



#MACHINE INTELLIGENCE & AUGMENTED FINANCE

How Artificial Intelligence creates \$1 trillion of change in the front, middle and back office of the financial services industry

Suitable only for professional investors



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Executive Summary (1 of 2)

- **Artificial intelligence is here because the needed hardware and software have been built**
 - AI requires hardware with massive computing power and data sets with millions of data points across many types of human activity, which have emerged from the web
 - There are 7.5 billion people but 20 billion smart computing devices, all with access to the storage and processing power of the Cloud, which is a \$100 billion market
 - Venture capital has flown into Machine Learning companies at a rate of \$5-10 billion per year
- **There are various scientific approaches to building AI; the current relevant development is the advance in Machine Learning, and in particular neural networks and deep learning**
 - Designing software by automating a process top-down is fundamentally different from leveraging AI techniques, which create probabilistic models that change in response to new data
 - Machines have developed the ability to derive information from sensory information, such as vision and sound, with an accuracy greater than humans
 - AI can also be used in a creative capacity to explore a space of ideas quickly or to do emotional tasks
- **The growth and potential of Artificial Intelligence is a massive challenge for the traditional economy, and its development is likely to only accelerate**
 - Most of AI research is publicly available through academic archives and much of the code is open source
 - Moore's law suggesting exponential information processing continues to hold; current number of total scientific research submissions to ArXiv is 1.3 million, lines of open source code is likely over 100 million
 - Popularity of machine learning courses at top universities skyrocketed with compensation levels
 - Important to be grounded -- today's narrow Artificial Intelligence is not a panacea and does not have general reasoning capacity; but there are many practical applications of automated human judgment



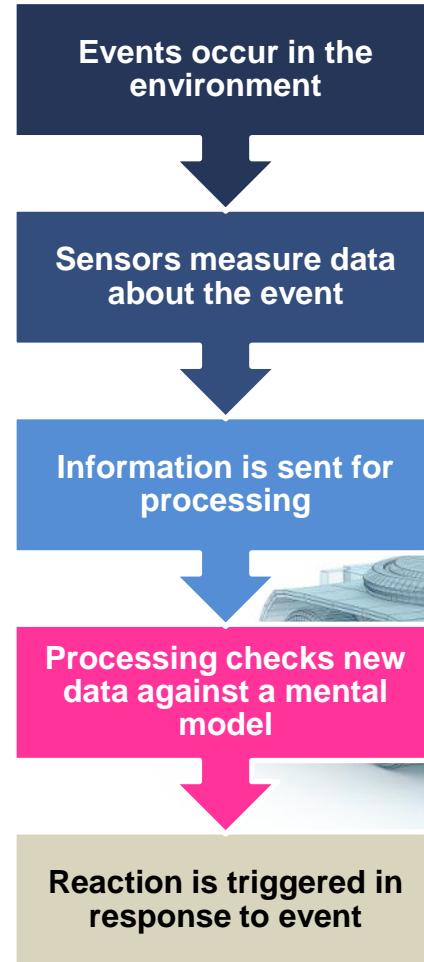
Executive Summary (2 of 2)

- **Financial AI use-cases include conversational interfaces, biometrics, workflow and compliance automation, and product manufacturing in lending, investments and insurance**
 - In the front office, the most promising applications focus on integrating financial data and account actions with software agents that can hold conversations with clients, as well as support staff
 - In the middle office, as regulations become more complex and processes trend towards real-time, artificially intelligent oversight, risk-management and KYC systems can become very valuable
 - In product manufacturing, we see AI used to determine credit risk using new types of data (e.g., social media, free text fields), take insurance underwriting risk and assess claims damage using machine vision (e.g., broken windshield), and select investments based on alternative data combined with human judgment
- **Deploying AI across financial services has a \$1 trillion potential impact**
 - In US alone, 2.5 million financial services employees are exposed to AI technologies
 - Potential cost savings of \$490 billion in front office (distribution), \$350 billion in middle office, \$200 billion in back office (manufacturing), totalling \$1 trillion across banking, investment management and insurance
 - Many firms talk about AI, few actually hold intellectual property in the space, which creates Black Swan risk
- **Future of AI in financials can take several routes; ethical and safety concerns are paramount**
 - One potential path is that AI tech companies like Amazon and Google continue to add skills to their smart home assistants, with Amazon Alexa sporting over 20,000 skills already, outcompeting finance companies
 - Another potential path is the example of China, where tech and finance merge (e.g., Tencent, Ant Financial) to build full psychographic profiles of customers across social, commercial, personal and financial data
 - A third path is towards decentralized autonomous organizations that are built by the crypto community to shift power back to the individual, with skills made from open source component parts

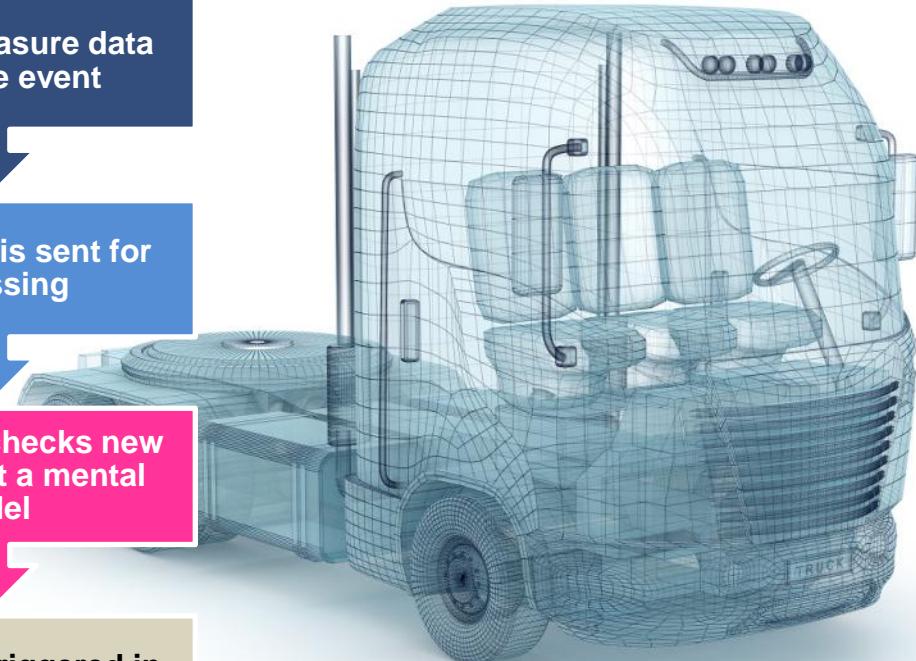
The Artificially Intelligent Corpus

The current metaphor for digitizing the physical world compares human brains with computer systems

Organic Nervous System in Physical Body



Virtual “Digital Twin” System for Mechanical Body





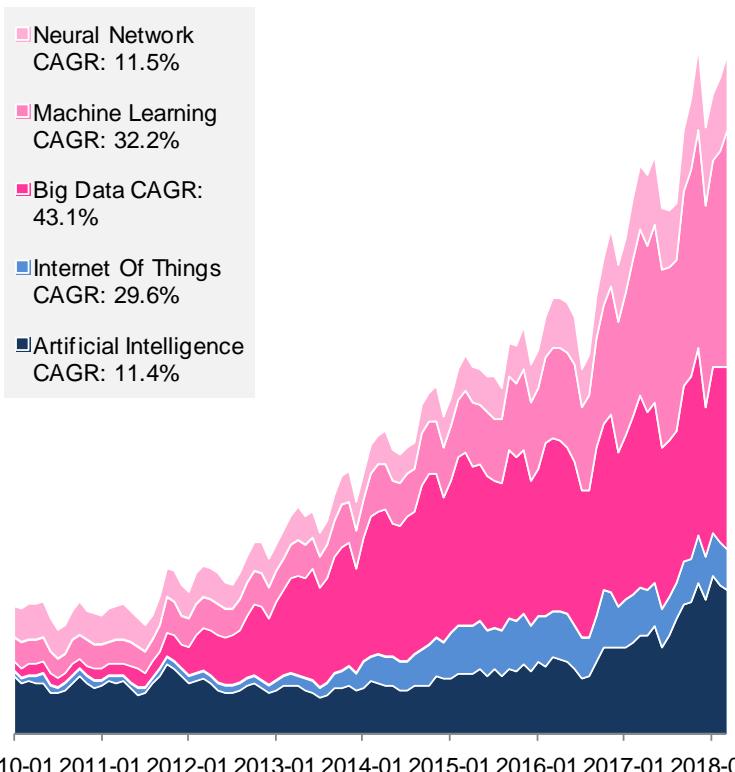
Artificial Intelligence, Big Data and IoT are closely connected

Events occur in the environment	Theme	Human View	Machine View
Sensors measure data about the event	Internet of Things	<ul style="list-style-type: none">Humans have general intelligence and respond to many stimuli, but only some events are observed and are relevant to our senses	<ul style="list-style-type: none">Machines are custom-built to react to specific events (narrow AI), but can be programmed to sense things humans cannot, like ultrasound
Information is sent for processing	Big Data	<ul style="list-style-type: none">Humans use our natural senses and the systems of the body to capture information and send it to the brain through the nervous system	<ul style="list-style-type: none">Machine sensors can be built for specific data and placed within objects to collect "Big Data". Digital Twin projects from industrial companies render physical things in virtual worlds as a digital nervous system.
Processing checks new data against a mental model	Artificial Intelligence	<ul style="list-style-type: none">Different systems in the organism are used to measure and react to stimuli, from conscious/unconscious thought, to activations of emotions and hormonal systems	<ul style="list-style-type: none">Machines must structure the data they collect and find ways to store and process massive amounts of information, which only now has become possible with cheap computing power
Reaction is triggered in response to event		<ul style="list-style-type: none">The sensory experience has impacted a system, which has made a determination for actionA person will withdraw a hand from the flame after processing a pain signal through the spinal cord and brain	<ul style="list-style-type: none">Upon receiving the data, a model will be updated, perhaps even changing the model, and an action will be causedA self-driving car may change course on perceiving an obstacle

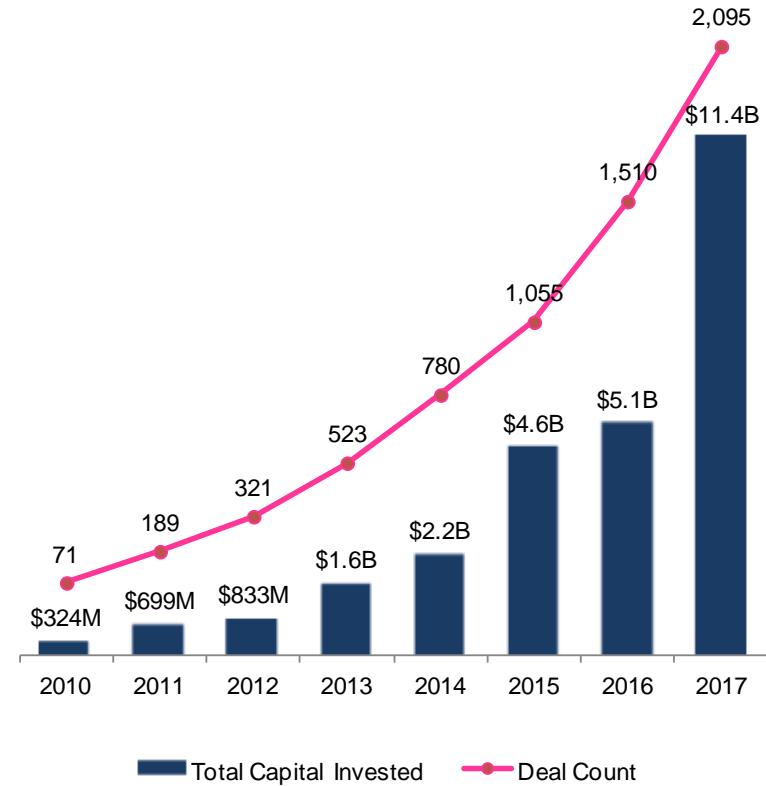


The artificially intelligent corpus has seen both an increase in interest (from body to brain) and venture funding

Google Trends (Sum of Terms)



Venture Funding into AI companies



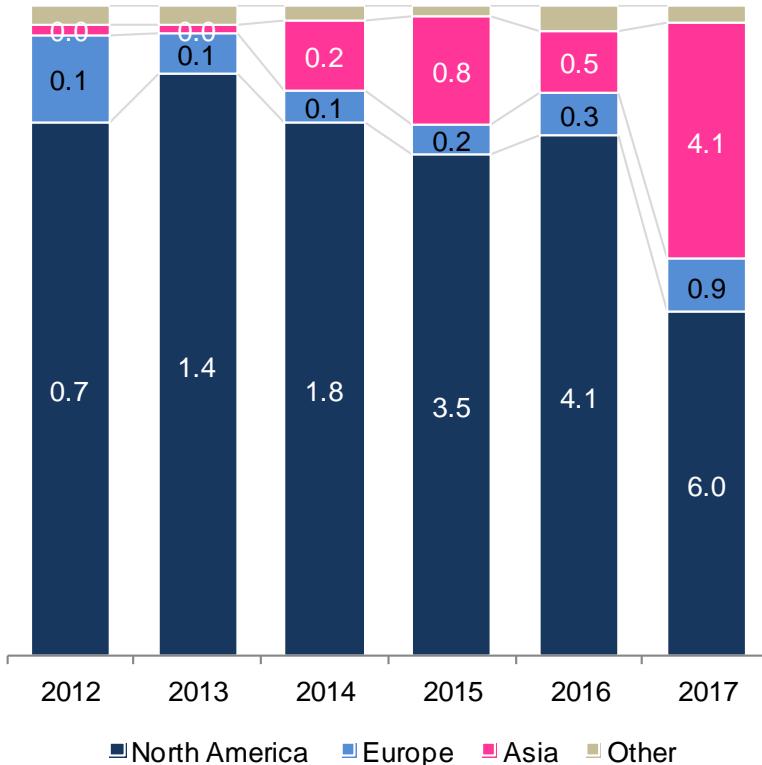
- Interest in the foundation of big data, and the machine intelligence to analyze it, has seen a fast acceleration in the last decade

- Venture for AI, machine learning, neural networks, data science, self-driving cars and chat agents continues to grow

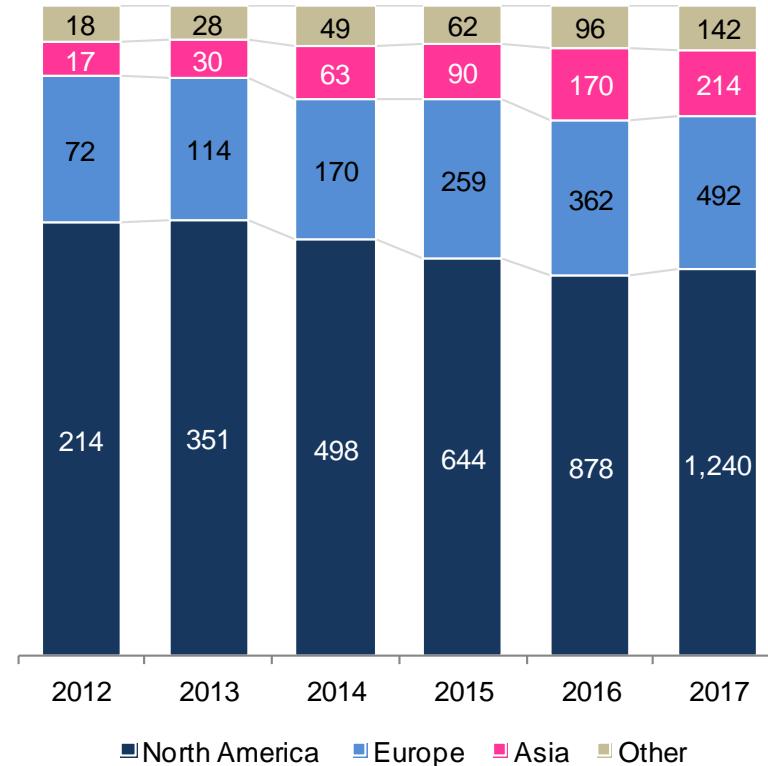


North America has the highest deal count and invests the most capital, but Asia is gaining incremental share

Venture Financing into AI (\$ billions)



Venture Financing into AI (deals)



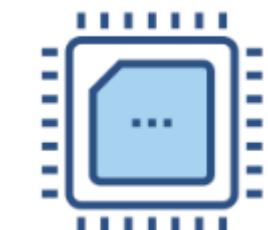
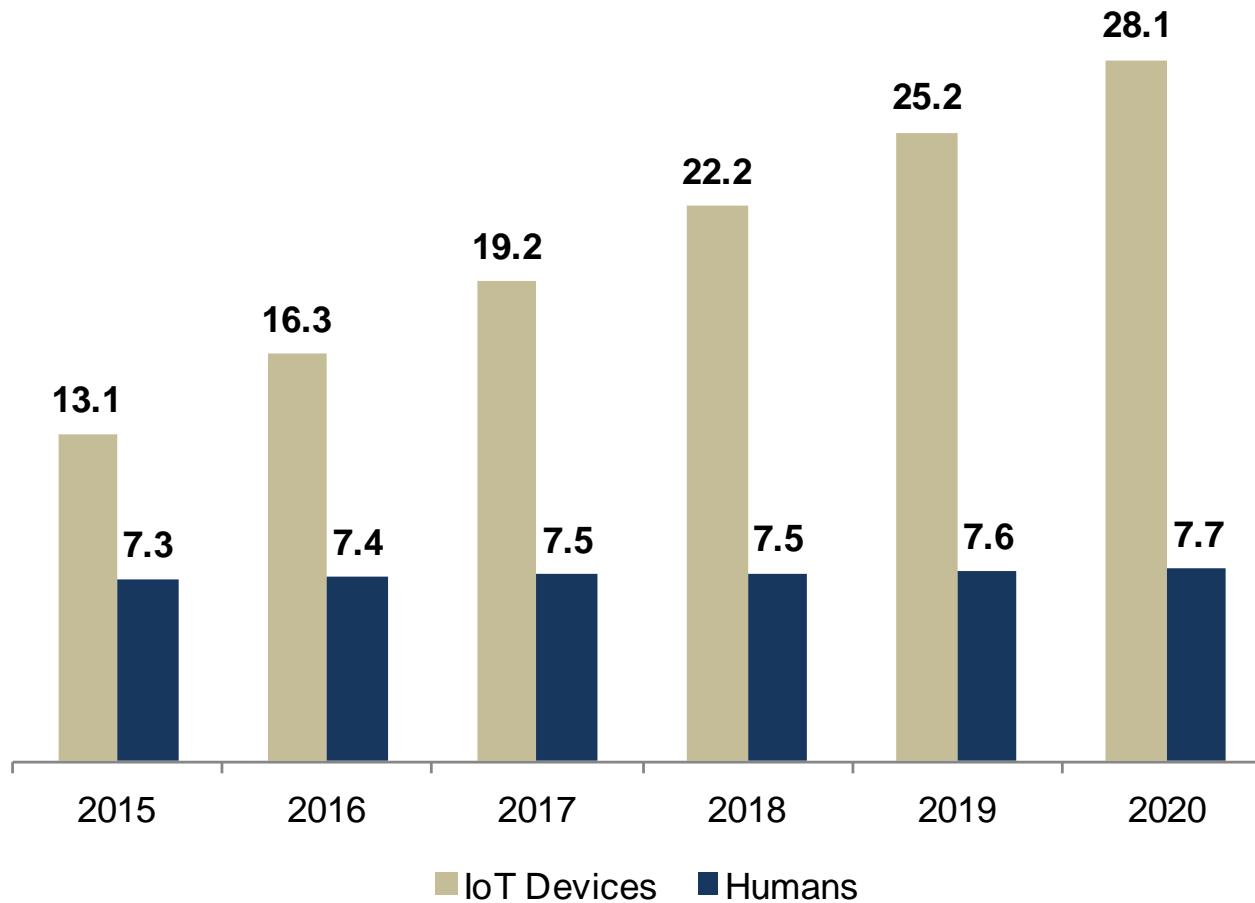
- North America has tended to dominate AI funding, but the role of Asia is rapidly increasing

- From a deal count perspective, all regions have shown increased activity

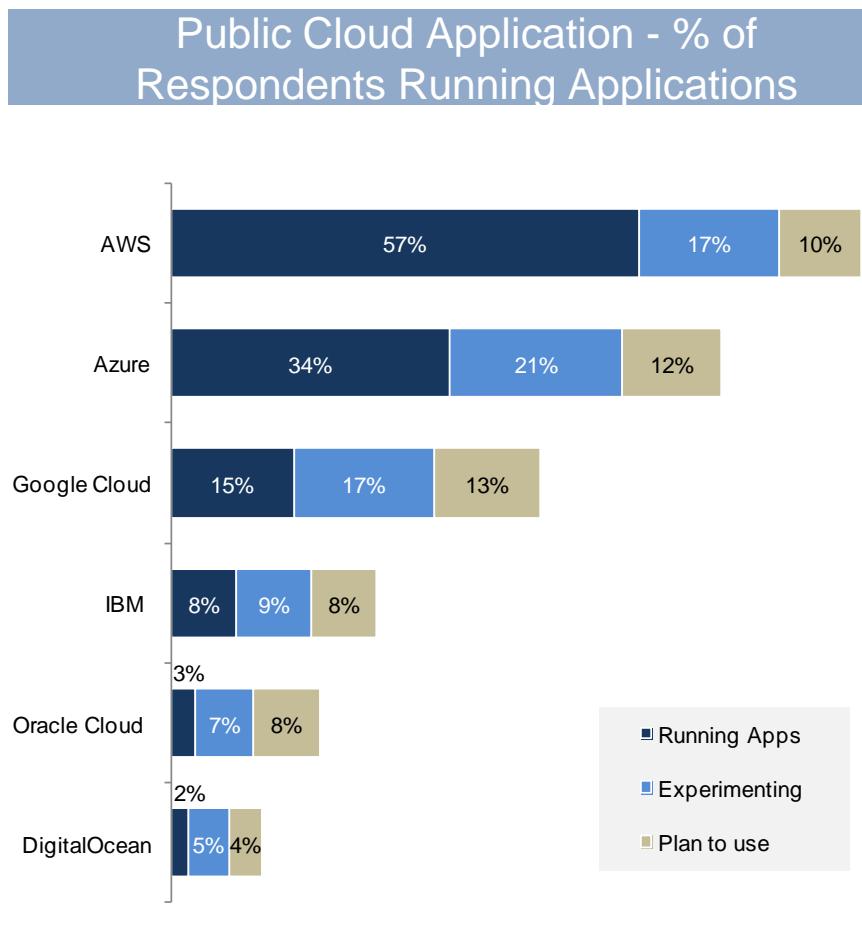
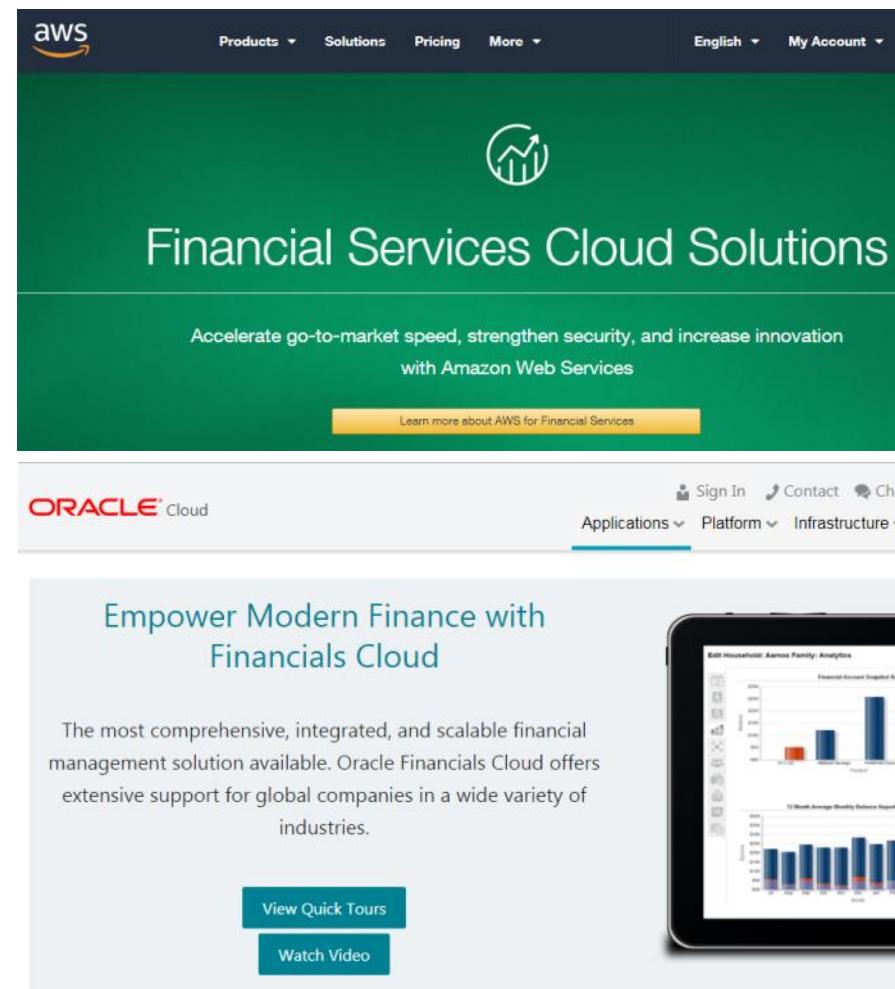


Hardware processors, via the emergence of Internet of Things outnumber human brains

Internet of Things vs Humans (billions)



Biggest beneficiaries of the infrastructure build are the high-tech firms, now competing for financial services data

Financial Services Cloud Solutions

Accelerate go-to-market speed, strengthen security, and increase innovation with Amazon Web Services

ORACLE® Cloud

Empower Modern Finance with Financials Cloud

The most comprehensive, integrated, and scalable financial management solution available. Oracle Financials Cloud offers extensive support for global companies in a wide variety of industries.

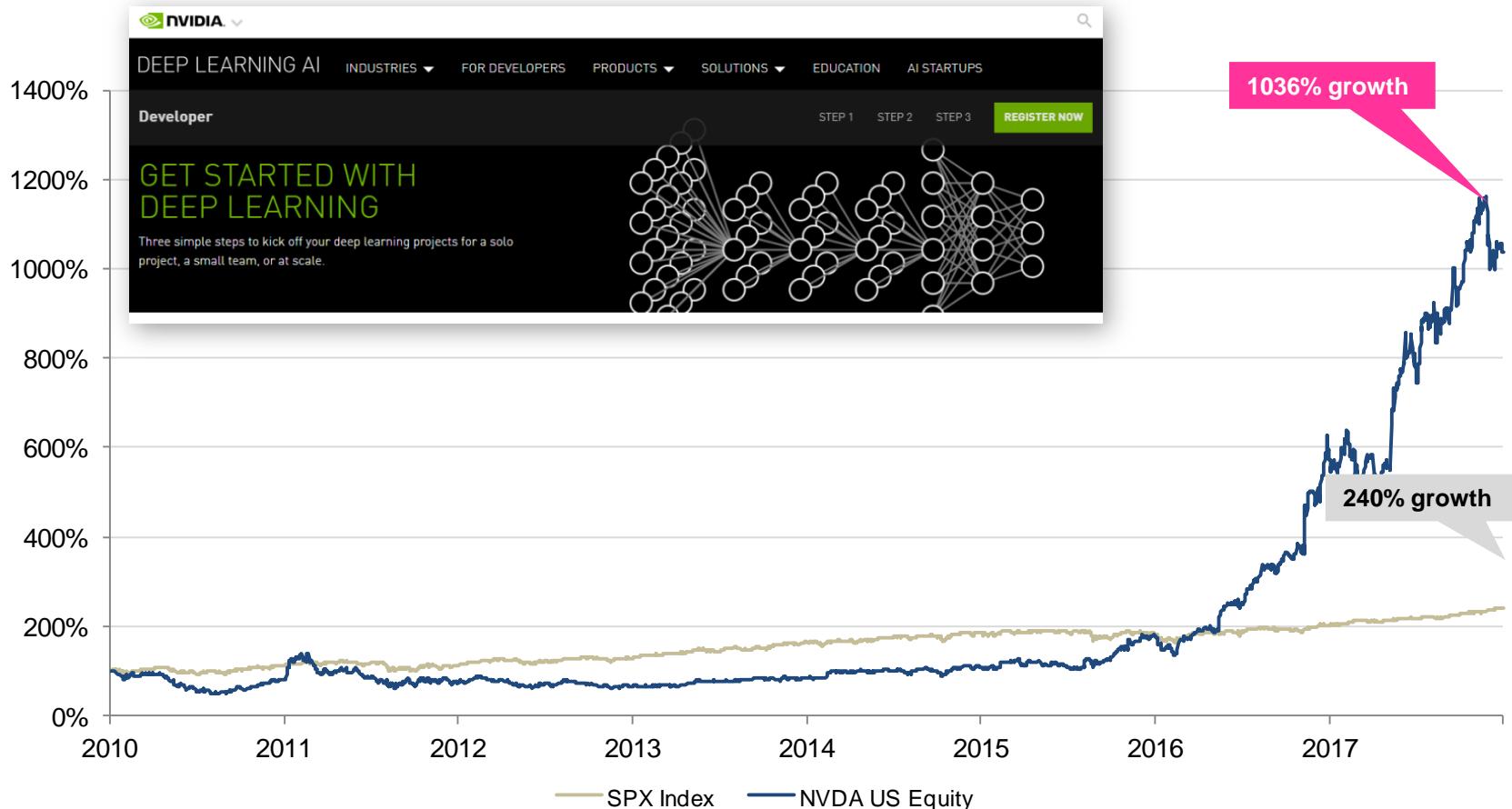
[View Quick Tours](#)

[Watch Video](#)



Hardware manufacturers of specialized hardware for machine learning have seen investment and appreciation

Growth In Price Of NVIDIA Stock Vs SP 500 Index (01/01/2010 To 12/01/2017)



The Machine Brain and its Senses



Understanding the chemistry of the AI ecosystem

- **Artificial intelligence has been an ongoing project since the 1950s**

- Artificial intelligence, whether narrow or general, has been a focus of scientific research since the 1950s
- AI has seen two boom-bust cycles -- in the late 1970s and again in the early 1990s -- where expectations, and associated investment, exceeded the results possible in that time period
- However, much of the mathematical work underpinning current AI had been done in the last century and is now being implemented, which explains why current applications have grown so rapidly

- **Machine learning has experienced the most notable progress**

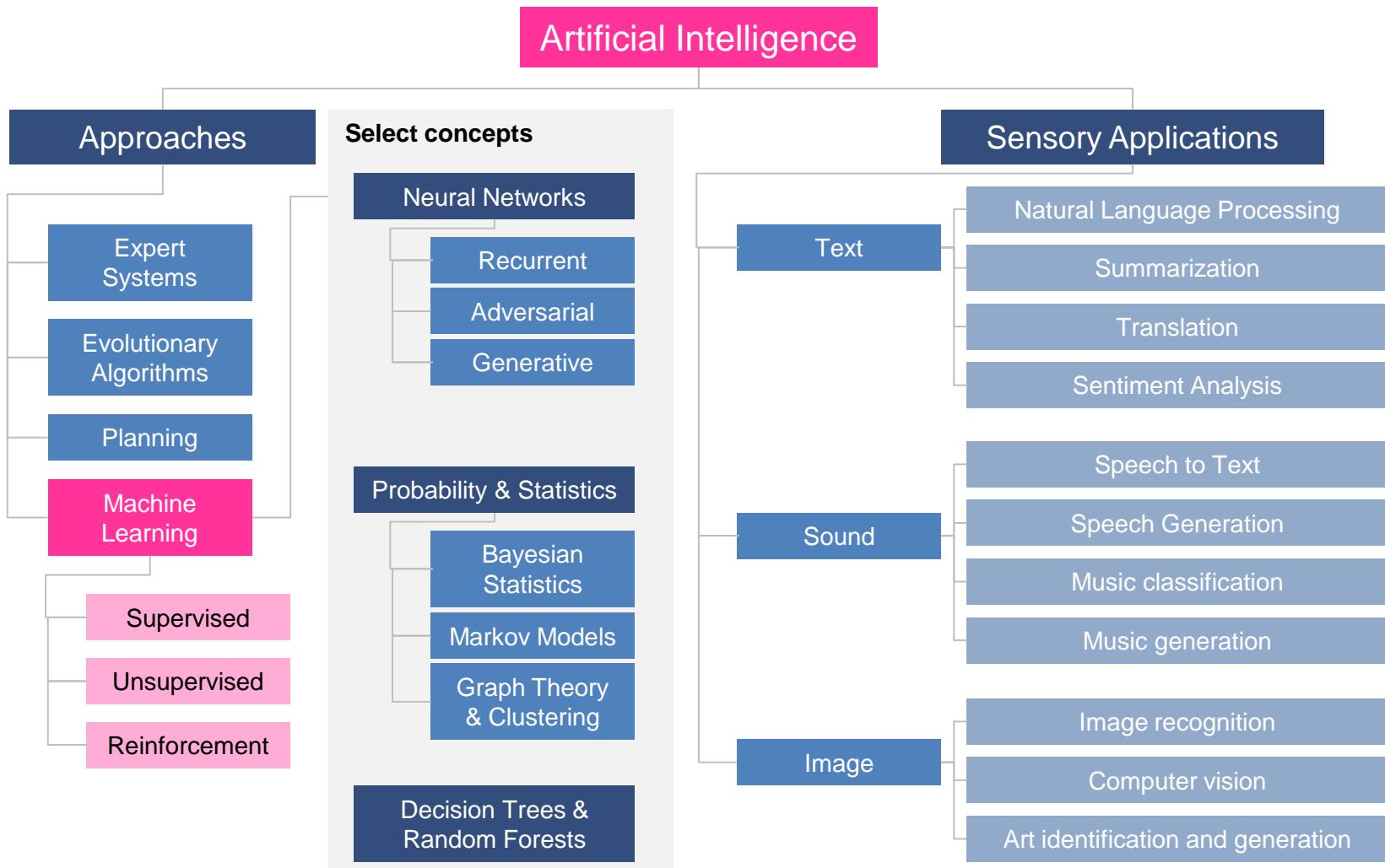
- There are several high-level approaches to creating AI, but most participants in the ecosystem today talk about machine learning and deep learning when discussing the latest in artificial intelligence
- Machine learning is a set of mathematical approaches, algorithms, and techniques that enable software to undergo a learning process that leads to a desired outcome
- The recent explosion in the field is due to (1) the massive data sets generated by humans using the web, such as images and text, and (2) the use of “deep neural networks” that have been able to use greater available computing power to make sense, or even recreate, the data points in those data sets

- **Advances in applications that mirror human senses have again captured our imagination**

- Unprecedented progress has been made in helping software agents process text, speech, music, sound, images, and video leveraging greater processing power
- Not only can software understand the contents of inputs and categorize it at scale, but it has exhibited the ability to generate new examples of those inputs. Artists are as endangered as lawyers and bankers.
- This technology is being commercialized and applied across industries, from media to healthcare and finance
- Specialized hardware by companies like NVIDIA will accelerate processing speeds exponentially

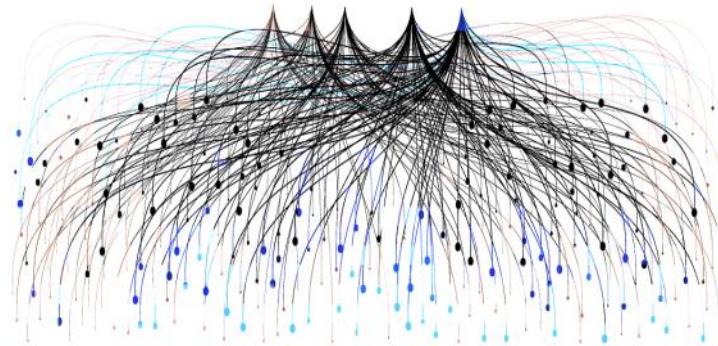
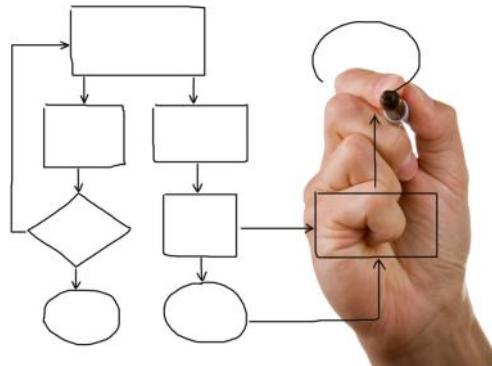


The chemistry of the AI ecosystem





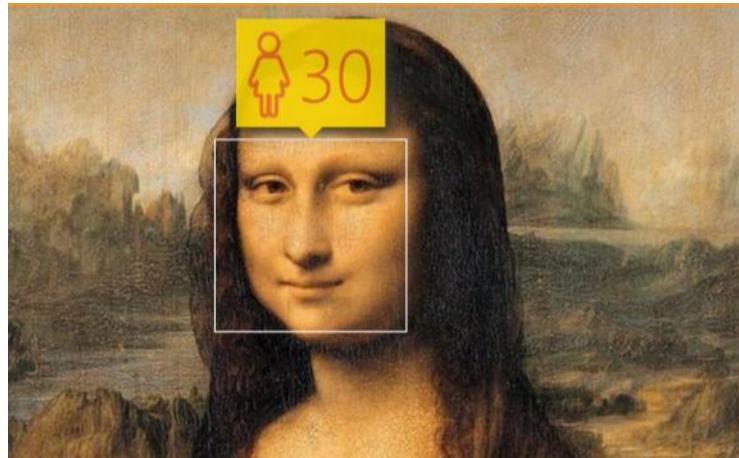
Designing software by automating a process is fundamentally different from leveraging AI techniques



	Top Down	Bottoms Up
Description	<ul style="list-style-type: none">To date, centrally-planned, deterministic systems have been the core of software developmentIn such systems, the full model of inputs and outputs is known, and can be understood by tracing the progress of defined variablesThese systems efficiently automate repeatable tasks with known boundaries and desired outcomes	<ul style="list-style-type: none">New approaches to computing and machine learning have ushered in an age of probabilistic models that behave like human intuitionKnowing that something is likely is more useful than knowing something is true or false, and mirrors how the human mind is believed to workThe foundations for these approaches were laid decades ago, but new hardware has led to a resurgence in interest and precision
Examples	<ul style="list-style-type: none">Manufacturing a car in a factory using robotsRule-based workflow automation like Zapier.comHigh frequency trading using structured dataTotalitarian communism	<ul style="list-style-type: none">Recognizing cats in billions of photosAuthenticating bank clients with their voiceUnderwriting loans using social media dataLibertarian capitalism



The automation of vision opens up many possibilities



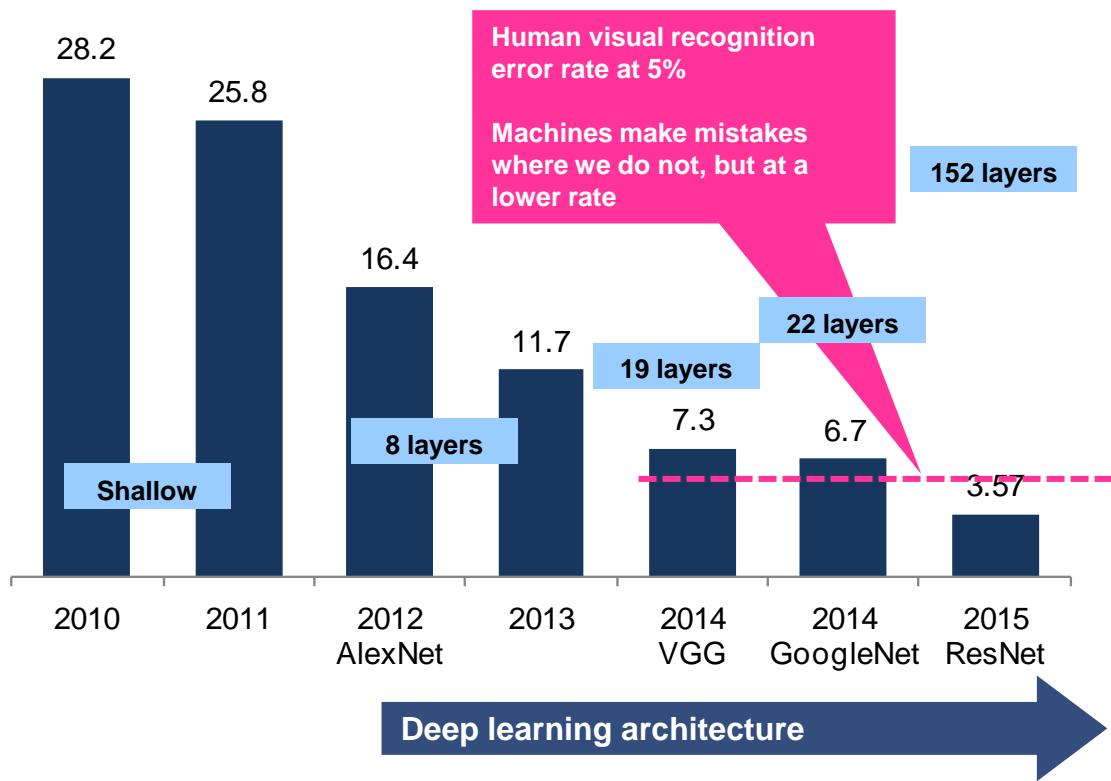
Discussion

- In recent years, computer vision has become uncannily competent in recognizing and categorizing faces and a variety of objects
- This was in large part driven by big data available through Google images and Facebook photos
- Neural networks trained on a particular type of subject may prefer to have millions of examples, but once they are mapped for processing, they can be used at scale
- It has become trivial to recognize gender and age, and the technology is being extended into medical diagnostics and entire planet indexing
- The next dimension is time – video can be processed similar to static images to build self driving cars, which require powerful chip hardware



Machine vision error rates have decreased below human vision error rates

Error Rate in Image Recognition in the ImageNet Competition (%)



- ImageNet is a project focused on powering visual object recognition software
- The ImageNet Challenge has been run since 2010, where teams of data scientists and developers compete to achieve high accuracy on machine vision tasks
- A breakthrough in 2012, using neural networks on modern hardware, paved the way for machine vision that is more accurate than human vision on this particular data set



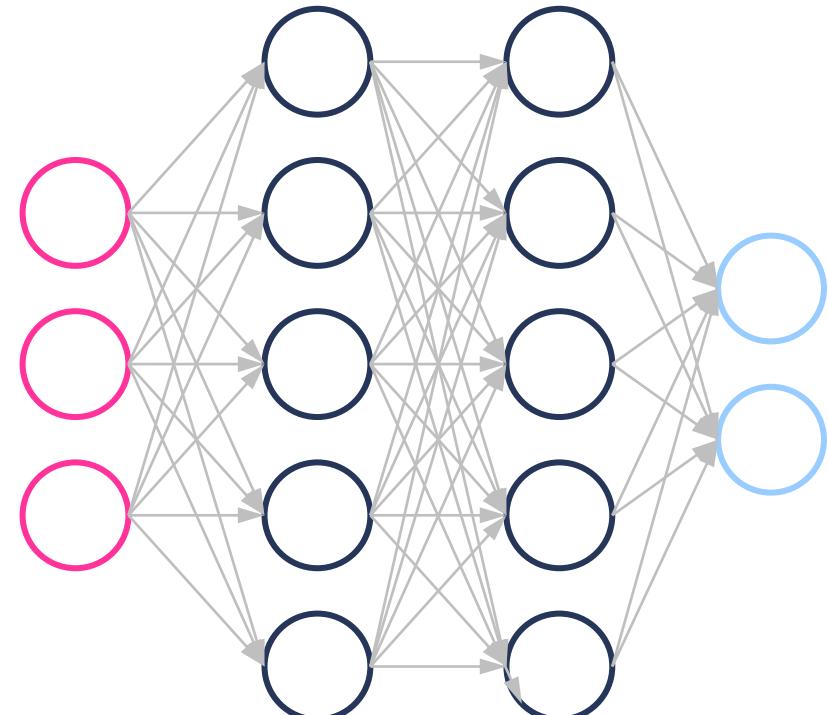
How does a Neural Network work?

Discussion

- There are different architectures to neural networks, of which the most recent developments are in (1) **deep feedforward neural networks** and (2) **recurrent neural networks**
- The key variables are:
 - **Neurons** that receive, process, or output information
 - **Connections** that transfer data between neurons
 - **Weights** for each connection that create relative importance within the network of the data
 - **Learning rules** that changes the weights and other attributes of the network in response to new data and in accordance with either learned outcomes or optimization functions
 - **Layers** of neurons that bundle certain neurons into a group if they are to perform a similar function, such as data transformation (convolution), though these are not required or always present

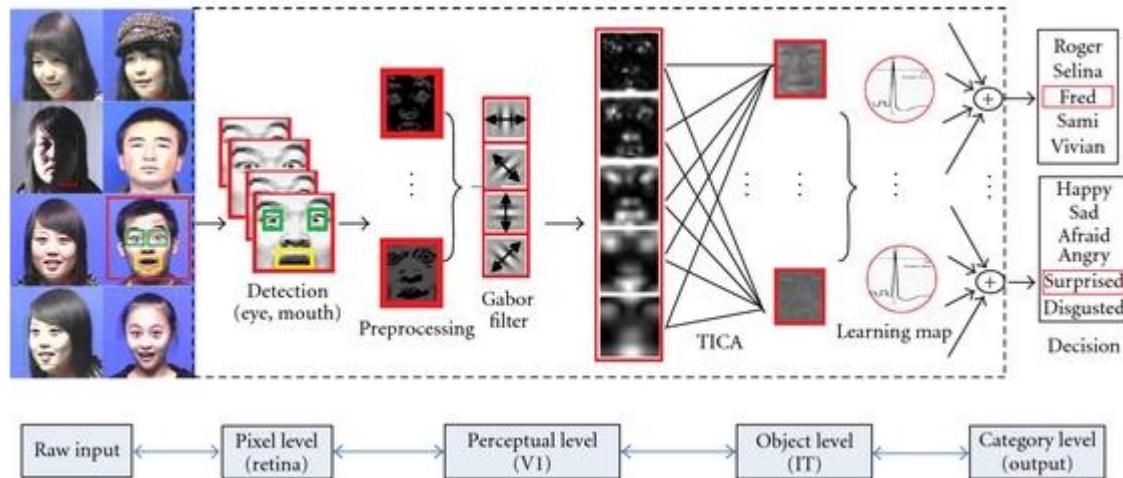
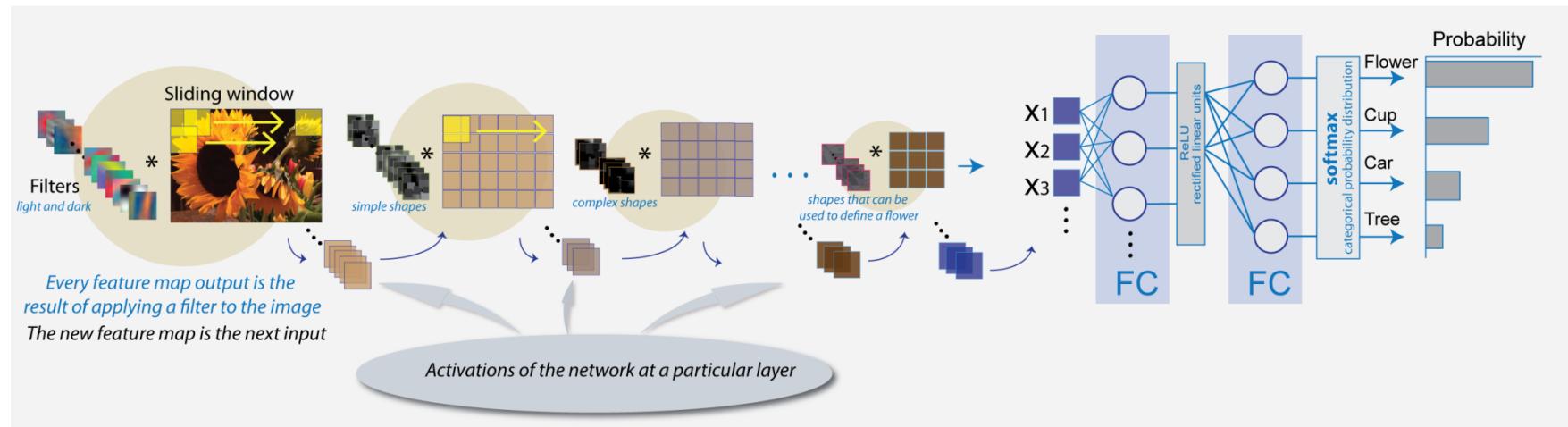
Illustrative Example

Layer 1 Input	Layer 2 Hidden	Layer 3 Hidden	Layer 4 Output
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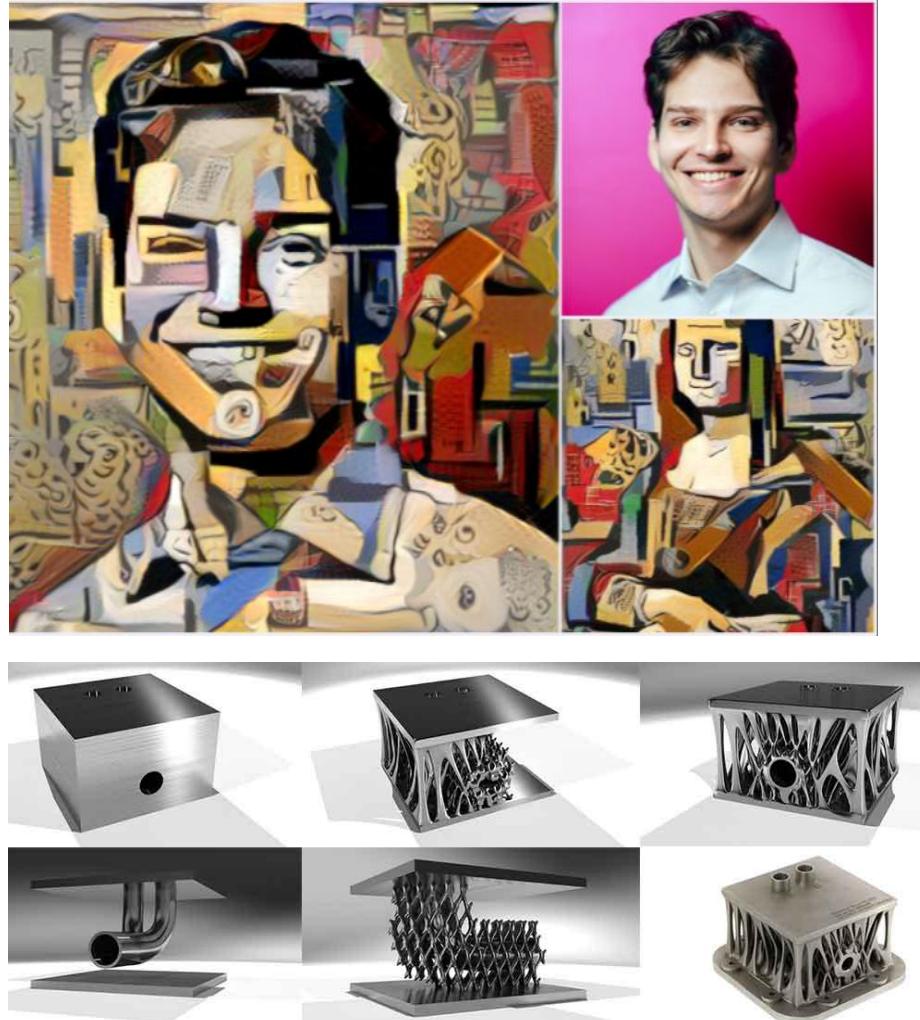
What does that really mean?



- In these examples, the images are transformed with various filters – from those that look at the entire composition of the images, to those that trace edges and find granular shapes – in order to create several additional maps on which correlate with particular objects, like cats, dogs, faces or emotions



Artificial Intelligence can also be creative by hallucinating image styles and objects, using similar data architecture



Source: Pikazo, Autodesk Within, Professional Work Station

Discussion

- In teaching software how to sense the world, scientists have created the wiring that identifies certain outputs
- That wiring can be run in a reverse direction, generating output rather than judging input
- For example, neural networks have learned the style of all painting masters, can be used to identify forgeries, and then can be used to hallucinate style onto any image or video
- Generative design systems can use algorithms to solve for defined constraints, like load or function, and could incorporate the approaches from machine learning
- Creativity, as a function of idea cross-pollination and novelty, can be automated through software that has evolutionary utility functions

The automation of text recognition and speech generation is enabling the rise of Conversational Interfaces



Discussion

- Conversational interfaces use multiple machine learning techniques from Speech Recognition to Natural Language Processing
- These techniques take sound and transform it into machine-readable data, and then extract meaning and emotion in order to frame the appropriate designed response
- Virtual assistants in the form of chatbots or speaking computers are the next operating system for tech companies and will dominate self-driving cars and the smart home
- Google Home and Amazon Alexa are powering the smart home; Facebook Messenger and WeChat lead texting chatbot adoption
- Developers can already plug into these ecosystems and build voice/text apps



And in reverse – neural networks can write infinite Shakespeare, or tight journalism copy

JULIET:

But you that have her moments proud; this day doth do
His rich wounds domethng hunting himself to his act,
She shall be found and overpresel'd this performance
To reckon him, that overreason I, to cannot be
The first to year a hid. This way beximpt me
Would dream so farther for their purposes;
As let distractions all the life of this;
Sir John Armardo's true applement,
Of fresh besome accountance barren; but I'll see
And did ask her to know that all this sea.

TROILUS:

Then not would give us that his earth in every Nephew
Romans, and I peep home, I ask my glove and ravish
In all the spirits of your rudesty.

CRESSIDA:

Till I am no return; and I will practise at my grace in single shore;
And his ambitious air he knows all one.
I had not speak'd lord, if bawd,
That all this holy boy I have they heard it
But they are bloody by all natures,
Shour'd for renown, as greater tent will break.
Let's make a sort with walls and senseless kings,
His annoint'd mad ammunition comes itself. You break
The malicious love into distance.

LAERTES:

To't.
Appears her cease who all.

A neural network fed on all
Shakespeare plays can endlessly
regurgitate similar-sounding verse

Startups like Narrative Science, which
has raised \$43 million to date,
commercialize speech generation over
data sets across industries

narrative science

Intelligent Narratives

Amplify the intelligence of
your business

We're not just helping you tell better stories. With Intelligent Narratives, we're giving you a richer, more nuanced understanding of your business, with data storytelling at machine scale. So, your people, your company and your customers can make more informed decisions and realize their greatest potential.

See how Quill turns your data into insights.



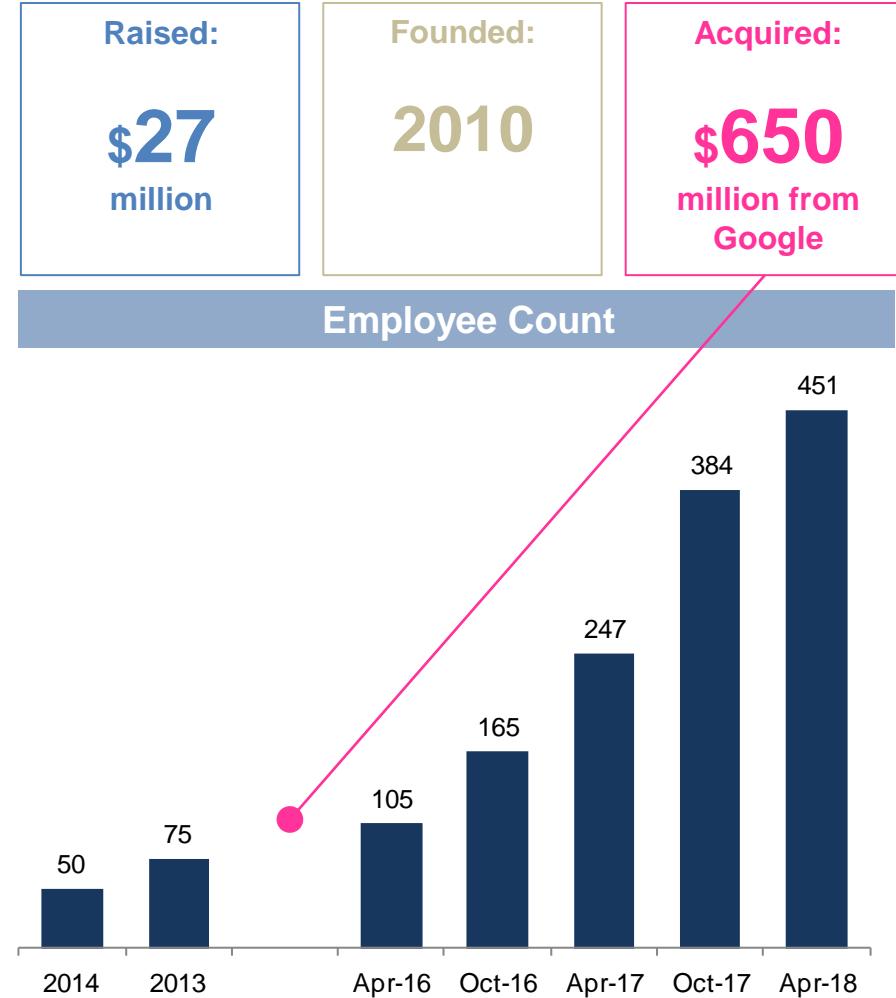
More capabilities are being created through projects like Google's DeepMind, which focuses on core research



DeepMind

Overview

- Google DeepMind has a scientific mission to push the boundaries of Artificial Intelligence, moving from narrow to general applications
- Responsible for building the winning AlphaGo software, which defeated all human opponents, who later described it as "creative", "beautiful", and a "Go god"
- Commercial applications include optimizing energy usage across Google's cloud server infrastructure and working with the healthcare industry to improve service levels
- Employed scientists produce open academic research, publishing over 150 peer reviewed papers
- Major recruiter of young talent out of universities, competing with Facebook and IBM Watson





Two key machine learning frameworks are battling for dominance, backed by Google and Facebook

TensorFlow

- Open source software library that was built at Google Brain (later DeepMind) and then open sourced
- Can scale down from desktops and servers to mobile devices, which is important for building AI-first consumer habits
- Highly active Github code repository
 - 31,000 commits (i.e. code contributions)
 - 1,400 contributors
- Used by Airbnb, AMD, Nvidia, Uber, Dropbox, ebay, Snap, Intel, Twitter, Lenovo and countless others

PYTORCH

- Open source software built on top of the powerful Python programming language, and its extension Numpy, which has a deep quantitative library
- Used as the machine learning framework by Facebook, and several developer leads are Facebook engineers
- Designed to be fast and lean in terms of memory usage, can run on CPUs and GPUs
- Highly active Github code repository
 - 10,500 (i.e. code contributions)
 - 600 contributors

... and others

- Theano
- Caffe
- CNTK
- Amazon Machine learning
- Apache Singa
- Microsoft CNTK
- Torch
- Accord.NET
- Apache Mahout
- Brainstorm
- Spark MLlib

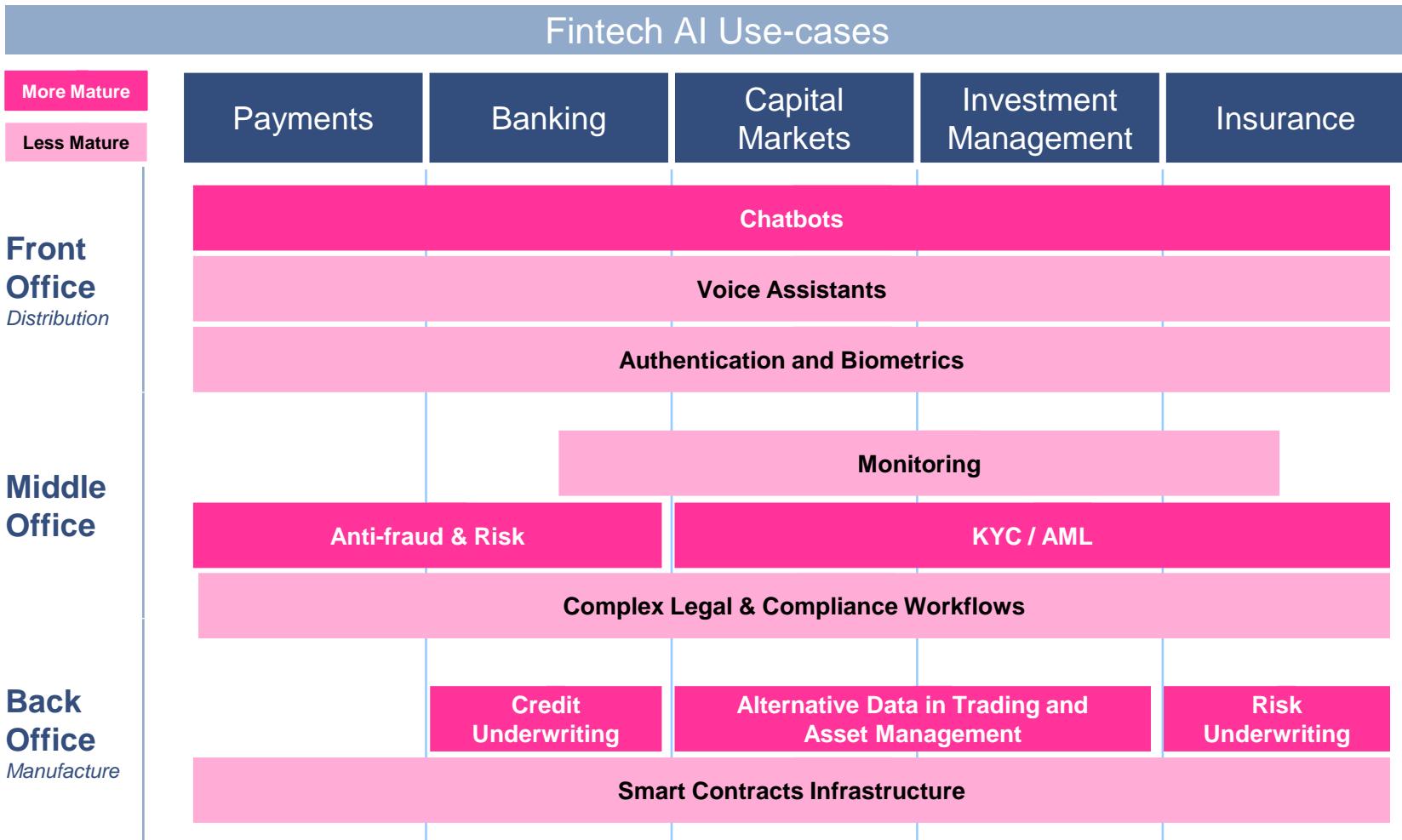
Deploying AI in Financial Services & Economic Impact

\$1 trillion in savings from AI implementations by 2030

- As the services economy is incrementally automated with judging machines, financial professionals are highly exposed
 - In US alone, 2.5 million financial services employees are exposed to AI technologies in front, middle and back office; 1.2 million working in banking and lending, 460,000 in investment management, and 865,000 in insurance
 - These functions will see 20-40% productivity gains, or unemployment, depending on your vantage point
- Total impact across financial sectors is \$1 trillion, a 22% traditional cost reduction
 - Estimates are built from financial company public filings, global revenue pools, and granular analysis to assess likelihood of automation
 - Banking industry to see \$450 billion in AI impact, which is a 25% reduction of the traditional cost base
 - Investment Management industry to see \$200 billion in AI impact, which is a 38% reduction of the traditional cost base
 - Insurance industry to see \$400 billion in AI impact, which is a 14% reduction of the traditional cost base
 - Reconfigured, this suggests impact of \$490 billion in front office, \$350 billion in middle office, \$200 billion in back office
- Long-run market opportunity of \$500 billion to build financial AI companies by 2030
 - To catalyze change from industry incumbents, new solutions must be meaningfully more economic than the traditional cost base which AI displaces
 - We expect 10% of that traditional cost base to be captured by 2025, and 50% by 2030
 - \$100 billion for manufacturing, \$250 billion for distribution, and \$175 billion for middle office
 - But this could be stymied by software failure or limitations from regulation

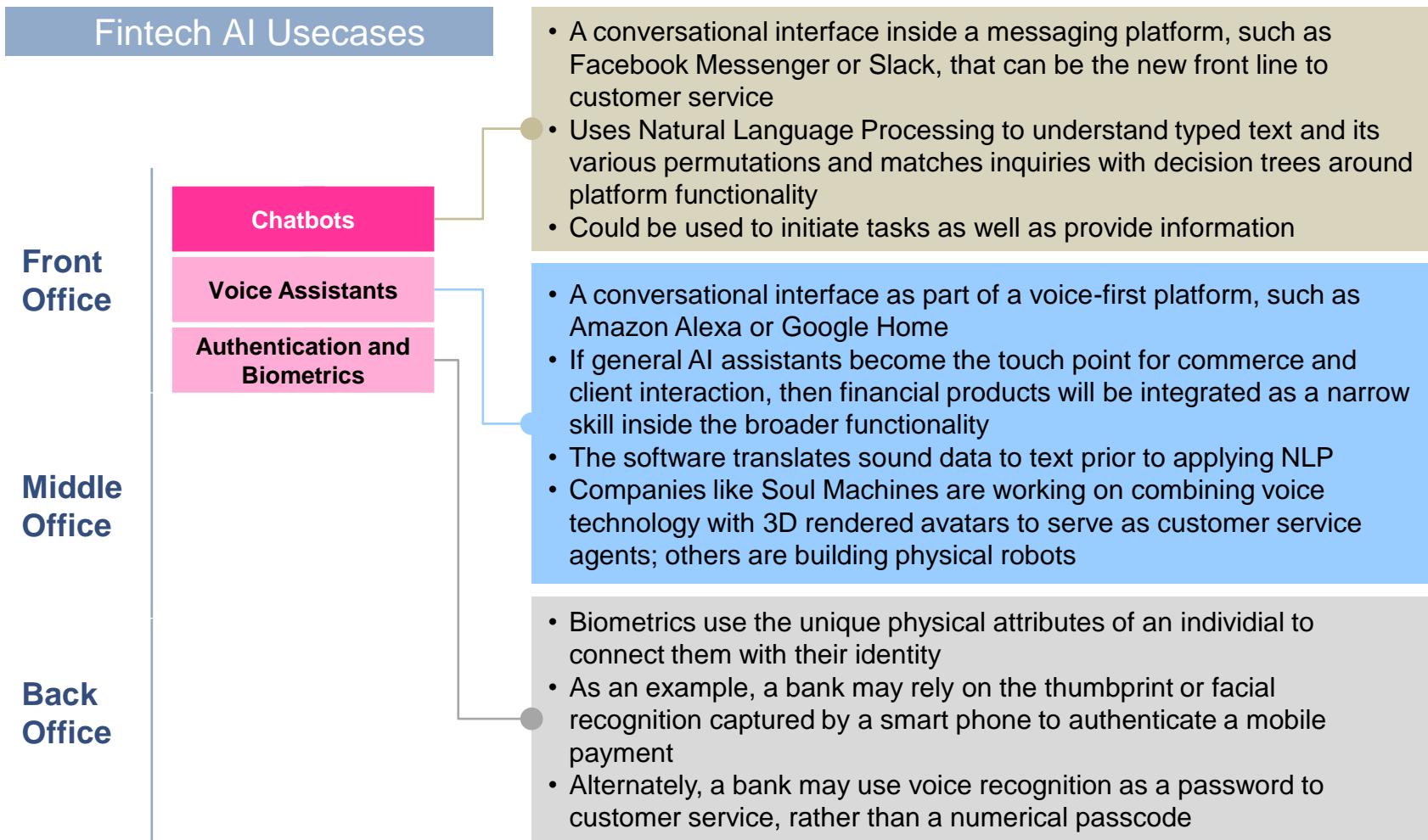


Artificial Intelligence is being applied across Financial Services



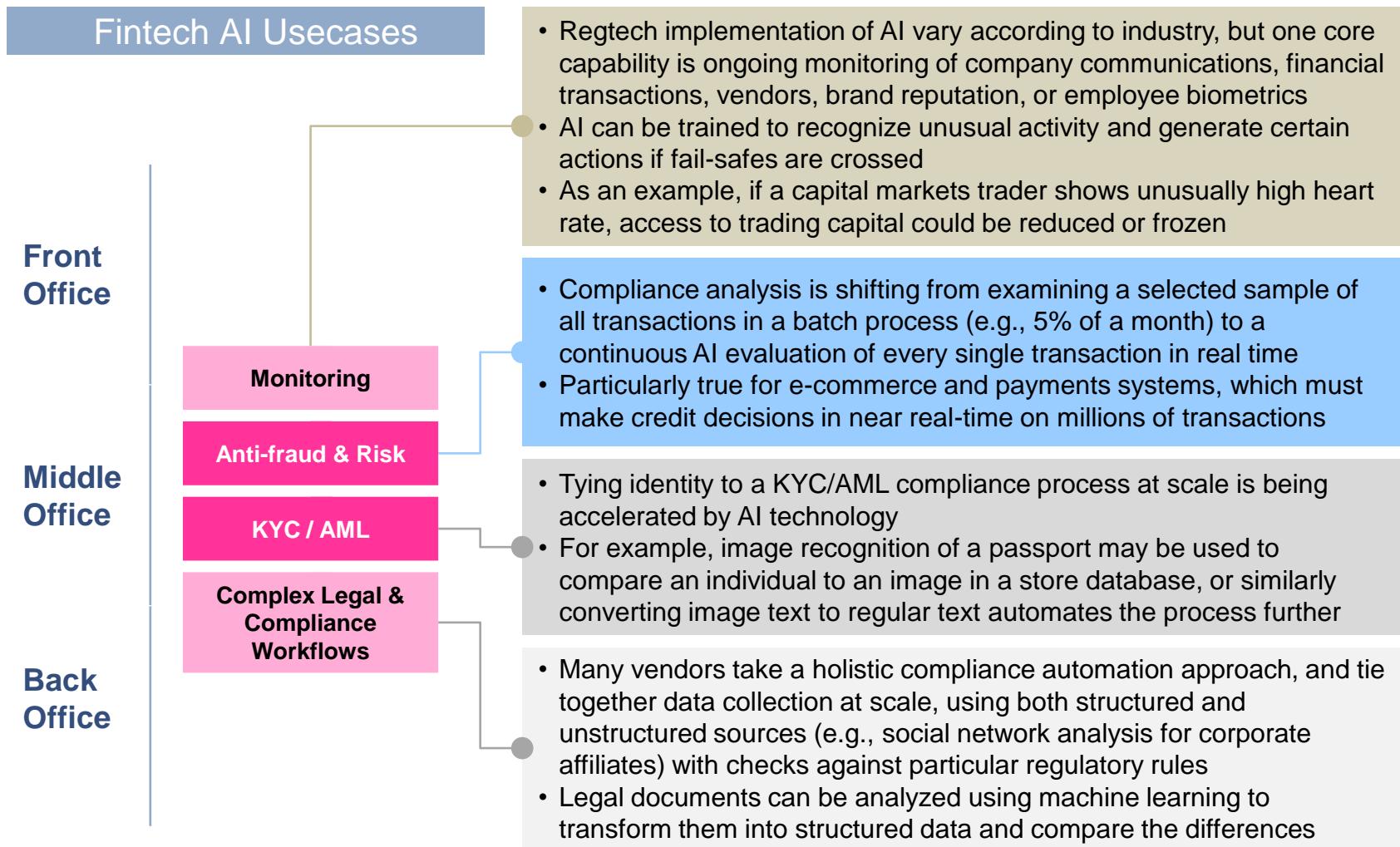


AI technologies impacting Financial front office



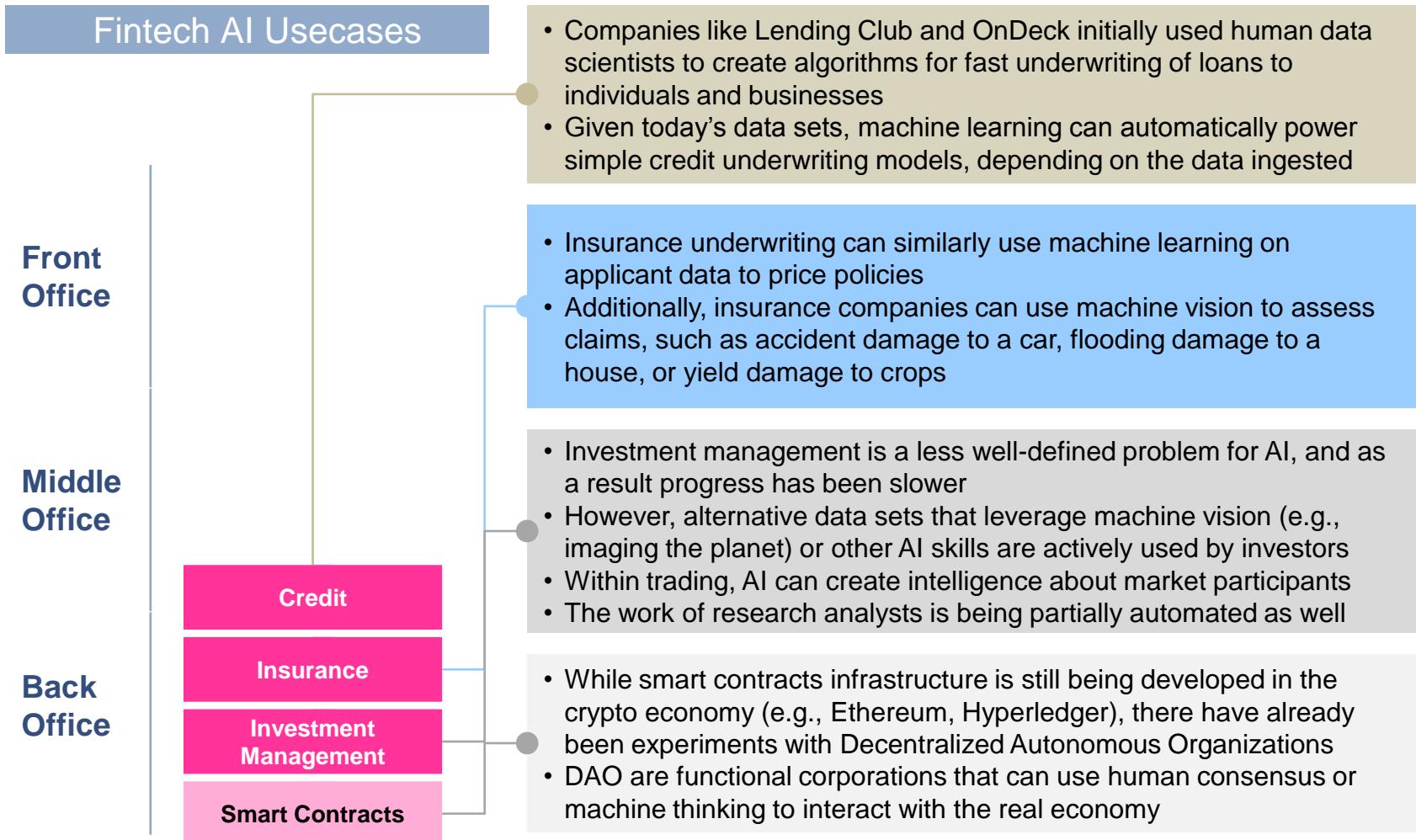


AI technologies impacting Financial middle office



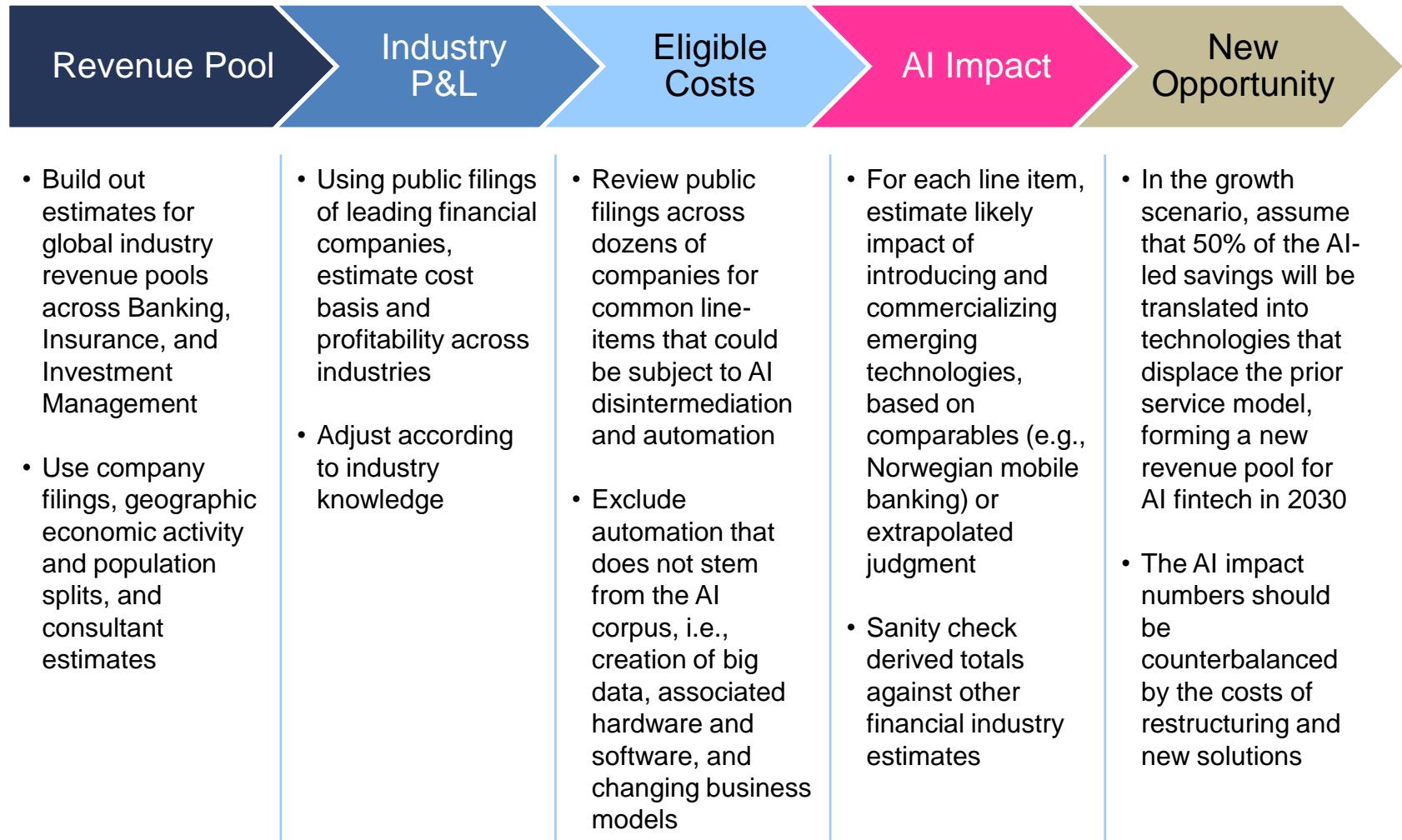


AI technologies impacting Financial back office



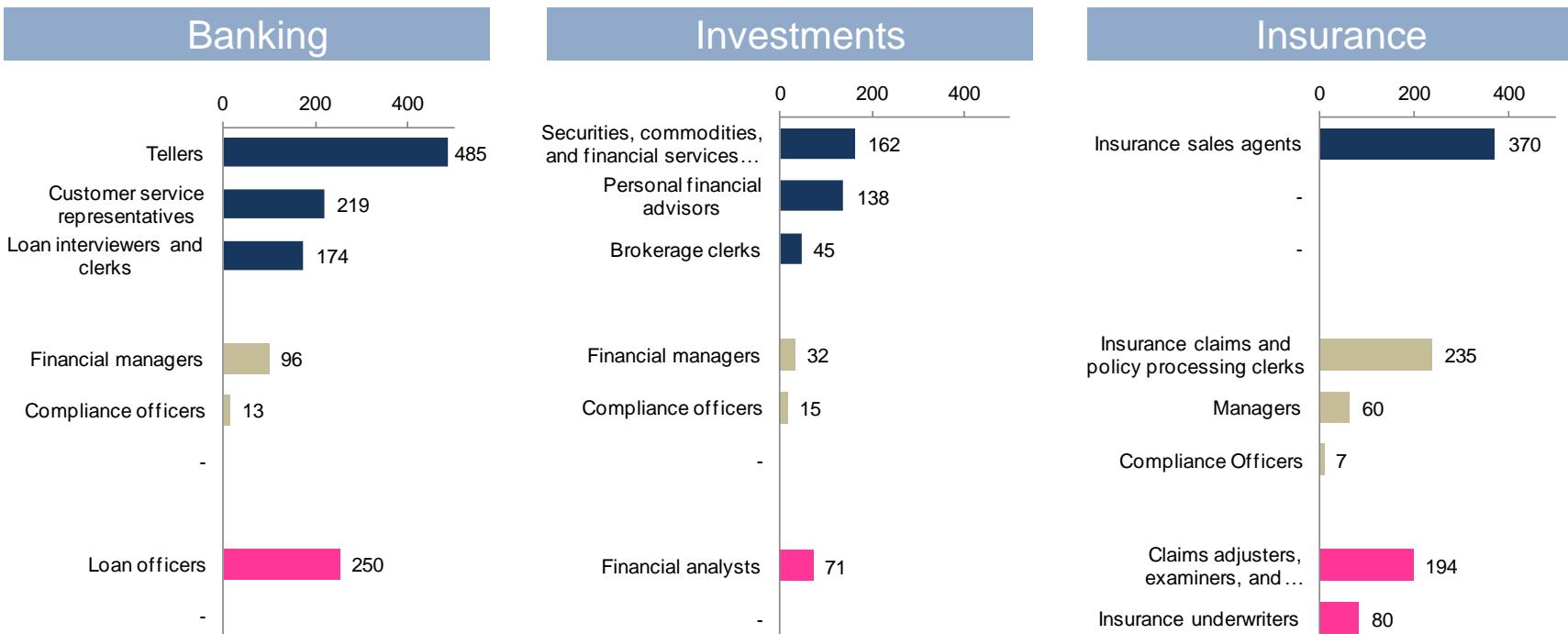


Methodology for estimating impact on financial industry





In US alone, 2.5 million financial services employees are exposed to AI technologies in front, middle and back office



- 1.2 million people exposed to AI employment impact
- 70% in the front office
- 10% in middle office
- 20% in the back office

- 460 thousand people exposed to AI employment impact
- 75% in the front office
- 10% in middle office
- 15% in the back office

- 865 thousand people exposed to AI employment impact
- 43% in the front office
- 35% in middle office
- 32% in the back office

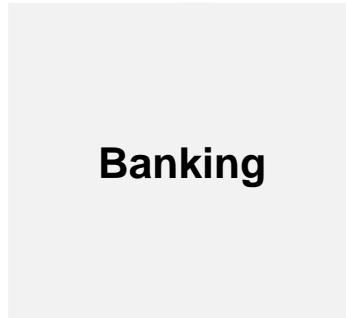
Front office (sales) ■

Middle office (process) ■

Back office (manufacturing) ■

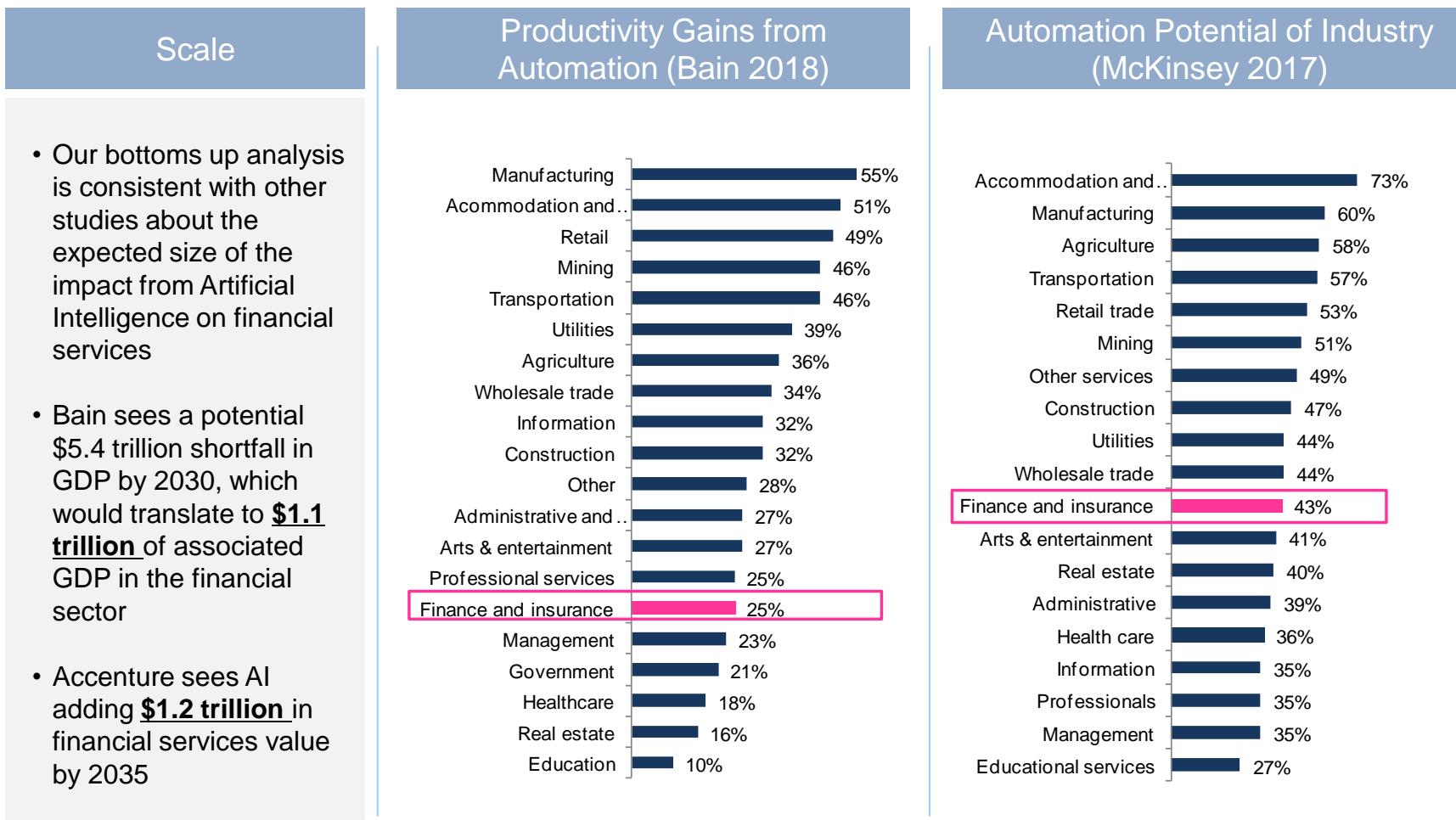


Total impact across financial sectors is \$1 trillion, a 22% traditional cost reduction





Other studies send similar message -- 20-40% impact on human employment and productivity at \$1T level



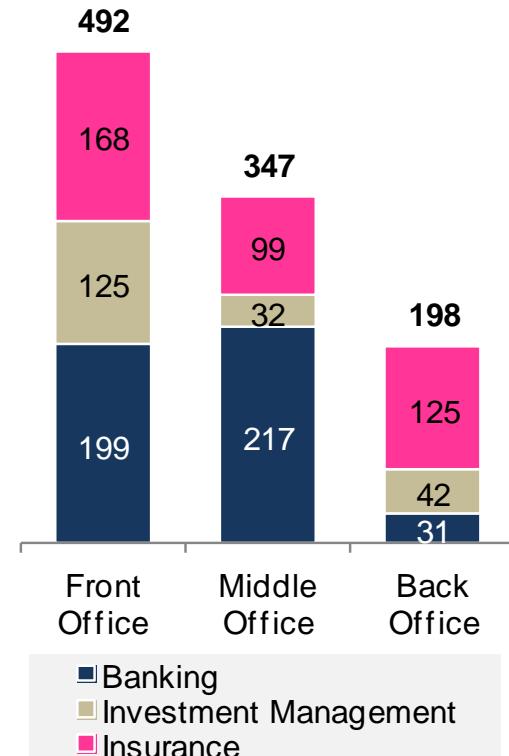


Large opportunity across distribution, middle office, and manufacturing to implement new solutions

Sizing the Opportunity

- In the next several pages, we dive more deeply into the impact due to each part of the financial firm in order to understand the importance and size of each theme (e.g., chatbots, AI-funds, automated KYC)
- We then combine the pieces to arrive at a revenue pool for new solutions that will succeed in this space
- Operating executives will implement AI based software and go through restructuring only if it is meaningfully cheaper than existing alternatives; we assume a 50%+ cost reduction as such a trigger
- Thus, the \$1 trillion of impact would not be fully absorbed as cost savings, but would be mitigated by the introduction of new solutions, albeit at a lower price point
- Further, such reductions are likely to be industry wide, allowing for a competitive advantage in the short term, but not long term
- The translation of this value into commercially successful production software will happen on a 10 year time horizon, which drives our 2030 timeline

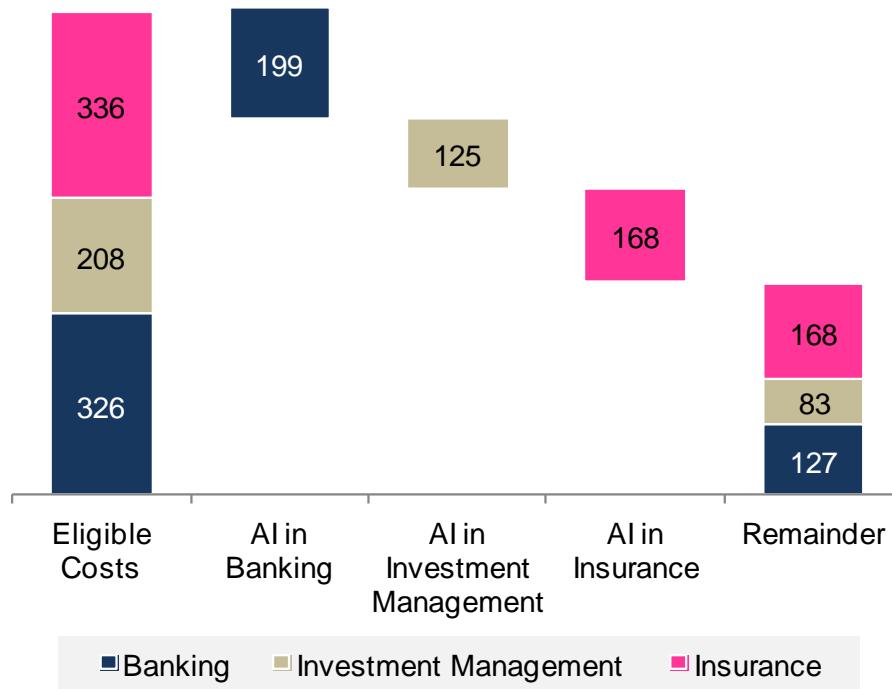
Impact of AI by Function of Financial Firms(\$B)





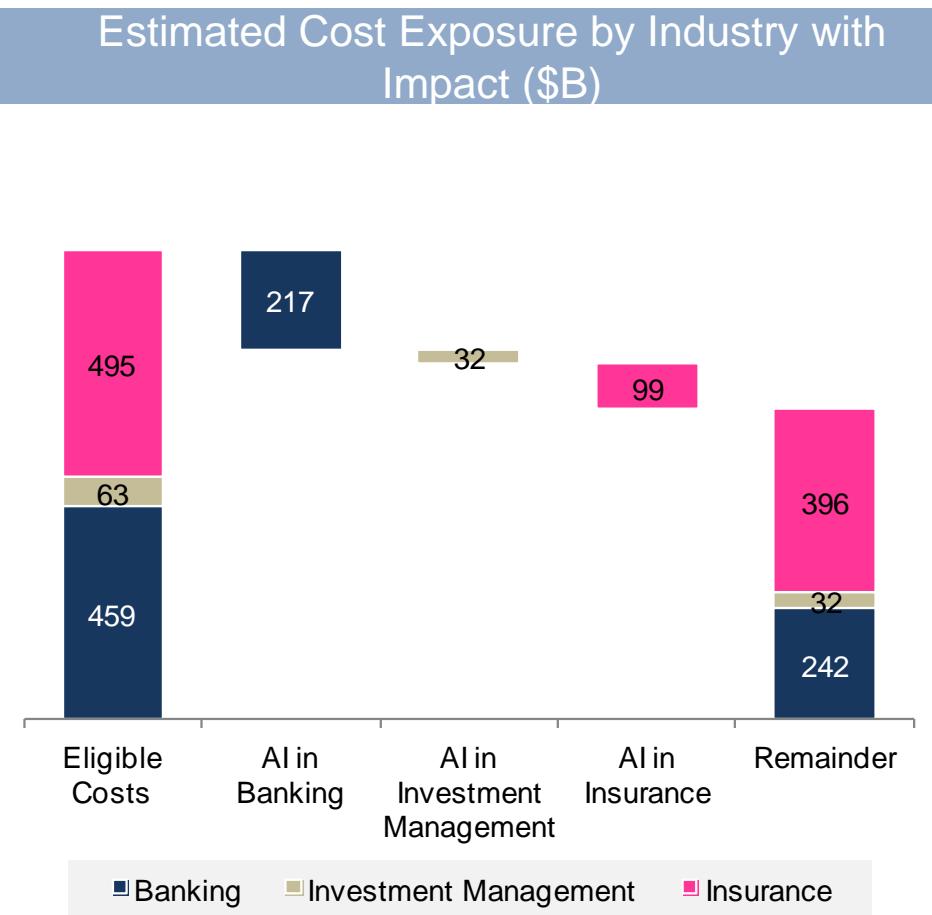
Front Office – Potential cost savings of \$490 billion

Estimated Cost Exposure by Industry with Impact (\$B)



- We estimate that the following costs related to distribution can be reduced through artificial intelligence technology
- \$326 billion of Banking industry cost can be reduced by 61%, by targeting retail branches, security, tellers and cashiers, and other distribution staff, resulting in a reduction of **\$199 billion**
- \$208 billion of Investment Management cost can be reduced by 60%, by targeting financial advisors and associated infrastructure and client service support, resulting in a reduction of **\$125 billion**
- \$336 billion of Insurance industry cost can be reduced by 50%, by targeting insurance sales staff, customer service agents, and commissions, resulting in a reduction of **\$168 billion**

Middle Office – Potential cost savings of \$350 billion

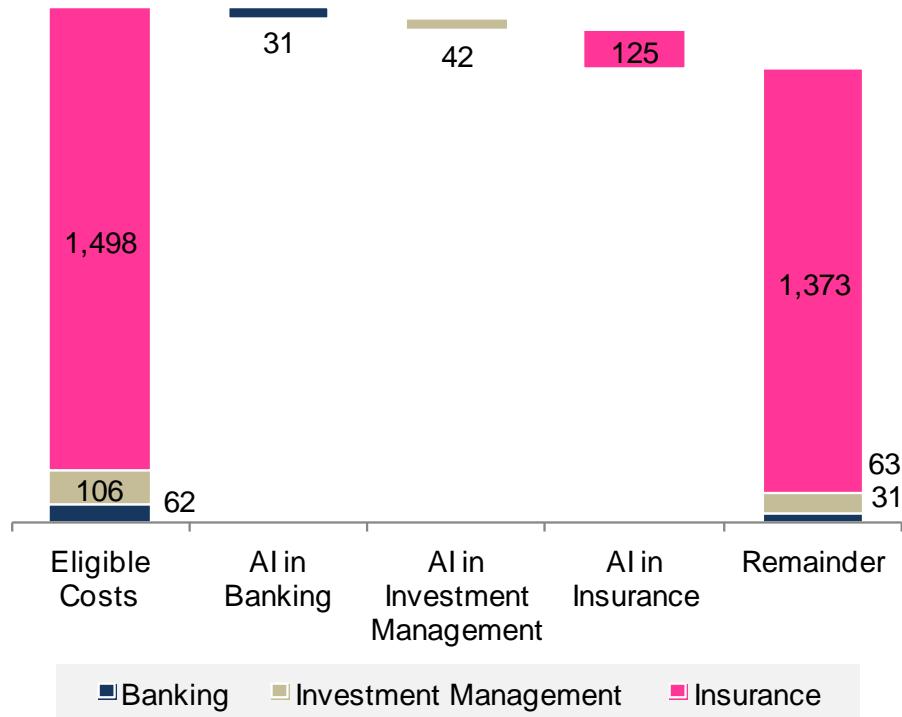


- We estimate that the following costs related to the middle office can be reduced through artificial intelligence technology
- \$459 billion of Banking industry cost can be reduced by 47%, by targeting Compliance, KYC/AML, authentication and data processing, resulting in a reduction of **\$217 billion**
- \$63 billion of Investment Management cost can be reduced by 50%, by targeting Compliance, home office compensation, workflow and trading systems, and other data processing, resulting in a reduction of **\$32 billion**
- \$495 billion of Insurance industry cost can be reduced by 20%, by targeting Compliance, information services, workflow and accounting systems, and other data processing resulting in a reduction of **\$99 billion**



Back Office – Potential cost savings of \$200 billion

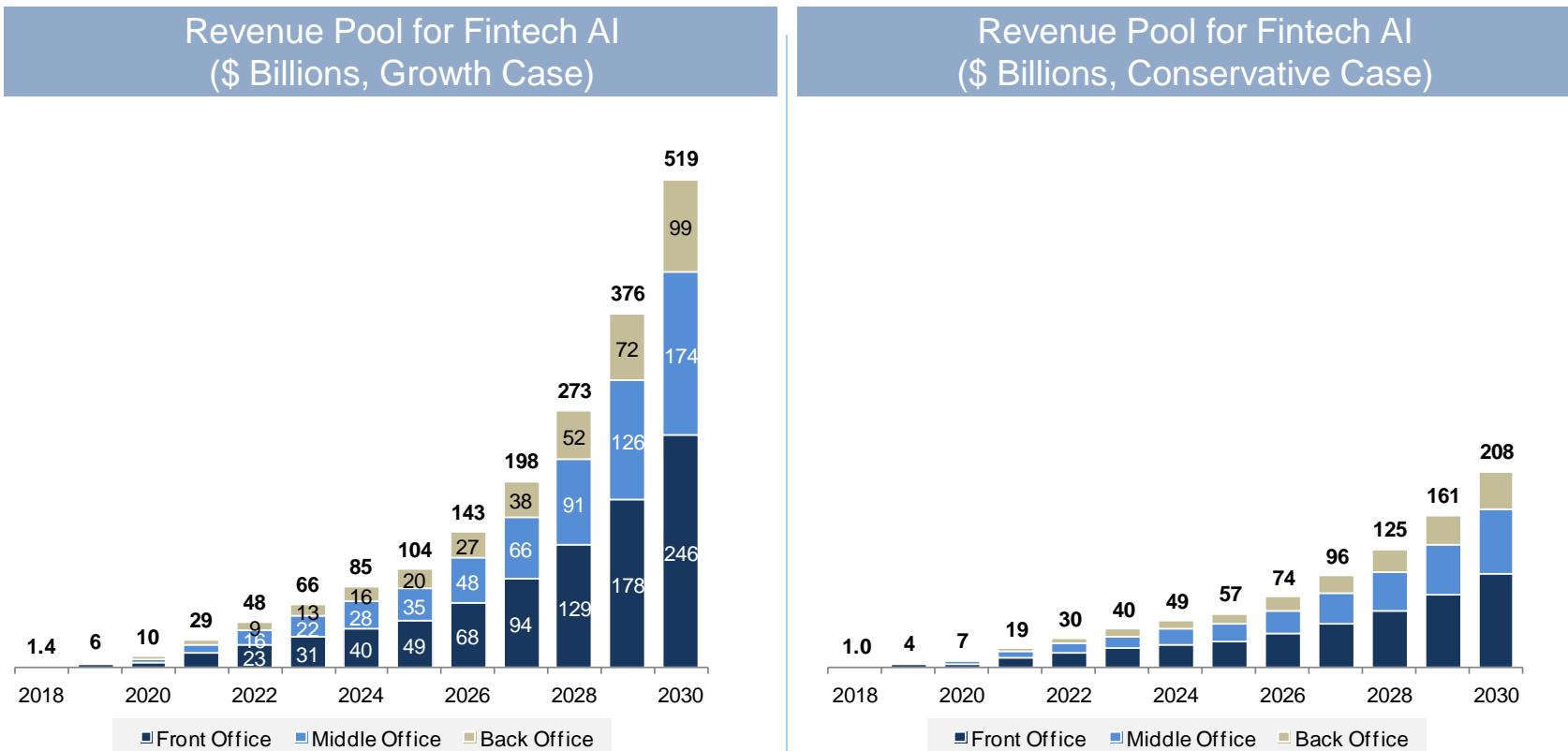
Estimated Cost Exposure by Industry with Impact (\$B)



- We estimate that the following costs related to product manufacturing can be reduced through artificial intelligence technology
- \$62 billion of Banking industry cost can be reduced by 50%, by targeting credit underwriting and collection systems and related professional compensation, resulting in a reduction of **\$31 billion**
- \$106 billion of Investment Management cost can be reduced by 40%, by targeting portfolio manager compensation and associated research costs, resulting in a reduction of **\$42 billion**
- \$1.5 trillion of Insurance industry cost can be reduced by 8%, by reducing claims due to higher underwriting accuracy, as well as targeting claims assessment, resulting in a reduction of **\$125 billion**



Revenue Pool for AI startups in financial services to reach \$500 billion by 2030, over \$100 billion by 2025



- We expect 10% of potential value to be captured by 2025, and 50% of AI impact by 2030
- \$100 billion for manufacturing, \$250 billion for distribution, and \$175 billion for middle office

- In the conservative case, long term value is capped due to failure to deliver on technology's promise, or a regulated limitation on its deployment

Front Office: Chatbots & Conversational Interfaces



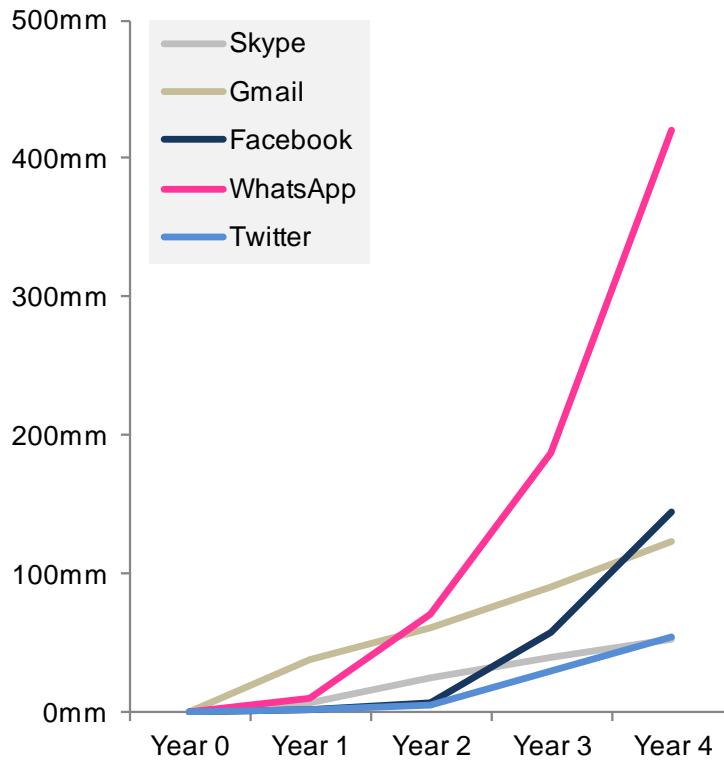
The power of conversational interfaces across industries

- **Consumer preferences continue to shift to new media channels, and are starkly divided among generational lines**
 - 90% of the Silent Generation (born 1925-1945) have a preference towards human service over the phone, while only 12% of Millennials prefer phone, with nearly all others looking for chat, social or text channels
 - Conversational interfaces like chat and voice are powered by natural language processing, and are the natural evolution after the mobile web, simplifying experiences from managing dozens of apps to one stream
- **Secular trend of reducing front office staff and retail footprint in favor of tech-enabled communication and products, through mobile wallets, apps, and conversational interfaces**
 - On average, people have 6 financial apps on their phone – but there are dozens of thousands of banks, credit unions, and financial advisors that have to compete for those spots
 - Norway is an example of digital banking leading to a shrinking in the branch footprint and shifting consumer behavior; and Asian countries show 50%+ adoption of mobile payments over traditional methods
- **Rich ecosystem of startups working on the client experience across banking, payments, investments and insurance, leveraging platforms like Amazon Echo and Facebook Messenger**
 - To build a chatbot or voice channel, developers need to select from (1) competing open-source frameworks and private platforms that power machine learning and associated NLP, and (2) the end points that touch consumers, from Slack, Skype, Messenger, Telegram and several large Asian tech players
 - Chatbot platforms can be consumer facing as direct distribution channels, as well as private label platforms for banks and financial institutions to more cheaply serve their customers
 - However, this software is still in the early stages, and the best use-cases are those where chat agents respond to low-level requests (e.g., balance inquiries) while humans manage more complex cases

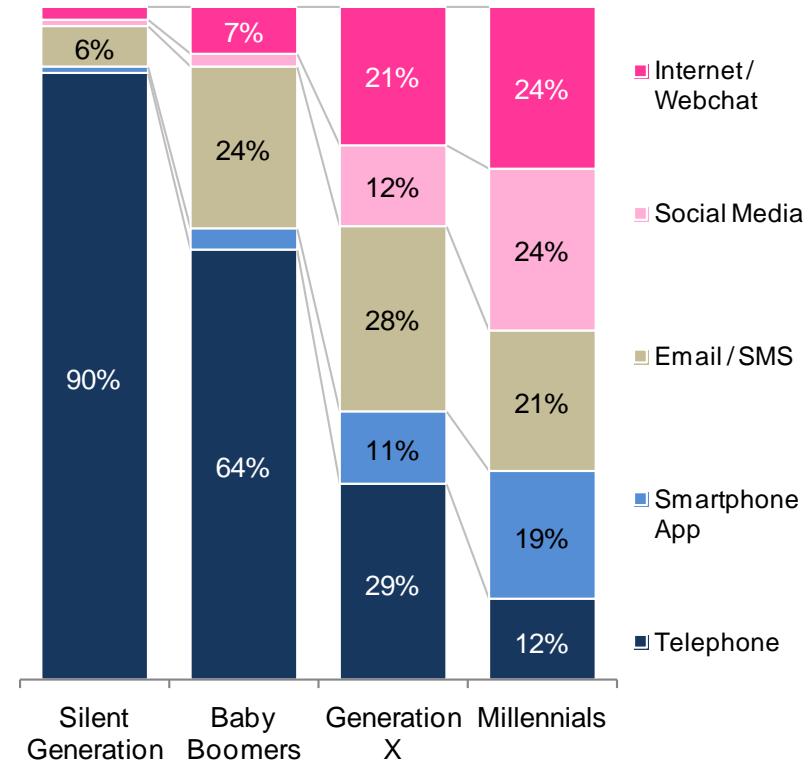


Generational divide in service preference shows Millennials prefer chat and social media to telephone

First Four Years after Launch
(Active Users in Millions)



Most Popular Channels for Contact Centers by Generation (2015)

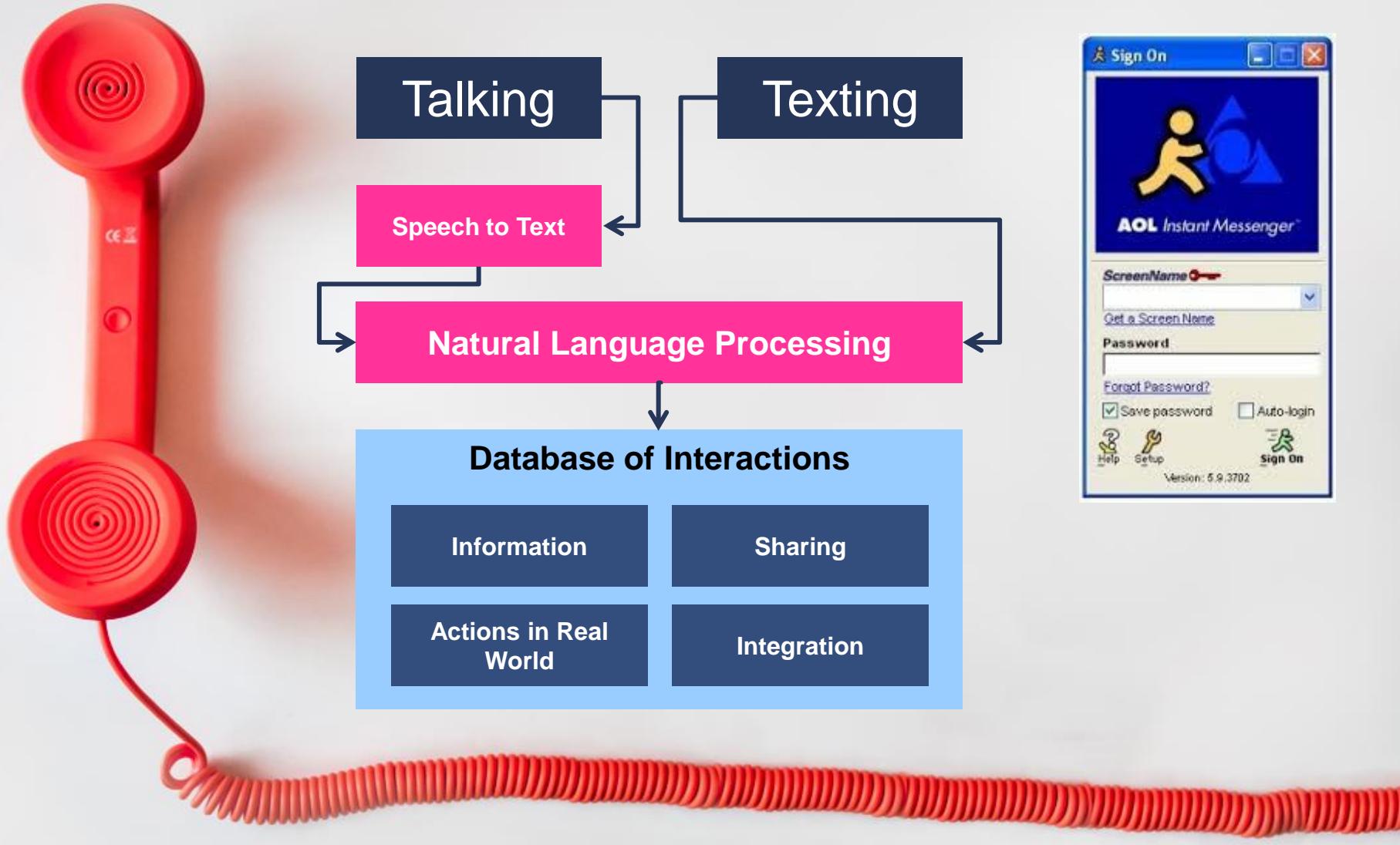




AUTONOMOUS

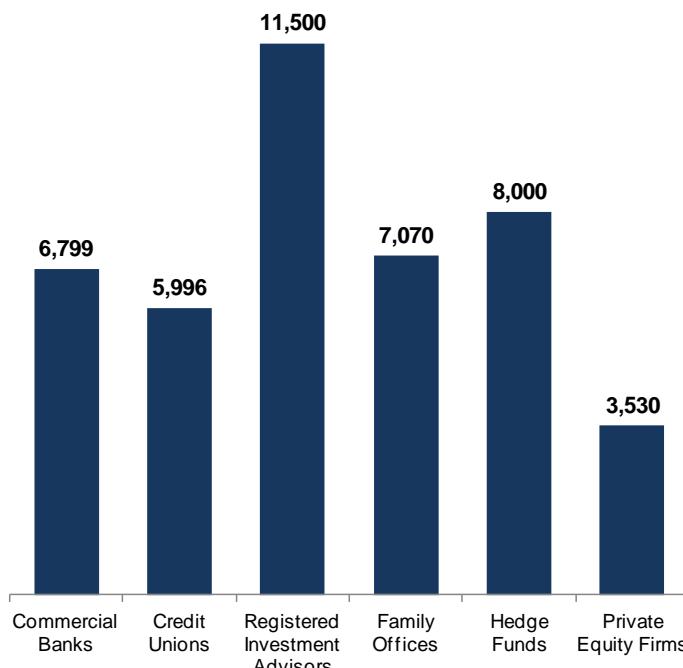


A chatbot is an automated call center with machine empathy built in the place where Millennials communicate



Will there be room for human relationships in a winner-take-all tech platform, like iOS or Android?

Number of Select Financial Institutions
in the United States



Number of Apps on Phones
(2017, n=200 bloggers)

How Many Financial Apps Do You Have on Your Phone?

Total # of finance apps used by bloggers	882
Average # of finance apps used by bloggers	6
Highest # of finance apps used by a blogger	35
Lowest # of finance apps used by a blogger	0

10% is financial

How Many TOTAL Apps Do You Have on Your Phone?

Total # of overall apps used by bloggers	8978
Average # of overall apps used by bloggers	66
Highest # of overall apps used by a blogger	217
Lowest # of overall apps used by a blogger	4

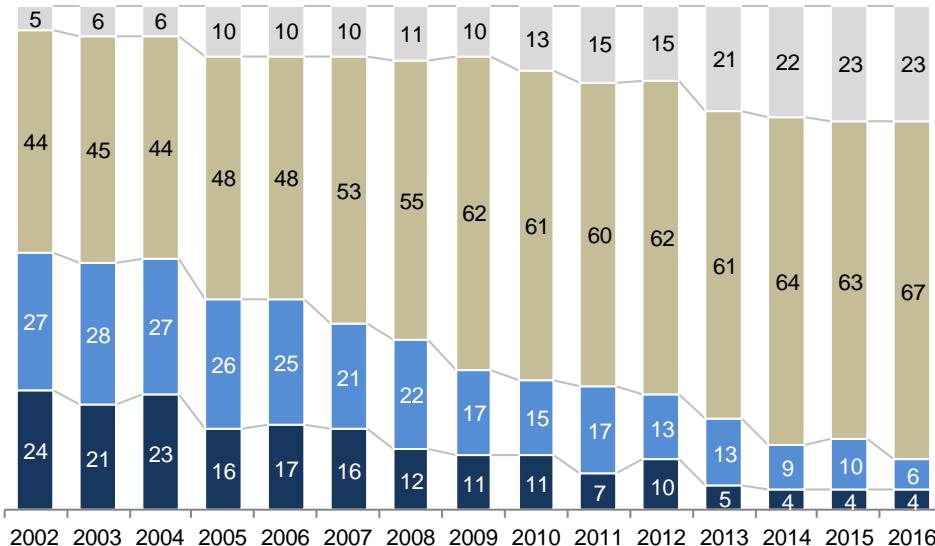
- Plethora of small financial distributors and manufacturers to serve the long tail

- Centralized platform limited by attention means 6 financial spots on average

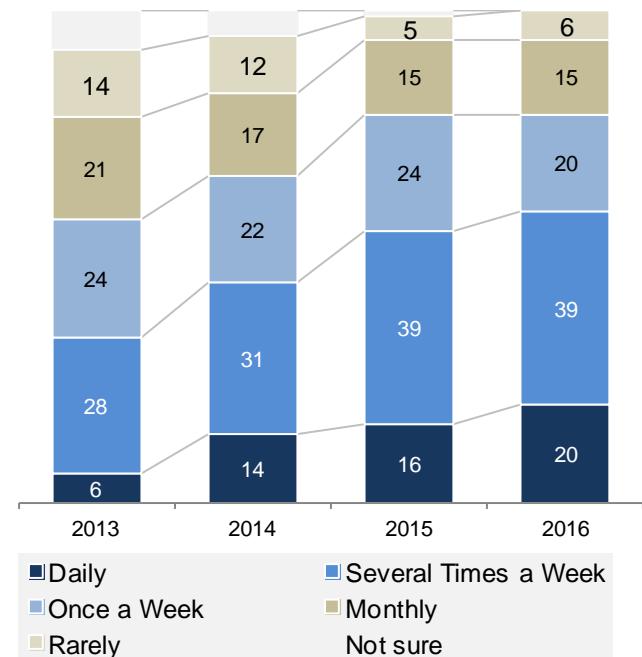


It is possible to decrease reliance on legacy client servicing,
see Norway as a leader in digital banking

Frequency of Visiting Bank in Norway



Frequency of Accessing App



■ Every 14 days or more ■ Every month ■ Every six months or less ■ Never

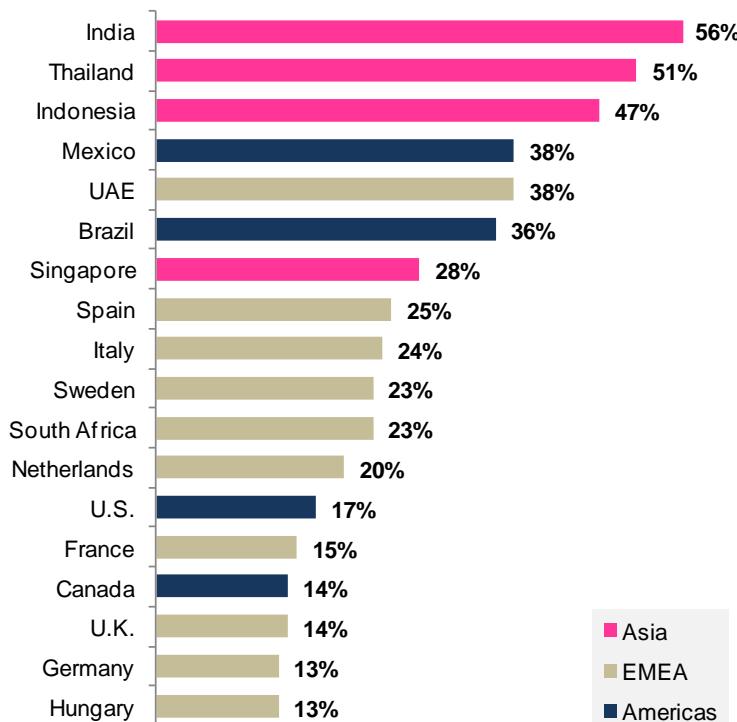
■ Daily ■ Once a Week ■ Several Times a Week
■ Monthly ■ Every six months or less ■ Never

- Percentage of clients that visit a physical bank branch at least monthly has decreased from 50% to 10% between 2002 and 2016
- Conversely, percentage of clients that use the bank app at least weekly is at 80% in 2016

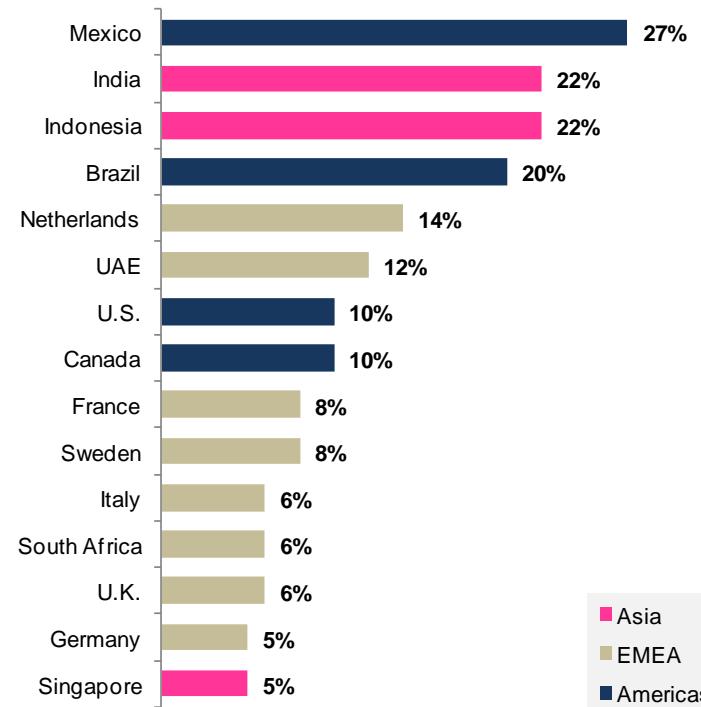


... or mobile wallet penetration in developing countries

**Mobile Wallet Adoption
(2016, % by Country)**



**Mobile Wallet Adoption
(Delta 2012-2016, Change in %)**



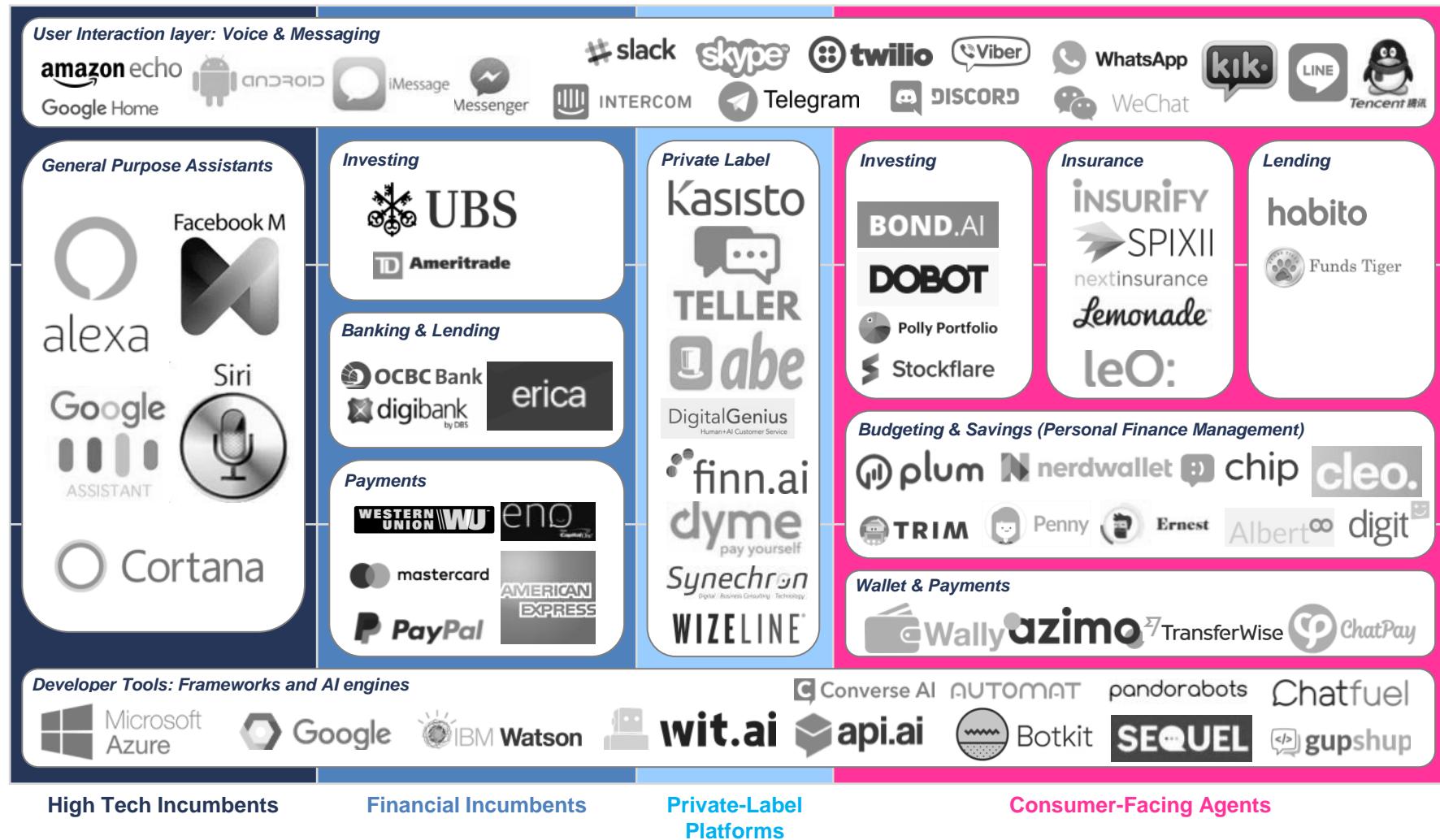
- India, Thailand, and Indonesia show 50% mobile wallet adoption, nearly double the 28% average, and nearly triple that of the United States

- High absolute penetration growth has happened in the developing world, with the US trending around the average



Financial chatbot & conversational interface ecosystem

Closer to Client





AUTONOMOUS



B2B offerings for banks starting to integrate core banking systems into conversational interfaces (chat / voice)

IBM

Watson

Watson Financial Services

Use the cognitive power of Watson to drive deeper consumer engagement, new experiences and augment the management of regulatory compliance.

IBM core strategic bet on Artificial Intelligence as a Service.

Started out paired with internal VC, then opened to external developers, then productizes into API, tech + services

Unavoidable cost of training and setup (\$250K+)

Kasisto

KAI For Banks ▾

finn.ai

Home

About

LET'S TALK

Today 10:15AM

Congratulations, you got paid!
My estimates show that
you can afford to save \$500
this month, want to transfer
that now?

Digital banking for
the cognitive age

Agile, secure and built for banks. Finn.ai is a personal banking and financial management assistant, powered by artificial intelligence.

How will Facebook and FISERV be integrated?

Productivity uplift for the middle office & the customer service reps

The Power of Conversation

KAI, a conversational AI platform, makes engaging with customers as natural as chatting. It weaves easily into their everyday lives.

Example of private-labeled chatbot platform

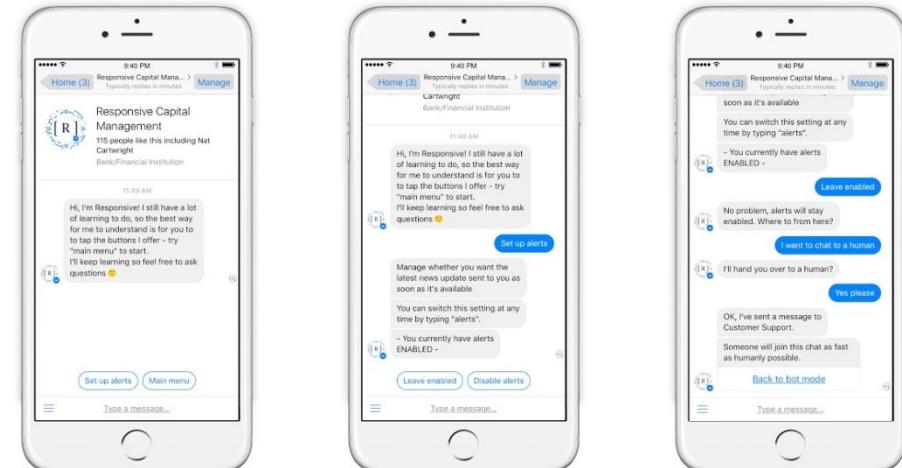


Overview

- The company provides banks with a chatbot technology that integrates into core processors and conversational apps (e.g., Messenger)
- Currently working with T1 and T2 banks across 4 continents, Finn.ai is automating hyper-frequency front office tasks that results in up to 50% time savings for support staff
- The system is a rule-based agent, making decisions based on a given set of scenarios
- Company uses data aggregator, MX, which extracts consumer information from their online banking services.
- Plans to use machine learning and voice recognition to create 'behavior profiles', allowing users to receive personalised advice based on their characteristics, sentiments and cash flows

Raised:
**\$3
Million**

Founded:
2014



Chatbot

Personality
Profiles

Built for Banks

Middle Office: Regtech & Identity



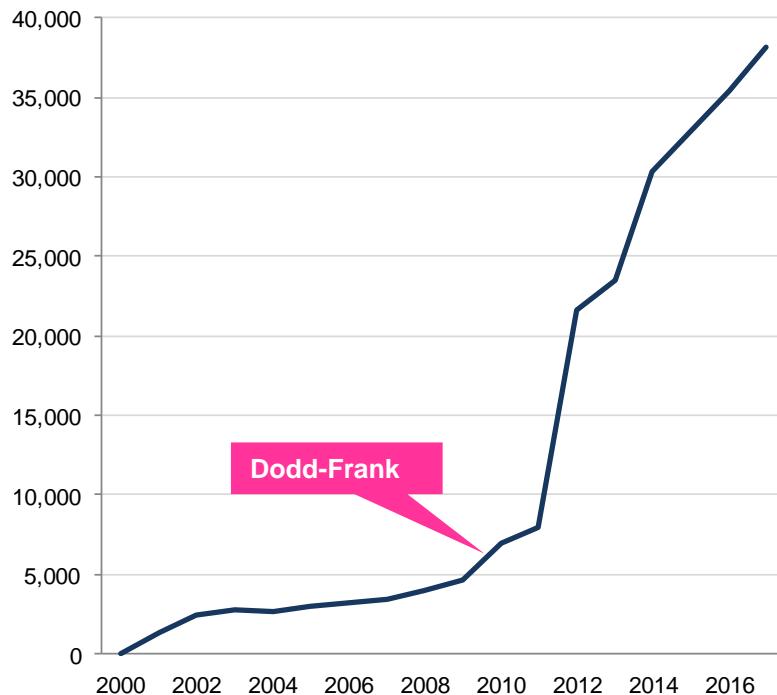
Compliance and workflows bolstered by AI

- Increasing regulatory complexity and the consumer expectation of real-time products and services is putting significant pressure on financial institutions
 - Nearly 30,000 pages of financial regulation have been added in the United States alone, and this has led to billions of venture capital funding for the regulation technology (RegTech) category
 - As products are provided in real time, compliance functions and fraud/risk management must shift from a batch process approach that tests samples of clients to an “always-on” approach for every transaction
- Artificial Intelligence cannot be built without large, open, live structured data sets – the regulatory initiatives of PSD2 and GDPR are catalyzing the opening of bank financial APIs, which will make it possible for third parties to access permissioned client data
 - PSD2 creates a way for machines to access data that is of a higher quality than the screen scraping tools developed in the United States during the mid 2000s
 - GDPR creates rights to data privacy and portability, which has implications for financial services infrastructure, and the legacy core systems that may be unable to flex for full compliance
- AI systems in the middle office are designed for financial institutions, and span from specific use-case applications to broad compliance and risk management platforms
 - Machine vision can be used to scan faces in passports or live photos and authenticate users; similar approaches can be applied to voice data, behavioral data and other biometric identity markets
 - Vendor and customer risk management can be automated with robots that index the web’s unstructured data and monitor changes and threats in real time
 - Machine learning can also be turned inwards towards employee communication for ongoing monitoring and threat prevention of trading or other behavior, useful in businesses with exposure to client capital

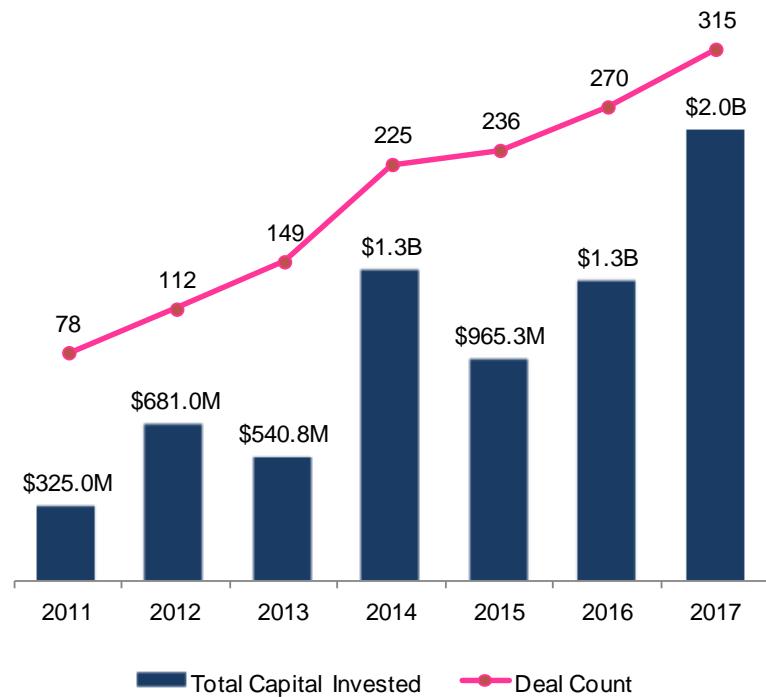


Complexity of middle office requirements has risen, as has funding for companies using software to lighten the burden

Cumulative Pages of Financial Regulation Since 2000



Venture Capital Funding in RegTech & Fraud Prevention

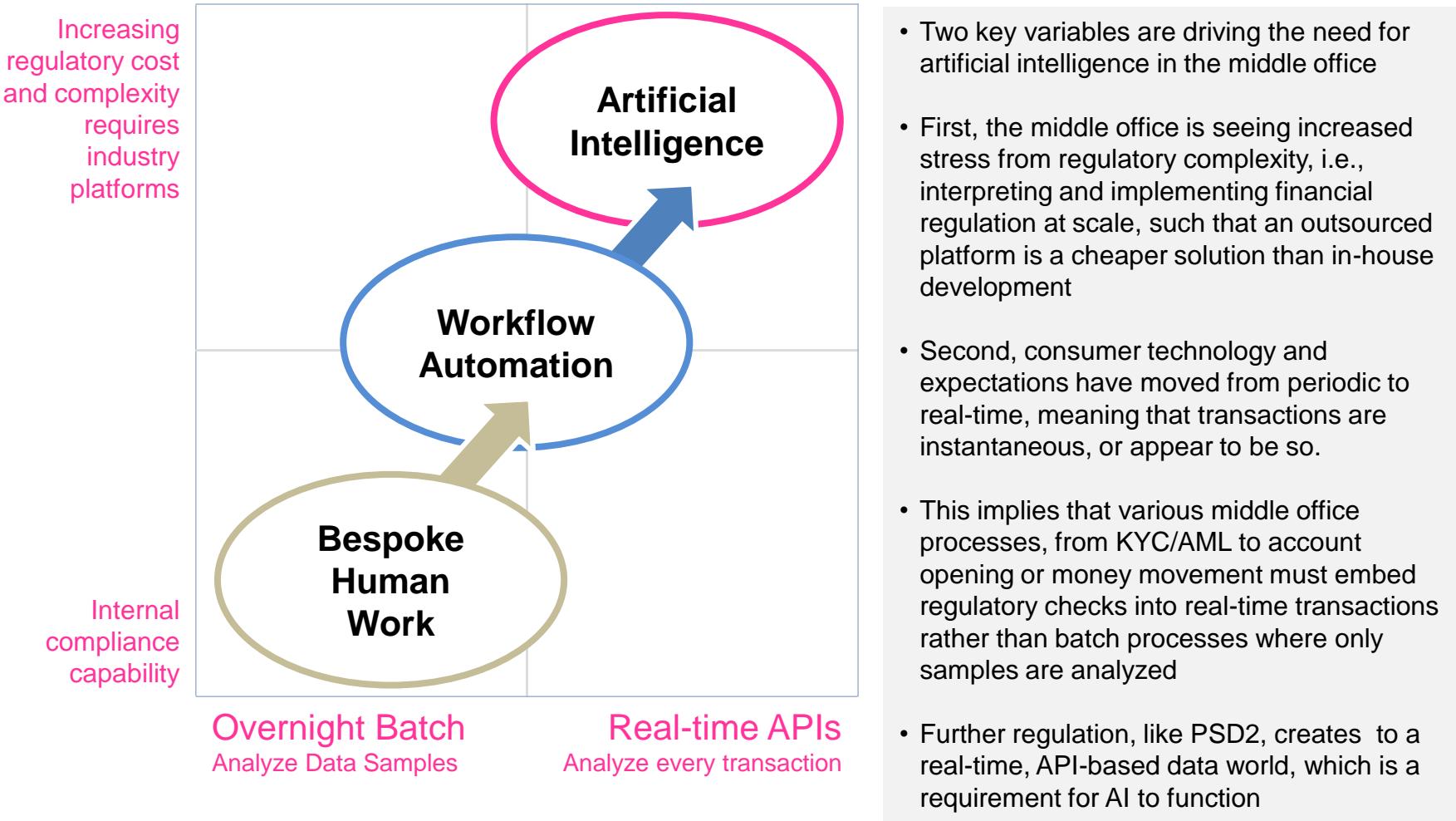


- The last decade has seen a steady increase in writing dedicated to financial regulation

- To deal with the increasing complexity of regulation, compliance and fraud, early stage investors have been funding RegTech as a theme



Artificial Intelligence is the next step for regulatory technology and workflow automation platforms





AUTONOMOUS



Banks are opening Developer Portals for third parties to leverage their APIs – mandated, but still a surprise to see

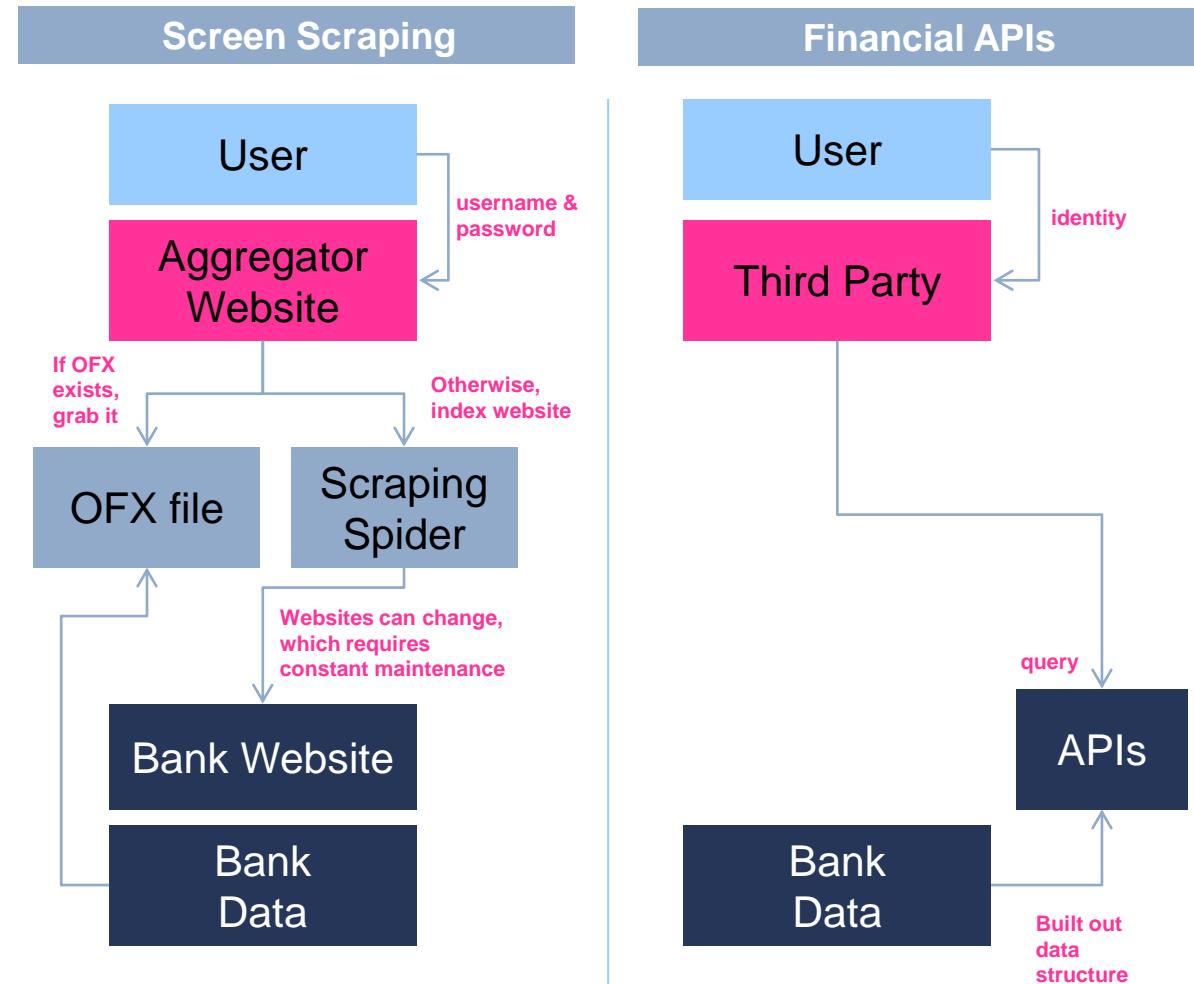
The image is a collage of screenshots from different bank developer portals, illustrating the trend of banks opening developer portals to leverage their APIs.

- Barclays API Store:** A screenshot showing three people looking at a screen, with the text "Barclays API Store" and "Helping you build the digital experiences of tomorrow with our Fintech APIs".
- Standard Chartered API for Developers:** A screenshot showing the Standard Chartered logo and the text "for Developers".
- API PORTAL:** A screenshot showing the text "API PORTAL" and "Build the future of banking with our APIs".
- Deutsche Bank API Program:** A screenshot showing the Deutsche Bank logo and the text "The theme of ‘bank-as-a-service’ is enabled through the most competitive financial APIs, similar to the iOS and Android app stores".
- HSBC Group developer portal:** A screenshot showing the HSBC logo and the text "HSBC Group developer portal". It includes a callout: "The key to successful APIs is whether the software can merely read information, or whether it can actually move money, open accounts, and take account actions."
- first direct M&S BANK:** A screenshot showing the first direct and M&S BANK logos.
- Chatbot companies and AI-giants like Amazon will leverage such APIs for integration with conversational interfaces:** A callout pointing to the HSBC developer portal page.



Such efforts have already been undertaken by industry in the United States, but using a screen-scraping backdoor

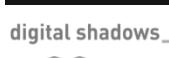
- In the United States, a wave of account aggregation companies were started in the early 2000s, pioneered by a eWise, Yodlee (banking) and ByAllAccounts (investments)
- The data was aggregated from the user side, rather than via APIs. This means either downloading an OFX file from the bank (used in personal finance software) or by “screen-scraping” the website for account information after getting login credentials from the user
- Mint.com was the most notable example of personal financial management software using this approach, leveraging Yodlee for data and eventually selling to Intuit for \$170M





Market Landscape for AI and Advanced Analytics Regtech

Closer to Client

KYC / AML**Biometrics & Identity****Compliance Workflows****Cyber Security****Diligence & Vendor Risk Management****Financial Risk Management****Surveillance / E Comms****Complex, multi-step processes****Operating Use-Cases****Transactions**

Example of machine learning solution for Compliance



Overview

- Synthesys® cognitive computing platform is able to holistically analyze huge volumes, multiple streams and forms of data
- By unifying data around a customer, their activities, needs and intentions, cognitive computing uses machine learning and natural language processing to understand what customers are talking about, their sentiment and buying behaviors
- Deploys bespoke solutions for multiple use-cases across industries:
 - Understanding financial markets
 - Customer profiling, relationship management and cross-selling
 - Government analytics
 - Conduct surveillance and risk management within internal communications
- Investors include BNP Paribas, Barclays, Goldman Sachs, Square Capital, and Nasdaq

Raised:

**\$140
Million**

Founded:

2000



Tennessee, USA

SYNTHESYS HELPS COMPLIANCE ANALYSTS DETECT:



MARKET MANIPULATION

- Reveal collusion and market manipulation
- "Quid-pro-quo" exchanges
- Clustered Bid/Ask Quotes
- Order execution around the benchmark



UNAUTHORIZED TRADING

- Identify trade abuse
- Deal-related language
- Abusive/dirty references
- Improper placement and execution



WALL CROSS VIOLATIONS

- Uncover insider trading
- M&A terminology
- Personal trade execution
- Discussing Companies on Restricted List

Machine Learning

Sentiment Analysis

E-Surveillance

Back Office: Financial Product Manufacturing using AI



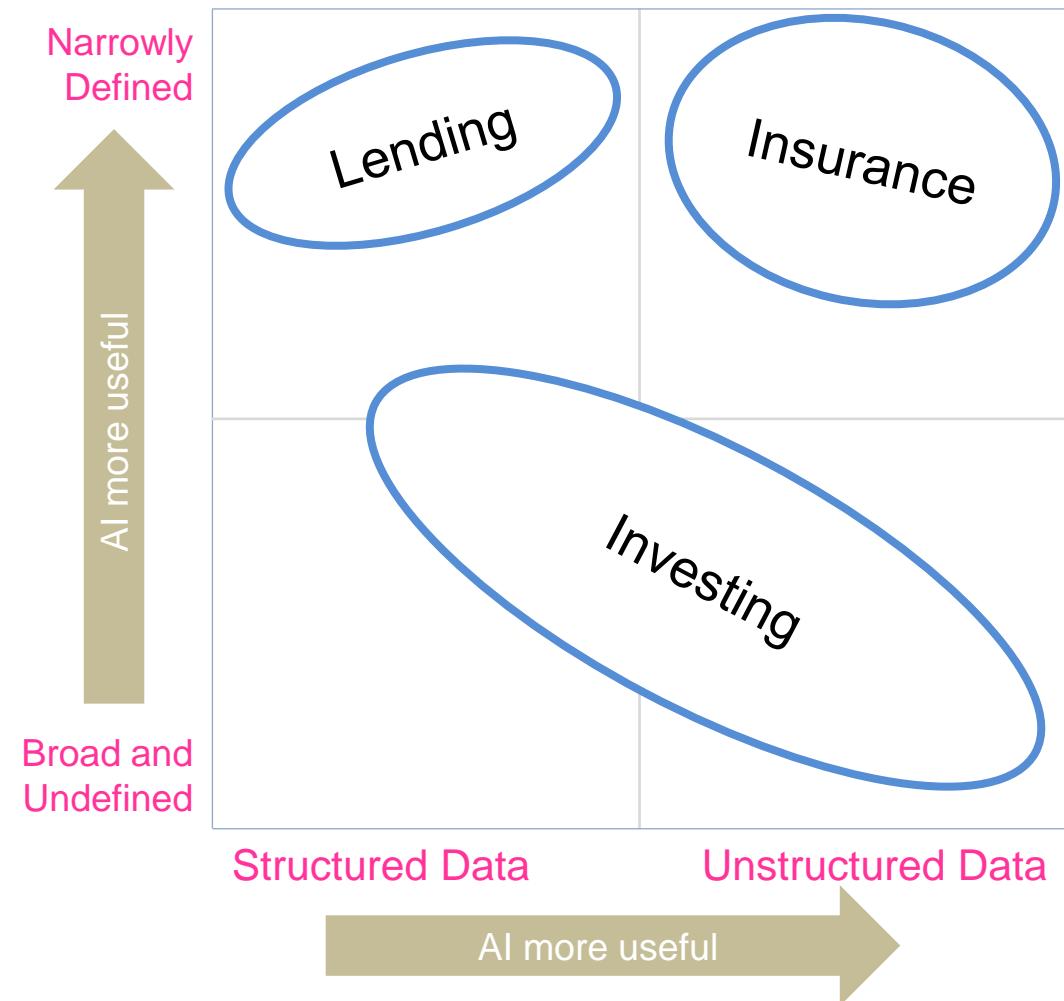
AI-led product manufacturing goes to the heart of Finance

- Quantitative methods have always been used to manufacture financial products – from loans, to insurance, to picking investments – but applying machine learning is a new challenge
 - There is a distinction between Data Science, a discipline practiced by human statisticians to build algorithms, and Machine Learning, a discipline where human engineers build machine statistician algorithms that write their own algorithms
- Artificial Intelligence is most useful where the problem set is narrowly defined, i.e., it is well known what is being optimized and how, and where the fuzzy data needs the structuring at scale that AI provides
 - A narrowly defined problem may be – given this particular set of personal characteristics about a person, should they be allowed to borrow this particular amount of money based on prior examples. A poorly defined problem may be – predict the price of a stock tomorrow given thousands of inter-correlated data points and their price history.
 - Insurance data sets, like photos of damage to insured objects, seem particularly well suited to the type of work that AI does well
- Until now, most Fintech companies have transformed and automated the client experience. Using AI to automated the manufacturing of financial products could lead to a fundamental shift in the heart of the industry.
 - In response to passive factor-based asset managements, investors are racing to build augmented investment analysts that make selections based both on fundamental analysis and alternative data interpreted by AI
 - Looking at the Asian fintech giants like Baidu and Ant Financial shows us how powerful an AI profiling mechanism can be if given access to social, commercial, and behavioral data in addition to financial data



AI is most powerful for financial products where data is unstructured but the goals are narrowly defined

- **Credit:** AI Solves the narrow problem of whether to provide a consumer or business credit, and does so leveraging structured data like financials, zipcode, age, salary and savings
- **Insurance:** Within underwriting, AI can attempt to minimize losses from decisions; and within claims assessment it can incorporate unstructured data sets like images of broken cars and houses, or health data
- **Investment management:** Still learning how to define a problem set narrow enough not to be overwhelmed by noise and unachievable goals, but progress has been made in AI-enhanced trading and alpha-generating hypothesis formulation and testing





AUTONOMOUS



Market Landscape for AI in Product Manufacturing

Repayment and Collections



Credit Underwriting



AI / Quant funds and software



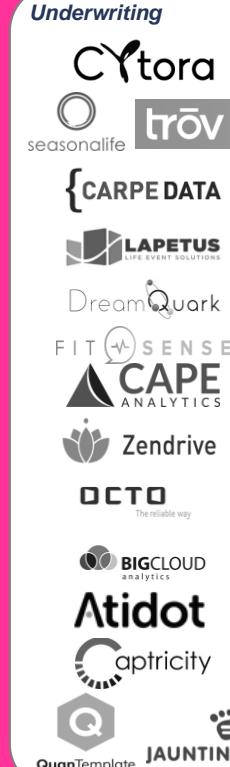
Augmented Analyst



Claims / Risk Management



Underwriting



Incumbents



Banking & Lending

Investment Management

Insurance

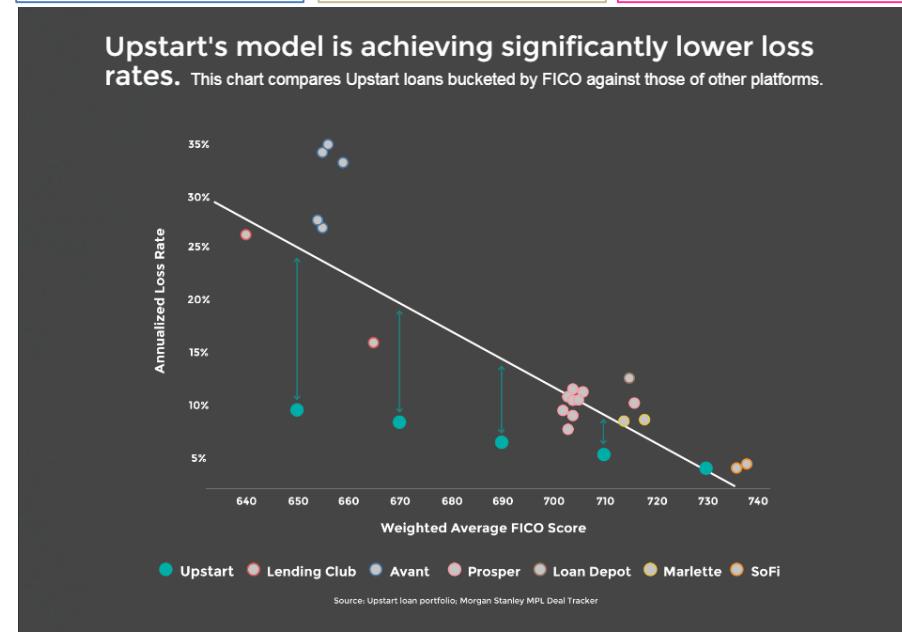


Example of an AI-based lending underwriter



Overview

- Founded by ex-Googlers, Upstart is a direct-to-consumer lending platform as well as a provider of lending-as-a-service via its 'Powered by Upstart' technology to banks and credit unions
- Upstart leverages artificial intelligence and machine learning to power its underwriting engine to identify high quality borrowers using variables such as:
 - Schools attended
 - Work experience
 - Neighbourhood
 - Web behaviour during the online application process
- Resulting in instant approval of over 30% of all loan applications.
- With the average size of each loan being \$11,500 to a customer of average age 28, Upstart have been able to originate over \$1.7B in loans to date.



Lending Underwriting

Platform for Banks

Machine Learning



Example of an industry-leading Quantamental fund

BLACKROCK

Overview

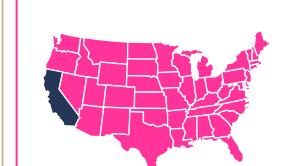
- BlackRock is embracing quantamental strategy by placing its Scientific Active Equity unit at the core of its fundamental stock-picking products. This is separate from its quantitative, factor driven smart beta products.
- The unit and its 80 staff (of which 30 are PhDs) use alternate data sources to enhance the fundamental decision making process:
 - Satellite imagery to understand extent of commercial activity and traffic patterns
 - Conference call transcripts to interpret current affairs, using semantic analysis and levels of specificity
 - Social media to gather real-time sentiment
 - Google trends to decipher public interest and economic trends
 - Employee satisfaction on Glassdoor
 - Online invoices
- 89% of SAE's assets have outperformed their benchmarks over past 3 years net of fees, and 95% have outperformed over 10 years

Fund Size:

**\$100
Billion**

Employees:

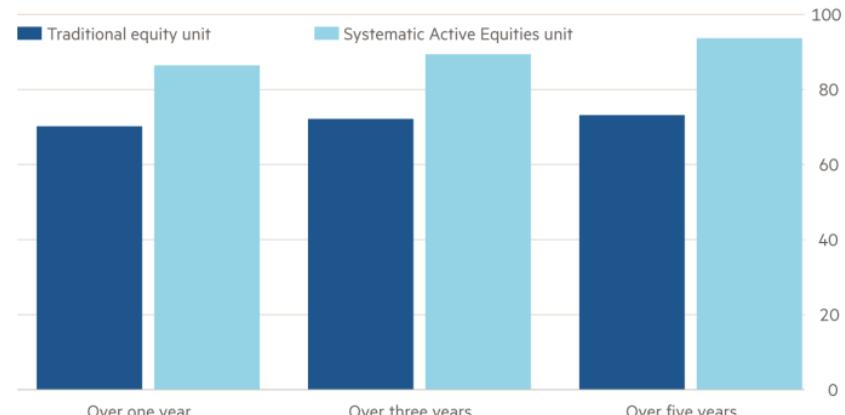
**80 FTEs
30 PhDs**



California, USA

BlackRock's SAE arm outperforms its traditional stock pickers

% of assets under management above benchmarks (as of Dec 31 2017)



Source: company
© FT

Fundamental
Research

Big Data

Machine Learning

Example of crowdsourced machine learning hedge fund using crypto tokens to reward 35,000 data scientists



- Numerai is a decentralised hedge fund that works by building its own financial model that incorporates the machine learning models submitted by data scientists from various backgrounds and expertise.
- The Numerai team democratises participation by making an encrypted dataset readily accessible via their platform.
- Data scientists download the dataset in order to build and submit their own machine learning model, targeting regions or sectors of the stock market in search of the best accuracy in predictability.
- Numerai synthesise all submitted models into their meta model, rewarding those with the most accurate predictive models in Numeraire-Numerai's token.
- The diversity of models submitted leads to diversification in the meta model, reducing risk.



Tournament 51 Results

This tournament has resolved.

PARTICIPANTS	CONTROLLING CAPITAL	USD PAID OUT	NMR PAID OUT		
475	266	\$3603.05	14412.09		
#	DATA SCIENTIST	LIVE LOGLOSS	VAL LOGLOSS	ROUND USD	ROUND NMR
1	GIRAS	0.690556	0.692082	\$1000.00	4000.00
2	THEAFH	0.691091	0.692447	\$435.28	1741.10
3	STUDYAI	0.691223	0.660740	\$267.58	1070.32
4	JOSEPH_SCHUMPETER	0.691505	0.692316	\$189.46	757.86
5	INVAI	0.691647	0.661223	\$144.96	579.82
6	KARL_MARX	0.691776	0.692233	\$116.47	465.88
7	ANYTT	0.691778	0.680470	\$96.80	387.21
8	HENRYWANG7	0.691880	0.692742	\$82.47	329.88
9	UUAZED2	0.691991	0.692207	\$71.60	286.40
10	INTELAYER	0.691995	0.692595	\$63.10	252.38

Crowd Sourced

Hedge Fund

Cryptocurrency

Example of an augmented investment analyst platform



Overview

- Kensho Technologies is a company assisting in the scalable deployment of artificial intelligence, machine learning, natural language processing and data analytics systems to governments, global banks and investment institutions
- Kensho uses natural language processing as well as machine learning to digest data stored in its Global Event Database- considered to be one of the world's largest data repositories of unstructured data
- Kensho's service offerings include:
 - Financial Analytics Software: deploys scalable analytics systems across institutions.
 - Applied Mind: AI engine to process social and economic data across industries.
 - Koto: harnesses machine learning and natural language processing techniques to provide insight to governments and geopolitical analysts

Acquired by
S&P Global:
**\$550
Million**

Founded:
2013



Data Analytics

Natural Language Processing

AI / Machine Learning

Example of image recognition in insurance claims



TRACTABLE

Overview

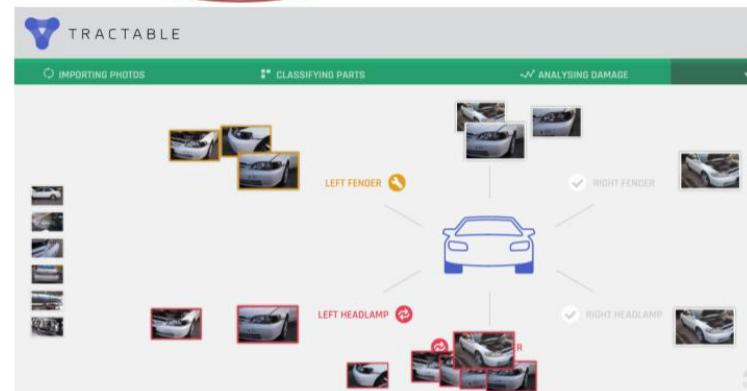
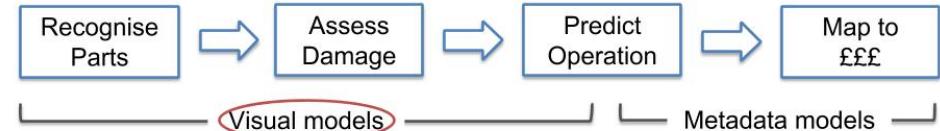
- Tractable ingests large data set of photos of damaged car parts and associated claims estimates; machine learning creates associations between visual images and expected costs
- Algorithm with UI can allow much faster claims processing – customer can take photo of damage and receive estimate in real time
- Applicable to automated body shop adjustments, hail damage, roof inspection, and other use-cases
- Instead of claimants, company drones can also perform the same task in the future
- Difficult cases with low image recognition certainty can be directed to more specialized human service

Raised:
**\$9.9
Million**

Founded:
2014



London, UK



Insurance

Claims Assessment

Machine Vision

The Macro View on Intelligence Explosion

What's next for AI-based financial products?

Data profiling

Baidu's AI enabled user profiling



Baidu builds user portraits based on big data in 4 key distinct categories, 24 vertical fields and nearly 300 tags depicting interests, hobbies, habits and demands from multi-dimensions to profile their customers.

Baidu Financial Products (Wallet, Lending)

Social Credit

China's dystopian citizen surveillance mechanism

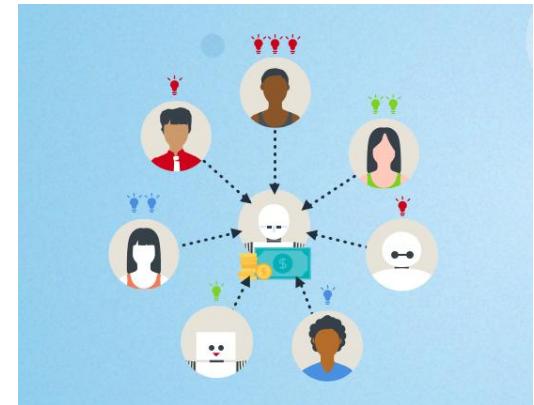


China is testing a Social Credit System –a government initiative using an individual citizen's social, financial and personal data to build a score which determines access to a multitude of public and private goods and services

Access to Credit

DAOs

Decentralized Autonomous Organizations pushing back



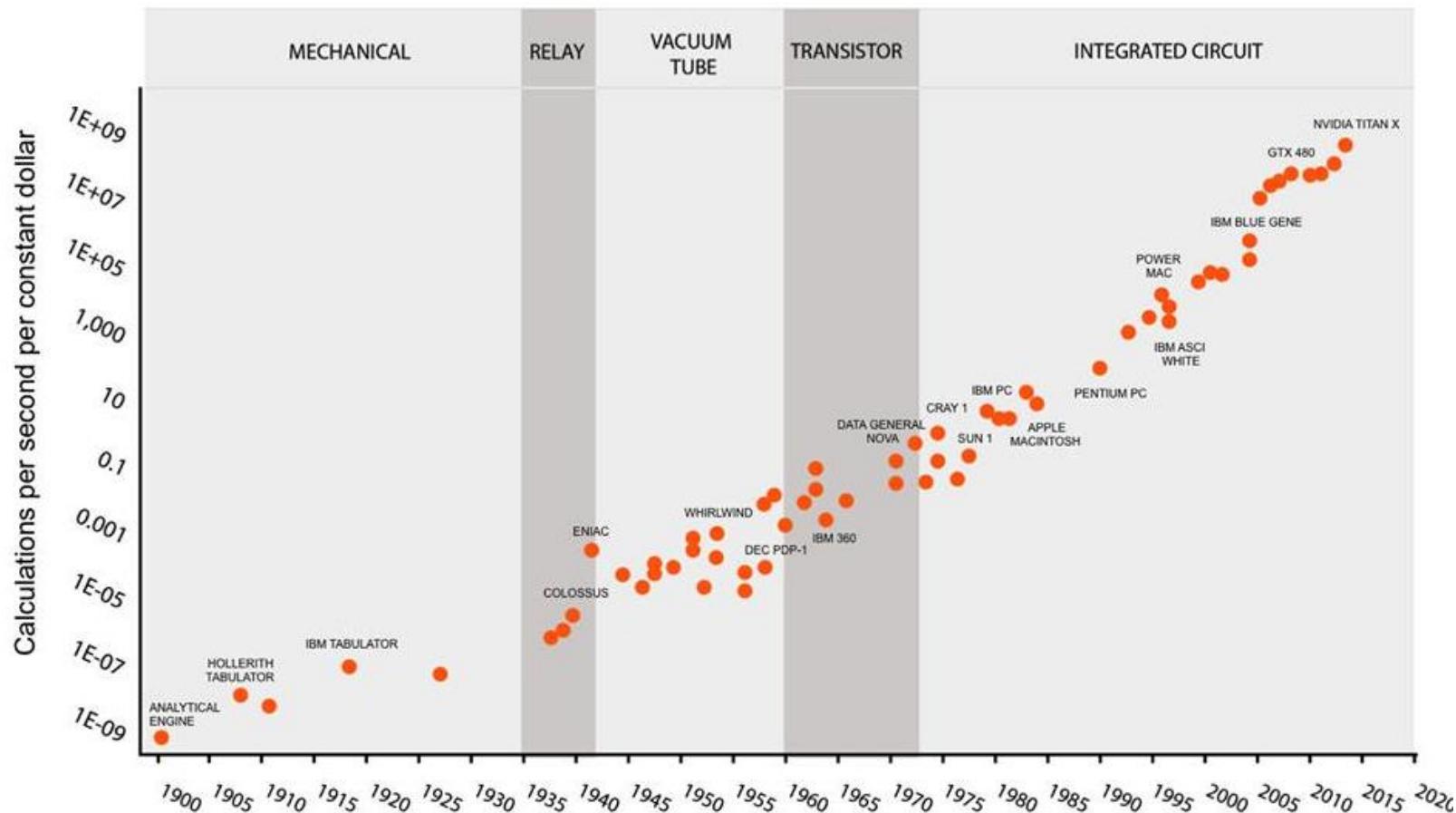
DAOs create organization hierarchies on the blockchain, allowing for governance to be enforced digitally through smart contracts. In recent years, DAOs have been set up at investment pools with digital and trustless means for transaction and investment

Investments

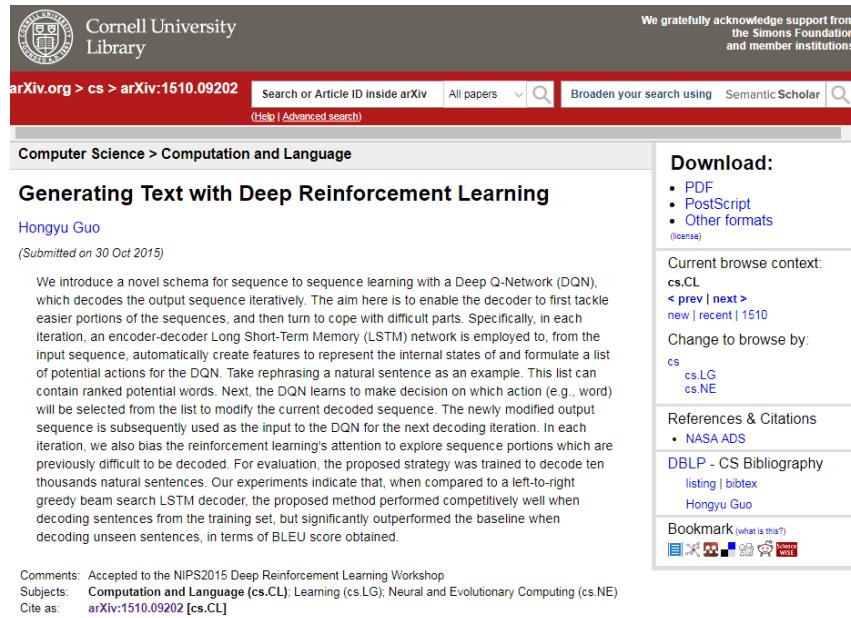


Exponential increase in computational power still holds,
supported by development of powerful GPUs

Number Of Calculations Per Second Per Constant Dollar (Updated Moore's Law)



Exponential increase in open scientific research, including those in computer science and mathematics



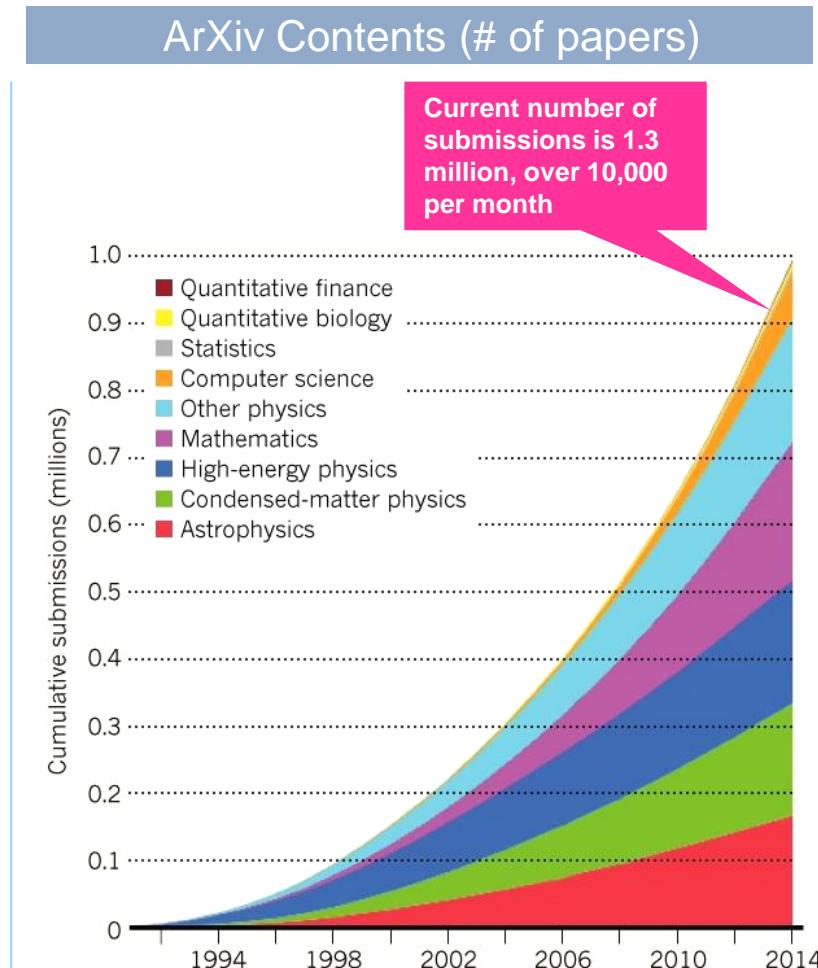
Cornell University Library
arXiv.org > cs > arXiv:1510.09202 Search or Article ID inside arXiv All papers Broaden your search using Semantic Scholar (Help | Advanced search)

Computer Science > Computation and Language
Generating Text with Deep Reinforcement Learning
Hongyu Guo
(Submitted on 30 Oct 2015)

We introduce a novel schema for sequence to sequence learning with a Deep Q-Network (DQN), which decodes the output sequence iteratively. The aim here is to enable the decoder to first tackle easier portions of the sequences, and then turn to cope with difficult parts. Specifically, in each iteration, an encoder-decoder Long Short-Term Memory (LSTM) network is employed to, from the input sequence, automatically create features to represent the internal states of and formulate a list of potential actions for the DQN. Take rephrasing a natural sentence as an example. This list can contain ranked potential words. Next, the DQN learns to make decision on which action (e.g., word) will be selected from the list to modify the current decoded sequence. The newly modified output sequence is subsequently used as the input to the DQN for the next decoding iteration. In each iteration, we also bias the reinforcement learning's attention to explore sequence portions which are previously difficult to be decoded. For evaluation, the proposed strategy was trained to decode ten thousands natural sentences. Our experiments indicate that, when compared to a left-to-right greedy beam search LSTM decoder, the proposed method performed competitively well when decoding sentences from the training set, but significantly outperformed the baseline when decoding unseen sentences, in terms of BLEU score obtained.

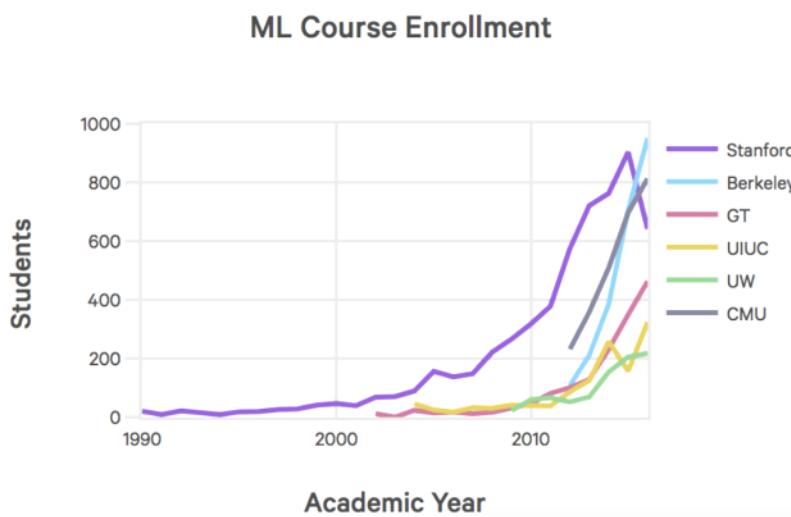
Comments: Accepted to the NIPS2015 Deep Reinforcement Learning Workshop
Subjects: Computation and Language (cs.CL); Learning (cs.LG); Neural and Evolutionary Computing (cs.NE)
Cite as: arXiv:1510.09202 [cs.CL]

- Launched in 1991
- Prestige of being included and cited in academic community
- Google, Facebook and Alibaba engineers contribute to this open knowledge base

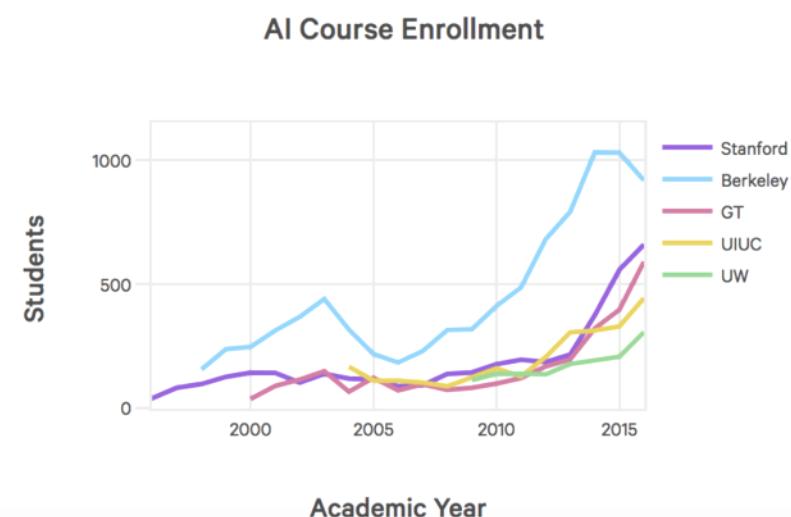


American student interest in building artificial intelligence has sky-rocketed, as have the salaries for the field

Machine Learning Course Enrolment



AI Course Enrollment



Typical A.I. specialists, including both Ph.D.s fresh out of school and people with less education and just a few years of experience, can be paid from \$300,000 to \$500,000 a year or more in salary and company stock, according to nine people who work for major tech companies or have entertained job offers from them. All of them requested anonymity because they did not want to damage their professional prospects.

New York
Times



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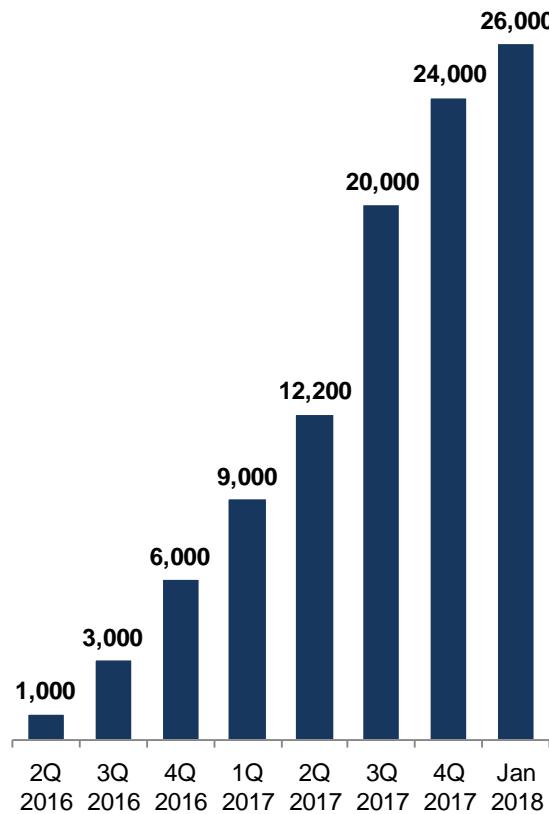


Path from narrow to general Artificial Intelligence, or at least virtual assistants, could be by narrow skill acquisition

Amazon Alexa Skills

TNW

LATEST INSIGHTS DISTRACT FULL STACK INVESTING 2.0



Google's AI can create better machine-learning code than the researchers who made it



by TRISTAN GREENE — 10 days ago in ARTIFICIAL INTELLIGENCE

FACEBOOK

No, Facebook Did Not Panic and Shut Down an AI Program That Was Getting Dangerously Smart



Tom McKay

7/31/17 8:31pm • Filed to: SKYNET ▾



449.2K



183



14



OpenAI

Discovering and enacting
the path to safe artificial
general intelligence.

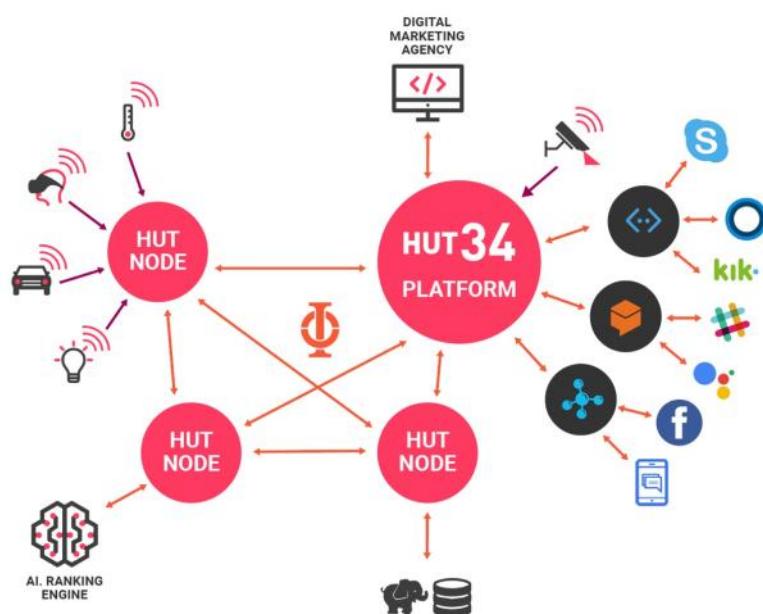


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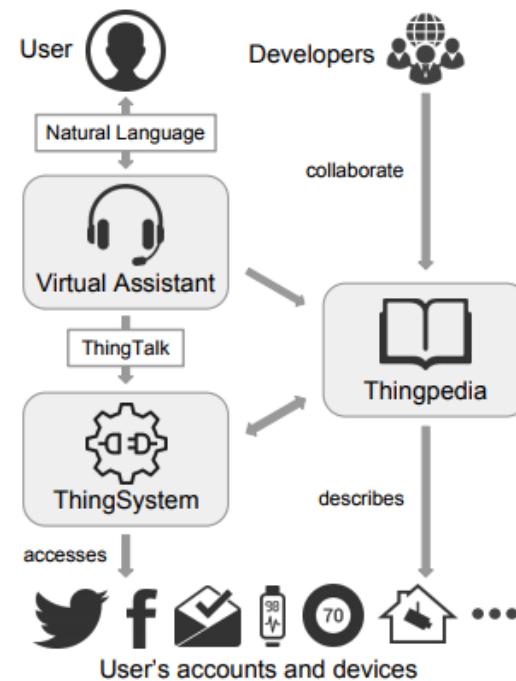


AI skills need not be centralized at a tech giant or have proprietary code – they can be decentralized and open

Crypto Project Funded by \$3.5 million ICO



Stanford Mobile & Social Computing Research Group



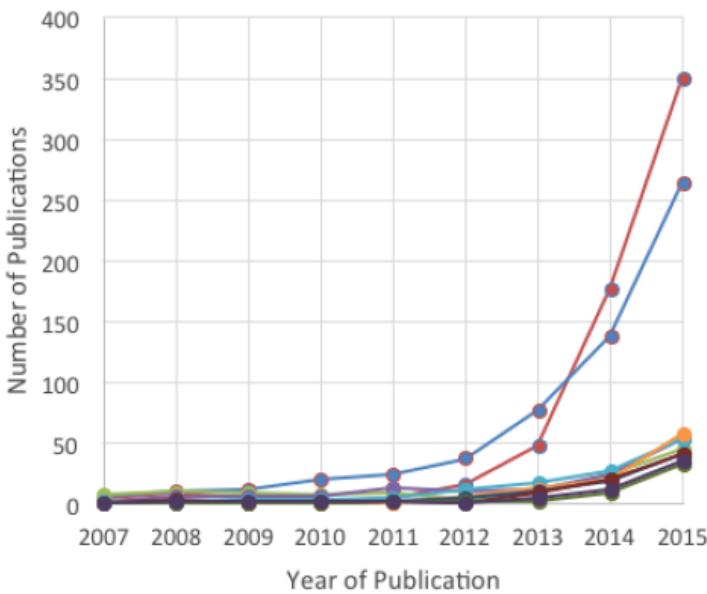
- Monetization between bots via a decentralized middle crypto token layer

- Almond: The Architecture of an Open, Crowdsourced, Privacy-Preserving, Programmable Virtual Assistant

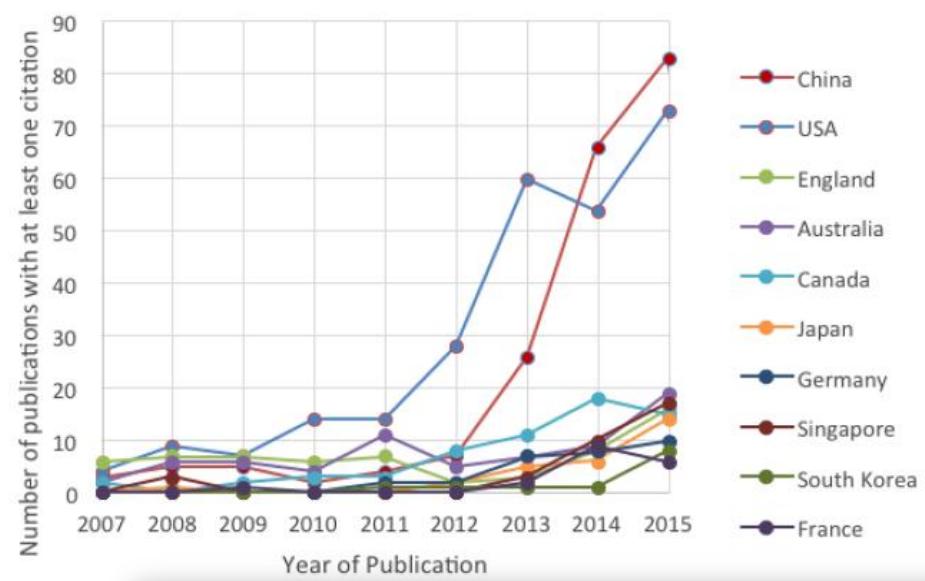


China has invested into AI and has begun to outperform the United States on related academic research

Journal Articles Mentioning “Deep Learning” by Nation



Journal Articles Cited at least Once “Deep Learning” by Nation



- Since 2014, China has seen 350 journal articles mentioning deep learning (vs. US at 260), and 80+ citations (vs US at 70+)
- Chinese Fintech companies, like Baidu and Alibaba, are global leaders in AI and are investing billions into development

Bloomberg Technology Markets Tech Pursuits Politics Opinion Businessweek

Alibaba to Spend \$15 Billion Exploring 'Moonshot' Projects

By Lulu Yilun Chen
October 11, 2017, 3:28 AM GMT+1



Ethical and safety considerations are paramount

Discrimination and Bias

- Machine learning is trained on existing data, which reflects the ways that society and the economy are structured today
- By replicating distributional results, AIs may perpetuate inequities and achieve outcomes that hurt minorities and protected classes
- As an example, in a study of image recognition artificial intelligence systems, top three commercial software packages had an error rate of 0.8% when determining the gender of a light-skinned man, and a 20-24% error rate when analyzing pictures of dark-skinned women. Using such software for police work, for example, is a clear problem.
- Similarly, AIs used in credit underwriting may use thousands of data points, but then overweight items like Zipcode, which can correlate with income levels and ethnicity, prejudicing protected classes
- We cannot only be mathematicians, but must also be social scientists designing kind systems

The Control Problem



- Long term, a super-intelligent AI may be entirely indifferent to human needs and severely harm our interests, either on purpose or by unintended consequence
- Aligning the utility function of such an AI in a with human requirements, i.e., building a friendly AI, is called the “Control Problem” and has challenged thinkers from Nick Bostrom to Stephen Hawking
- The Machine Intelligence Research Institute was formed in 2000 to create the formal technical tools to help people prevent bad outcomes
- OpenAI, another project focused on this problem, was founded by Elon Musk and Sam Altman in 2015, and is backed by \$1 billion in pledges

About Autonomous



Autonomous NEXT is a mission-driven innovation and fintech research process for financial firms and investors



- We are independent, creative and original thinkers about the future of finance serving the world's largest financial services investors
- We combine both a fundamental and innovation perspective
- Better decisions in financial services = better outcomes for real people





We are a global financial research firm ...



- 📍 Founded in London in 2009 as an independent research firm, specialising in European banks and insurers.
- 📍 In 2012, Autonomous opened an office in New York and launched coverage on US financials.
- 📍 Autonomous opened an office in Hong Kong in Q1 2015 and launched coverage on Chinese financials and China macro.

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- Autonomous is a partnership, fully owned by its people, with no external investors.
 - The founding partners of Autonomous were top ranked for 5 years in the European banking and insurance sectors (ex ML and Citi).
 - Autonomous covers 196 companies globally, with a combined market capitalisation of \$4.4 trillion.
 - Autonomous offers exclusivity/limited distribution to provide a more bespoke service.
 - Our objective is to be the leading global research firm for financials.
 - Our strategy is to be the trusted advisor to the world's leading asset managers.
 - Autonomous has 90 people globally including 40 full time analysts with unrivaled experience covering banks, insurers, diversified financials and FinTech.
 - Autonomous offers unique and unbiased perspectives on the future of Fintech by exploring the way in which technology will shape the global financials industry.



... that combines an entrepreneurial and fundamental view

Lex Sokolin

Global Director Fintech Strategy

Lex is a futurist and entrepreneur focused on the next generation of financial services. He directs Fintech Strategy at Autonomous Research, a global research firm for the financial sector, helping clients understand and leverage innovation.

Lex is on the Board of Directors and previously was the Chief Operating Officer at AdvisorEngine (formerly Vanare), a digital wealth management technology platform that received a \$25mm investment from Wisdom Tree. He was also founder and CEO of NestEgg Wealth, a roboadvisor that pioneered online wealth management in partnership with financial advisors, acquired by AdvisorEngine.

Lex is a contributor of thought leadership to the Economist, the WSJ, CNBC, Reuters, Investopedia, American Banker, ThinkAdvisor, and Investment News, among others. He has spoken on the future of technology and achieving extraordinary growth at conferences for Money2020, LendIt, Techonomy, In|Vest, T3 Enterprise Edition, and the FPA.

Prior to NestEgg, Lex held a variety of roles in investment management and banking at Barclays, Lehman Brothers and Deutsche Bank. He holds a JD/MBA from Columbia University and a B.A. in Economics and Law from Amherst College.

The collage includes several news snippets:

- InvestmentNews**: "40 Under 40 | THE POWER OF PERSONALITY" featuring Alexey Sokolin, AGE 32, Chief operating officer, Vanare.
- WealthManagement.com**: "The Finance Futurist" by Ryan W. Neal.
- ThinkAdvisor**: "Lex Sokolin: Fintech Futurist – The 2016 IA 25". Subtext: "In Sokolin's future, financial services has no robo-advisor overlords". Includes a photo of Lex Sokolin.
- WSJ MONEYBEAT**: "Lex Sokolin Talks Top FinTech Predictions for 2017". Subtext: "Artificial Intelligence and bitcoin will reshape the way advisors do business, Sokolin says." Includes a graphic of a calculator.

Our thought leadership in Fintech has practical implications for financial services companies, tech firms and startups.



The new funding mechanism using distributed ledger technology that displaces both public markets (IPOs) and private investment with \$ billion of Cryptocurrency



We see clearing and settlement as the first major implementation. Blockchain can reduce industry spend by 30% or \$16bn on a five year view.



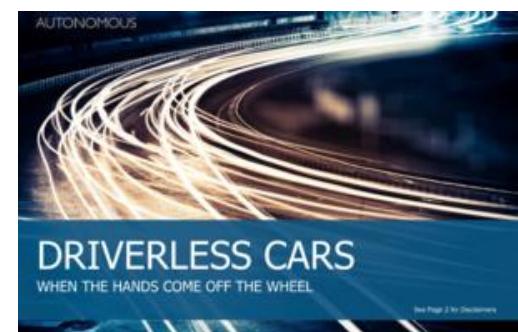
Making sense of blockchain, digital currencies, roboadvisors, wealthtech and other futurist themes within a unified, quantified framework



We expect digital lending to double again before 2020, reaching \$100bn in loan origination volumes from the US and Europe combined



A blueprint for the strategic roles and competitive options of financial services, high-tech and start-up companies in 2030



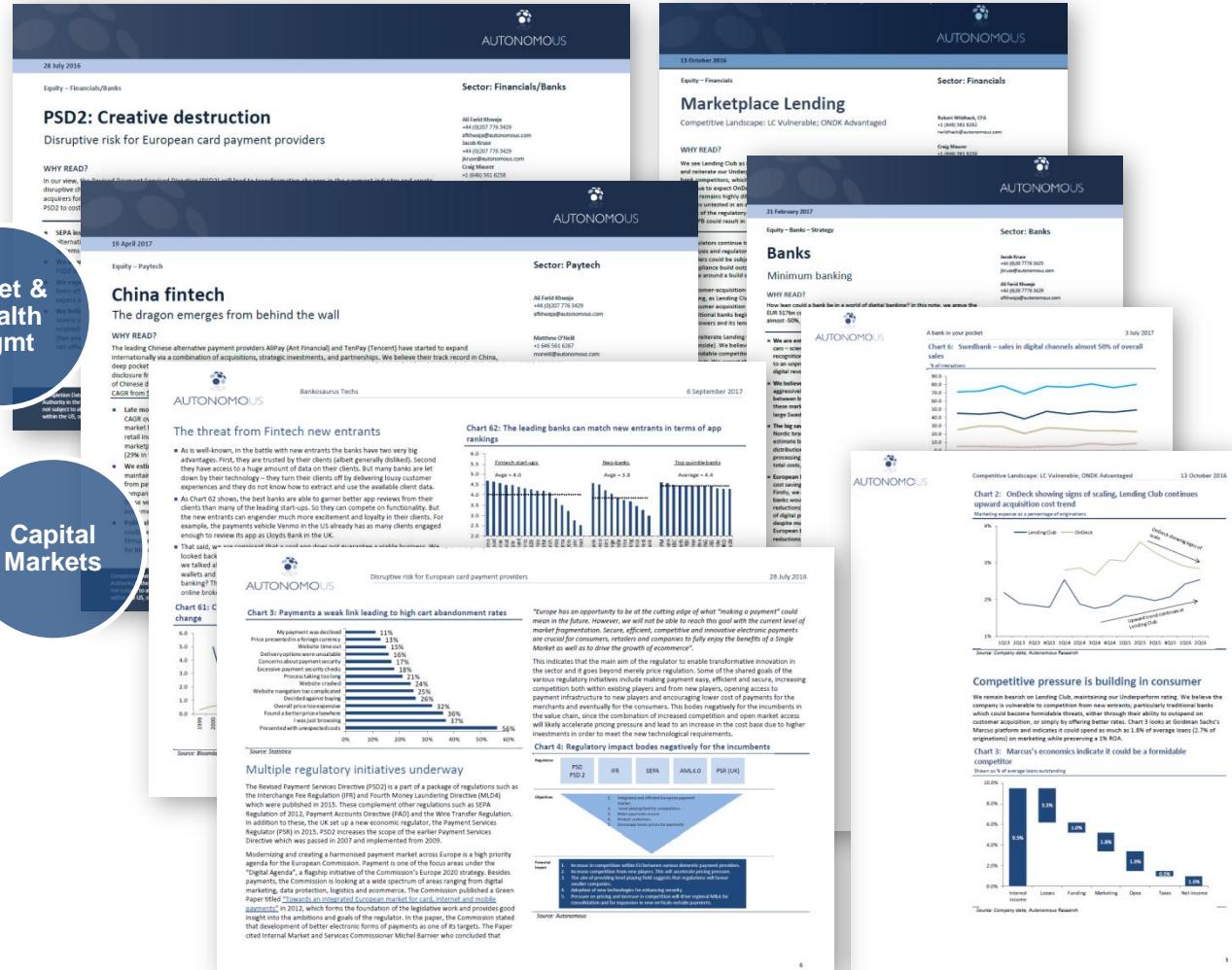
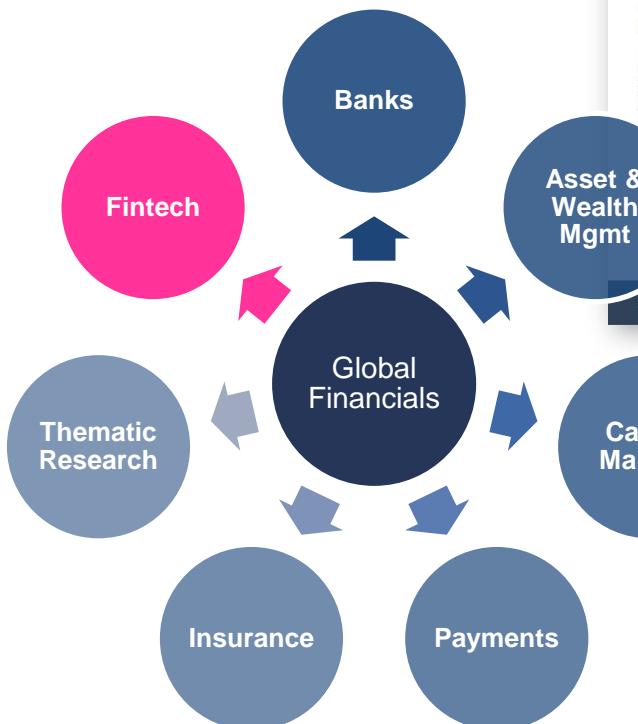
We see 2025 as the point when fully autonomous cars become a commercial reality. We see motor premiums in the developed world more than halving between 2025-40.



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Autonomous Research is a leader in equity research on financial services, translating themes into investment ideas





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