

Artificial Intelligence, Machine Learning, and Deep Learning



Content

- AI, Machine Learning, & Deep Learning
- Natural Language Processing
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- Natural Language Processing - Finance

What is the deep learning?

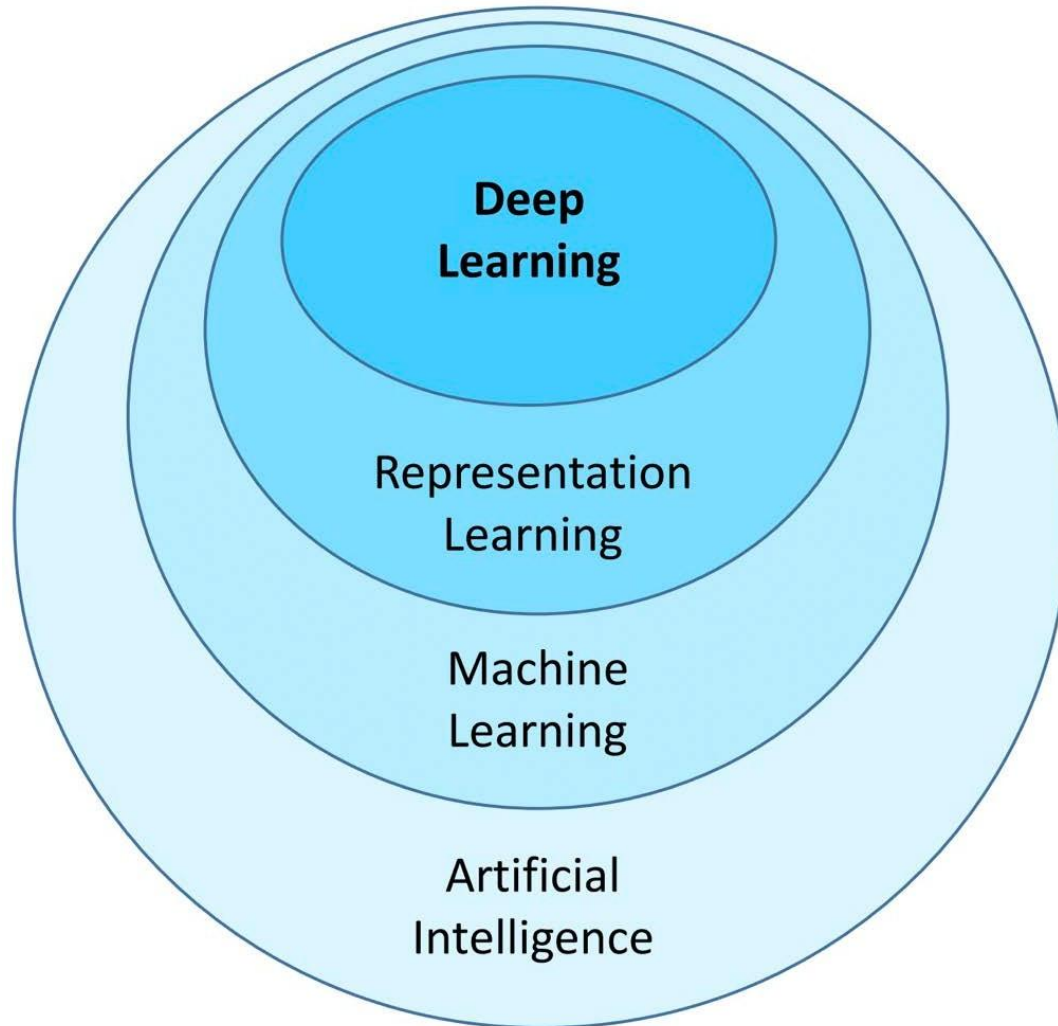
Deep learning is a computer program that can identify what something is
Technical Definition: Deep learning is a class of machine learning algorithms in the form of a neural network that uses a cascade of layers (tiers) of processing units to extract features from data and make predictive guesses about new data.

Source: Extending Jann LeCun, <http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/facebook-ai-director-yann-lecun-on-deep-learning>

What is an Artificial Neural Network?

1. Collection of connected units called artificial neurons (analogous to axons in a biological brain)
 - Organized in layers of signaling cascades
 - Each neuron transmits a signal to another neuron
2. Neurons may have state
 - Represented by a number between 0 and 1
3. Variable parameters
 - Neurons may have a weight that varies as learning proceeds, which can increase or decrease the strength of the signal that it sends downstream
 - Neurons may have a threshold (bias) such that only if the aggregate signal is below (or above) that level is the downstream signal sent

AI and Machine Learning[2]



DL - => 2010's => ML with Multi-layer Neural Networks

RL – ML Extracting Features of Data Sets

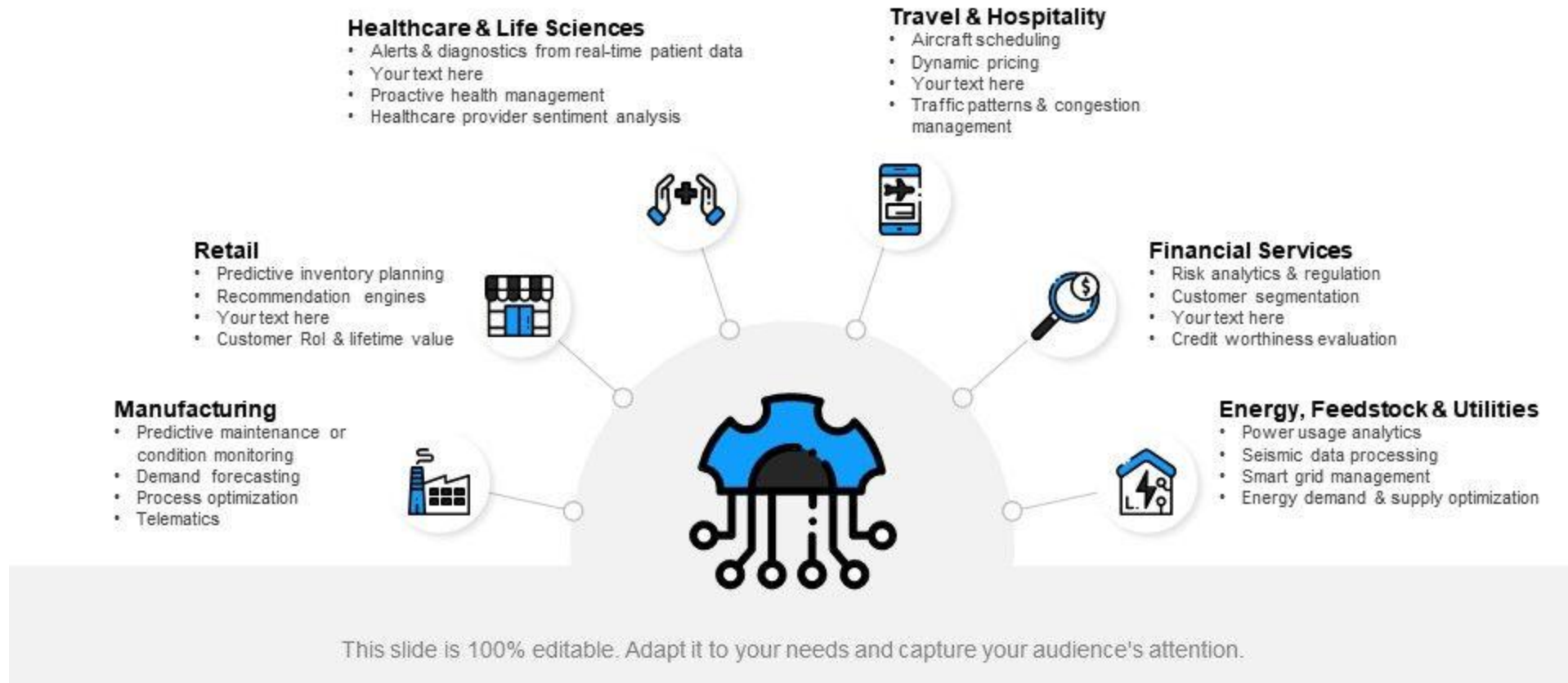
ML – 1980's => Machines Improve with Experience

AI – 1950's => Computers Mimic Human Intelligence

Alternative Data

- Bank, Checking, Employment, Income, Insurance, Tenant, Utilities
- Cash Flow Underwriting
- Consumption and Purchase Transactional Data
- App Usage, Browsing History, Email Receipt, Geolocation, Social Media Data,
- Educational Background, Employer, Occupation, Work History

Machine Learning Use Cases



Natural Language Possessing[1]

- Computer Input, Interpretation and Output of Human Language
- Natural Language Understanding and Natural Language Generation
- Audio, Image, Text and Video including Spoken, Written or Gestured
- Content Generation, Content Summarization, Information Retrieval, Intent Parsing, Sentiment Analysis, Speech Generation, Speech Recognition and Translation
- Chatbots, Conversational Interfaces and Voice Assistants

AI, Big Data and Machine Learning

Financial Stability Board

- ‘The application of computational tools to address tasks traditionally requiring human sophistication is broadly termed **artificial intelligence**’
- “**Big data**’ is a term for which there is no single, consistent definition, but the term is used broadly to describe the storage and analysis of large and/or complicated data sets using a variety of techniques including AI.’
- **Machine learning** may be defined as a method of designing a sequence of actions to solve a problem, known as algorithms, which optimise automatically through experience and with limited or no human intervention.’

Customer Interface[2]

Chatbots, CI & Voice Assistants (2010s)

Open APIs (2000s) & Open Banking (2015)

Contactless & Cardless Systems (2000s) >

Mobile Payments (2000s) & Wallets (2008) >

Internet (1990s) & On-line Banking (1990s - 2000s) >

Automatic Teller Machines (1970s) >

Credit Cards (1940 – 50s) & Point of Sale Systems (1980s) >

Mortgage Brokerage (1890s) & Automobile Indirect Lenders (1910s) >

Electronic Payments (1870s), Wires (1910s), ACH (1970s) & Direct Deposits (1970s) >

Checks (800s), Negotiable Checks (1500s), & Preprinted Checks (1760s) >

Banking - Tents, Temples, Bricks & Mortar (4th – 1st millennium BCE) >

Funding & Risk Management [2]

ML Based Underwriting (2010s) >

Peer to Peer Lending (2005) >

Credit Default Swaps (1990s) >

Asset Backed Securitizations (1970s – 90s) >

Interest Rate Futures (1970s) & Interest Rate Swaps (1980s) >

Consumer Credit Scoring (1960s) & FICO Scores (1990s) >

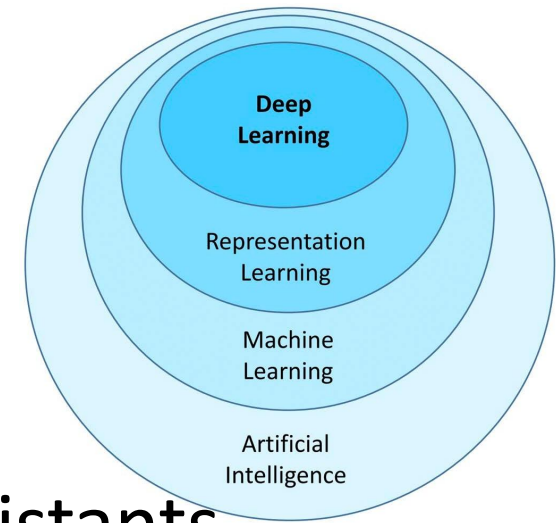
Consumer Finance Companies & Warehouse Lines of Credit (1920s) >

Private (1880s, 1950s), Government (1930s) & GSEs (1930s) Mortgage Insurance >

Bankruptcy & Secured Lending Laws, Loan Servicing & Collection Agents (Days of old) >

Bank Deposits - (Antiquity) >

AI and Machine Learning – Finance[2]



- Asset Management
- Call Centers, Chatbots, Robo-Advising & Virtual Assistants
- Credit & Insurance - Allocation, Extension, Pricing & Scoring
- Fraud Detection & Prevention
- Regulatory – Anti Money Laundering, Anti Manipulation
- Risk Management & Underwriting
- Robotic Process Automation
- Trading

AI use cases

Criteria

| Criteria | Further detail | Scale |
|-------------|---|---|
| Impact | <ul style="list-style-type: none">- Will it disrupt/change in the industry? (+)- Can it be applied in other industries? (+)- Are the big players in the industry interested in implementing it? (+)- Will it create cost savings for the company? (+) | 0-4 |
| Feasibility | <ul style="list-style-type: none">- Is there technology for the idea to be implemented? (+)- Are there regulatory or ethical roadblocks? (-)- Is the technology development in a boom phase? (+)- Data feasibility – availability of data and ease of access to it (+) | 0-4 |
| Time | <ul style="list-style-type: none">- Do we see it starting to appear now?- Is it a theory in development/ model in progress?- Is it a technology already in used but underused- Is it too far in the future/ relying on technological developments? | Short Term: 0 – 3 yrs Medium Term: 4 – 5 yrs Long Term: 6 + yrs |

AI use cases

Insurance - Overview of use cases

| Proposition | Company name | Impact | Feasibility | Final score | Time |
|---------------------------------|--------------------|--------|-------------|-------------|--------|
| 1. Internet of Things | Concirrus | 2 | 2 | 4 | Medium |
| 2. AI Subsound Technology | Cocoon | 4 | 4 | 8 | Short |
| 3. Real-time data analytics | MetLife Xcelerate | 3 | 2 | 5 | Short |
| 4. Machine learning | RiskGenius | 2 | 1 | 3 | Medium |
| 5. Open Source Machine Learning | Zurich Insurance | 2 | 3 | 5 | Long |
| 6. Automating processes | Genworth Financial | 3 | 3 | 6 | Short |

More detail in appendix

AI use cases

Use Case Impact - AI Subsound Technology

Cocoon is an InsurTech start-up that combines advanced Machine Learning with Internet of Things in a home security device



Short Term Impact

- Changes are beginning to occur as InsurTech partners with open-minded incumbents

Medium Term Impact

- For customers, IoT devices will reduce premiums and improve their customer service

Long Term Impact

- As IoT provides the data, Machine Learning will then extract the actionable insight for insurers

AI use cases

Banking & Capital Markets - Overview of use cases

| Proposition | Company name | Impact | Feasibility | Final score | Time |
|---------------------------------|---------------|--------|-------------|-------------|--------|
| 1. Fraud detection | IBM | 3 | 4 | 7 | Short |
| 2. Credit decisioning | Logical Glue | 2 | 2 | 4 | Medium |
| 3. Fraud Hub for Gaming | Feature Space | 4 | 3 | 7 | Short |
| 4. Financial market predictions | Kensho | 4 | 4 | 8 | Short |
| 5. High frequency trading | RenTech | 3 | 2 | 5 | Long |

More detail in appendix

AI use cases

Use Case Impact - Kensho

Partnered with CNBC, which is running a new series called #AskKensho

Provides the tools to powerhouse investment banks to compete with the “quants” that have taken over the business for the last decade

Long Term

Creating new business lines in emerging sectors such as the commercialisation of space, autonomous vehicles and wearable technologies.

Medium Term

Making this technology more accessible to the masses.

Short Term

Seeking to replace equity analysts and thus generating significant cost cutting for firms.

KENSHO



AI in Financial Services

Prepared for EY
FinTech team



AI use cases

Wealth & Asset Management - Overview of use cases

| Proposition | Company name | Impact | Feasibility | Final score | Time |
|--------------------------------|---|--------|-------------|-------------|--------|
| 1. Natural Language Processing | Avlien | 3 | 3 | 6 | Short |
| 2. Sentiment Analysis | Sensai, Sentifi, Running Alpha, Amareos | 2 | 3 | 5 | Short |
| 3. Clusters in real-time | AbleMarkets, AlgoDynamics | 2 | 2 | 4 | Medium |
| 4. Predictive analytics | Aidyia, hiHedge, FNA platform | 4 | 3 | 7 | Medium |

More detail in appendix

AI use cases

Use Case impact - Aidyia

Aidyia has been developing AI-driven strategies based on deep learning for years. It demonstrates the ultra application of machine learning and may change the whole market completely.



Short Term

Decreases risks and costs for fund managers

Medium Term

Brings differentiated market position with unbiased methodology and better performance

Long Term

Changes the Asset Management Industry completely as the amount of assets managed by AI increases

AI use cases

Short, Medium and Long-Term Impact

| Short-Term | Medium-Term | Long-Term |
|---|--|--|
| <ul style="list-style-type: none">• Fraud detection, Anomaly Detection, Pattern Recognition, Natural Language Processing become the norm• Rise of RegTech• Increased demand for data science talent | <ul style="list-style-type: none">• Predictive Analytics – Tailored customer service• High Frequency Trading will be completely automated• Change management systems – how to prepare for an Intelligent Agent | <ul style="list-style-type: none">• Displacement of Jobs – even non-routine and cognitive roles• Physical presence on the high street will become obsolete• Restructuring of business models |

MACHINE LEARNING AS A SOLUTION

MACHINE LEARNING OFFERS SOLUTIONS TO SOME OF THE MOST IMPORTANT CHALLENGES FACED BY THE BANKING SECTOR TODAY.

Customer Segmentation

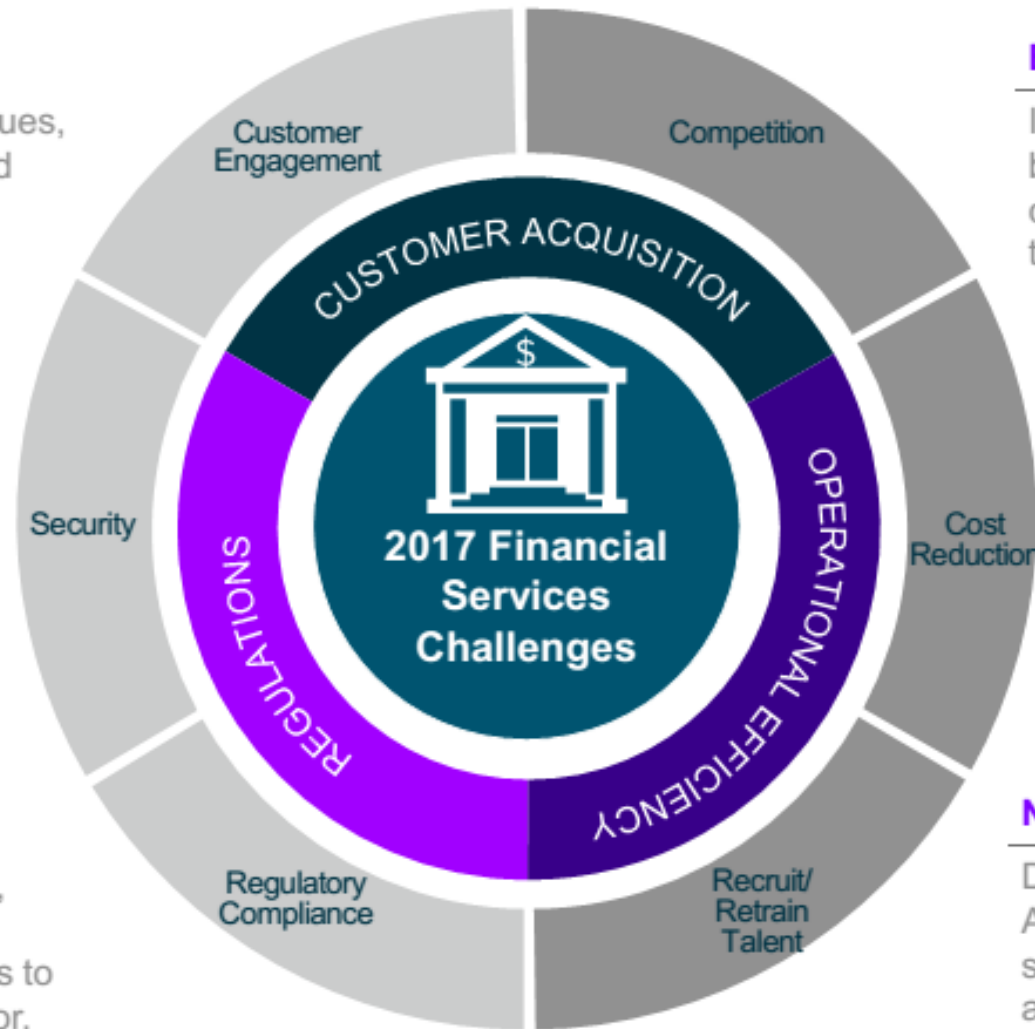
Through unsupervised learning techniques, banks can segment their customers and offer a personalised, targeted product offering.

Fraud & AML Detection

Machine Learning offers significantly improved fraud, AML (Anti-Money Laundering) and credit risk detection possibilities.

Compliance

Compliance through automated reports, stress testing solutions, and behavioral analysis of emails and phone recordings to determine suspicious employee behavior.



Big Data & Agility

Investment in Machine Learning offers banks the speed and agility they need to compete with tech-savvy Fintech firms and to make use of Big Data.

Cognitive Automation

Combined with Robotics, Machine Learning offers the ultimate automation potential with many back office risk, finance and regulatory reporting processes contenders for automation.

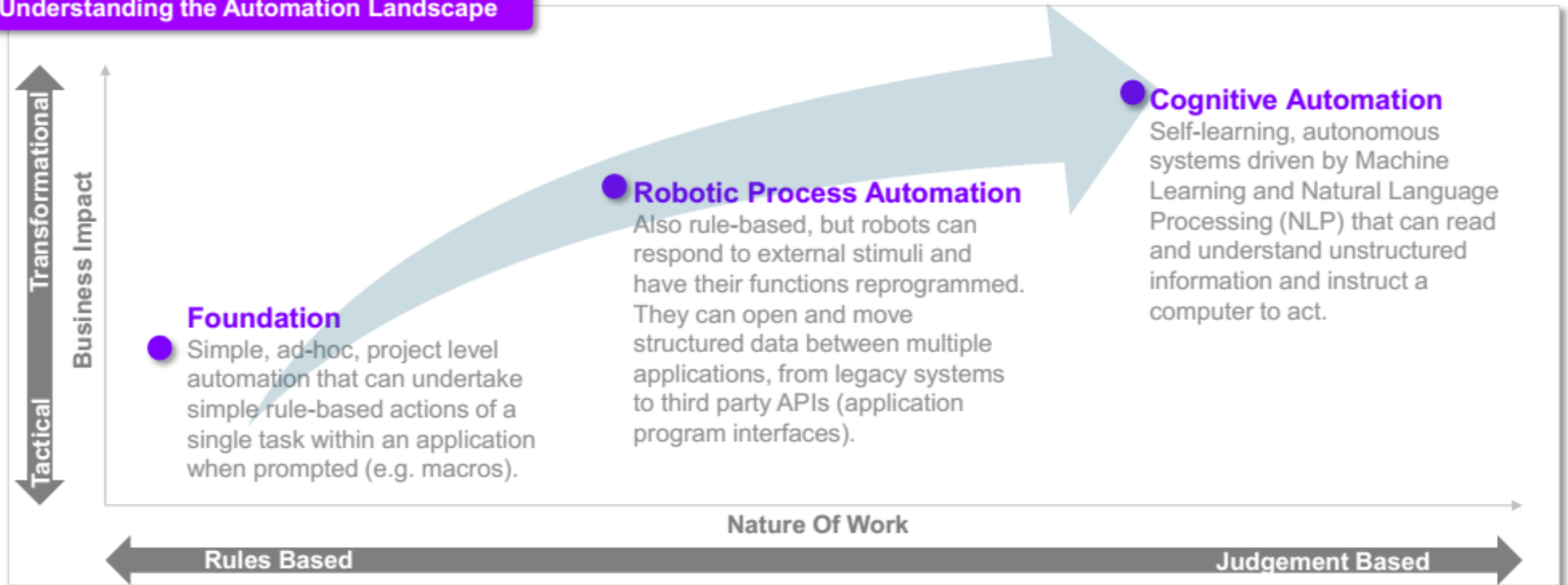
Natural Language Processing

Digital skills are in short supply in FS. Algorithms can evaluate CVs of successful employees and search for and identify online candidates with similar traits and experience.

COGNITIVE AUTOMATION (1/2)

MOST BANKS HAVE GROWN ORGANICALLY, MEANING THEY HAVE A WEB OF OVERLY COMPLEX PROCEDURES BUILT ON MULTIPLE LEGACY PLATFORMS. DEVELOPMENTS IN ROBOTICS AND MACHINE LEARNING MEAN AUTOMATION OF THESE PROCESSES IS NOW MORE FEASIBLE AND POWERFUL THAN EVER.

Understanding the Automation Landscape



COGNITIVE AUTOMATION (2/2)

ACCORDING TO A 2013 STUDY BY OXFORD ACADEMICS, ABOUT 54% OF FINANCIAL INDUSTRY JOBS ARE AT HIGH RISK OF BEING AUTOMATED.¹ COGNITIVE AUTOMATION HAS THE POWER TO AUTOMATE MANY F&R PROCESSES, IN PARTICULAR RISK AND REGULATORY REPORTING.

Cognitive Automation In Action – Document Processing Example







- **Robotics can be thought of as the ‘hand’ work and cognitive the ‘head’ work** – together they form a powerful alliance and can automate even those processes that involve comprehending unstructured text or recognising voices, and making subjective decisions
- Benefits of cognitive automation include:
 - ✓ Reduce headcount and associated operational costs
 - ✓ Decreased cycle times for processes that can operate 24 hours per day (e.g. risk/regulatory reporting)
 - ✓ Improved accuracy – reduction of human error

1. "Which finance jobs are safe from robots and automation?". Silicon Angle, May 31., 2016. Access at: <http://siliconangle.com/blog/2016/05/31/which-finance-jobs-are-safe-from-robots-and-automation/>

DEEP DIVE 1: FRAUD DETECTION

FRAUD COSTS THE FINANCIAL INDUSTRY \$80BN PER YEAR.¹ WITH REGULATIONS EVOLVING IN RESPONSE TO THE FINANCIAL CRISIS, AND TECHNOLOGY DEVELOPING AT AN EXPONENTIAL RATE, BANKS SHOULD INVEST IN THE LATEST SOFTWARE TO REDUCE THEIR EXPOSURE TO RISK.

Credit Card Fraud Detection Scenario

| |  Method |  Human Involvement |  Speed |  Accuracy | |
|------------------------------|---|--|---|--|--|
| Traditional Detection | <ul style="list-style-type: none"> Rely on pattern matching against recognised past fraud types. Transactions then assessed based on general rules, such as whether the customer is buying abroad. Humans to identify trends and manually update their models to account for changes in fraudulent activity. | <ul style="list-style-type: none"> High Requires significant manual analysis and review, with regular updates to fraud systems. | <ul style="list-style-type: none"> Medium More human involvement, often using audit trails to identify fraud. Less computing power. | <ul style="list-style-type: none"> Medium Often corrective over preventive with limited use of data, meaning lower detection success rates. | <div style="border: 1px solid gray; padding: 10px;"> Machine Learning Summary <ul style="list-style-type: none"> ✓ Lower fraud losses ✓ Lower operational costs ✓ Improved customer service ✓ Reduced reputational risk ✓ Reduced regulatory risk </div> |
| Machine Learning | <ul style="list-style-type: none"> Algorithms analyse historical transaction data for each customer to understand their individual spending patterns. They can therefore spot subtle anomalies that indicate fraud. Algorithms self-learn, meaning they quickly adapt to new means of fraud, and can stay ahead of fraudsters. | <ul style="list-style-type: none"> Low Automatic -humans to maintain the algorithmic models. | <ul style="list-style-type: none"> High Real-time, automatic reviews of transactions using vast amounts of data from multiple sources. | <ul style="list-style-type: none"> High Preventive over corrective, meaning higher rates of fraud detection and fewer false alarms. | |

1. "Using machine learning and stream computing to detect financial fraud," IBM Research. Access at: <https://www.research.ibm.com/foiling-financial-fraud.shtml>

DEEP DIVE 2: CREDIT RISK

MACHINE LEARNING ALLOWS FOR PROACTIVE RISK MANAGEMENT, REDUCING EXPOSURE TO CREDIT RISK WHILST ALSO OFFERING A FASTER, MORE EFFICIENT PROCESS TO CUSTOMERS.

Virtual Advisors

Virtual advisors can understand customer questions and instantly provide well-informed responses, improving customer service levels.

Robotics & Cognitive Automation

Automation of labour intensive processes, e.g. risk, finance and regulatory reports, to cut costs and improve speed of output.

Early Warning System (EWS)

A machine learning-enhanced EWS allows automated reporting, portfolio monitoring, and recommendations for potential actions, including an improved approach for each case in workout and recovery.



Stress Testing

Supervised learning algorithms learn from past events in a data-driven manner. They can incorporate vast amounts of internal and external information to more accurately predict potential scenarios, allowing for better risk planning.

Credit Default Prediction

- More accurate, instant credit default likelihood prediction based on both quantitative and qualitative data.
- Removes requirement for manual fact checking, approvals and complex workflows.
- Real time credit decisions could allow for instant, self-service credit applications.

DEEP DIVE 3: TRADING FLOORS

THE AUTOMATION OF INVESTMENT ADVICE AND TRADES UTILISING A VAST ARRAY OF INTERNAL AND EXTERNAL DATA HAS ABILITY TO SIGNIFICANTLY IMPROVE PERFORMANCE ON TRADING FLOORS AND CUT OPERATING COSTS

Compliance

- Undertake behavioral analysis by reviewing trade activity for each employee alongside mining chat-logs and emails to identify suspicious activity.
- Continuous and real-time, resulting in the ability to prevent non-compliant activity.

Performance

- Algorithms autonomously evolve and search for new patterns in data, making real-time high-frequency trading decisions to exploit volatility in stock.
- Ability to utilise external data such as stock prices, Google™ searches and news articles to strengthen pre-trade predictions.



Automated Trades

- Deal orders, execution and settlement of trades and the analysis and monitoring of risk automated, significantly reducing costs.

Robo-Advisors

- Provide algorithm-based portfolio management advice without the requirement for financial planners.
- Anticipate changing investments needs as client circumstances change, improving customer service levels.

The Opportunities We See:

- ✓ Automated Investments – Cost Saving
- ✓ Improved Investment Decisions
- ✓ Enhanced Operational Speed and Accuracy

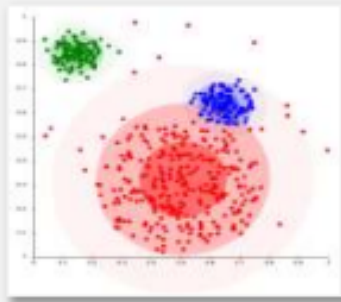
- ✓ Lower Compliance Risk
- ✓ Enhanced Customer Experience

- ✓ Navigation of Large Amounts of Data
- ✓ Reduction in Human Error

DEEP DIVE 4: FRONT OFFICE

UNSUPERVISED AND SUPERVISED LEARNING TECHNIQUES ALLOW BANKS TO TRULY UNDERSTAND THEIR CUSTOMERS AND PROVIDE THEM WITH A PERSONALISED SERVICE WITH TARGETED PRODUCT OFFERINGS.

Customer Segmentation



- Through cluster analysis, an unsupervised learning technique, banks can discover distinct groups in their customer base and see similarities over several dimensions.
- Unlike supervised learning, they do not need to define what characteristics the computer should be looking for.
- This way, banks can segment in ways traditional analytics would not allow.

Product Targeting



- Customer segmentation discoveries can be used to build predictive, supervised models.
- Algorithms produce personalised views of the most suitable products for each customer, helpful for cross-selling and up-selling.
- Since algorithms learn, they recognise changes in customer preferences in real-time and therefore automatically adjust product recommendations.

Benefits



- Personalised, improved customer offerings.
- Speed of service - banks recognise change in behavior and respond in a timely manner.
- Revenue can increase from successful identification of cross-sell and up-sell opportunities.
- Automated – reduced human involvement.

Natural Language Processing – Finance[1]

- Customer Services
 - Chatbots, Conversational Interfaces and Voice Assistants
- Process Automation
- Sentiment Analysis

Bank of America Erica



Hi, I am Erica.
See what I can do for you.



References

1. 'Artificial intelligence and machine learning in financial services'
Financial Stability Board (Executive Summary & Sections 1 - 3)
2. "[Deep Learning and Financial Stability](#)." Gensler, Gary and Lily Bailey,
MIT Sloan Working Paper 6223-20. Cambridge, MA: MIT Sloan School
of Management, November 2020. [SSRN Link](#).