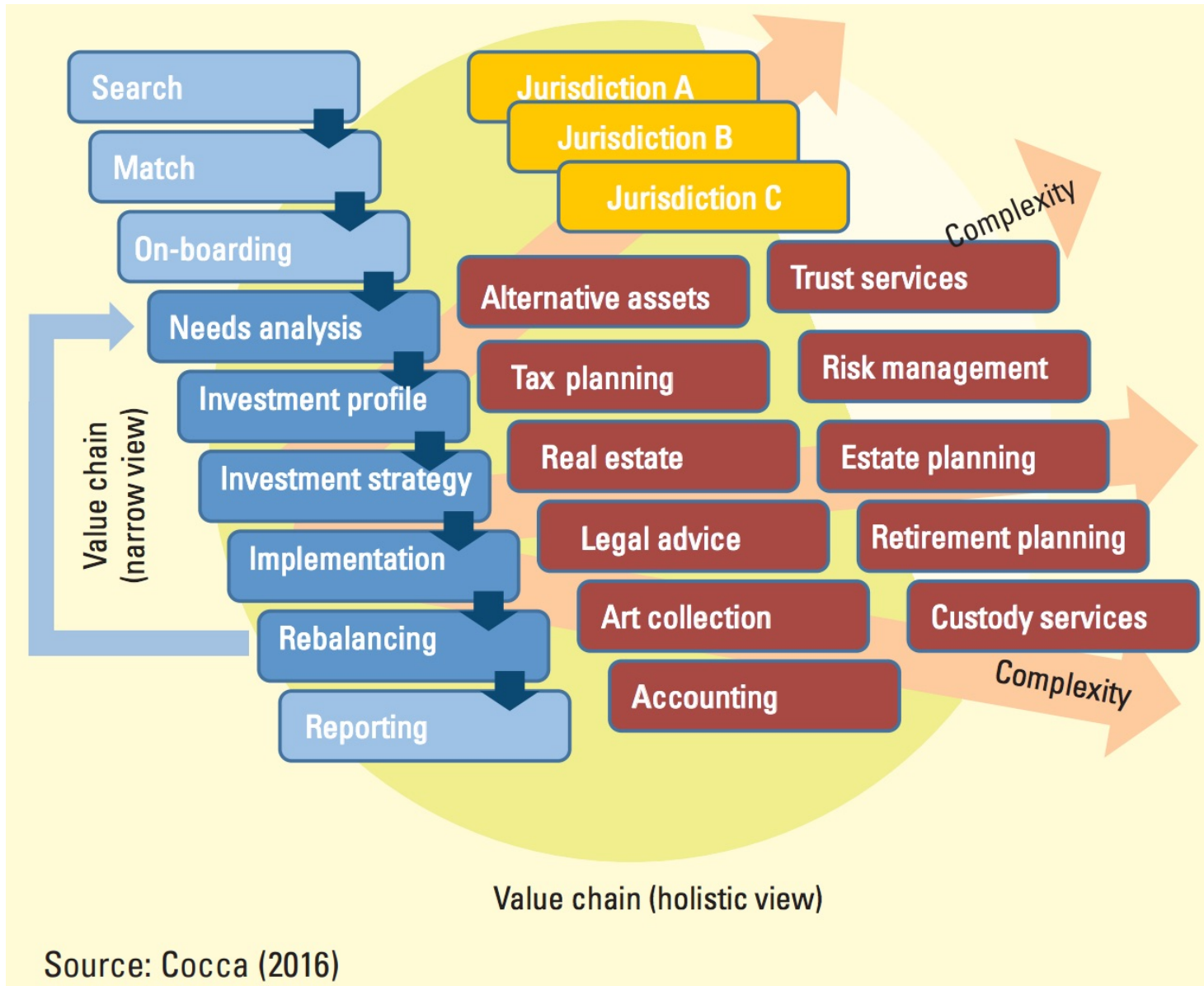| Company	Select Investors
Wealthfront	DAG Ventures, Index Ventures, Greylock Partners, The Social+Capital Partnership
Betterment	Bessemer Venture Partners, Athemis Group, Menlo Ventures
SigFig	Doll Capital Management, Union Square Ventures, Bain Capital Ventures
Aspiration	Renren, GSV Capital, Capricorn Investment Group, IGSB
Blooom	Commerce Ventures, DST Systems, Hyde Park VP, QED Investors, UMB Financial
Rebalance IRA	N/A
Hedgeable	SixThirty
WiseBanyan	VegasTech Fund
Personal Capital	Institutional Venture Partners, Venrock, Crosslink Capital

Fintech: Personal Investing

Company	Select Investors
eToro	BRM Group, Ping An Ventures, Spark Capital
Openfolio	FinTech Collective
DriveWealth	Route 66 Ventures
Tip'd Off	Raj Parekh, Bill Crane, Shaun Coleman
Kapitall	Bendigo Partners, Linden Venture Fund
Stash	N/A
Stox	SingulariTeam
Robinhood	Google Ventures, Index Ventures, Andreessen Horowitz, Ribbit Capital, NEA
Motif Investing	Norwest Venture Partners, Foundation Capital, Ignition Capital, Goldman Sachs
Loyal3	DNS Capital

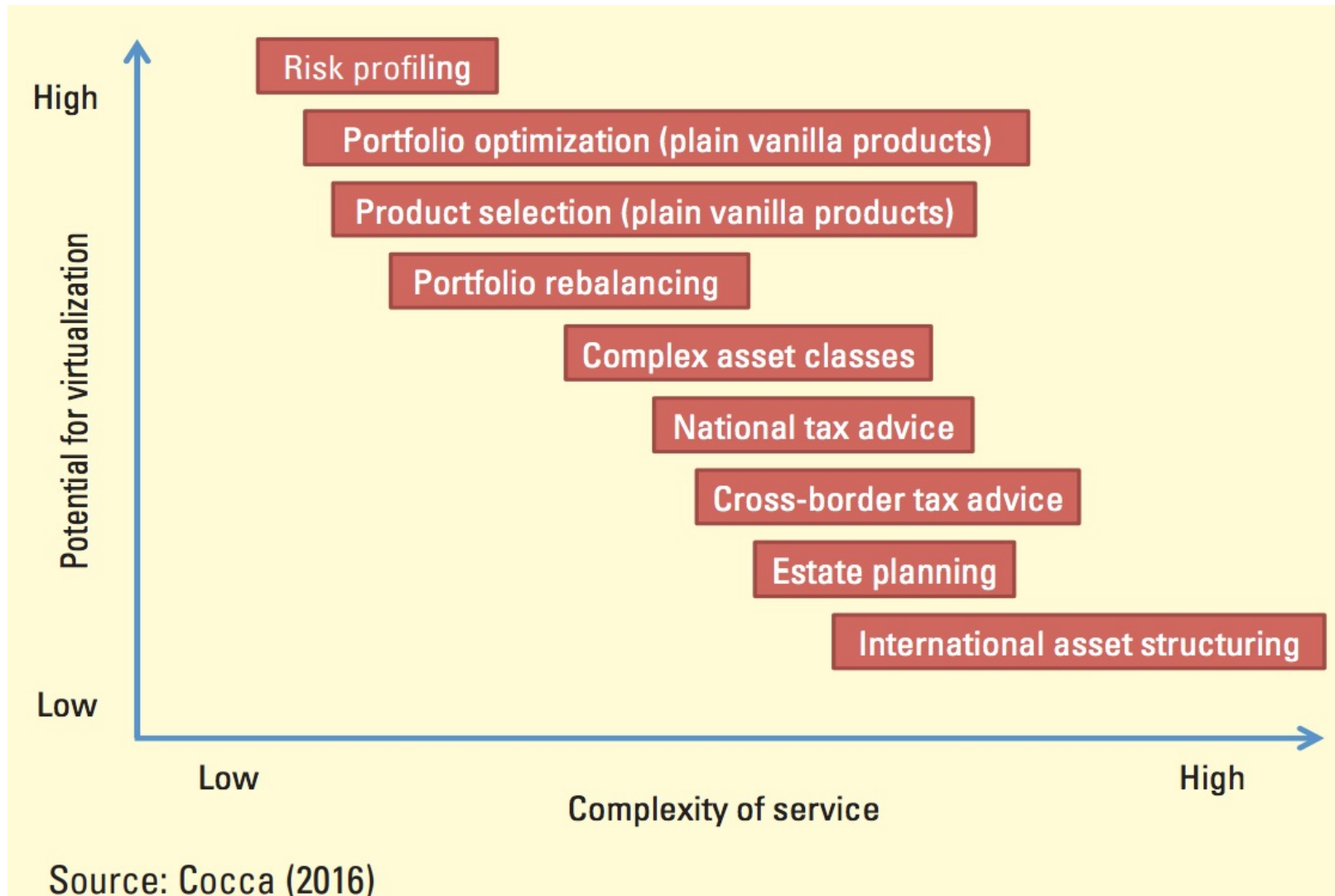# Wealthfront Investment Methodology

1. Identify an ideal set of asset classes for the current investment environment

2. Select low cost ETFs to represent each asset class

3. Determine your risk tolerance to create the appropriate portfolio for you

4. Apply Modern Portfolio Theory to allocate among the chosen asset classes for your risk tolerance

5. Monitor and periodically rebalance your portfolio

Wealth Management Value Chain

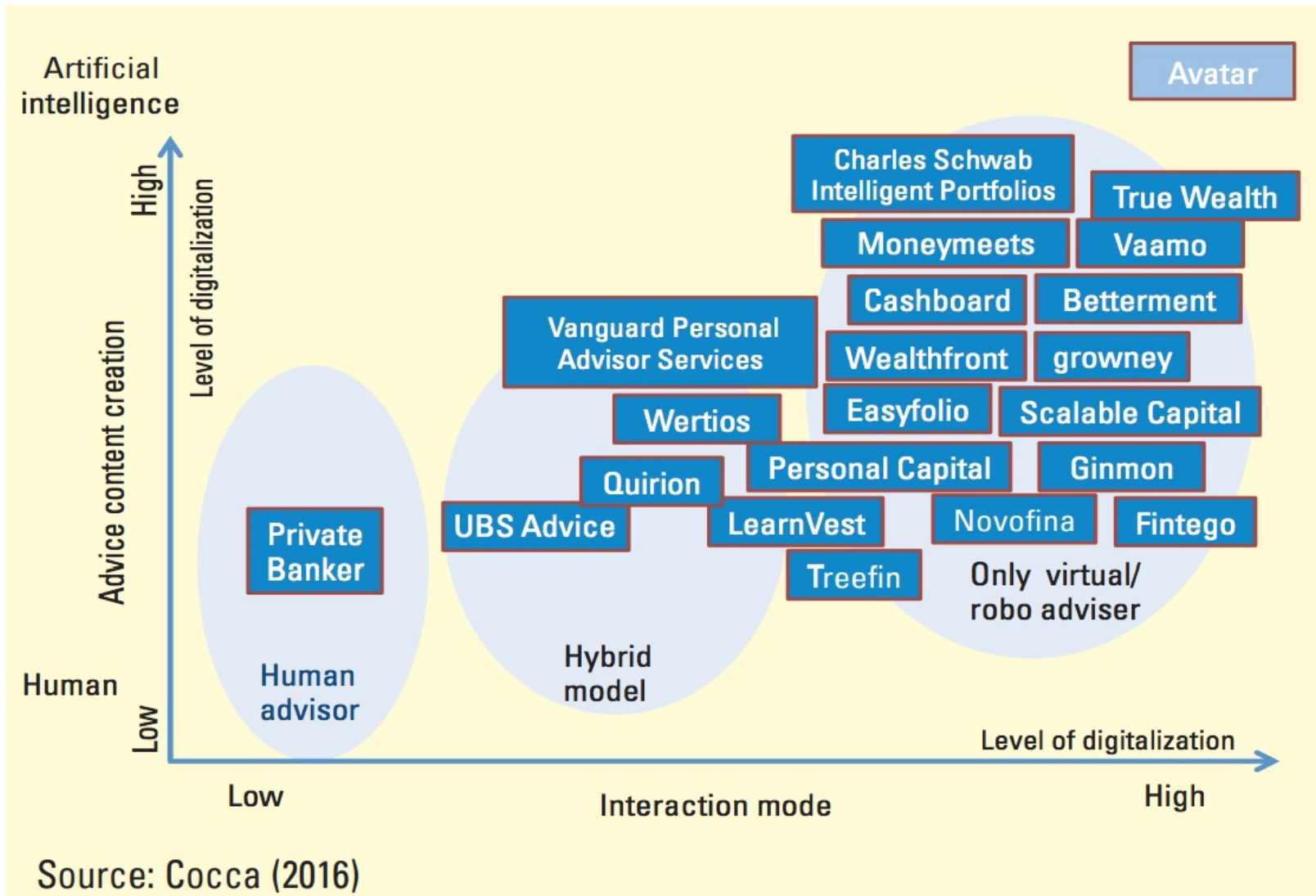Value chain (holistic view)

Value chain (narrow view):
- Search
- Match
- On-boarding
- Needs analysis
- Investment profile
- Investment strategy
- Implementation
- Rebalancing
- Reporting

Jurisdiction A
Jurisdiction B
Jurisdiction C

Complexity

Alternative assets
Tax planning
Real estate
Legal advice
Art collection
Accounting

Trust services
Risk management
Estate planning
Retirement planning
Custody services

Complexity

Source: Cocca (2016)

Source: Cocca, Teodoro (2016). "Potential and Limitations of Virtual Advice in Wealth Management." Journal of Financial Transformation, 44, 45-57.

Wealth Management Service and Potential for virtualization

Source: Cocca (2016)

Source: Cocca, Teodoro (2016). "Potential and Limitations of Virtual Advice in Wealth Management." Journal of Financial Transformation, 44, 45-57.

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AI and Robo Advisor Virtualization Dimensions

Source: Cocca (2016)

Source: Cocca, Teodoro (2016). "Potential and Limitations of Virtual Advice in Wealth Management." Journal of Financial Transformation, 44, 45-57.

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Degree of Digitalization of Wealth Management Customers
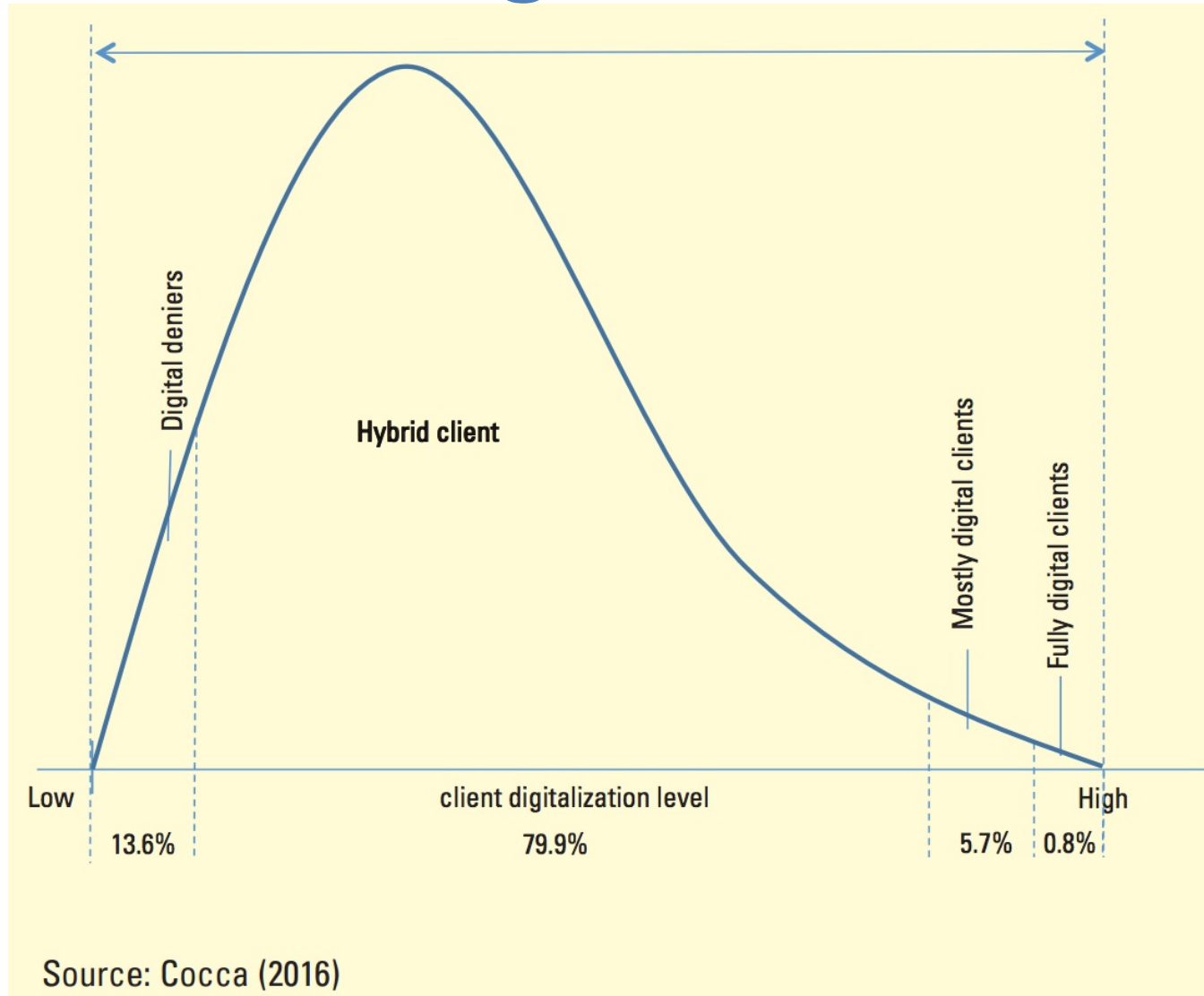
Digital deniers

Hybrid client

Mostly digital clients

Fully digital clients

Low — client digitalization level — High

13.6%   79.9%   5.7% 0.8%

Source: Cocca (2016)
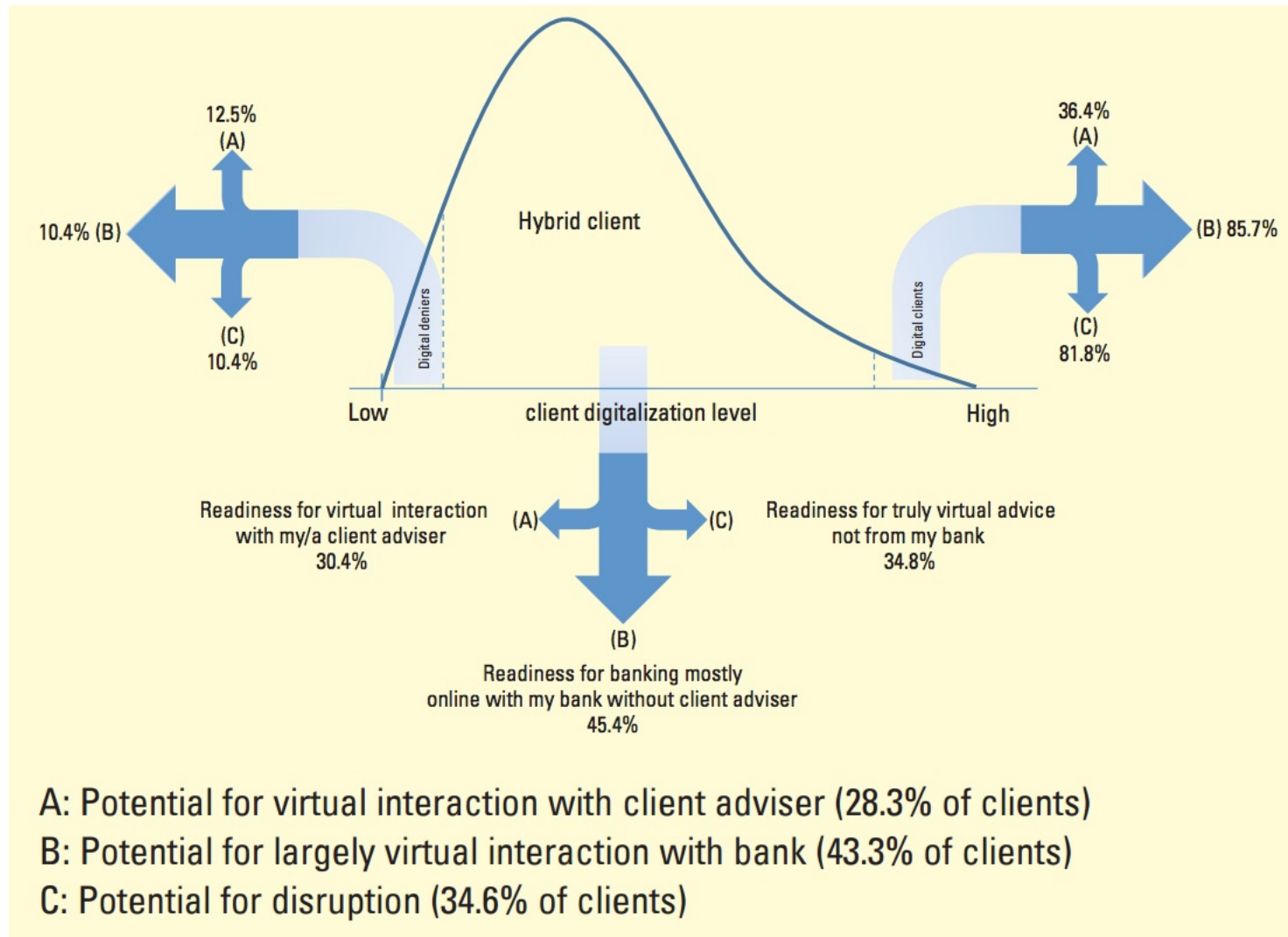
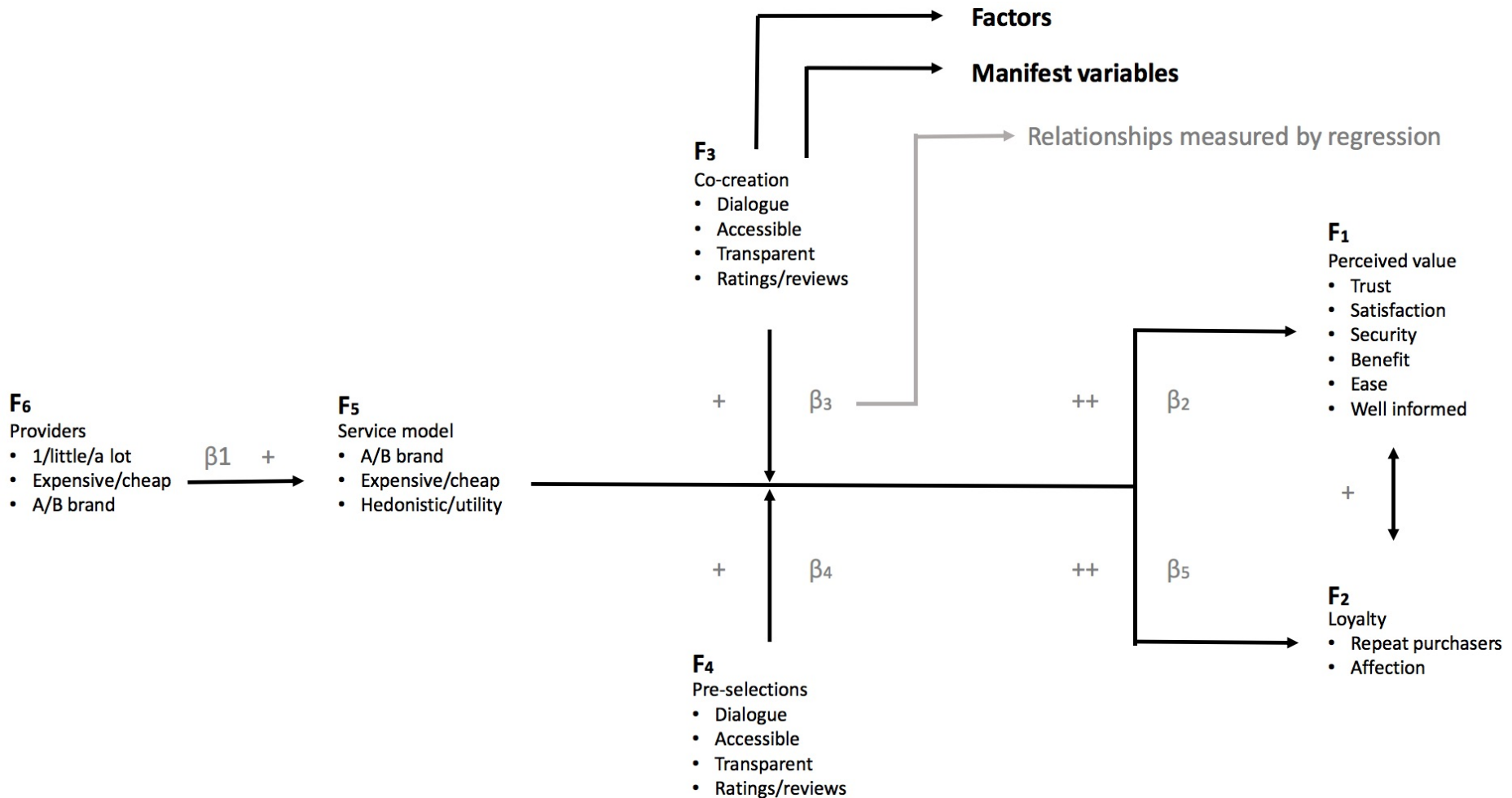# Use of Online Services by Hybrid Customers

Source: Cocca, Teodoro (2016). "Potential and Limitations of Virtual Advice in Wealth Management." Journal of Financial Transformation, 44, 45-57.

Use of Online Services by Hybrid Customers

12.5% (A)
10.4% (B)
(C) 10.4%

36.4% (A)
(B) 85.7%
(C) 81.8%

Hybrid client

Digital deniers

Digital clients

Low — client digitalization level — High

Readiness for virtual interaction with my/a client adviser 30.4%

Readiness for truly virtual advice not from my bank 34.8%

(A) (C)

(B)

Readiness for banking mostly online with my bank without client adviser 45.4%

A: Potential for virtual interaction with client adviser (28.3% of clients)
B: Potential for largely virtual interaction with bank (43.3% of clients)
C: Potential for disruption (34.6% of clients)

Explaining Customer Experience of Digital Financial Advice

Modern Portfolio Theory and Investment Analysis

- Financial Securities

- Financial Markets

- The Characteristics of the Opportunity Set Under Risk

- Delineating Efficient Portfolios

- Techniques for Calculating the Efficient Frontier

Modern Portfolio Theory and Investment Analysis

- The Correlation Structure of Security Returns:
  - The Single-Index Model
  - Multi-Index Models and Grouping Techniques
- Simple Techniques for Determining the Efficient Frontier
- Estimating Expected Returns
- How to Select Among the Portfolios in the Opportunity Set

Modern Portfolio Theory and Investment Analysis

- International Diversification
- The Standard Capital Asset Pricing Model
- Nonstandard Forms of Capital Asset Pricing Models
- Empirical Tests of Equilibrium Models
- The Arbitrage Pricing Model APT
  - A Multifactor Approach to Explaining Asset Prices

Source: Edwin J. Elton, Martin J. Gruber, Stephen J. Brown, and William N. Goetzmann (2014), Modern Portfolio Theory and Investment Analysis, 9th Edition, Wiley.

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Modern Portfolio Theory and Investment Analysis

- Efficient Markets

- The Valuation Process

- Earnings Estimation

- Behavioral Finance, Investor Decision Making, and Asset Prices

- Interest Rate Theory and the Pricing of Bonds

- The Management of Bond Portfolios

Modern Portfolio Theory and Investment Analysis

- Option Pricing Theory
- The Valuation and Uses of Financial Futures
- Mutual Funds
- Evaluation of Portfolio Performance
- Evaluation of Security Analysis
- Portfolio Management Revisited

The **New Alpha**: 30+ Startups Providing Alternative Data For Sophisticated Investors

New sources of data mined by startups like Foursquare, Premise, and Orbital Insight are letting investors understand trends before they happen.

The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

Alternative Data Sources

FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)

Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924
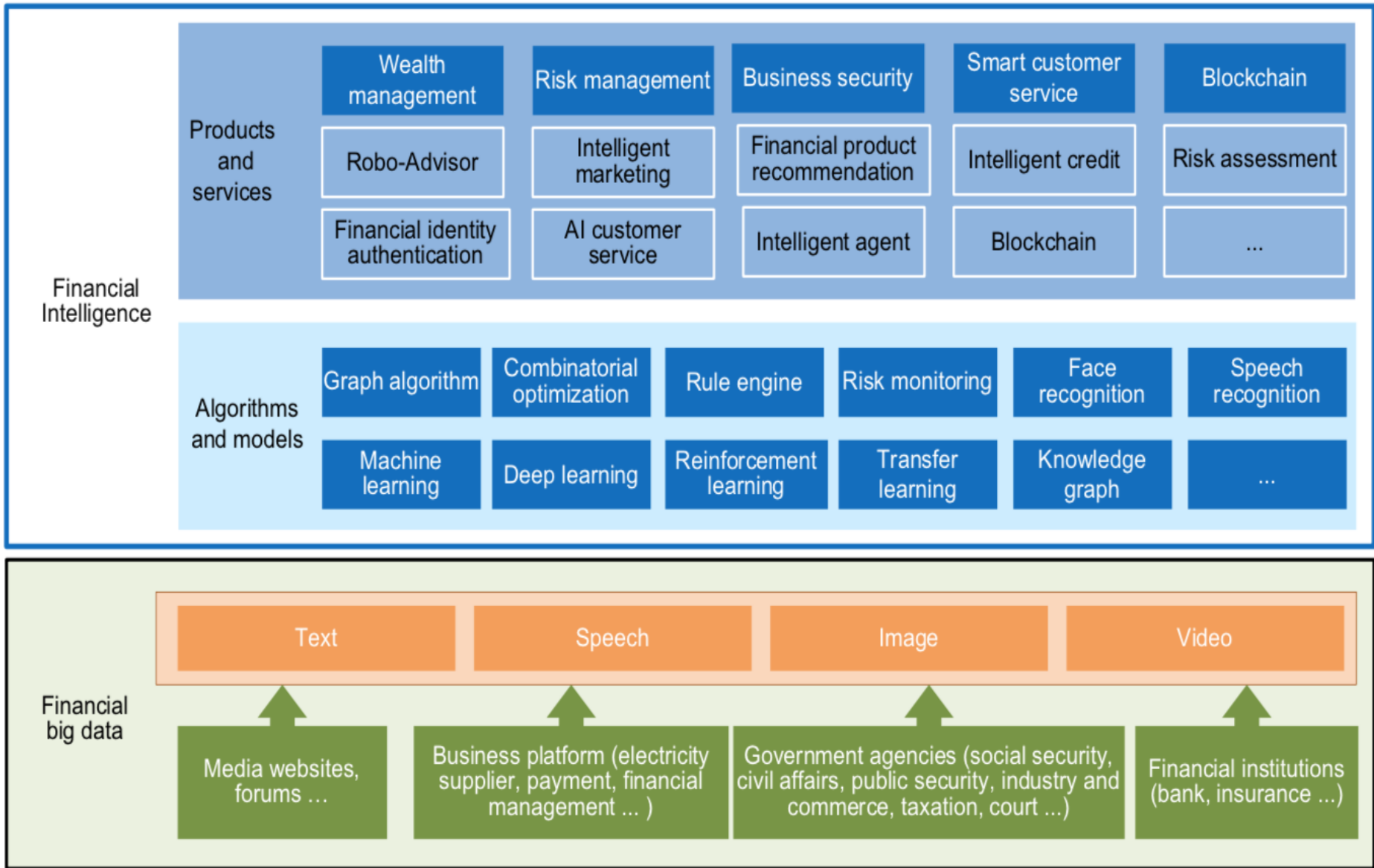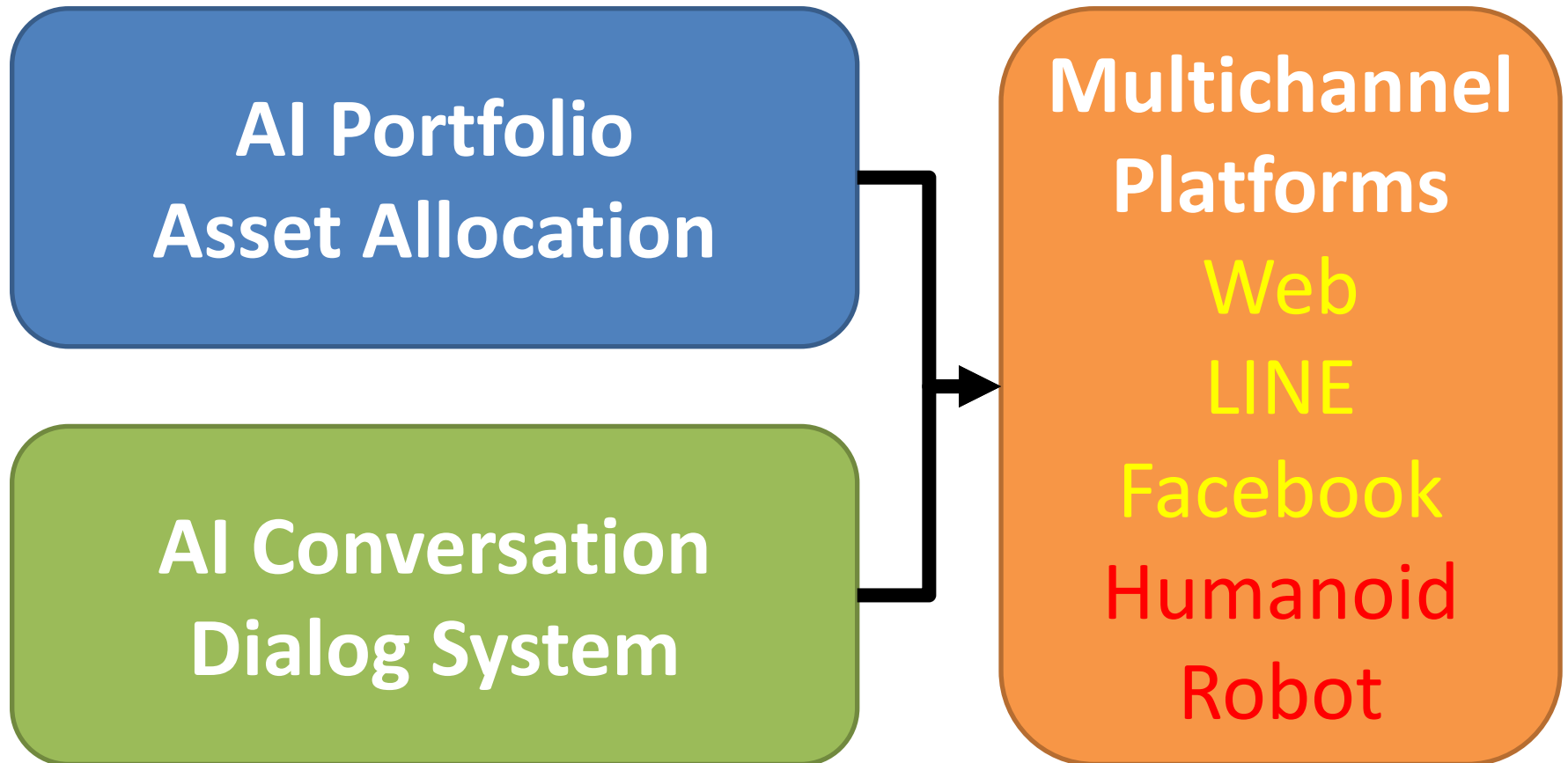
Technology-driven Financial Industry Development

Development stage	Driving technology	Main landscape	Inclusive finance	Relationship between technology and finance
Fintech 1.0 (financial IT)	Computer	Credit card, ATM, and CRMS	Low	Technology as a tool
Fintech 2.0 (Internet finance)	Mobile Internet	Marketplace lending, third-party payment, crowdfunding, and Internet insurance	Medium	Technology-driven change
Fintech 3.0 (financial intelligence)	AI, Big Data, Cloud Computing, Blockchain	Intelligent finance	High	Deep fusion

AI Humanoid Robo-Advisor

AI Humanoid Robo-Advisor
for Multi-channel Conversational Commerce

AI Portfolio Asset Allocation

AI Conversation Dialog System

Multichannel Platforms
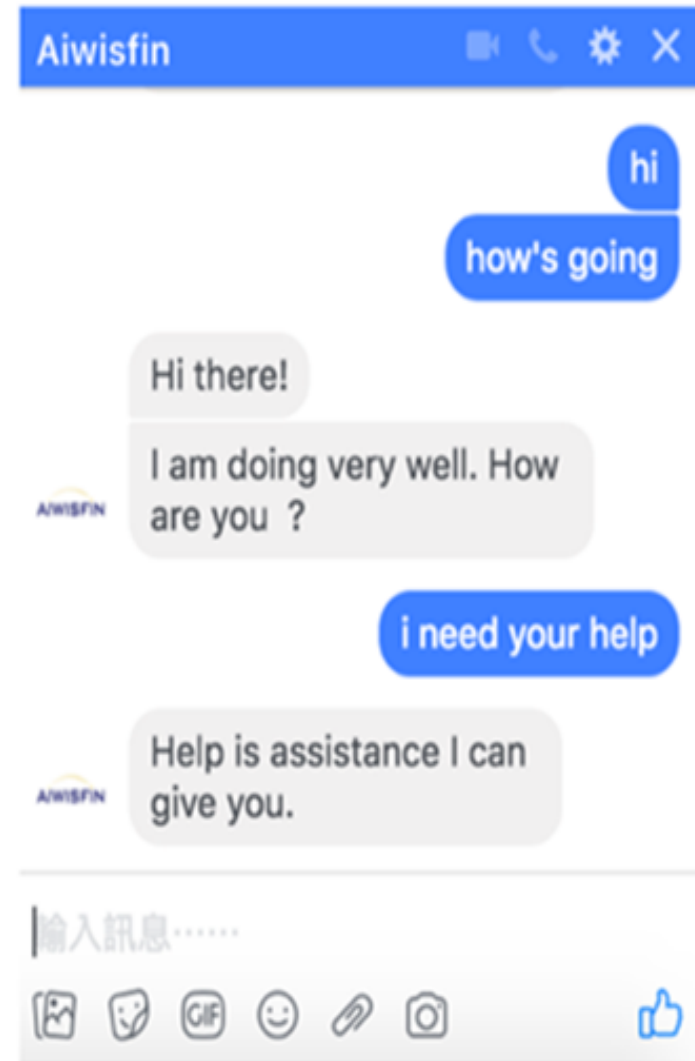Web
LINE
Facebook
Humanoid Robot

System Architecture of
AI Humanoid Robo-Advisor
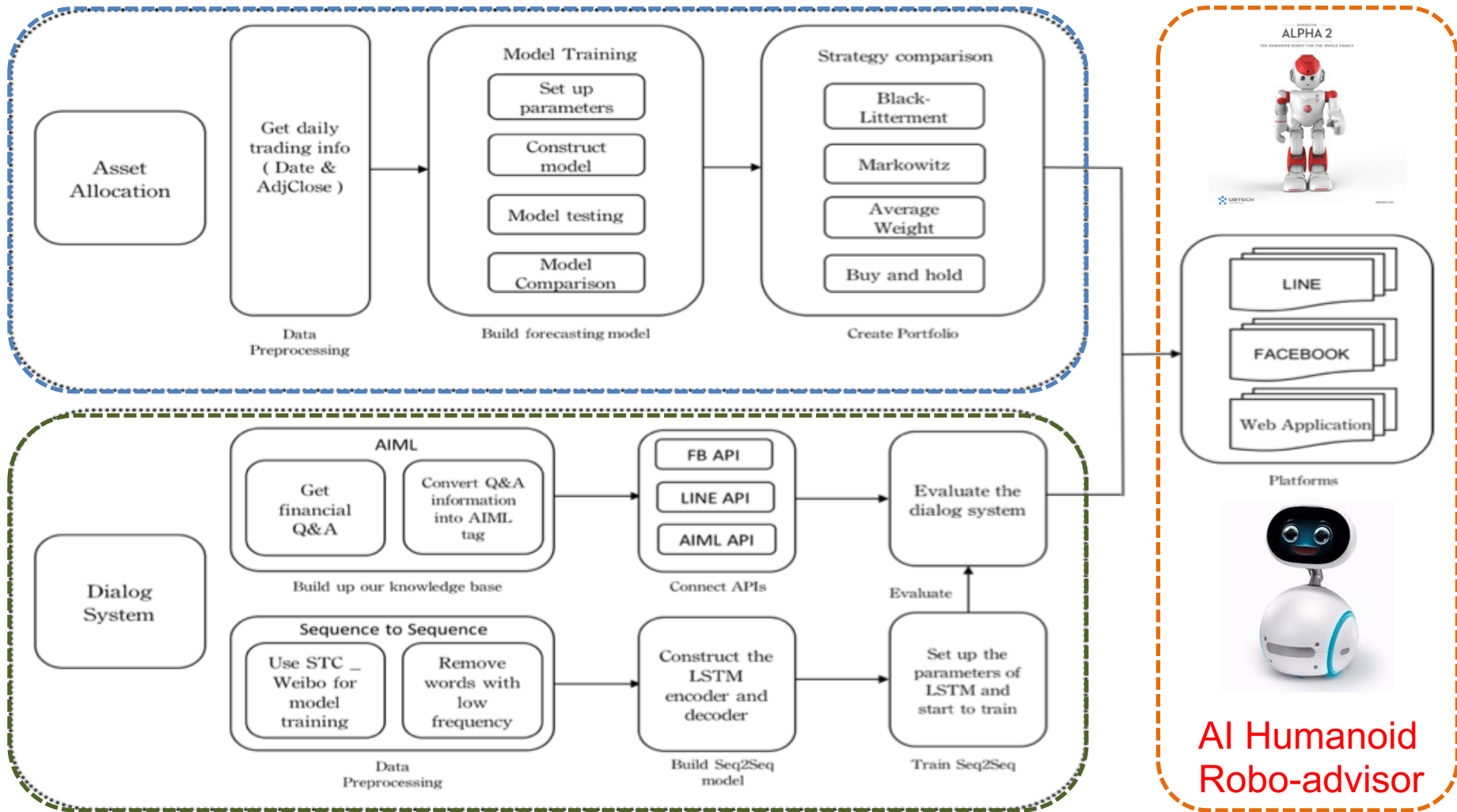
Conversational Model
(LINE, FB Messenger)

Conversational Robo-Advisor Multichannel UI/UX Robots

ALPHA 2

ZENBO

Portfolio Performance in 2016
Annual Portfolio Statistics

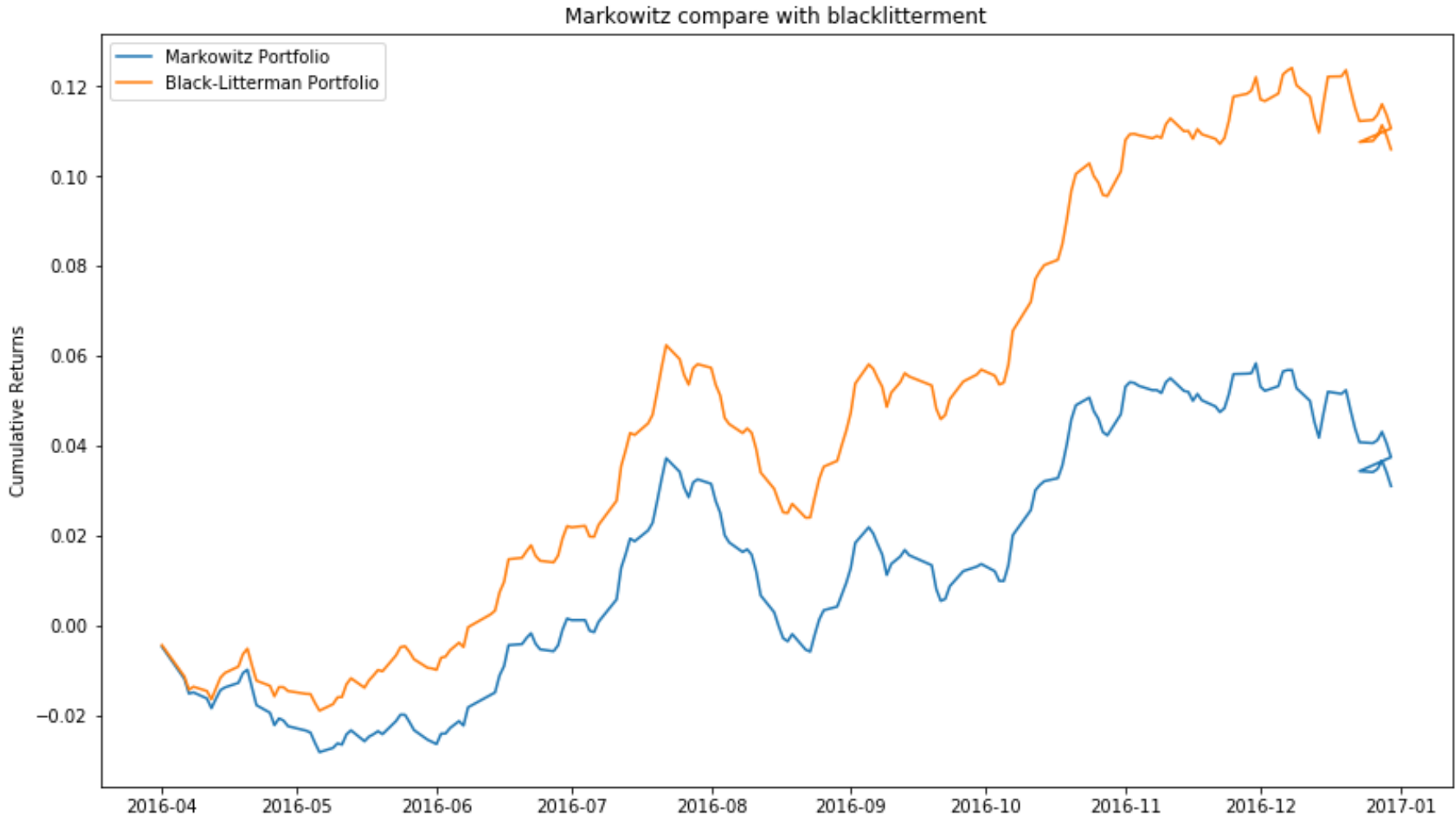|	Black-Litterman Portfolio - the LSTM Investor Views	Markowitz Portfolio	Equally Weighted Portfolio	S&P 500 Index
Annual return	16.151%	15.172%	12.428%	9.643%
Annual volatility	13.897%	14.365%	15.870%	13.169%
Sharpe ratio	1.14697	1.05534	0.81762	0.76492
Stability	0.82500	0.82515	0.82514	0.78754
Max drawdown	-10.105%	-10.465%	-12.529%	-10.306%
Skew	-0.35652	-0.52985	-0.56976	-0.36795
Kurtosis	2.49845	3.00613	2.41894	2.21958
Daily value at risk	-1.688%	-1.750%	-1.948%	-1.619%
Alpha	0.06445	0.05354	0.02158	0.00000
Beta	1.01485	1.04816	1.15631	1.00000
Information ratio	0.10935	0.09129	0.04655	-

Portfolio Cumulative Returns
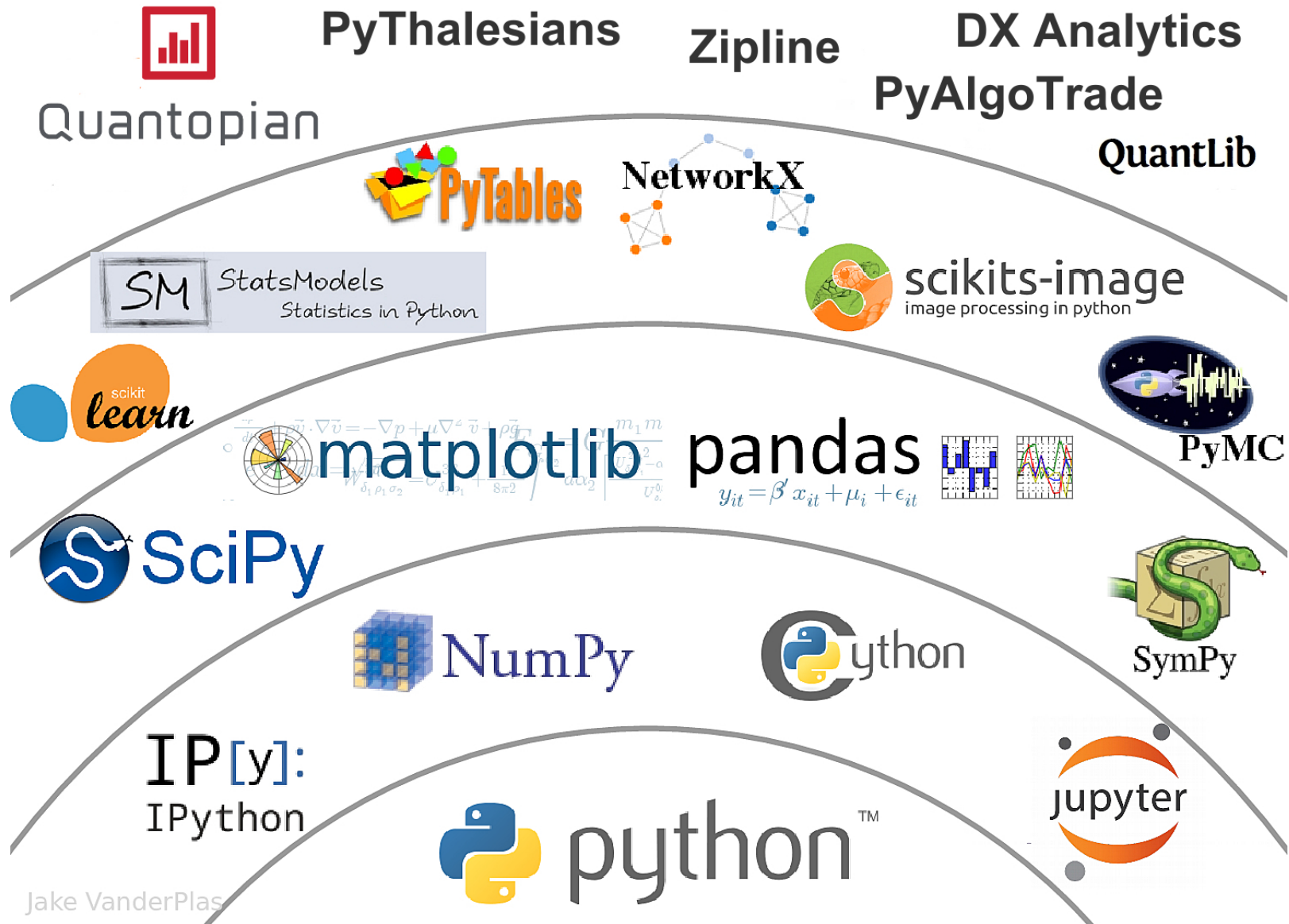

Cumulative Returns: Portfolios

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Cumulative Returns
Markowitz v.s. Black-litterment

Markowitz compare with blacklitterment

The Quant Finance PyData Stack

Quantopian

17.88 ▴
29.73 ▴
53.89 ▴
19.88 ▴
31.66 ▴

Leveling Wall Street's Playing Field

Quantopian inspires talented people everywhere to write investment algorithms.
Select authors may license their algorithms to us and get paid based on performance.

20.97 ▴

37.95 ▴

Start Coding

47.24 ▴

74.42 ▴

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- Min-Yuh Day, Jian-Ting Lin and Yuan-Chih Chen (2018). "Artificial Intelligence for Conversational Robo-Advisor." submitted to MSNDS 2018 in the 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2018), Barcelona, Spain, August 28-31, 2018.