Machine Learning in the Payments Industry

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Agenda

- A Brief Introduction to Machine Learning
- Machine Learning Applications in the Payment Industry
- Decision Making with Machine Learning
- Threats from Machine Learning-based Attacks
- Managing and Monitoring of Machine Learning
- Questions and Answers

A Brief Introduction to Machine Learning

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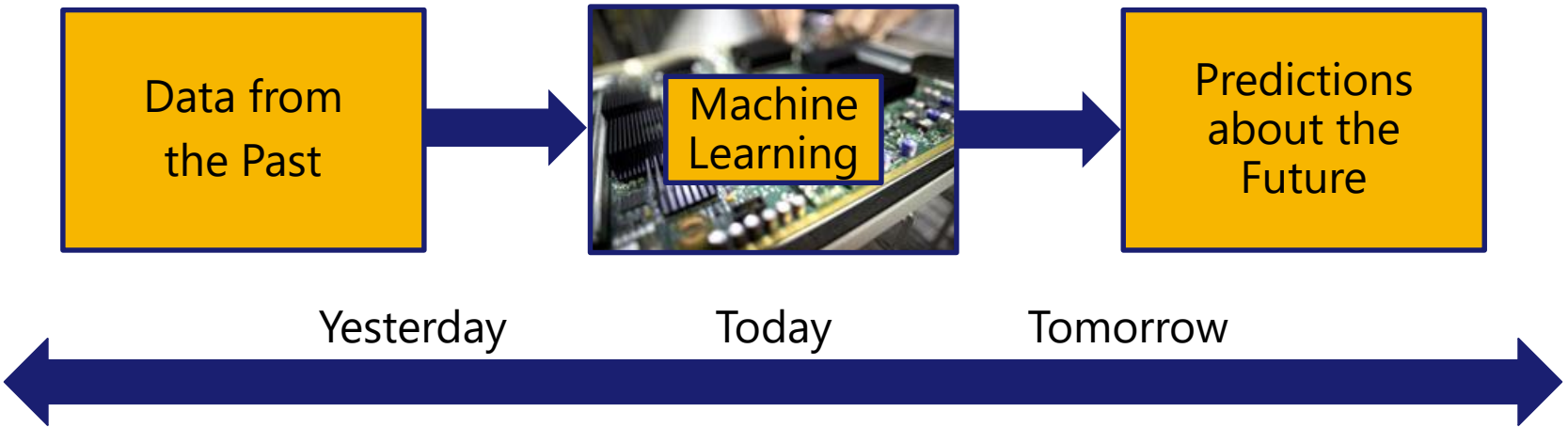
What is Machine Learning?

- Machine Learning is a part of computer science that "gives computers the ability to learn without being explicitly programmed".
  Arthur Lee Samuel, 1959



What is Learning?

- Learning is the process of acquiring a body of knowledge, usually with the intent of performing some actions based upon that knowledge.

By identifying the most influential cause-and-effect relationships from the past, a machine can learn to make accurate predictions about the future.

Find Arsenic

Find Gold

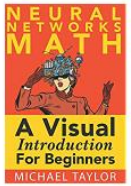
Machine Learning is Becoming Widely Used

"In recent years many successful machine learning applications have been developed, ranging from data-mining programs that learn to detect fraudulent credit card transactions, to information-filtering systems that learn users' reading preferences, to autonomous vehicles that learn to drive on public highways."[1]

Machine Learning: A Technical Approach To

Hands-On Machine Learning with Scikit-Learn

Neural Networks and Deep Learning: Deep Learning

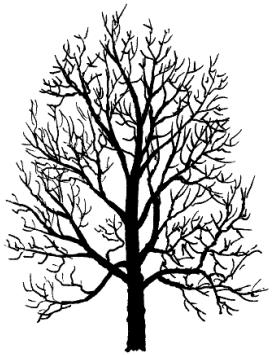


The Math of Neural Networks

[1]Machine Learning by Tom M. Mitchell, 1997 (p. xv)

Machine Learning Applications are Models

- Models are simplified approximations to the real world.



- Most models are built to support a specific activity within a specific environment.

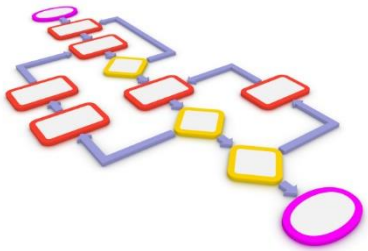
Models are Built upon Data

- In machine learning the data columns are referred to as “features”. Getting the data ready to use is called “feature engineering”.

- Although payment systems generate a lot of data, because of industry standards, much of it is well structured which reduces the effort needed to prepare it for use in machine learning algorithms.

Implementing Machine Learning

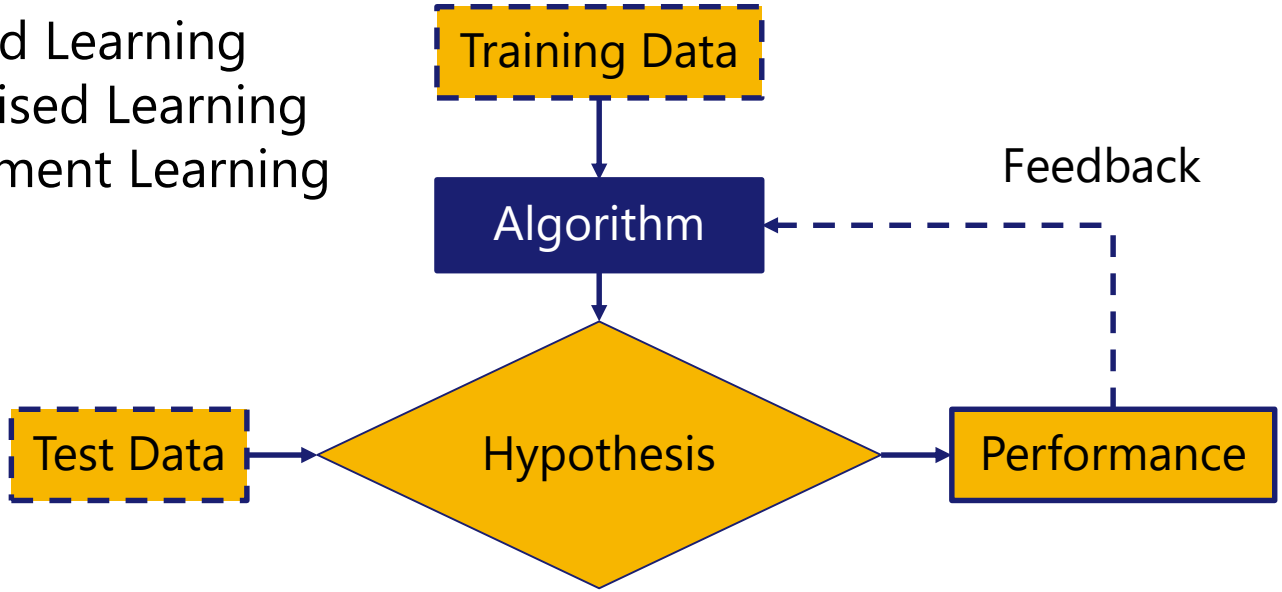
- Machine learning uses many different algorithms.
- Algorithms are just step-by-step processes to calculate a result.



- Data is needed by these algorithms to “train” them and to “test” them.
  - Some algorithms need data that is expertly prepared to exacting specifications before they can work.
  - Some algorithms can analyze large volumes of raw data (often called “Big Data”) and prepare the data themselves.

Types of Machine Learning Algorithms

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning



- Each of these have specific problem areas that they are best suited for.
- Part of the data scientist's job is to know which of these algorithm types to apply to the business situation they are facing.

Supervised Learning

- Step 1: Identify the outcome variable which is to be predicted
- Step 2: Identify the set of input variables called predictors
- Step 3: Generate a mathematical function that maps the input variables to outcome variable. This mapping process is called “training” and is repeated until the model achieves a desired level of accuracy on the training data and the testing data.
- This algorithm is called “Supervised” because there is outcome data that is already known to be correct and the training is supervised by the data scientist in trying to find an acceptable mapping function.

Unsupervised Learning

- Using this algorithm, there is not any specific target or outcome variable to predict or estimate.
- It is used for clustering a population into different groups. For example, it is widely used for segmenting customers into different groups for specific intervention or marketing activities.
- The algorithm is “tuned” by rerunning with different parameters until the desired granularity or group-size is achieved.
- These algorithms are called “Unsupervised” because they identify the clusters or groupings by themselves.

Reinforcement Learning

- Using this algorithm, the algorithm is trained to make specific decisions.
- The algorithm is exposed to an environment where it trains itself repetitively using trial and error.
- This algorithm learns from past experience and tries to capture the best possible knowledge to make accurate business decisions.
- It is call “Reinforcement” learning because the training reinforces the desired behavior from the algorithm.

Machine Learning Areas of Application in the Payment Industry

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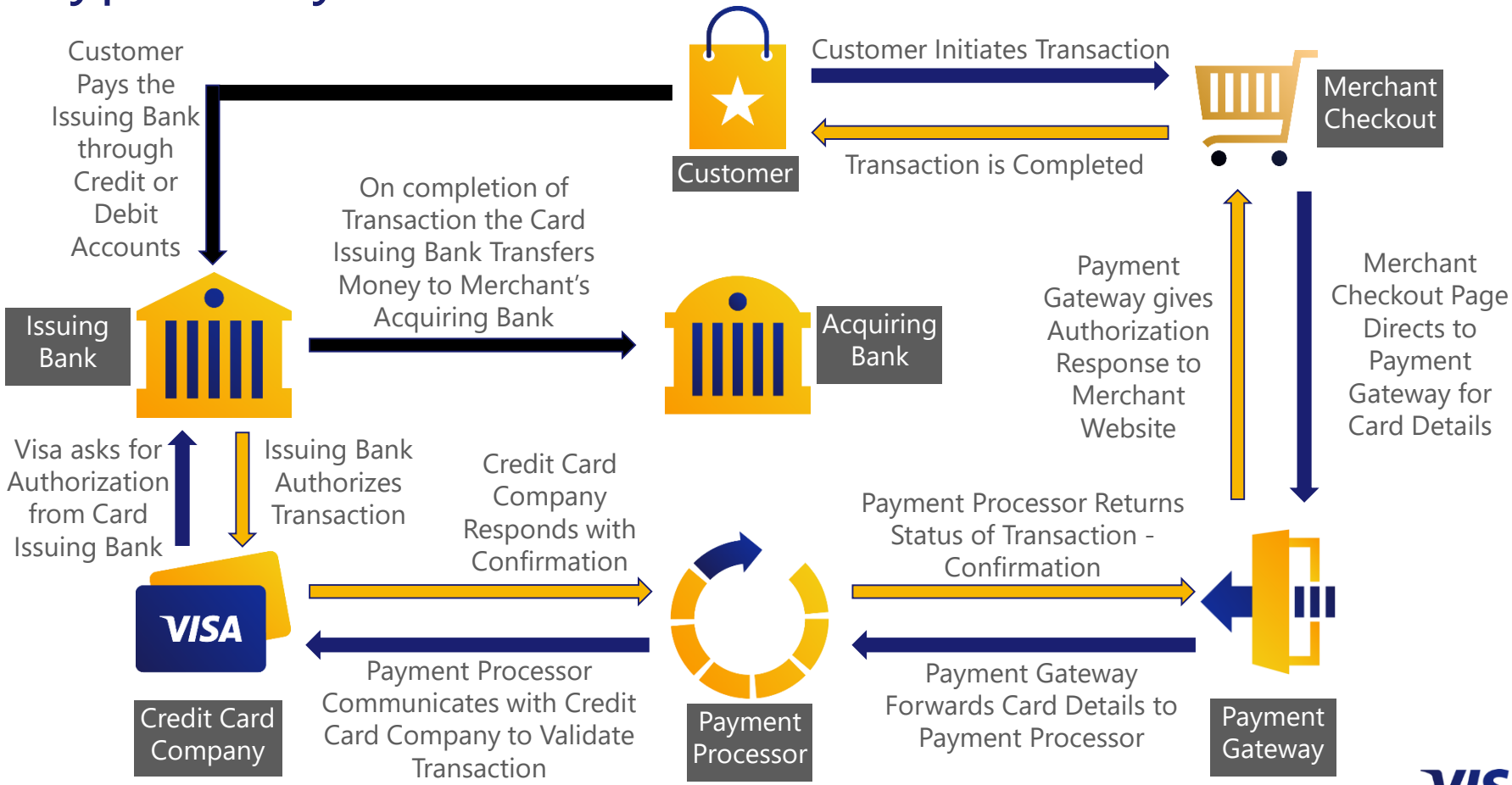
A Typical Payment Flow



Payment Flow Metrics Determination

- **WHO** → Is initiating the transaction?
  Was the recipient of the transaction?
- **WHEN** → Is the transaction initiated?
- **WHERE** → Is the transaction initiated from?
- **HOW** → Was the transaction initiated?
  Often were transactions initiated?
- **WHAT** → Was the transaction trying to accomplish?
  Is the value associated with the transaction?

What are Machine Learning's Unique Advantages?

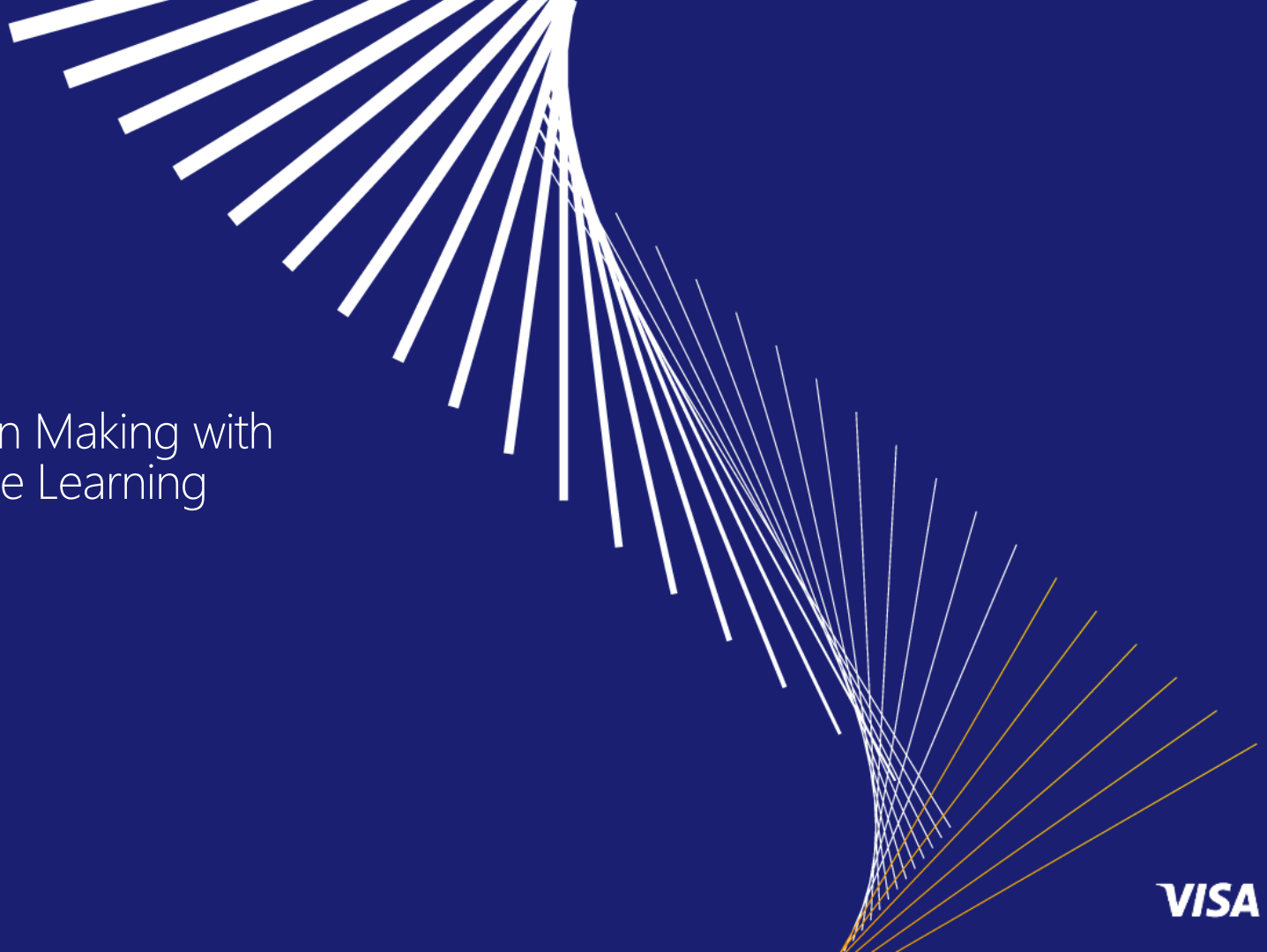
- Based upon real data, not human interpretations of data.
- Can incorporate massive amounts of data.
- Can typically outperform business rule-based processing approaches.
- Algorithms can be combined into something called "ensembles" allowing for more variety in the solutions.

Fighting Fraud

Machine learning fraud fighting strengths:

- Facilitating real-time decision-making power that allows for evaluation of huge numbers of transactions
- Improving accuracy of decisions resulting in detection of subtle or non-intuitive patterns to help identify fraud and avoid erroneous false positives

Decision Making with Machine Learning



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Machine Learning “Accuracy” is a Business Decision

- Machine learning is about understanding the past to make predictions about the future ~ and some of those predictions will be wrong.
- Inaccurate rules logic may result in rejections of valid transactions or “false negatives” leading to revenue loss or customer dissatisfaction.
- Always remember that machine learning, like any tool or technology, is there to serve the needs of the business.

Tuning Your Machine Learning Algorithms

- Machine learning algorithms must be accurate:
  - Algorithms tied too tightly to past behavior are “over-training”.
  - Algorithms tied too loosely to past behavior are “under-training”.
- Determine the acceptable business balance between “false positives” (approving payments that should have been rejected) and “false negatives” (rejecting payments that should have been approved.)
- Algorithms can be re-trained on often as necessary to keep up with changing trends in the business environment.

Threats from Machine Learning-based Attacks

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Machine Learning is a Tool for the Threat Actor

- Machine learning can allow threat actors to first gain a better foothold in the payment ecosystem to accomplish their mission.
- The threat actor may utilize machine learning to help in disguising a bad payment transaction as a good one.
- Remember that machine learning needs data to be properly trained so, to the extent you can, deny the availability of that data to the threat actor.

Threat Techniques Enhanced by Machine Learning

- Cloaking or “Wolf among the Sheep”

- “Outrun the Cops”

- “Wait out the Cops”

- “Friendly Microbe”

Managing and Monitoring of Machine Learning

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Managing Machine Learning

- Machine learning applications are models that are simplified approximations to the real world.
- If the nature of the specific activity, or the environment within which that activity takes place changes, you will need assurance that the model is still relevant.
- If your operating environment is dependent upon machine learning then you need to assess, or reassess on a regular basis, the premises and data underlying the machine learning application you are using. This is a new area of change management.

Monitoring Machine Learning

- How do you know that a machine learning application is becoming outdated?
- Monitor for a change in effectiveness of the machine learning application. For example, are you getting more of a specific result than you expect?
- If possible test the machine learning application outside of the rest of the system and review the metrics you first used to evaluate the application.

Summary

Opportunities for Action

- Machine learning has an important role to play in supporting a robust and safe payment environment.
  - Acquire trained professionals or develop staff through training and certification.
  - Train Internal Audit on risks associated with machine learning.
- Threat actors will try and use this technology to their advantage.
  - Deny criminals the ability to access data to train models.
- Proper monitoring and managing of this technology is essential.
  - Obtain feedback on the use of machine learning.
- Model Risk Management (MRM) programs should include all critical models.
  - Determine applicability of MRM to machine learning-based models.

Question & Answer

Visa Data Security Resources

Visa Data Security Resources

Visa Data Security Website www.visa.com/cisp

- Alerts, Bulletins
- Best Practices, White Papers
- Past Webinars

Visa Global Registry of Service Providers www.visa.com/onthelist

- List of registered, PCI DSS validated third party agents

PCI Resources for Small Merchants https://www.pcisecuritystandards.org/merchants/

- Guide to Safe Payments, Common Payment Systems, Questions to Ask your Vendors
- Payment Data Security Essential: Video and Infographics

PCI Security Standards Council Website www.pcissc.org

- Data Security Standards, Qualified Assessor Listings, Data Security Education Materials