Artificial Intelligence & Machine Learning in the Finance

About me:

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7+ years (IIM Nagpur, Goa Institute of Management, EDII Ahmedabad)

More than 15 international journals, American Accounting Association; Venture Capital,Multi-criteria Decision Analysis; IIM Indore, IIT Kharagpur; IIT Madras; MDI Gurgaon; Elsevier; Wiley, Emerald

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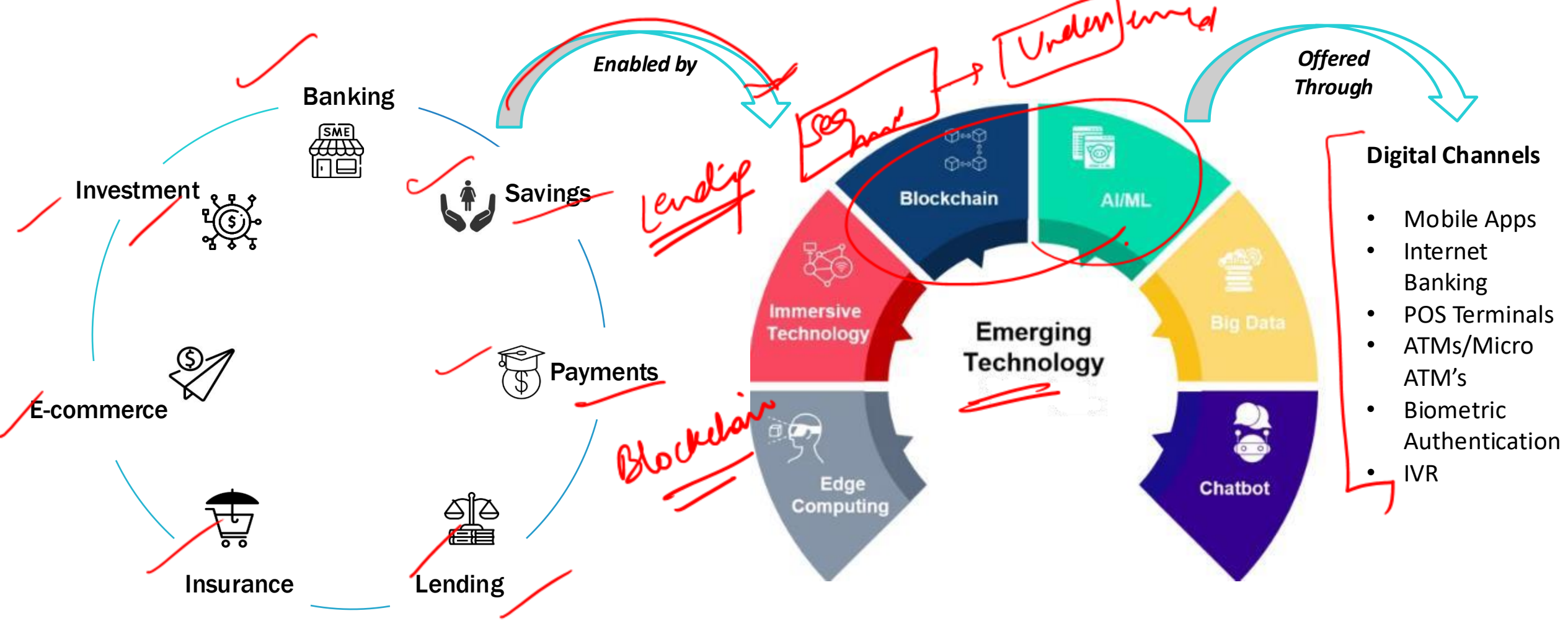
Motivation?

Have you ever used in Finance Space?

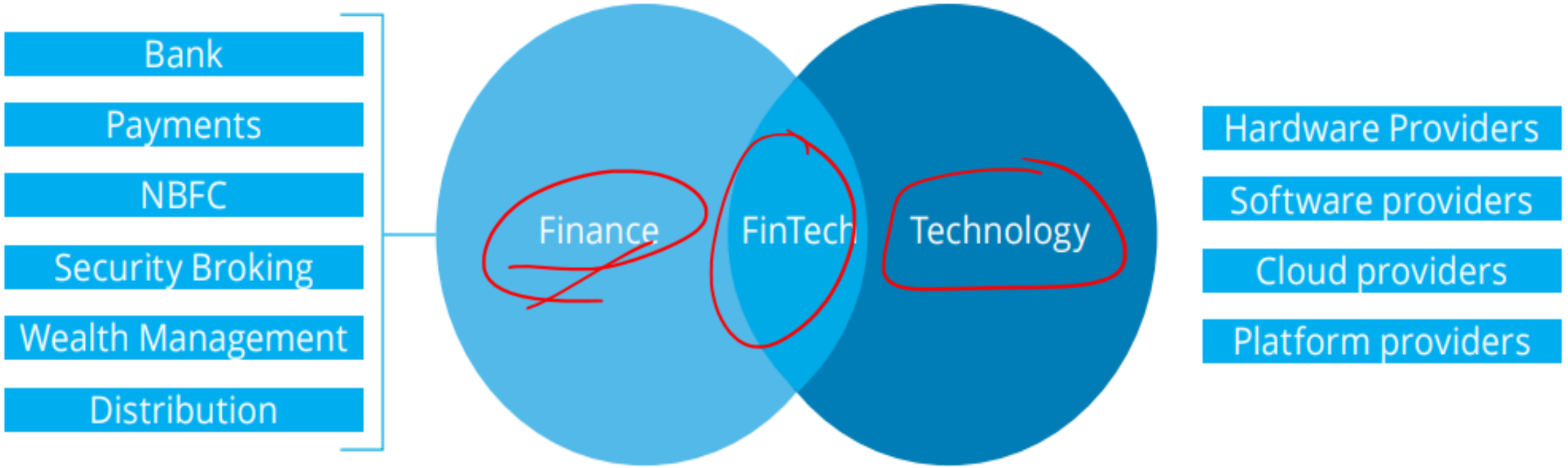
What are the Products/Services provided by Finance Companies?

Application of Technology in Finance - FINTECH

Fintech leverages digital platforms, technologies or infrastructure to provide access to various formal financial products and services providing us with both **opportunities** and **risks**.

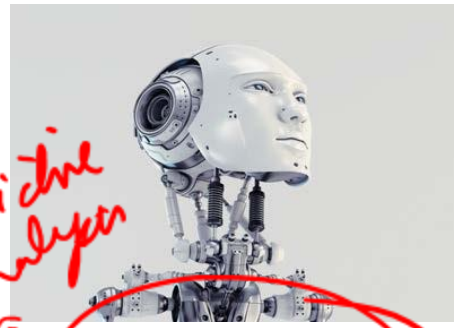


Aligning Finance & Technology



Source: Deloitte Internal Analysis

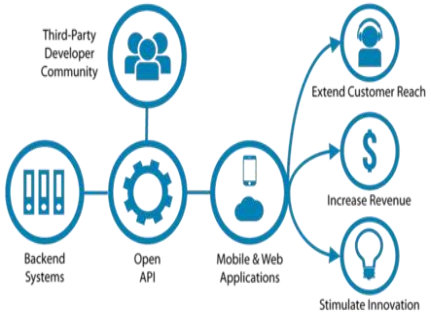
FinTech – Technologies of our Times



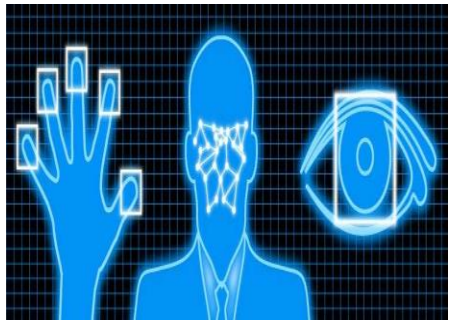
AI & ML

Blockchain

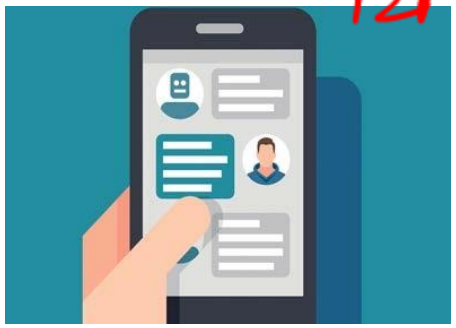
Natural Language Possessing



Open API



Biometrics

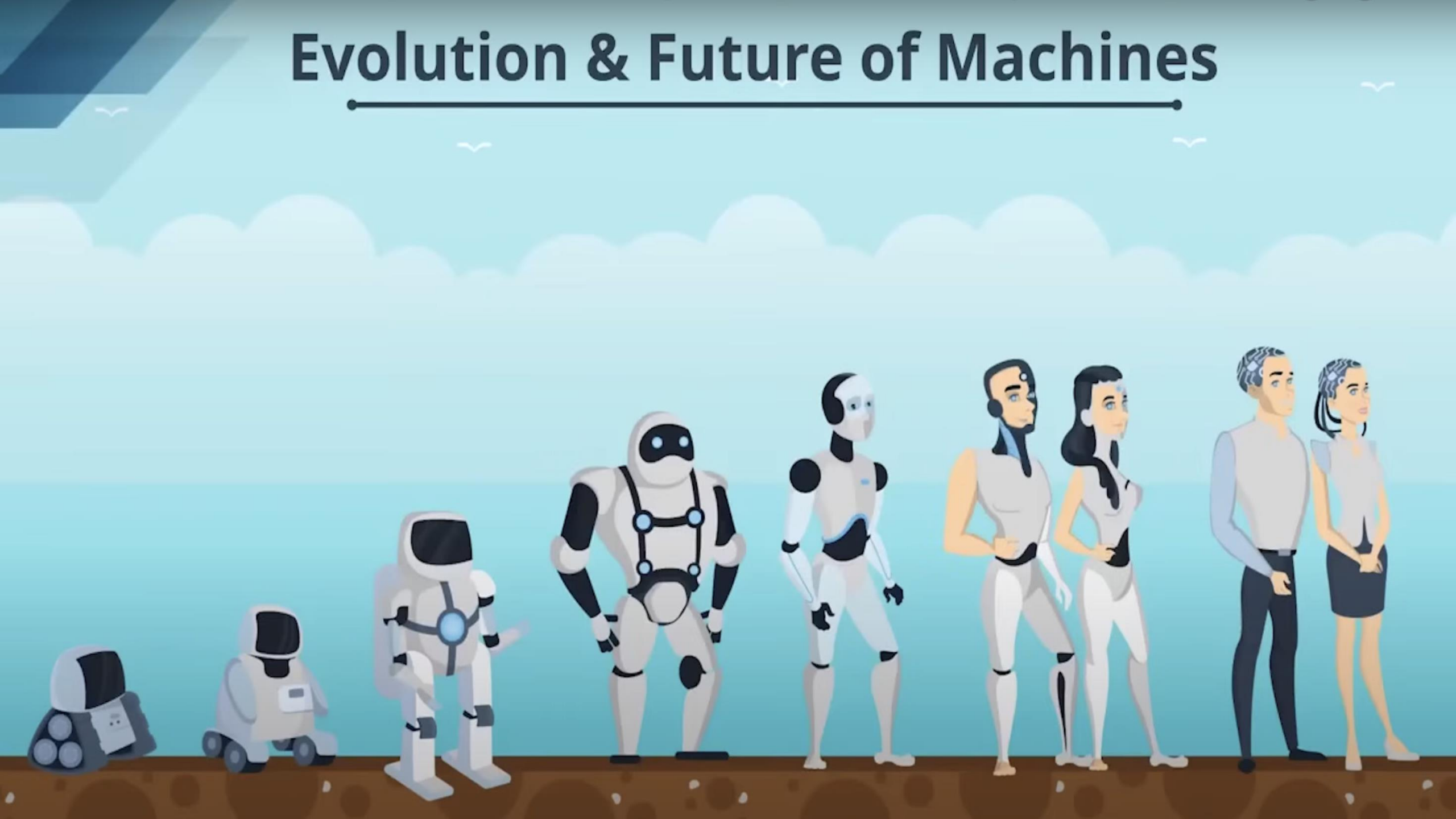


Chatbots

Cloud

Robotic Process Automation

Evolution & Future of Machines



Let’s define AI in the context of a task..

If a machine were to perform a task or process, would you consider the machine to possess intelligence?

AI can involve machine learning, natural language processing & knowledge representation

There are many applications of AI research in these areas

Why AI and ML?

- Autonomous vehicle captures – 1000 times content compared to human eye
- AI based algorithms **processes** and **acts** on this information in half the time compared to humans
- Potential to **automate** and **disrupt** transportation sector completely
- Analogy applies to finance

Why AI and ML

Reasons for Exponential Growth

Key AI/ML advantages

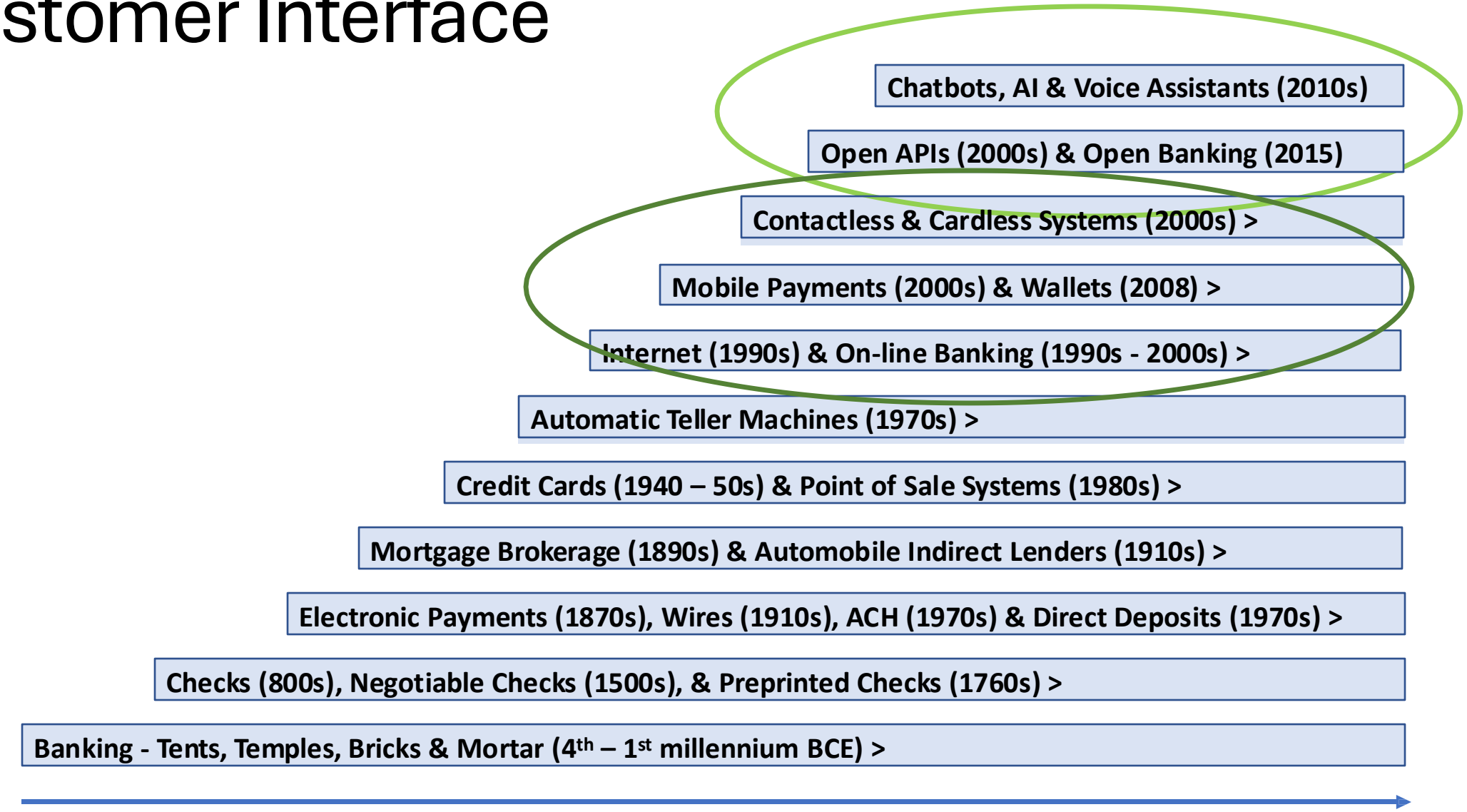
- AI/ML process high volume data, multi-dimentional, multi-variety data quickly
- Potential of increased automation and decreased costs

Recent Innovations

- Growth of data
- Affordable computing power
- Complex AI/ML algorithms and their easy implementation

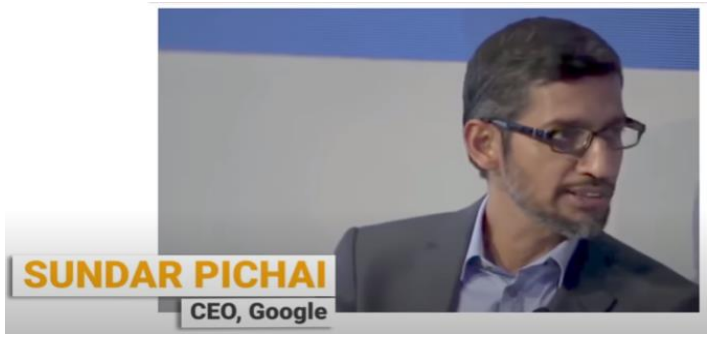
48% of companies already use AI in some capacity

Customer Interface



I . Introduction to AI

- AI is a branch of Science and assist machines to find solutions to complex problems in a more human-like fashion.
- Artificial Intelligence is the future of Next Generation Technology.
- It encompasses variety of disciplines like Medical, Finance, Engineering.



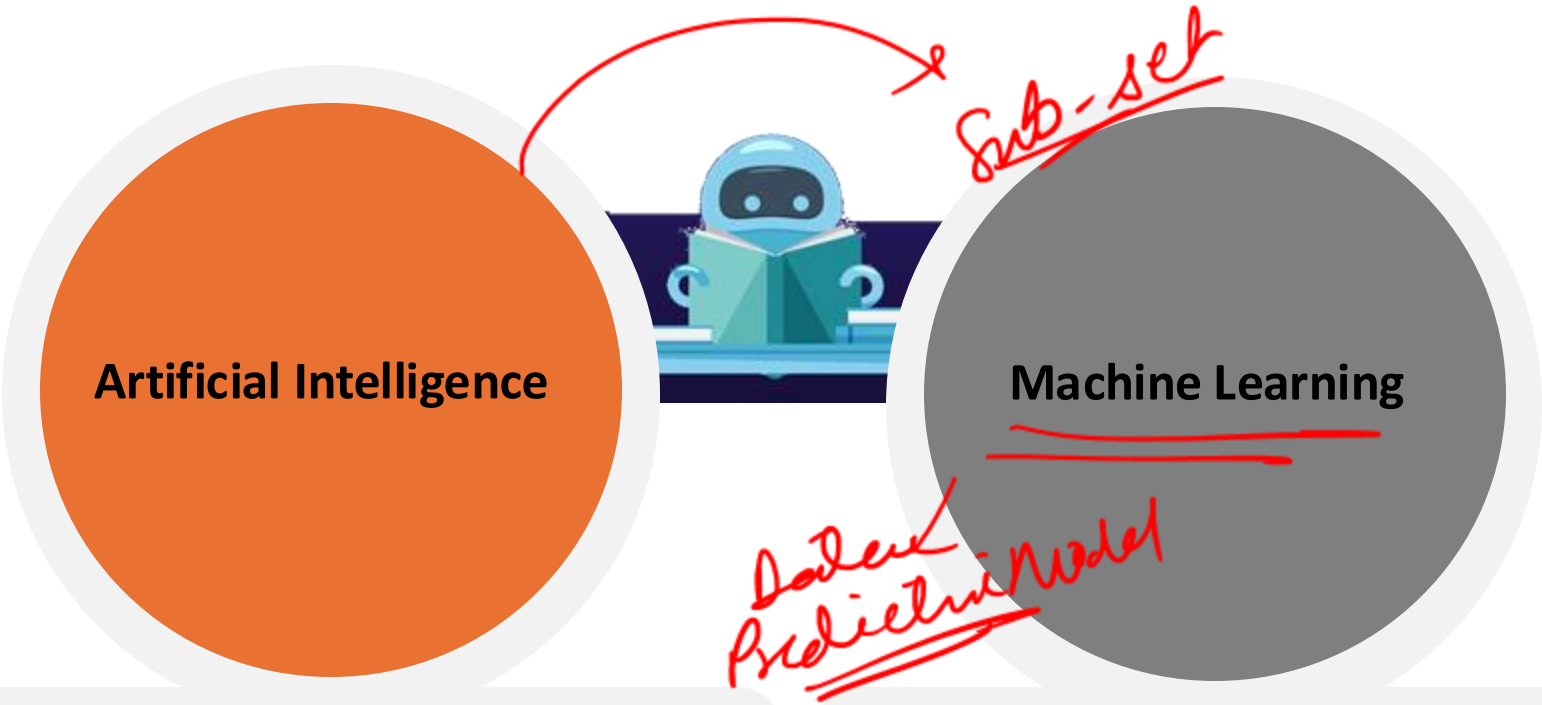
AI is the main tool behind new-age innovation and discoveries like driverless cars or disease detecting algorithm

Generalized AI is worth thinking about because it stretches our imaginations and it gets us to think about our core values and issues of choice

Artificial Intelligence will be ‘vastly smarter’ than any human and would overtake us by 2025.

We are now solving problems with machine learning and AI that were…in the realm of science fiction for the last several decades

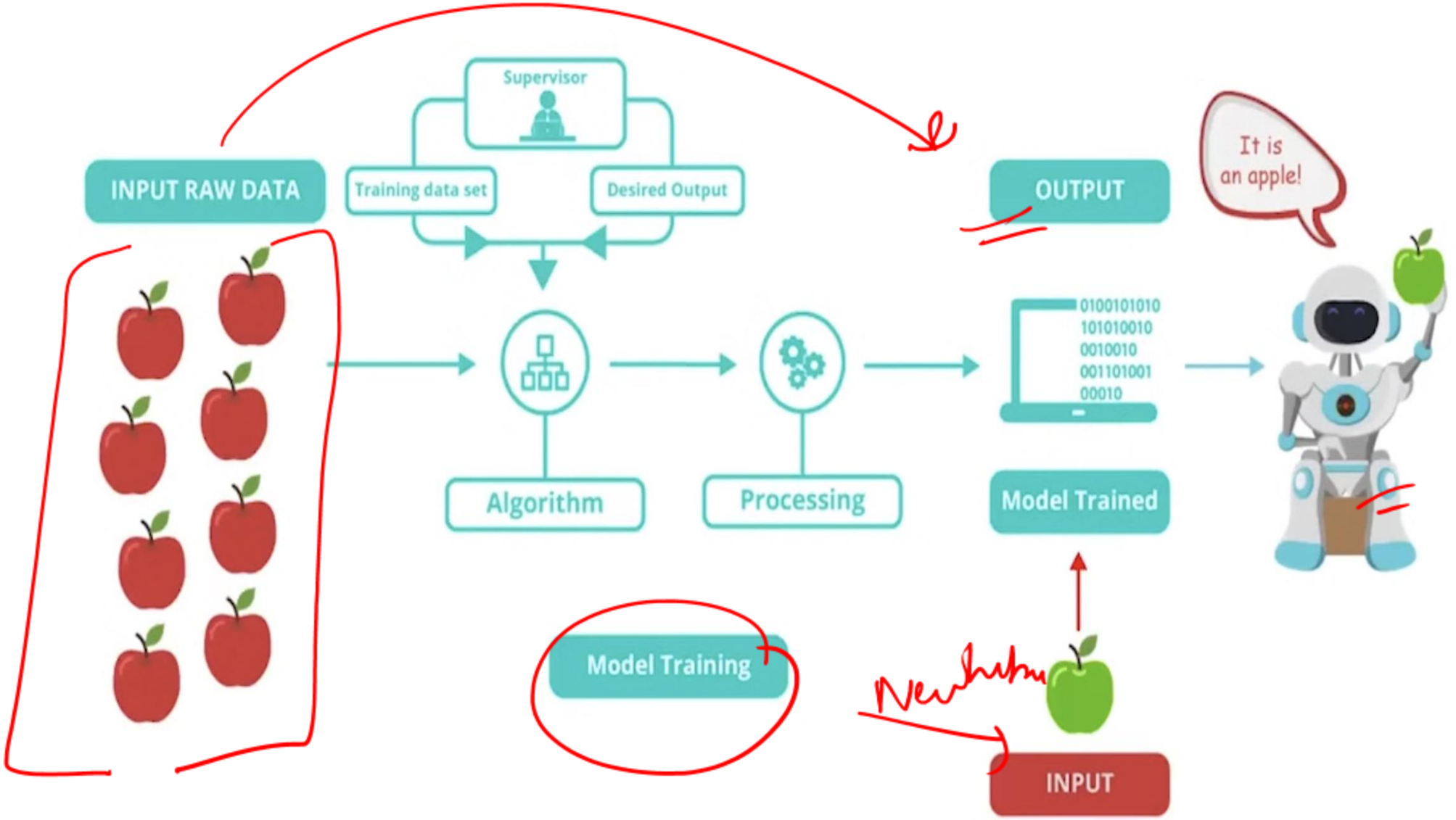
Artificial Intelligence and Machine Learning



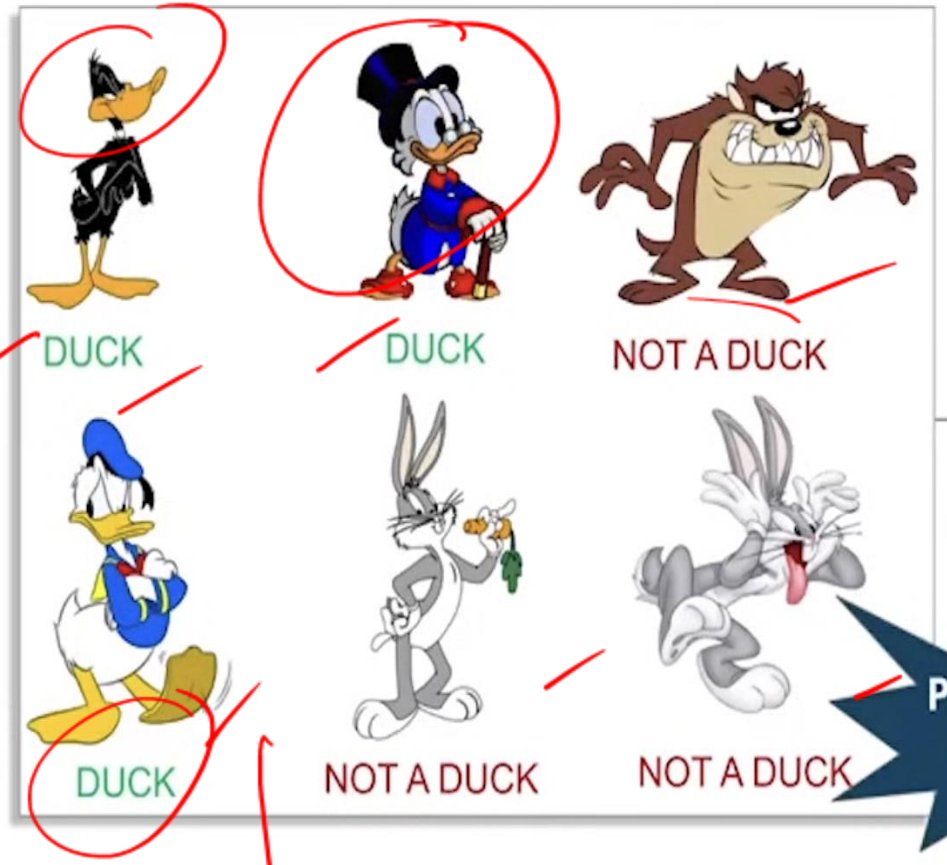
AI is trained final output machine which mimic like human brain
Ex: Amazon Alexa

ML is a subset of AI. It is a technique to achieve AI. Ex: Spam Detection

Machine Learning: Supervised



Supervised Learning Example



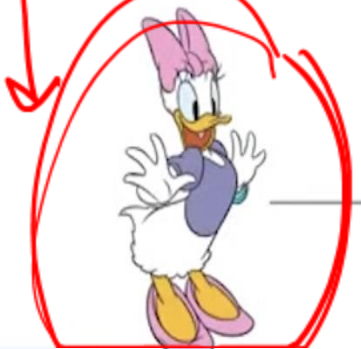
Predefined Dataset

Supervised Learning

Predictive Model

?

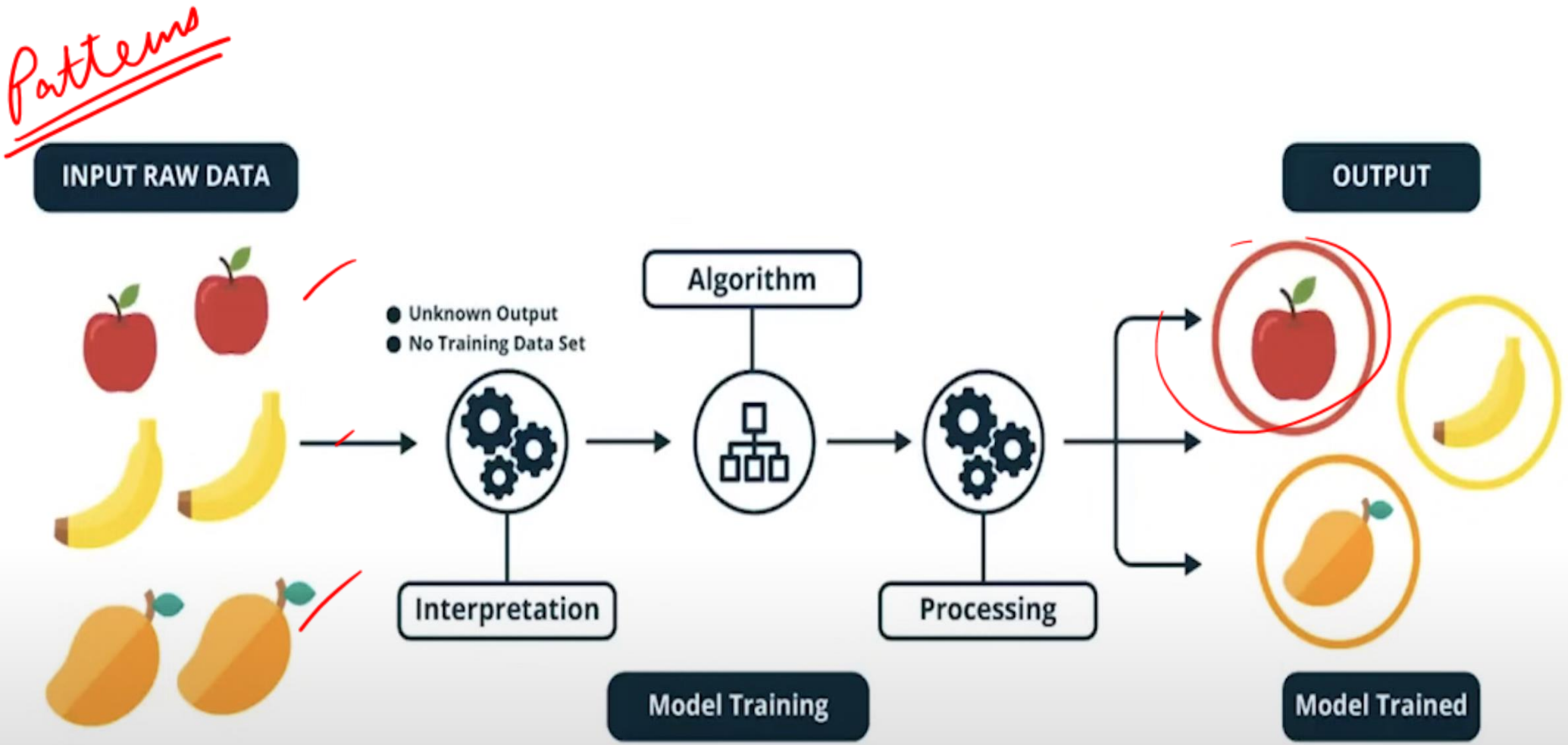
Duck



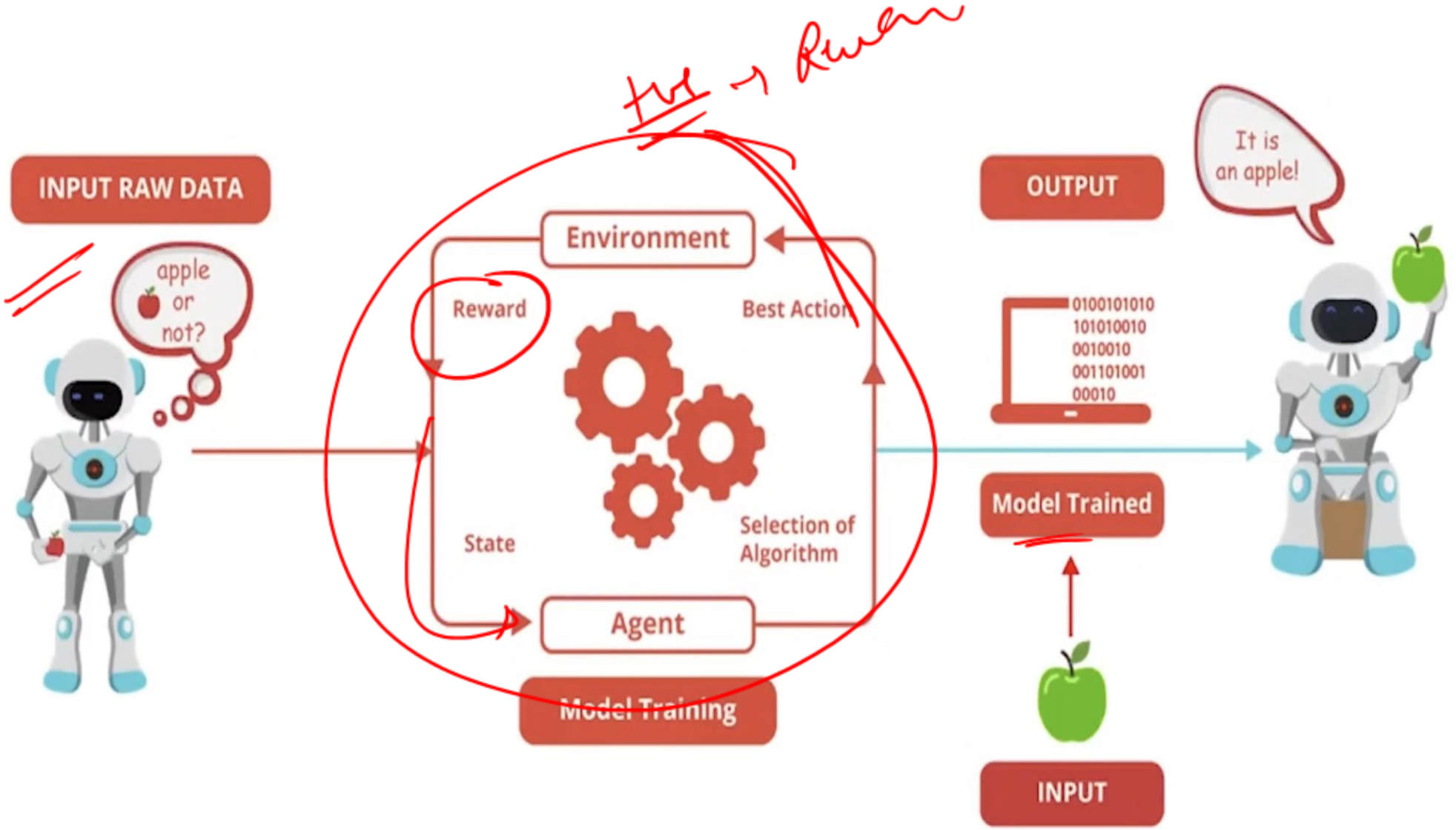
Predictive Model

Is a DUCK

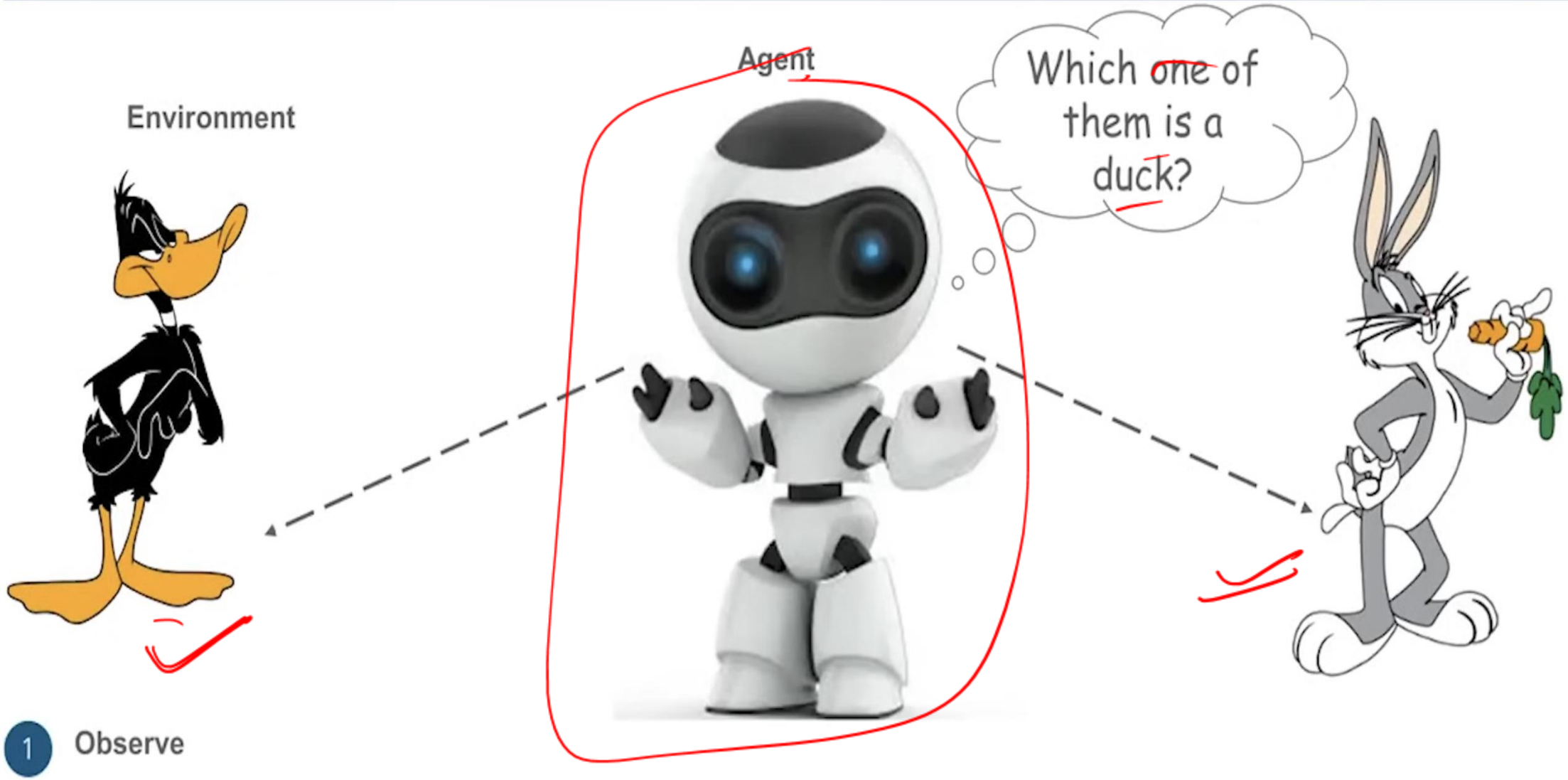
Machine Learning: Unsupervised



Machine Learning: Reinforcement

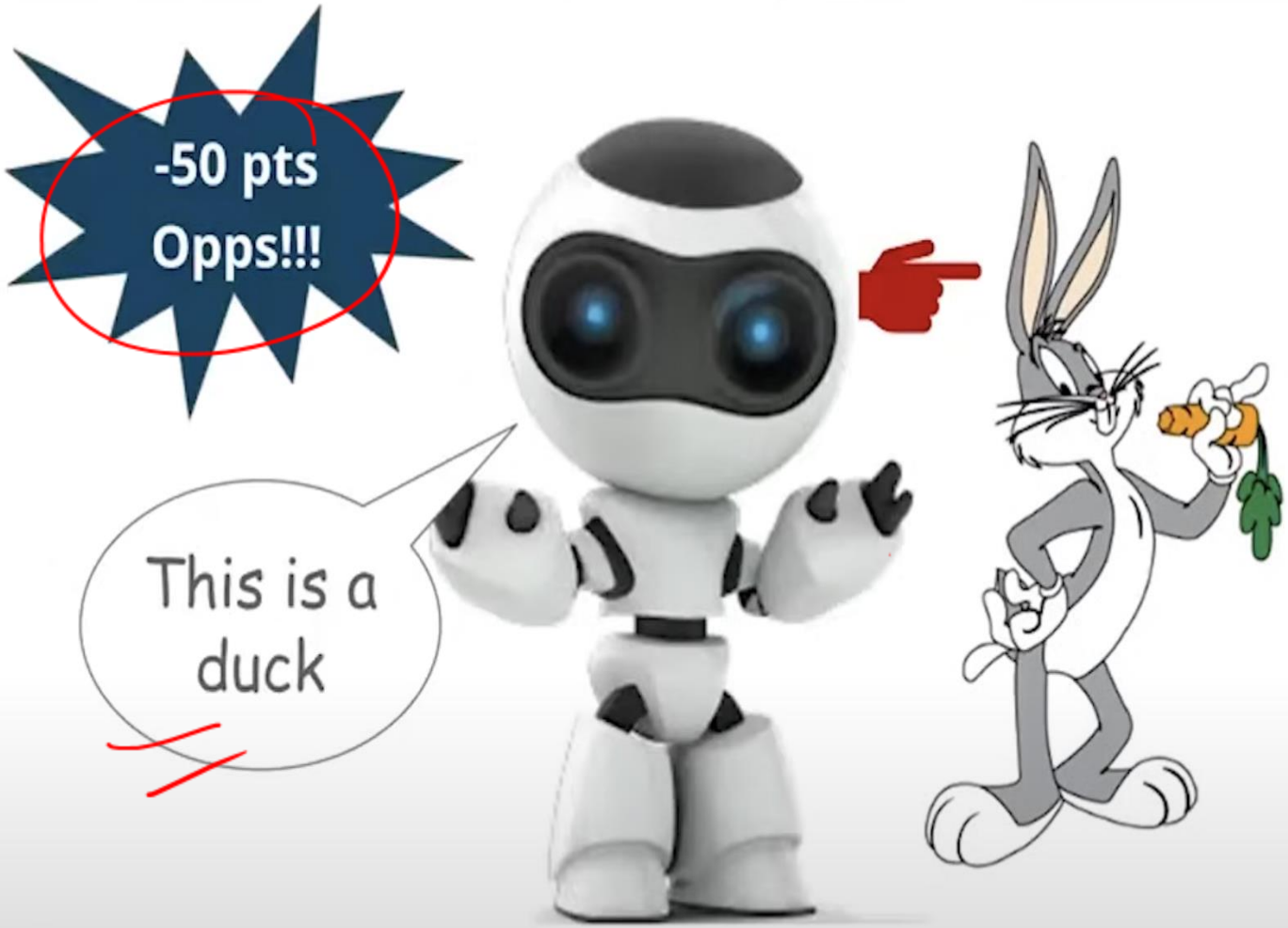


Machine Learning: Reinforcement



1. Observe
2. Select Action Using Policy

Machine Learning: Reinforcement

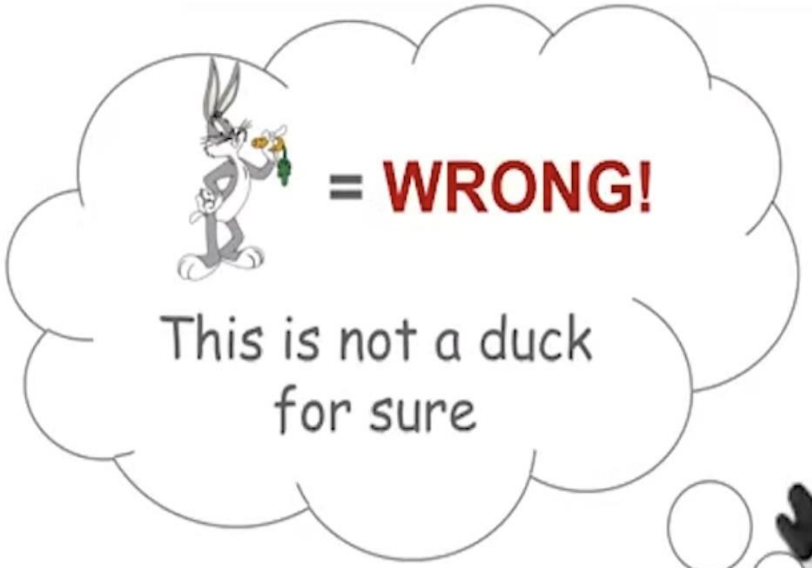


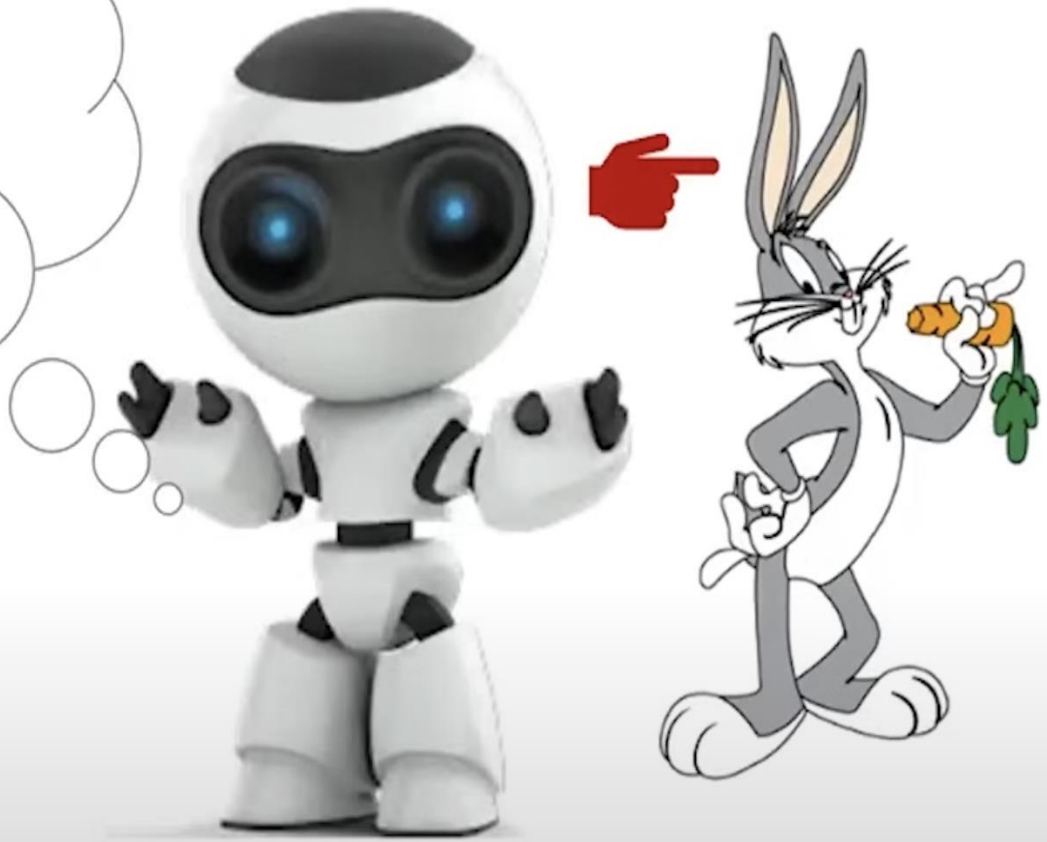
3. Action!

4. Get Reward or Penalty

Machine Learning: Reinforcement

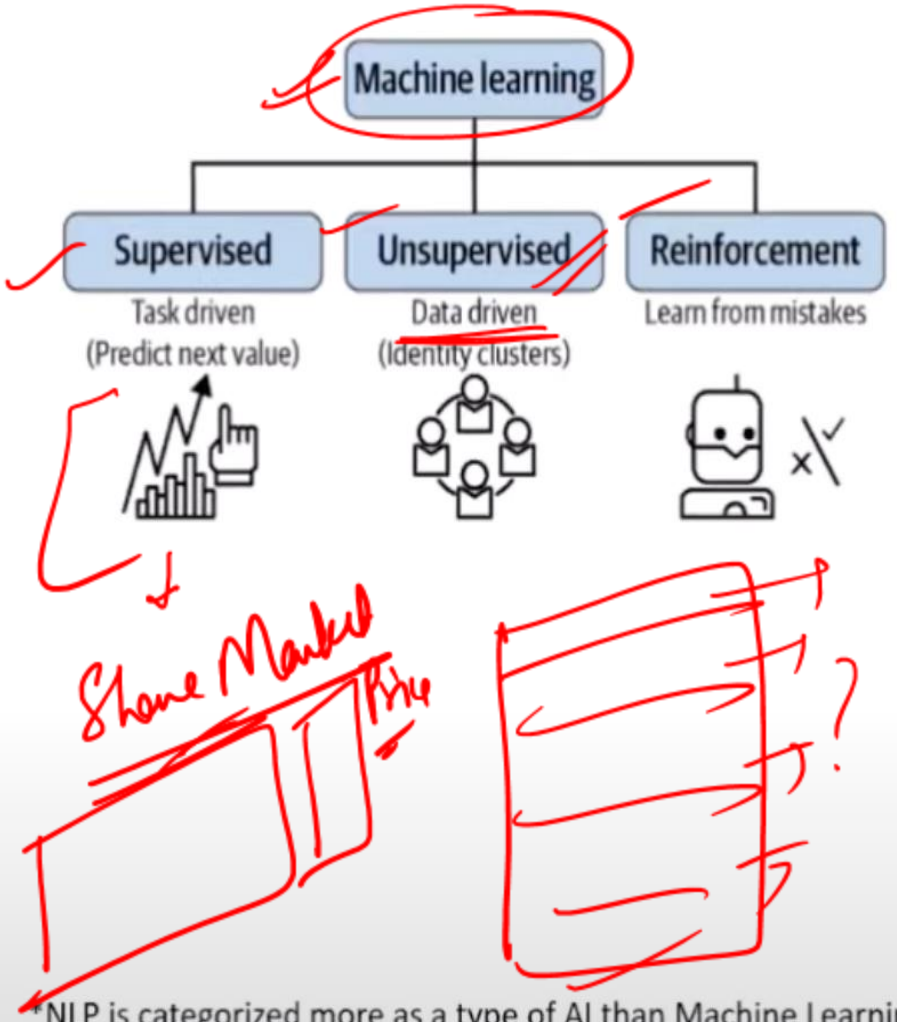
AI





5. Update Policy (learning step)
6. Iterate to get Optimal Policy

Machine Learning Types and related financial use cases



Supervised Learning: *labelled output*

- ❑ Classification : Categorized output
  - ➢ Financial use case: fraud detection, price go up or down, Credit Scoring.
- ❑ Regression : Continuous output
  - ➢ Financial use case: Price or return prediction, derivatives pricing

Unsupervised Learning: *learn patterns from unlabeled data*

- ❑ Dimensionality Reduction: transform data to low dimension
  - ➢ Financial use case: Reduce dimension, noise and redundancy
- ❑ Clustering: Grouping of the data
  - ➢ Financial use case: Segment assets, clients etc. in homogeneous groups.

Reinforcement Learning: *Learning from Experiences*

- ➢ Financial use case: Algorithmic Trading, Hedging

Natural Language Processing*: *Machine understand human language*

- ➢ Sentiment Analysis, chatbots, document interpretation

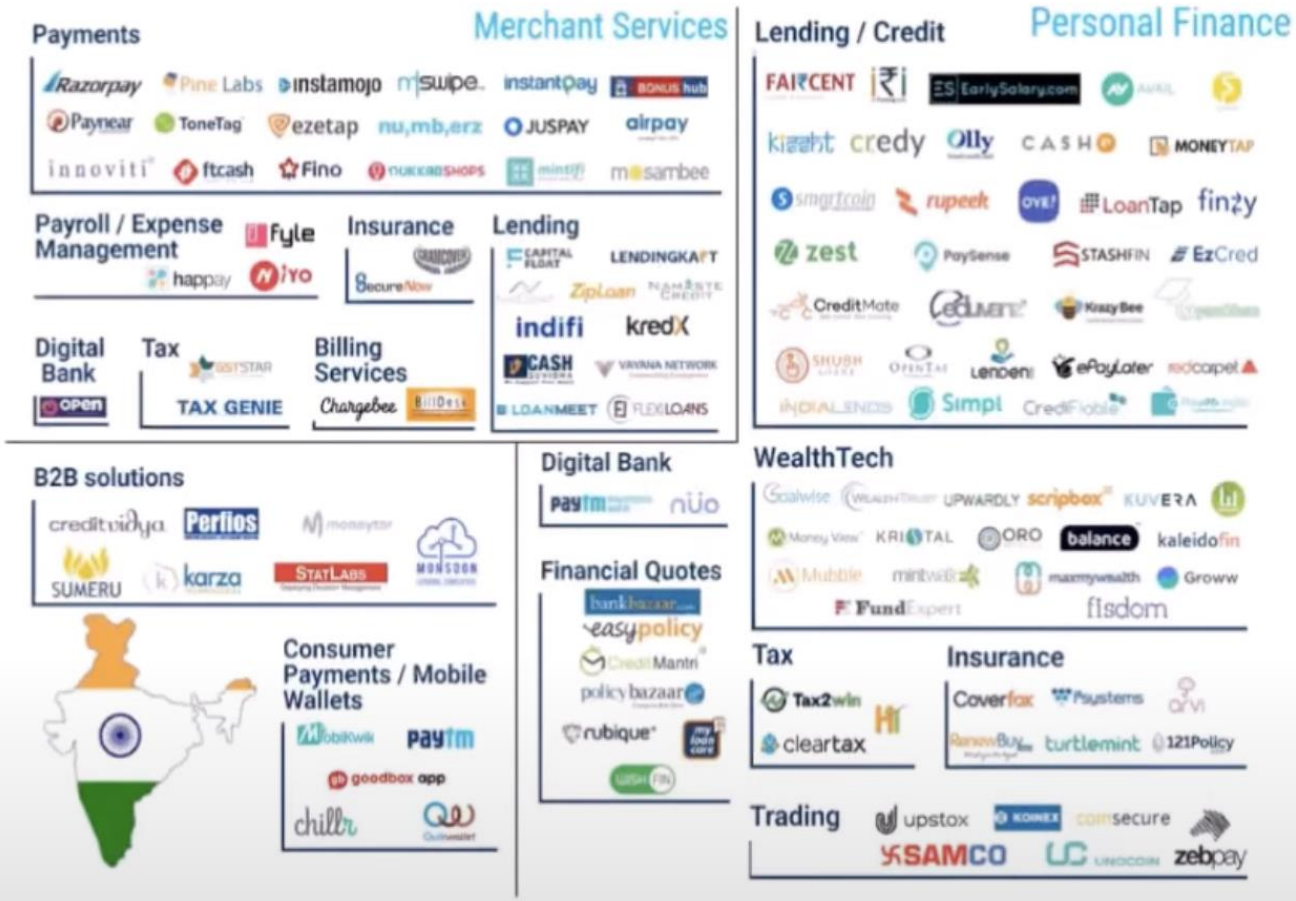
*NLP is categorized more as a type of AI than Machine Learning.

"Where do you see AI/ML used in financial services?”

"Have you come across any fraud detection in your banking transactions?"

Use cases of AI in Fintech/Finance

- Algorithmic Trading
- Digital Payments and Mobile Wallets
- Fraud Detection
- Lending or credit scoring
- Portfolio Management and Robo-advisors
- Taxes, insurance, market research etc.



Fintech Segments

Areas	FinTech Segments	Brief Description
A. Credit	01. Peer-to-Peer Lending 02. Crowd Funding 03. Market Place for Loans 04. Online Lenders – on-book lending by NBFCs 05. Credit Scoring Platforms	• All forms of lending market places including Peer-to-Peer lenders and market places that connect borrowers with both, institutional and lenders; • Also includes crowd funding and equity funding platforms • NBFCs that use alternative scoring and digital channels for acquisition
B. Payments	06. M-wallets and PPIs 07. Merchant Payments and PoS Services 08. International Remittance 09. Crypto Currencies	• Services that enable transfer of funds for various use cases - P2P (Person-to-Person), P2M (Person-to-Merchant), G2P (Government-to-Person) etc. • Services targeted at both Payees and Merchants by enabling requisite payment infrastructure through mobile or other technologies
C. Investment Management	10. Robo Advisors 11. Discount Brokers 12. Online Financial Advisors	• Wealth advisory services delivered through technology governed rules and investment strategies

D. Personal Finance Management	13. Tax Filling and Processing 14. Spend Management and Financial Planning 15. Credit Scoring Services	• Tools and services for active management of individual financial profiles (e.g. spend, investments, credit profile, etc.)
E. Bank tech	16. Big Data 17. Blockchain 18. Customer Onboarding Platforms	• Services that utilize many data points such as financial transactions, spending patterns to build the risk profile of the customer. This provides an alternate to traditional underwriting methods that are unable to serve people with limited credit data. • There is significant value in unstructured data. However, it is difficult to derive value from unstructured data, owing to challenges in analyzing it. A number of new tools are being developed to derive value from large data sets.
F. InsurTech	19. Insurance Aggregator 20. IOT, Wearables and Kinematics	• Small business insurance • Usage based insurance

Source: Deloitte Analysis

Used cases in Finance

Illustrative : global results showing the success of implementing AI/ML in Finance.

Enhanced Financial Forecasting and Analysis

Predictive Analytics

to enhance credit risk modeling, resulting in more precise forecasts and better risk management.

Real-Time Data Processing

for real-time market analysis, optimizing trading strategies and improving profitability.

Scenario Planning

for scenario analysis to better prepare for economic uncertainties.

Anomaly Detection

to detect fraudulent transactions, reducing financial losses.

Automated Reporting

to automate financial reporting, resulting in faster and more accurate reports.

Improved Risk Management

01

Advanced Risk Modeling

Swiss Re to model and predict insurance risks, leading to more accurate underwriting.

02

Fraud Detection

MasterCard for fraud detection, significantly reducing fraudulent transactions. might be mitigated.

03

Compliance Monitoring

BARCLAYS to monitor transactions for compliance with regulations, reducing the risk of penalties.

04

Stress Testing

BANK OF AMERICA for stress testing to assess resilience against financial shocks.

05

Portfolio Management

BLACK ROCK for portfolio optimization, improving investment performance.

COST REDUCTION AND EFFICIENCY

WELLS FARGO

to automate account reconciliation, lowering operational expenses.

EY

for auditing, leading to faster and more accurate audit results.

citi

for expense management, identifying areas for cost reduction.

IBM

for resource allocation, improving operational efficiency.

SAP

to optimize financial processes, resulting in significant cost savings.

STRATEGIC DECISION-MAKING AND INSIGHTS

01

Data-Driven Insights

for financial analytics, enabling better strategic planning and investment decisions.

02

Customized Financial Strategic sights

to create customized financial strategies, improving market positioning

03

Scenario Analysis for Strategic Planning

for scenario analysis, enhancing strategic planning and decision-making.

04

Market Trend Analysis

for market trend analysis, leading to more informed strategic decisions

05

Enhanced Forecast Accuracy

for pricing products based on customer inputs

Use Cases in Finance

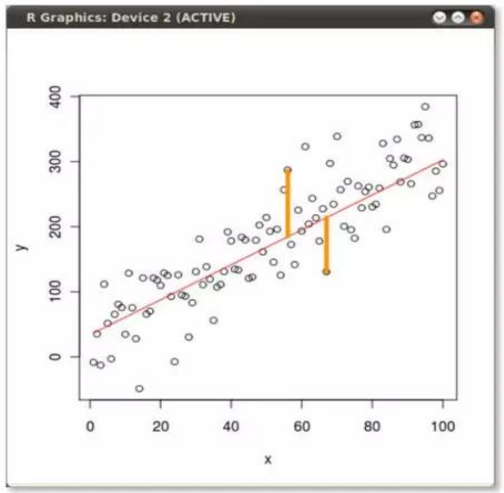
Multiple linear regression

- Given estimates $\hat{\beta}_0, \hat{\beta}_1, \ldots, \hat{\beta}_p$ We can make predictions using the formula

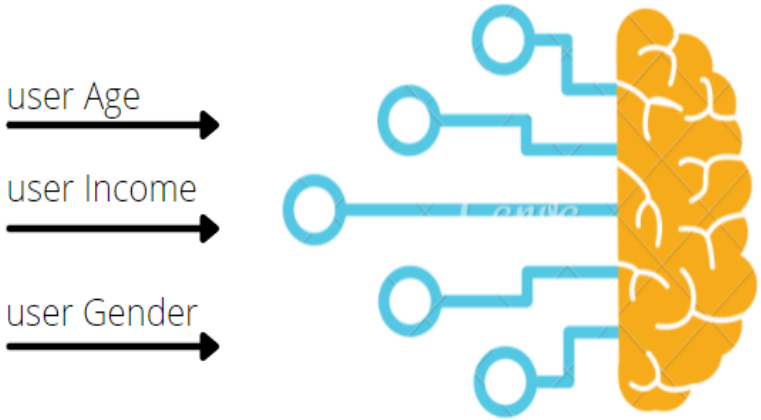
$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \cdots + \hat{\beta}_p x_p$$

- The parameters are estimated using the least squares approach to minimize the sum of squared errors

$$RSS = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$



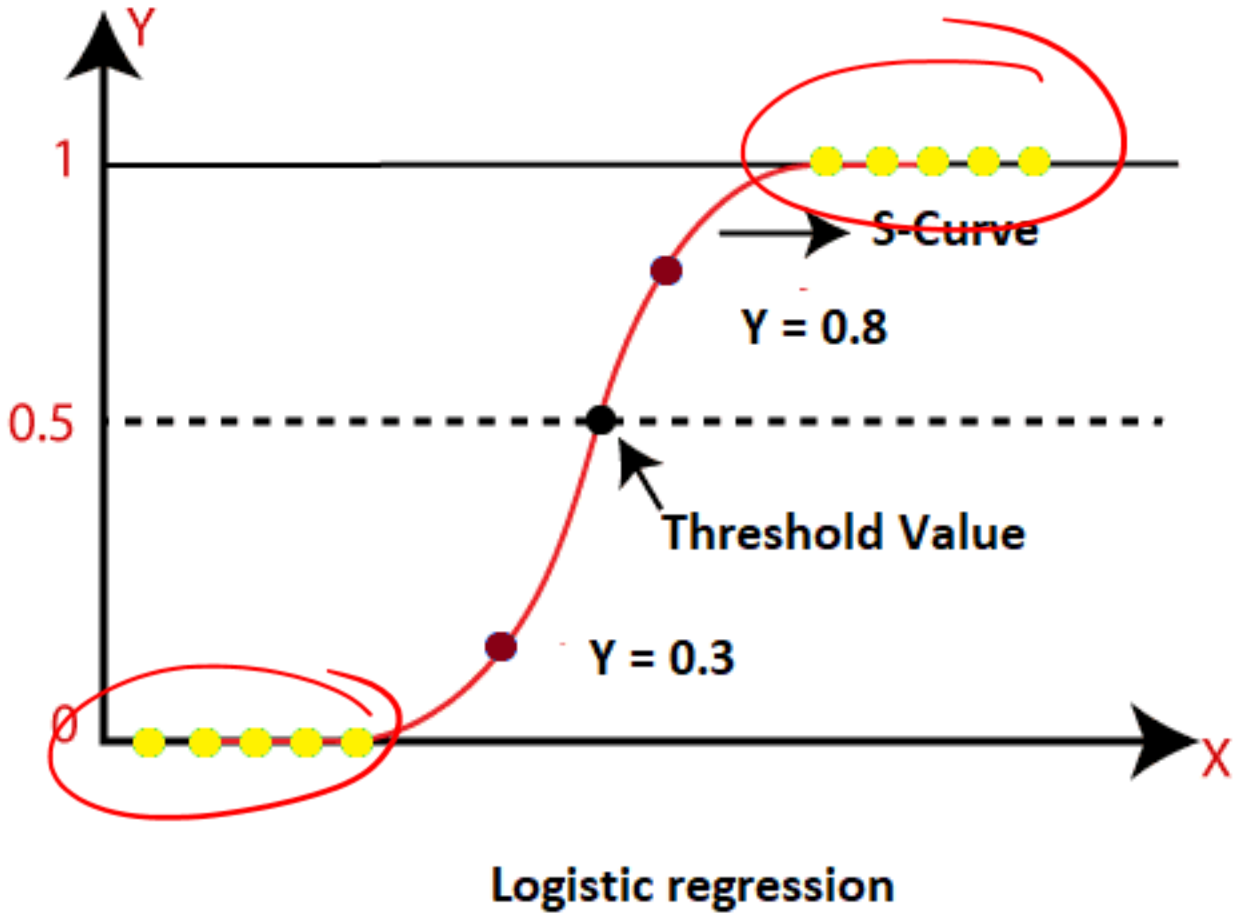
Logistic Regression



Yes

No

Output Purchase | Yes or No



Logistic regression

Stock Market Prediction using Machine Learning/ Valuation of a company

- **Stock Market**
  - A stock market is a place where buying and selling of shares happen for publicly listed companies. Stock exchange is the mediator that allows buying and selling of shares.

- **Importance of Stock Market**
  - Helps companies to raise capital
  - Helps create personal wealth
  - Serves as a indicator of the state of the economy
  - Helps to increase investment

Logistics Regression Example

Context

It is important that credit card companies are able to recognize fraudulent credit card transactions so that customers are not charged for items that they did not purchase.

Content

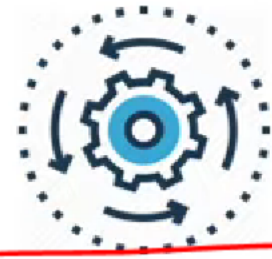
The datasets contains transactions made by credit cards. This dataset presents transactions that occurred in two days, where we have 492 frauds out of 284,807 transactions.

It contains only numerical input variables which are the result of a PCA transformation. Unfortunately, due to confidentiality issues, we cannot provide the original features and more background information about the data. Features V1, V2, ... V28 are the principal components obtained with PCA, the only features which have not been transformed with PCA are 'Time' and 'Amount'.

Feature 'Time' contains the seconds elapsed between each transaction and the first transaction in the dataset. The feature 'Amount' is the transaction Amount, this feature can be used for example-dependant cost-senstive learning. **Feature 'Class' is the response variable and it takes value 1 in case of fraud and 0 otherwise.**

Work Flow

Credit Card Data



Data pre processing

- Missing Values
- Unbalanced / Balanced Data
- Outliers

Data Analysis

Train Test split

Logistic Regression Model

Evaluation

What challenges do you see in deploying AI in finance?

A. Data-Related Challenges
- Data Quality & Availability
- Data Privacy & Security
- Imbalanced Datasets

B. Model-Related Challenges
- Explainability & Interpretability
- Bias in AI Models
- Generalization Issues

C. Operational & Regulatory Challenges
- Regulatory Compliance
- Cybersecurity Threats
- Integration with Legacy Systems

Suggestive Readings

‘Artificial Intelligence Applications in Financial Services’ Oliver Wyman (Section on ‘How is AI Applied in Financial Services?’)

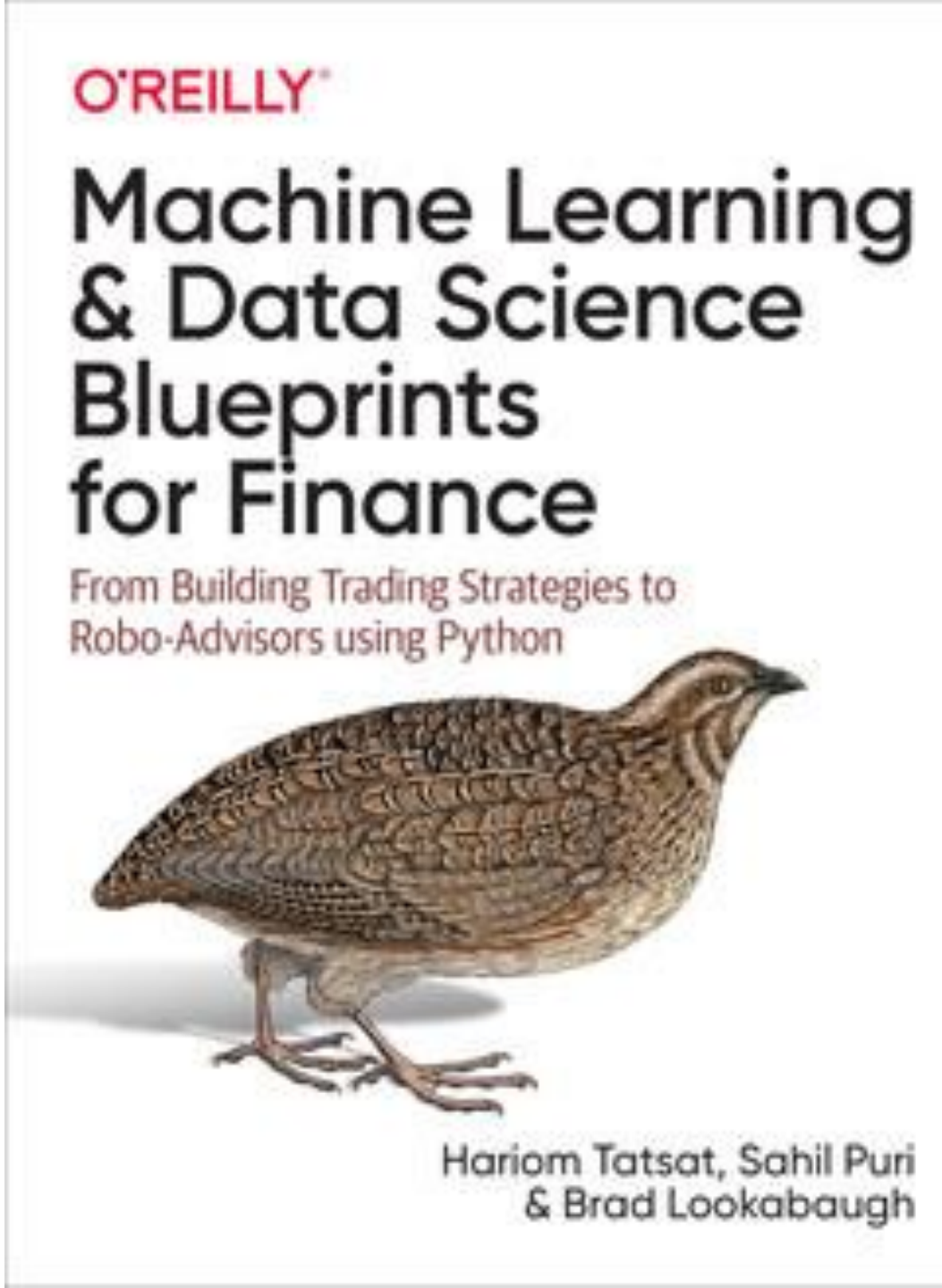
https://www.oliverwyman.com/our-expertise/insights/2019/dec/artificial-intelligence-applications-in-financial-services.html

Artificial Intelligence & Financial Services –Fall 2019 Report’ Mayer Brown(Section on ‘Aiand Big Data Regulatory Risks Under Banking and Consumer Financial Laws’)

https://www.mayerbrown.com/-/media/files/perspectives-events/publications/2019/10/mayer-brown--ai--financial-services-symposium--thought-leadership-articles--fall-2019.pdf

‘Fintech: Understanding AI Use in Financial Services’ Julie Stackhouse, St. Louis Federal Reserve Bank

https://www.stlouisfed.org/on-the-economy/2019/april/fintech-understanding-ai-financial-services



Thank You