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
副教授
Dept. of Information Management, Tamkang University

http://mail.tku.edu.tw/myday/
2019-09-27
<table>
<thead>
<tr>
<th>週次 (Week)</th>
<th>日期 (Date)</th>
<th>內容 (Subject/Topics)</th>
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<tbody>
<tr>
<td>1 2019/09/13</td>
<td>中秋節 (Mid-Autumn Festival) 放假一天 (Day off)</td>
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</tr>
<tr>
<td>2 2019/09/20</td>
<td>人工智慧財務金融應用課程介紹 (Course Orientation for AI in Financial Application)</td>
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<tr>
<td>3 2019/09/27</td>
<td>人工智慧投資分析與機器人理財顧問 (Artificial Intelligence for Investment Analysis and Robo-Advisors)</td>
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<tr>
<td>4 2019/10/04</td>
<td>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)</td>
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<td>5 2019/10/11</td>
<td>國慶日補假 (Bridge Holiday for National Day, Extra Day Off)</td>
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<td>6 2019/10/18</td>
<td>財務金融事件研究法 (Event Studies in Finance)</td>
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<td>週次 (Week)</td>
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</tr>
<tr>
<td>------------</td>
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<td>----------------------</td>
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</table>
| 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) |
<table>
<thead>
<tr>
<th>週次 (Week)</th>
<th>日期 (Date)</th>
<th>內容 (Subject/Topics)</th>
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<tbody>
<tr>
<td>13</td>
<td>2019/12/06</td>
<td>人工智能財務金融應用個案研究 II (Case Study on AI in Financial Application II)</td>
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<tr>
<td>14</td>
<td>2019/12/13</td>
<td>TensorFlow 深度學習財務金融應用 II (Deep Learning for Finance Application with TensorFlow II)</td>
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<td>15</td>
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<td>TensorFlow 深度學習財務金融應用 III (Deep Learning for Finance Application with TensorFlow III)</td>
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<td>16</td>
<td>2019/12/27</td>
<td>社會網絡分析財務金融應用 (Social Network Analysis for Finance Application)</td>
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<tr>
<td>17</td>
<td>2020/01/03</td>
<td>期末報告 I (Final Project Presentation I)</td>
</tr>
<tr>
<td>18</td>
<td>2020/01/10</td>
<td>期末報告 II (Final Project Presentation II)</td>
</tr>
</tbody>
</table>
Artificial Intelligence for Investment Analysis and Robo-Advisors
Robotic Process Automation (RPA)
AI
Robo-Advisor in FinTech
AIWISFIN
AI Conversational Robo-Advisor
(人工智能對話式理財機器人)
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
2018 International ICT Innovative Services Awards (InnoServe Awards 2018)
(2018第23届大專校院資訊應用服務創新競賽)

https://innoserve.tca.org.tw/award.aspx
FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification, Paolo Sironi, Wiley, 2016

Source: https://www.amazon.com/Modern-Portfolio-Theory-Investment-Analysis/dp/1118469941
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

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
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
- KENSCH
- cortical.io
- Numenta
- turi
- DataRobot
- nervana systems

Market Research & Sentiment Analysis
- indicio
- acuity trading
- Lucena Quantitative Analytics
- Numerai
- Dataminr

Search Engine
- alphasense

Quantitative Trading
- sentient technologies
- CLONE ALGO
- Alpaca

AI Assistants/Bots
- KASIST
- TRIM
- Penny
- INSURIFY
- SURE.

Blockchain
- Skry
- EUKLID

Credit Scoring
- TypeScore
- aire
- creditvidya
- zest finance
- ADF
- CREAM FINANCE

Personal Banking
- persononetics

Fraud Detection
- feedzai
- BIOTRACK
- less friction. less fraud.

Debt Collection
- TrueAccord

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

General Purpose/ Predictive Analytics

- AYASDI
- Digital Reasoning
- context relevant
- H₂O
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- cortical.io
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Market Research & Sentiment Analysis

- indico
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Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

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

AI Assistants/Bots
- KASIST
- TRIM
- Penny
- INSURIFY
- SURE.

Credit Scoring
- TypeScore
- aire
- creditvidya
- zest
- ADF
- APPLIED DATA FINANCE
- WeCash
- CREAM FINANCE

Blockchain
- Skry
- EUKLID

Debt Collection
- TrueAccord

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

Personal Banking
- personetics
- SBDA group

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

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.

1974
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 of possible positions.

Artificial Intelligence

Machine Learning & Deep Learning

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

Source: http://research.ibm.com/cognitive-computing/
Financial Technology

FinTech

“providing financial services by making use of software and modern technology”

Source: https://www.fintechweekly.com/fintech-definition
Financial Services
Money
Money

Makes

Money
Investment Analysis
Time Value of Money

Risk

Return
Fintech Robo Advisors
Big DataDriven
Disruption:
Robo-Advisor

Source: http://www.vamsitalkstech.com/?p=2329
FinTech high-level classification

Lending  Payments  Robo Advisors  Analytics  Others

Profile  Advice  Re-Balance  Indexing

FinTech: Financial Services Innovation

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Financial Services Innovation

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

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Financial Services Innovation

- **Payments**
  - 無現金世界 (Cashless World)
  - 新興支付 (Emerging Payment Rails)

- **Insurance**
  - 價值鏈裂解 (Insurance Disaggregation)
  - 保險串接裝置 (Connected Insurance)

- **Deposit & Lending**
  - 替代管道 (Alternative Lending)
  - 通路偏好移轉 (Shifting Customer Preferences)

- **Capital Raising**
  - 群眾募資 (Crowdfunding)

- **Investment Management**
  - 賦權投資者 (Empowered Investors)
  - 流程外部化 (Process Externalisation)

- **Market Provisioning**
  - 機器革命 (Smarter, Faster Machines)
  - 新興平台 (New Market Platforms)

5 FinTech: Investment Management

Source: http://www3.weforum.org/docs/WEF_The_future_of_financial_services.pdf
FinTech: Investment Management
Empowered Investors
Process Externalization
FinTech: Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Market Provisioning Smarter, Faster Machines New Market Platforms
Disrupting Banking: The Fintech Startups That Are Unbundling Wells Fargo, Citi and Bank of America

Source: https://www.cbinsights.com/blog/industry-market-map-landscape/
Fintech: Unbundling the Bank

Unbundling of a Bank

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/
Fintech: Unbundling the Bank

Wealth Management: Wealthfront
The most tax-efficient, low-cost, hassle-free way to invest

Invest with Wealthfront  See Our Journey

Do you have the time to invest well?

Wealthfront invests your money for you with a minimal amount of work. We monitor your portfolio every day to look for opportunities to rebalance or harvest tax losses. Are you doing the same?

https://www.wealthfront.com/
A classic workflow for financial recommendations

Process of Robo Advisors

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

Source: https://advisesure.com/blog/what-is-meaning-of-term-robo-advisor-and--their-benefits
Benefits of Robo Advisors

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

Source: https://advisesure.com/blog/what-is-meaning-of-term-robo-advisor-and--their-benefits
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

Source: http://www.vamsitalkstech.com/?p=2329
Robo-Advisor Business Models

• Full service online Robo-advisor
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• Hybrid Robo-advisor model
  – being pioneered by firms like Vanguard & Charles Schwab

• Pure online advisor
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Source: http://www.vamsitalkstech.com/?p=2329
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

Source: http://www.vamsitalkstech.com/?p=2418
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

Source: http://www.vamsitalkstech.com/?p=2354
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.

Source: http://www.vamsitalkstech.com/?p=2354
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.

Source: http://www.vamstalkstech.com/?p=2354
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.

Source: http://www.vamsitalkstech.com/?p=2354
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%

Source: http://www.vamsitalkstech.com/?p=2354
Architecture of a Robo-Advisor (RA)

1. Mass Affluent Client
   - Brokerage Accounts
   - Online Banking
   - Retirement Accounts
   - Call Data Records

2. Client fills out a detailed questionnaire

3. Portfolio is rebalanced based on movements in financial markets

4. Data scientists create chains of algorithms that rebalance client portfolios, provide tax loss harvesting & provide automated portfolio management

5. The Data Lake feeds EDW and other systems that specialize in conventional downstream analytics

6. Client accesses their portfolio using a website or a mobile application

Source: http://hortonworks.com/blog/architecture-of-a-roboadvisor/
Robo-Advisor

wealthfront

Betterment
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.
Plan your future
Grow your wealth
Invest in your life

Access proven investment strategies, tailored advice, and premium financial services - all powered by technology.

Invest with Wealthfront  Explore your options

https://www.wealthfront.com/
Betterment
Online Financial Advisor

HELLO, INVESTOR

Betterment is an online financial advisor built for people who refuse to settle for average investing. People who demand better. People like you.

Get started

Watch our video

Right for every type of investor

New investor
I'm new to investing, or am looking for some guidance.

Hands-off investor
I invest, but don't have the time or desire to do it myself.

Hands-on investor
I'm a confident, hands-on investor looking for an optimal solution.

https://www.betterment.com/
Betterment: Fintech Robo Advisor

This is simply a smarter way to invest your money.

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

Source: https://www.betterment.com/
## Betterment vs. Wealthfront

<table>
<thead>
<tr>
<th>Feature</th>
<th>Betterment</th>
<th>Wealthfront</th>
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</thead>
<tbody>
<tr>
<td>Investor Junkie Rating</td>
<td>4.5 star</td>
<td>5 star</td>
</tr>
<tr>
<td>Promotions</td>
<td>One Month Free</td>
<td>First $15k for Free</td>
</tr>
<tr>
<td>Fees</td>
<td>0.25%/yr</td>
<td>None first $10k; 0.25%/yr for more</td>
</tr>
<tr>
<td>Minimum Deposit</td>
<td>None</td>
<td>$500</td>
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<tr>
<td>Human Advisors</td>
<td>Yes — Additional Fee</td>
<td>No</td>
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<tr>
<td>Automatic Rebalancing</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tax Loss Harvesting</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct Indexing</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Fractional Shares</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Assets Under Management</td>
<td>$8.0B</td>
<td>$5.0B</td>
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</table>

Source: https://investorjunkie.com/36355/betterment-vs-wealthfront/
Wealthfront: 0.25% Flat annual advisory fee

- No trading commissions or hidden fees
- Portfolio of low-cost ETFs
- Your first $10,000 managed free

Source: https://www.wealthfront.com/
Wealthfront
Powering your financial life with technology

Source: https://www.wealthfront.com/
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

$2,394,391

My assumptions

What you’ll have  What you’ll need

Source: https://www.wealthfront.com/
Wealthfront Robo Advisor

Source: https://www.wealthfront.com/
Financial Revolution with Fintech

A financial services revolution
Consumer Trends

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

Source: http://www.hedgethink.com/fintech/european-fintech-top-100/
Millennial Personal Finance: 63 Fintech Startups Targeting Millennials

FinTech Startups for Millennials

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

Marketing to Millennials

**Millennial Personas**

- **Digital Window Shoppers**: Less engaged online than other millennials
  - 23% of the millennial population
  - Female majority

- **Digital Socialites**: Highly social and engaged online
  - 26% of the millennial population
  - Female majority

- **Dynamic Media Junkies**: Extremely tech savvy and engaged with online video and streamed content
  - 23% of the millennial population
  - Male majority

- **Casually Engaged**: Least engaged in digital world, more likely to be unemployed
  - 17% of the millennial population
  - Male majority

- **Emerging Technocracy**: Strongly engaged digitally and highly influential
  - 15% of the millennial population
  - Male majority

Marketing to Millennials

**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**.

**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

<table>
<thead>
<tr>
<th>Fintech Category</th>
<th>#Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowdfunding</td>
<td>2</td>
</tr>
<tr>
<td>Insurance (Non-Health)</td>
<td>4</td>
</tr>
<tr>
<td>Loans &amp; Credit Risk</td>
<td>20</td>
</tr>
<tr>
<td>Mobile Banking &amp; Payments</td>
<td>8</td>
</tr>
<tr>
<td>Personal Investing</td>
<td>10</td>
</tr>
<tr>
<td>Savings &amp; Finances Tracking</td>
<td>10</td>
</tr>
<tr>
<td>Wealth Management</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>63</strong></td>
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</tbody>
</table>

Source: https://www.cbinsights.com/blog/fin-tech-startups-millennials/
## Fintech: Wealth Management

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

Source: https://www.cbinsights.com/blog/fin-tech-startups-millennials/
# Fintech: Personal Investing

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

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

Source: https://research.wealthfront.com/whitepapers/investment-methodology/
Wealth Management Value Chain

Wealth Management Service and Potential for virtualization

AI and Robo Advisor

Virtualization Dimensions

Source: Cocca (2016)

Degree of Digitalization of Wealth Management Customers

Use of Online Services by Hybrid Customers

Use of Online Services by Hybrid Customers

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

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.

Source: https://www.cbinsights.com/blog/alternative-data-startups-market-map-company-list/
The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

Alternative Data Sources

**WEB/APP/SOCIAL MEDIA DATA**
- yipit DATA
- 7PARK DATA
- App Annie
- Selerity
- Dataminr
- DataSift

**WEATHER DATA**
- Aclima
- The Climate Corporation

**LOCATION/FOOT TRAFFIC**
- Foursquare
- Placemeter
- Airsage
- StreetLight Data
- Placed

**SATELLITE DATA**
- Orbital Insight
- Spire
- Rezatec
- Ursa
- RS Metrics
- Urthecast
- Planet Labs
- Windward

**LOCAL PRICES**
- PriceStats
- Premise

**ALTERNATIVE DATA MONETIZERS/AGGREGATORS**
- Eagle Alpha
- Quanton Data
- Sentieo
- Discern Insights as a Service

**CREDIT CARD TRANSACTIONS**
- Earnest
- Second Measure
- ynext data
- Envestnet Yodlee

**ALTERNATIVE CREDIT**
- First Access
- Cignim
- Factor Trust

Source: https://www.cbinsights.com/blog/alternative-data-startups-market-map-company-list/
FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)

Financial Intelligence

Products and services
- Wealth management
- Risk management
- Business security
- Smart customer service
- Blockchain
- Robo-Advisor
- Intelligent marketing
- Financial product recommendation
- Intelligent credit
- Risk assessment
- Financial identity authentication
- AI customer service
- Intelligent agent
- Blockchain
- ...

Algorithms and models
- Graph algorithm
- Combinatorial optimization
- Rule engine
- Risk monitoring
- Face recognition
- Speech recognition
- Machine learning
- Deep learning
- Reinforcement learning
- Transfer learning
- Knowledge graph
- ...

Financial big data

- Text
- Speech
- Image
- Video

- Media websites, forums ...
- Business platform (electricity supplier, payment, financial management ...)
- Government agencies (social security, civil affairs, public security, industry and commerce, taxation, court ...)
- Financial institutions (bank, insurance ...)

## Technology-driven Financial Industry Development

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

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

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

Portfolio Cumulative Returns

Cumulative Returns
Markowitz v.s. Black-litterment

Source: Min-Yuh Day, Jian-Ting Lin and Yuan-Chih Chen (2018), "Artificial Intelligence for Conversational Robo-Advisor", in Proceedings of the 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2018), Barcelona, Spain, August 28-31, 2018
The Quant Finance PyData Stack

PyThalesians  Zipline  DX Analytics
PyAlgoTrade  QuantLib

Quantopian

StatsModels  image processing in python
Statistics in Python

scikit-learn

matplotlib  pandas

y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}

SciPy

NumPy

IP[y]: IPython

Python

jupyter

Source: http://nbviewer.jupyter.org/format/slides/github/quantopian/pyfolio/blob/master/pyfolio/examples/overview_slides.ipynb#5
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.

Start Coding

https://www.quantopian.com/
References