

Expanding Roles of Artificial Intelligence and Machine Learning in Lending and Credit Risk Management

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AI/Machine Learning at Bank of America

Bank of America has partnered with Harvard University to form the “Council on the Responsible Use of AI” - focusing on the pace of innovation and how it could be deployed in a responsible manner across various domains.

Machine Learning and AI development spans a wide-range of applications, including:

- **Robotic Process Automation**– Intelligent automation solutions to reduce manual and repetitive tasks, e.g., credit financial spreading, interpreting legal documentation, among others
- **Supervised Learning** – Data mining and inference from training datasets, e.g., Credit Scoring, Algorithmic Trading, Fraud and Financial Crimes detection
- **Unsupervised Learning** – Draw inferences from data without labeled responses, e.g., Clustering analysis for geographic regions
- **Natural Language Processing** – Transform unstructured data (text/voice) into actionable insights, e.g., Bank’s virtual assistant Erica, Sentiment Analysis
- **Resources available at Bank of America** – Training, Community, and learning Hives for DataRobot, Python, R, Tableau and other tools used for Data Science/ ML

Artificial Intelligence

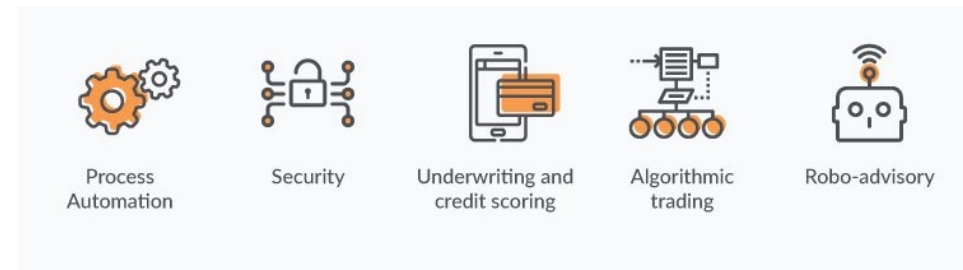
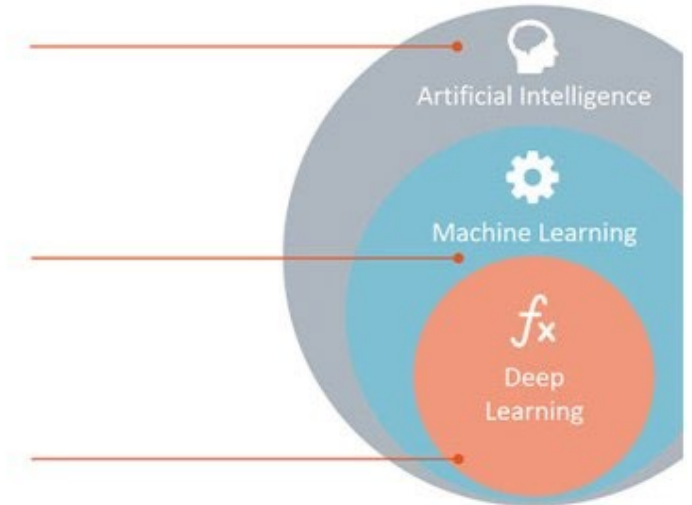
Any technique which enables computers to mimic human behavior.

Machine Learning

Subset of AI techniques which use statistical methods to enable machines to improve with experiences.

Deep Learning

Subset of ML which make the computation of multi-layer neural networks feasible.



C&I Lending



Can ML improve risk assessment?

Can AI be used to improve efficiency?

What are the risks and promises?

Retail Lending



Should we even try to emulate human loan decision-makers?

When is transparency necessary and/or desirable?

Are there areas of retail lending where AI/ML use is non-controversial?

Potential Benefits and Drawbacks of AI



Benefits

- Improving Efficiencies With AI:
- Improve risk assessments with AI:
- AI can enable better, faster decisions at scale
- Ability to process non-structured data

Drawbacks

- Generalizability?
- Robustness to data issues?
- Blackbox?

AI-Risk Analytics From Alternate Data



Yinyi Co Ltd ORG, a property developer in the Chinese NORP port city of Ningbo GPE, is the latest property developer to default on its bonds. Yinyi Co Ltd ORG said last week DATE that it could not pay to redeem the 300 million yuan MONEY (US\$43.62 million MONEY) due on bonds issued three years ago DATE because of short term liquidity problems.

Understand language, semantic context and meaning from alternate unstructured text data sources (previously not used)

Yinyi Co Ltd, a property developer in the Chinese port city of Ningbo, is the latest property **developer to default on its bonds**.

Yinyi said last week that it **could not pay to redeem the 300 million yuan (US\$43.62 million) due on bonds** issued three years ago because of **short term liquidity problems**.

The five-year bond had a put option allowing bondholders to request repayment at the end of the third year.

In an attempt to avoid early redemption, Yinyi sweetened the bond's annual coupon rate by 150 basis points to 8.78 per cent from 7.28 per cent, but investors still demanded that Yinyi repay their debts.

"If the company cannot properly resolve its overdue debt problems, it will **face further lawsuits, with bank accounts being frozen, assets frozen**, and may also need to **pay related default damages, late fees and penalties**," Yinyi said in a filing with the Shenzhen Stock Exchange, where it is listed.

"This will **affect the company's operations** and business, further **increase financial costs** and affect the company's performance for the current year."

Fuguiniao : SUSPENSION OF OFFICE OF INDEPENDENT NON-EXECUTIVE DIRECTOR



05/23/2017 | 08:26pm EDT

FUGUINIAO CO., LTD.

富貴鳥股份有限公司

(a joint stock company established in the People's Republic of China with limited liability)

(Stock Code: 1819) **SUSPENSION OF OFFICE OF INDEPENDENT NON-EXECUTIVE DIRECTOR**

The board (the "Board") of directors ("Director(s)") of Fuguiniao Co., Ltd. (the "Company") announces that the Board, having regard to the manner in which Chan Wah Man, Carman ("Ms. Chan") has been responding to the Company's efforts to resume trading in the shares of the Company on The Stock Exchange of Hong Kong Limited, considers that on balance, it is prudent and in the best interest of the Company **to suspend** and has resolved by a majority of votes **to suspend Ms. Chan from her office as an independent non-executive Director and a member of the audit committee of the Company** with immediate effect until such time as the Board considers appropriate. In reaching this decision, the Directors took into account that Ms. Chan **has not been exercising the reasonable care, skill and diligence expected of her as an independent non-executive director**, that Ms. Chan has been **unreasonably uncooperative** and has been unable to provide any constructive particulars to support and substantiate her views and has **failed to demonstrate that she is able to make decisions for the Company in an objective and timely manner** in the best interest of the Company.

By order of the Board of

Fuguiniao Co., Ltd. Lam Wo Ping

Chairman

Hong Kong, 23 May 2017

How will AI/ML Perform in a Recession?



Will an ML algorithm trained on the last recession be able to cope with the next one?

Could overuse of AI/ML cause a bubble/recession?

Cutting Room Floor

Introduction



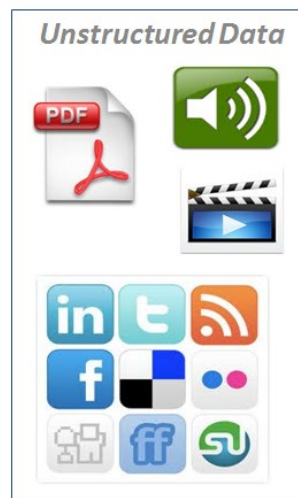
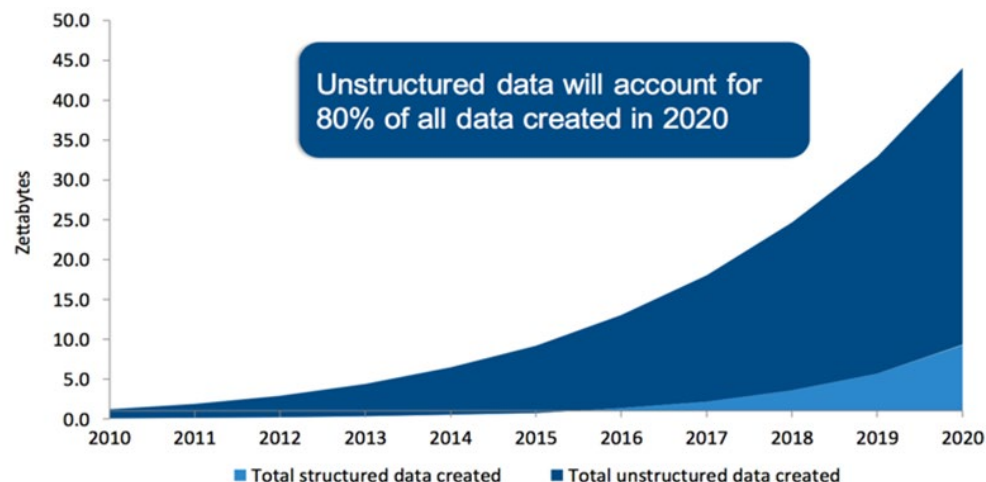
What is artificial intelligence?

What is machine learning?

AI-Enabled Analytics



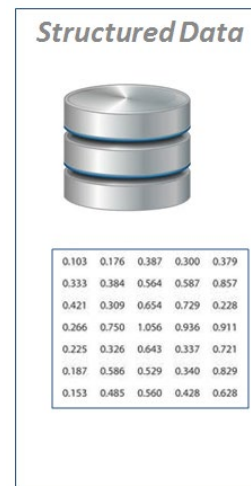
- » AI-ML that assist (& collaborate) with humans in decision-making
- » AI-ML tools provide new products, capabilities not possible before
 - *Extract new, timely, better knowledge, insights from alternate data sources (previously not used)*



Unstructured, Alternate, Multimodal Data with no machine-identifiable structure

AI models

AI-ML Solutions



Structured, Financial Data

Knowledge that fuels insights for better decision making

XYZ ARTS ORGANIZATION FINANCIAL STATEMENT - Accrual Method Fiscal Year July 1, 2004 - June 30, 2005		
Beginning Balance		\$ 52,004
Income:		
City Support	\$ 19,500	
County Support	\$ 2,000	
Tennessee Arts Commission	\$ 5,600	
Corporate Contributions	\$ 6,472	
Fees/Classes	\$ 39,828	
Gallery Sales	\$ 6,232	
Fund Raiser	\$ 7,847	
Interest	\$ 594	
Total Income	\$ 88,073	\$ 140,077
Expenses:		
Administrative/Staff	\$ 36,000	
Instructors/Performers/Artists	\$ 31,543	
Outside Services	\$ 2,005	
Utilities	\$ 5,322	
Postage/printing/supplies/insurance/etc.	\$ 7,364	
Gallery expenses	\$ 4,918	
Total Expenses	\$ 87,152	
Ending Balance		\$ 52,925

Risk Analytics: Potential Benefits of AI



Improving Efficiencies With AI:

- » Automate paper processes – digitization
- » Identify & extract relevant balance sheet info automatically

Improve risk assessments with AI:

- » Better data-driven models
- » Leverage Alternate data (more regular and timely)

AI can enable better, faster decisions at scale

- » Provide lending to underserved populations, SMEs

Risk Analytics: Potential Drawbacks of AI



Generalizable AI models:

- » Can AI models generalize across macro and micro-economic conditions
- » Can AI models be “tricked” by false data
 - » Active learning and adversarial training is key

Potential AI Biases:

- » Can AI overcome biases in the data

Explainable AI Models

- » Black-box models cannot be used under regulatory environments



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