Data Science Workshop
An Experiential Journey with Data to Inspire *Your* Work

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IBM

Data Science Workshop
An Experiential Journey with Data to Inspire *Your* Work

Data Science Workshop

02:00 – 03:30 US CT	**Data Science Workshop: An Experiential Journey with Data to Inspire Your Work**
	The Data Science Virtual Workshop, "An Experiential Journey with Data to Inspire Your Work", will make you think differently about data and how it can solve problems! This workshop includes surprising use cases that will make you think differently about data, sometimes laugh and hopefully inspire your own work to discover actionable insights in the mounds of data available. The use cases and introductory material will be followed by a hands-on experiential journey addressing a common challenge across industries – how to improve the customer experience. The most valuable part of this workshop is that it is designed to help you gain experience and relate it to your work – so at the end you have a plan of action on how you can make data more useful in your organization to solve a key challenge.
	"Improving Customer Experiences with Real-Time Insights", will be used as an example during the workshop. This experiential session will include a step by step journey based on how data science is helping companies to predict the customer experience journey and proactively address the issues, leading to the improvement of Net Promoter Score. The session will also highlight the importance of using AI Canvas, CRISP-DM (Cross Industry Standard Process for Data Mining) and Agile in Data Science projects.
	The methodology involves consuming historical NPS data; using machine learning and artificial intelligence to identify the most important features and creating an algorithm to predict the customer experience.
	Facilitators: Maureen Norton, Neeraj Madan, and Mwai Kalengamaliro

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Agenda

Section	Time (US CT)
Getting Started *a.* ***Session Introduction and Expectation Setting*** *b.* ***Data Science Introduction*** *c.* ***Predictive Analytics and Machine Learning Solutions***	**02:00 pm – 02:30 pm**
Hands on Experiential Journey (Net Promoter Score Example) *a.* ***Business understanding:*** *Exercise 1: Identify an opportunity in your business context and document* *b.* ***Data understanding:*** *Exercise 2: What data set would you gather to work the problem statement* *c.* ***Data preparation:*** *Exercise 3: How would you prepare the dataset and what challenges do you foresee?* **<<Break (15 mins)>>** *d.* ***Modeling:*** *Exercise 4: What modeling techniques would you attempt and why?* *e.* ***Evaluation:*** *Exercise 5: What metrics would you use to evaluate your model performance?* *f.* ***Deployment:*** *Exercise 6: How do you plan to consume the outputs of the model?*	**02:30 pm – 03:30 pm**

Let's talk about data

Is there a source of data that has information about

- ANY topic

- ANY where

- ANY time

Is there a source that has their finger on the pulse of what people think at any moment in time?

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Twitter

Soggy Fries

Let's talk about data

What other types of data can be used to drive deeper insights?

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# WEATHER

Four Common Data Science Models

Risk Assessment

Create a "Screening Model" to identify "threats". Threats can be any sort of fraudulent activity (e.g., credit transaction, passenger screening, ability to purchase, altered video/photo, Fake/Real news)
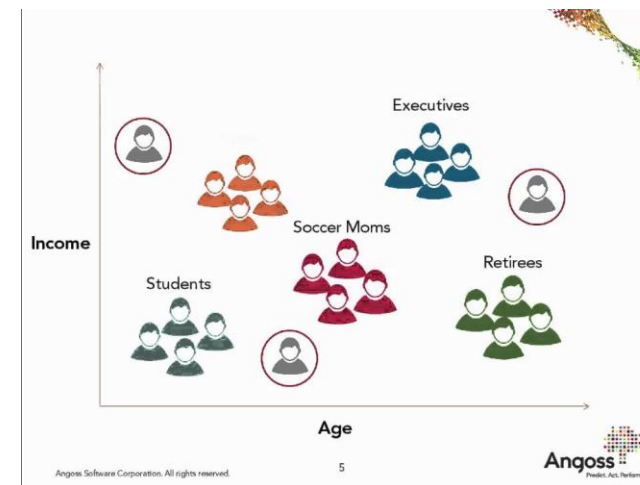

Quality/Defect

Identify problematic components, defects in a product (e.g., server failure, castings, ATM Machines)
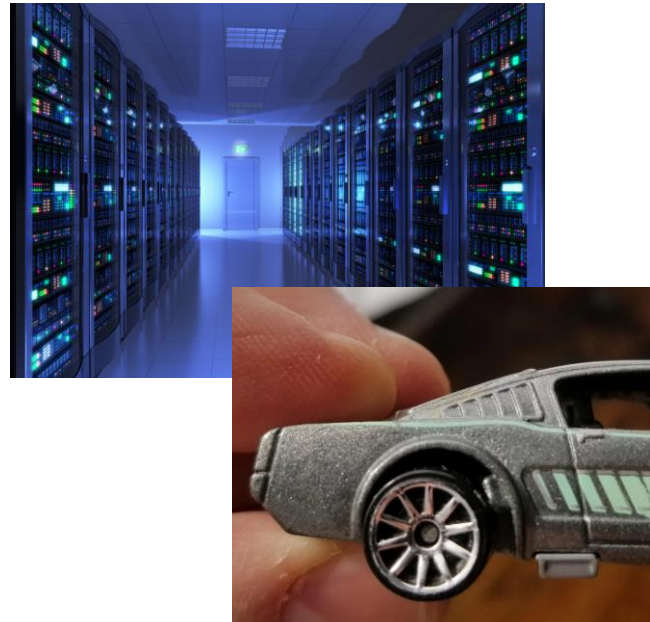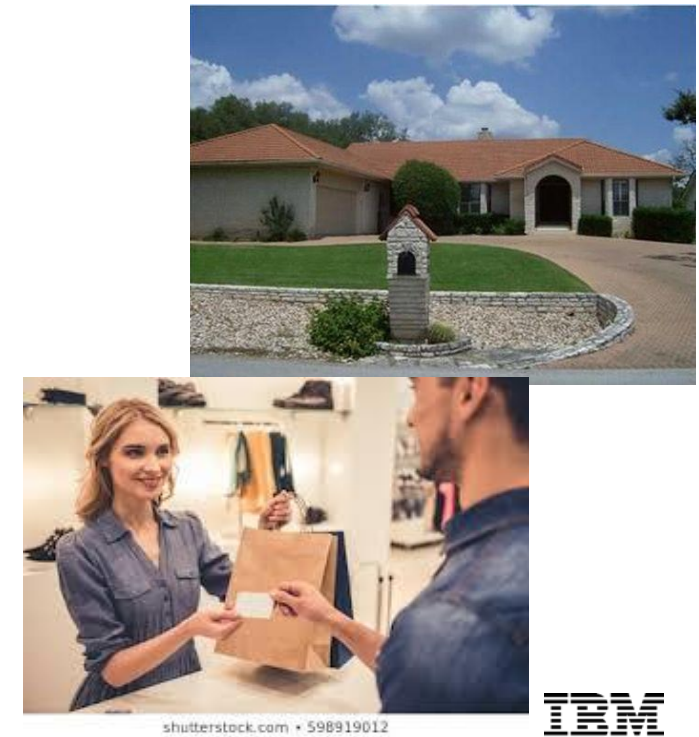

Business Value/ Customer Satisfaction

Identifies which customers have the most potential business value based on their characteristics and activities. Which customers are likely to be happy? Which will be promoters?
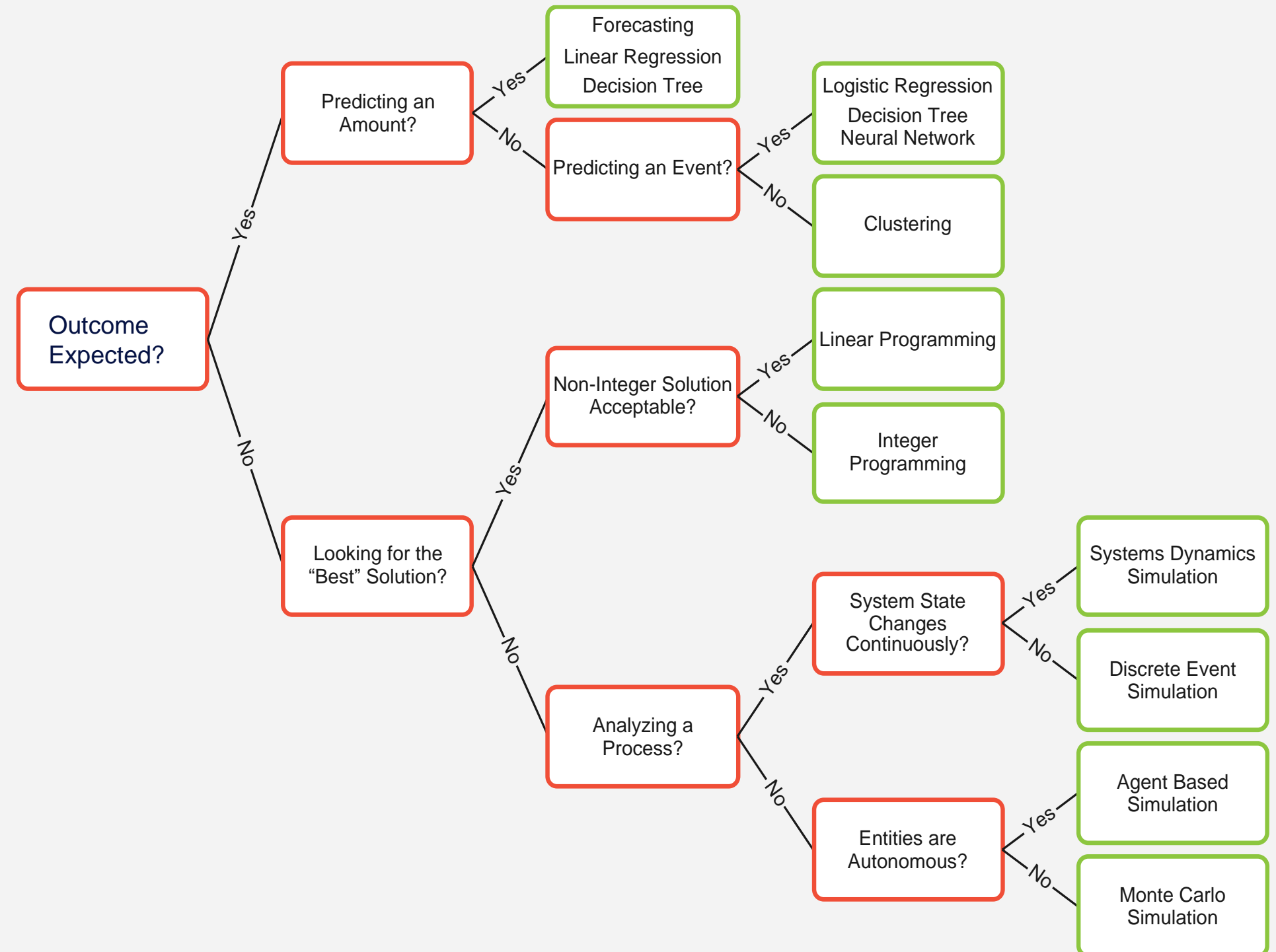

Price/Cost/Value

Predict value (e.g., home/rental prices, value of retail transaction, number of issues, etc.)
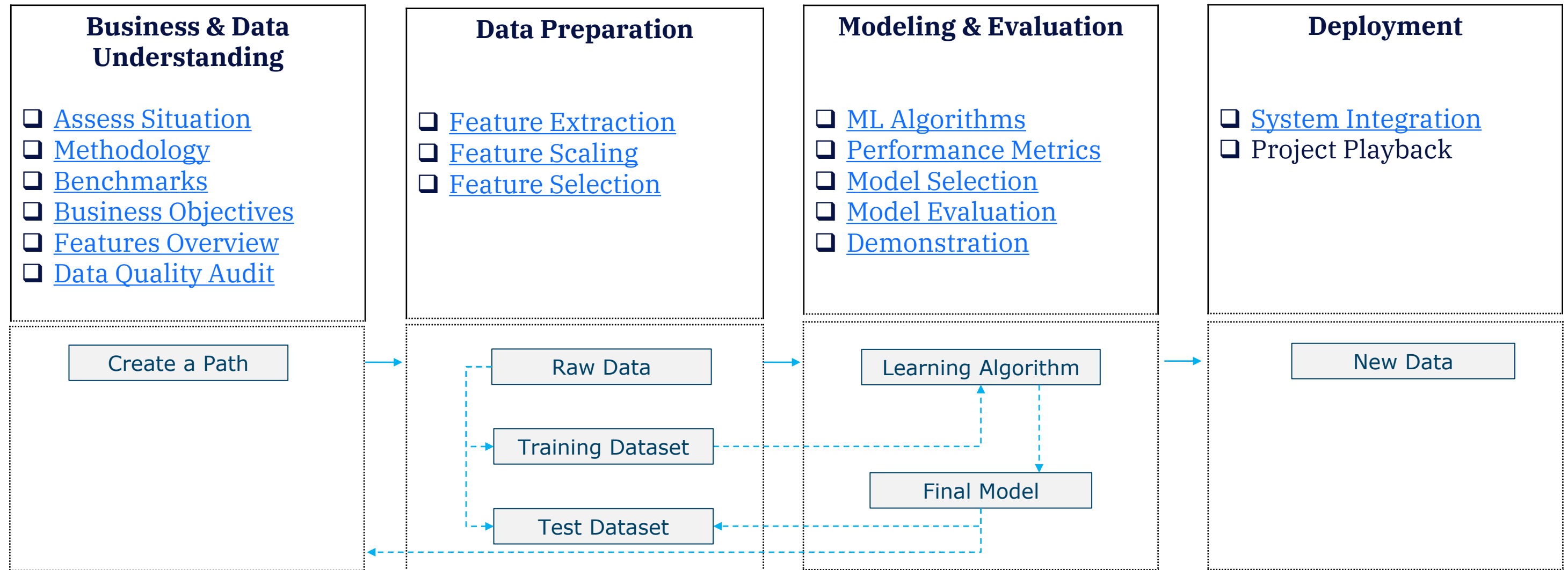
Choosing the right analytic approach

Framework: Roadmap to Building Machine Learning System

"Essentially, all models are wrong, but some are useful."--- Box, George E. P.; Norman R. Draper (1987). Empirical Model-Building and Response Surfaces, p. 424, Wiley. ISBN 0471810339.
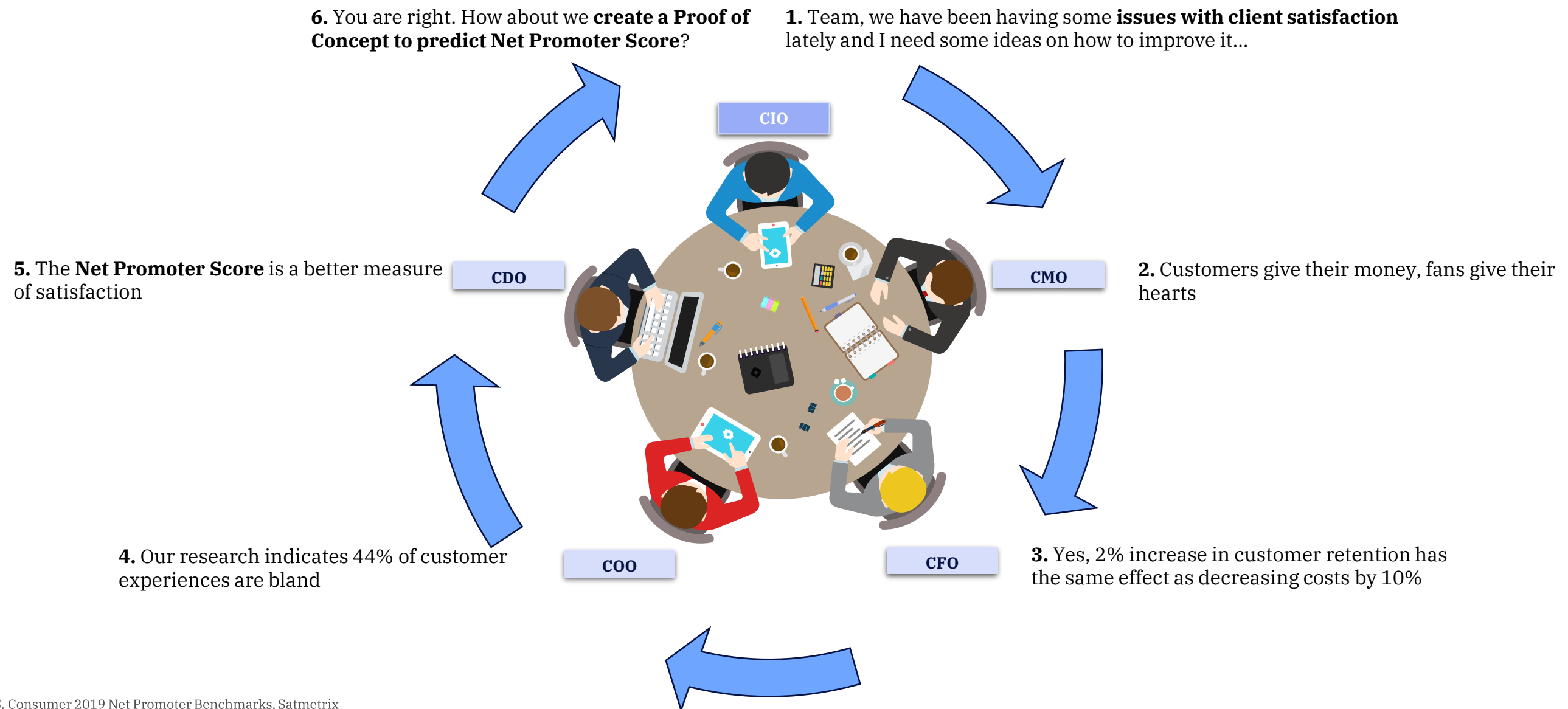
Business & Data Understanding

❑ Assess Situation
❑ Methodology
❑ Benchmarks
❑ Business Objectives
❑ Features Overview
❑ Data Quality Audit

Data Preparation

❑ Feature Extraction
❑ Feature Scaling
❑ Feature Selection

Modeling & Evaluation

❑ ML Algorithms
❑ Performance Metrics
❑ Model Selection
❑ Model Evaluation
❑ Demonstration

Deployment

❑ System Integration
❑ Project Playback

Create a Path

Raw Data

Training Dataset

Test Dataset

Learning Algorithm

Final Model

New Data

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Audience Poll

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Take away

Now, I am able to

✓ Learn the Roadmap to Building a Machine Learning System

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Behind the Scenes: Let us talk about Improving Customer Experience with Real-Time Insights

6. You are right. How about we **create a Proof of Concept to predict Net Promoter Score**?

1. Team, we have been having some **issues with client satisfaction** lately and I need some ideas on how to improve it...

5. The **Net Promoter Score** is a better measure of satisfaction

2. Customers give their money, fans give their hearts

CIO

CDO

CMO

COO

CFO

4. Our research indicates 44% of customer experiences are bland

3. Yes, 2% increase in customer retention has the same effect as decreasing costs by 10%
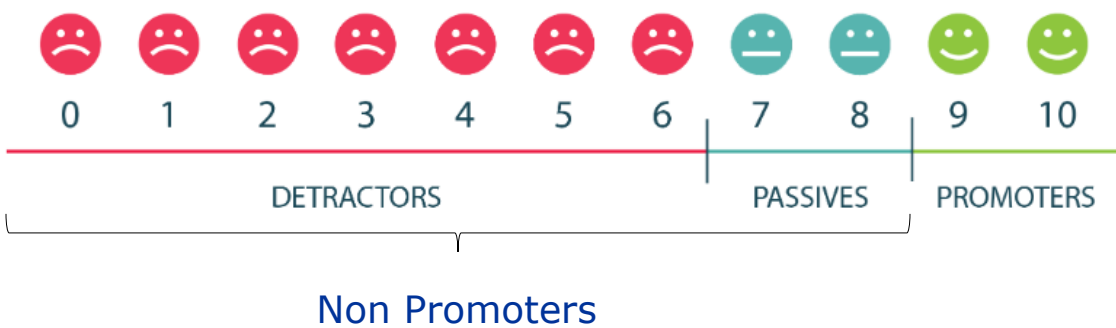
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Assess Situation

In year 2020, **The Company** world-wide **supported 500,000 cases** which were created in multiple platforms.

The **Net Promoter Survey (NPS)** response rate was **15%**.

**60% cases were non-promoters and 40% were promoters.**

Note: The numbers highlighted above are crafted for this workshop.

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Methodology

Net Promoter has become the industry standard customer loyalty measurement. Businesses see customer experience as an imperative.

On a scale of 0-10, how likely would you recommend [brand/ support] to a friend or colleague?

Calculating NPS score is as simple as tallying up your responses and subtracting the percentage of detractors from the percentage of promoters. The score is a whole number that ranges from -100 to 100, and indicates customer happiness with our brand experience.
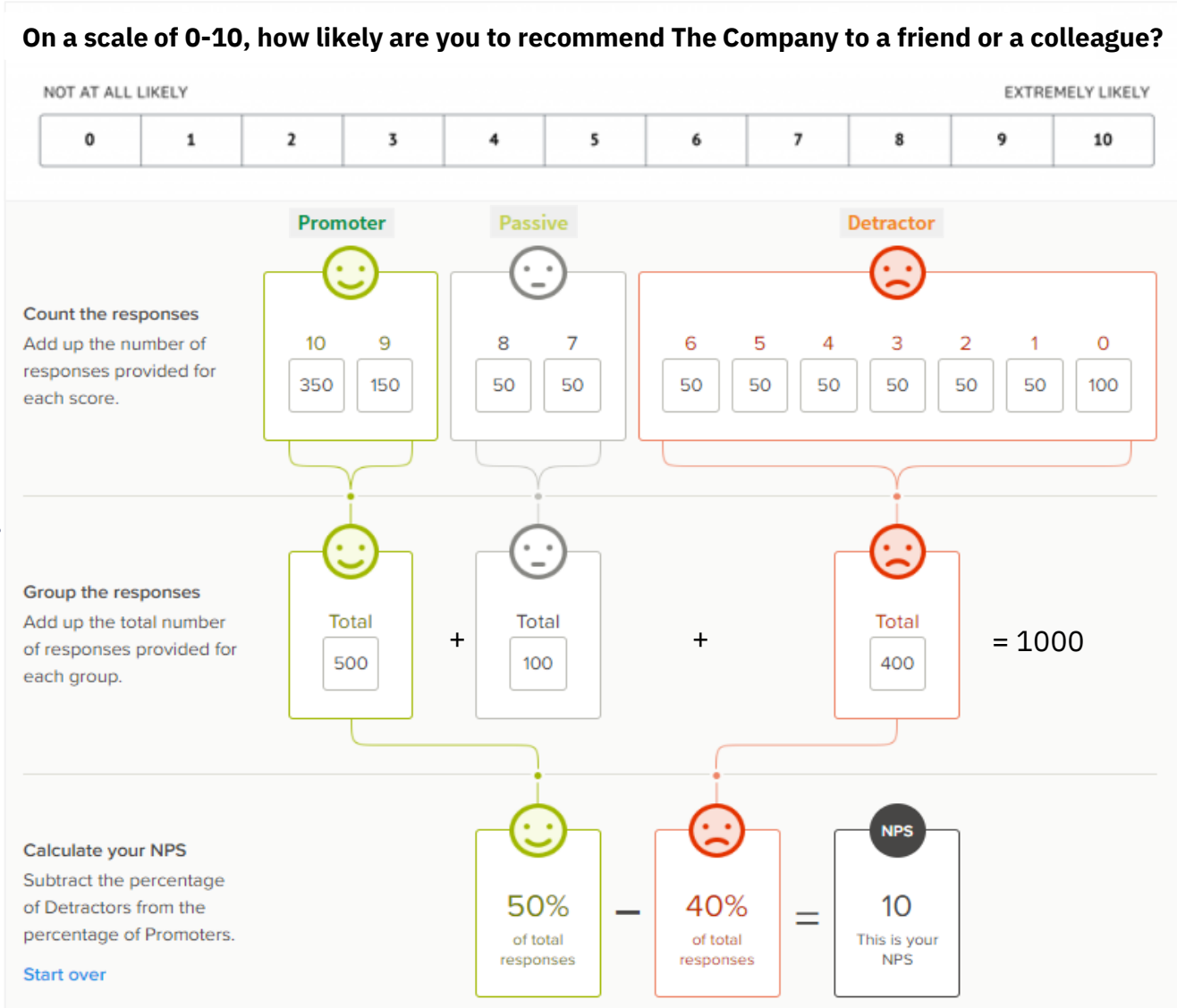

Source: How to Use Net Promoter to Drive Business Growth, Satmetrix and NPS Calculator

Benchmarks (Average NPS by Industry and Leaders)

Net Promoter Scores vary widely by industry, as you can see from the average scores for 23 industries.
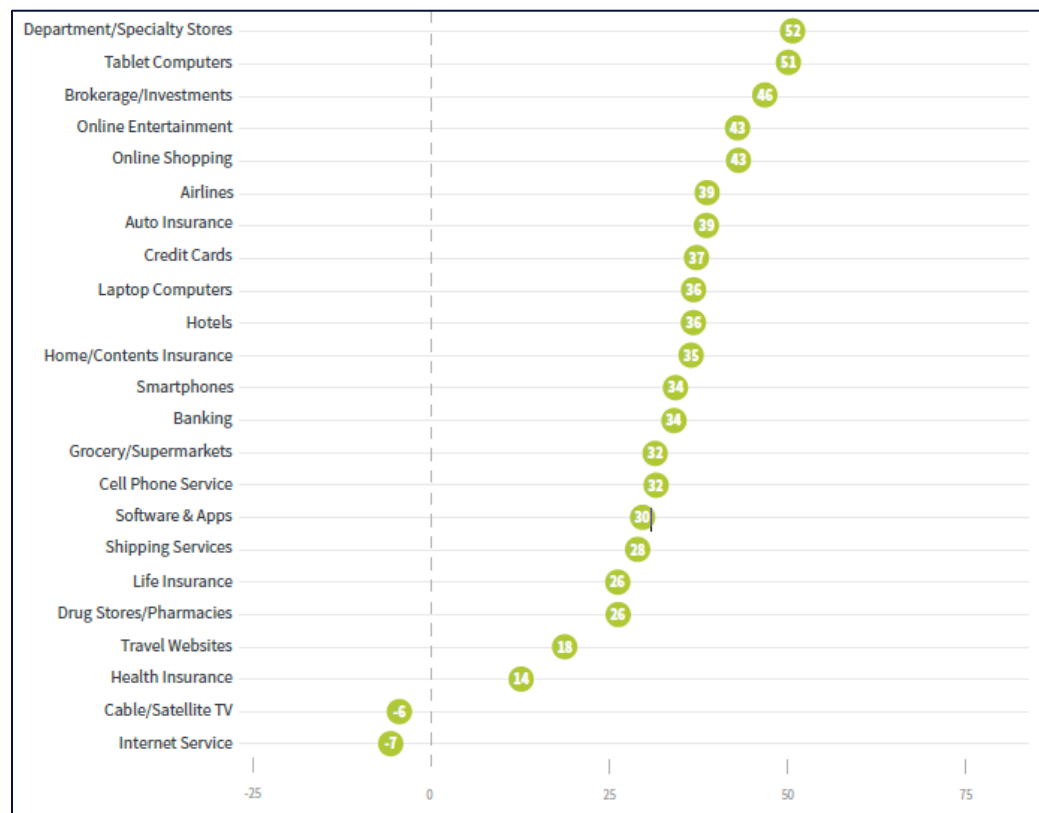
Knowing what similar companies have achieved helps us to set realistic goals for improvement, and realism is key to the long-term success of your program.
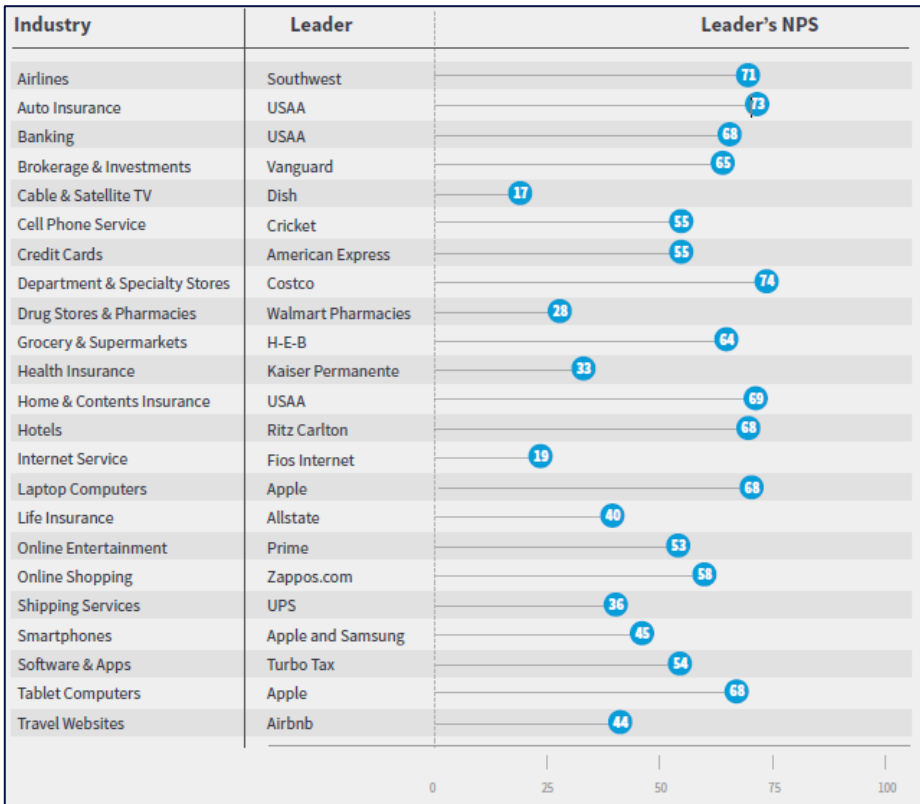
Source: U.S. Consumer 2019 Net Promoter Benchmarks, Satmetrix

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Business Objectives

Goal: Improve the Net Promoter Score by identifying potential non promoters ahead of time and proactively address customer issues

Approach: Consume historical NPS data; Use machine learning and artificial intelligence to identify the most important features and select an algorithm to predict the non promoters

Desired Result: Create a capability to share the top candidates for non-promoter surveys with The Company to proactively address customer issues.

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Exercise

1. Identify a data science opportunity in your business context and document.

Consider using this template...

As a \<role\>, I would like to \<direction\> the \<target variable\> for \<scope\> by \<amount\> in \<timeframe\>.

Role = End User

Direction = improve/reduce or increase/decrease

Target Variable = fraud, risk, customer satisfaction, volume, effort, price, cost, availability, productivity, revenue, etc.

Scope = section of the business of interest

Amount = value or percent

Timeframe = weeks, months, years

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Take-away

Now, I am able to

✓ Setup the Data Science environment on IBM Cloud

✓ Learn the Roadmap to build a Machine Learning System

✓ **Assess the situation, understand the methodology, identify the benchmarks, and define business objectives**
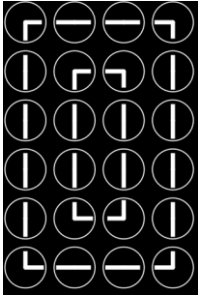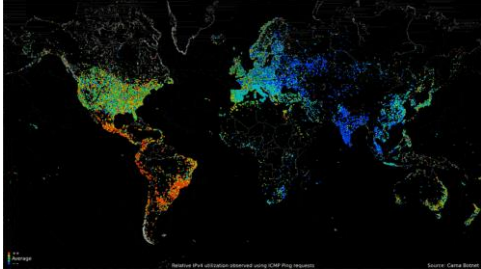
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Features Overview

Time	Geography	Money	Sentiment & Emotions

TIME	LOCATION	MONEY	SENTIMENT & EMOTIONS
Day of Week	Country	Lifetime Spent	Sentiment
Time Window (Prime or Non-Prime)	Geography	Monthly Recurring Spend	Emotion (Anger, Disgust, Fear, Joy, and Sadness)
Age of Account	Region		
Meaningful Update			

Other Features: Assignment Count, Support Plan, Account Type, Severity, Technology, Case Origination Source, Case Origination User Type, Tribe, Catalog

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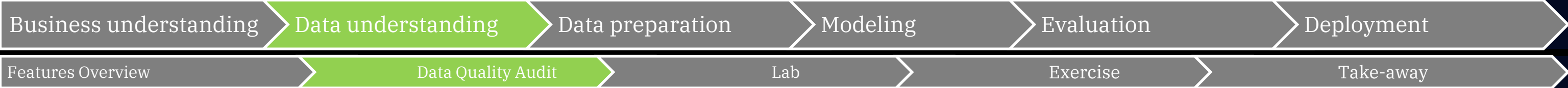
Data Quality Audit

Pandas-Profiling Report (Things to check)

❑ Number of observations, features, and type

❑ Large Number of Distinct Values (High Cardinality)

❑ Correlation

❑ Missing values

❑ End goal is to review the data and improve Data Quality

Source: Pandas Profiling

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Lab: Instructions

Run the following section in the notebook.

1. Introduction to Notebooks

2. Load packages and verify the version

3. Data Exploration

   • Load and read the files from GitHub

   • Explore the data and perform quality audit
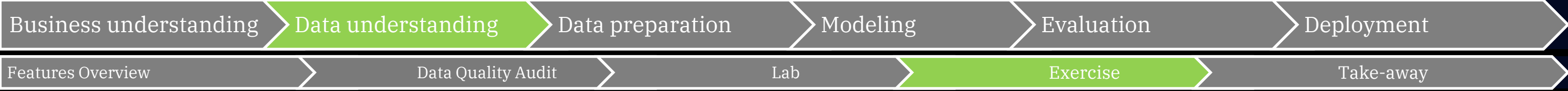
Exercise

2. What data set would you gather to work on the problem statement?

Be sure to include the feature that you believe would influence the outcome, the definition, type, and range (e.g., weather, forecasted rain probability at 10 am, percent, 0.0 to 1.0) of that feature, and the data source that would provide it (weather.com).
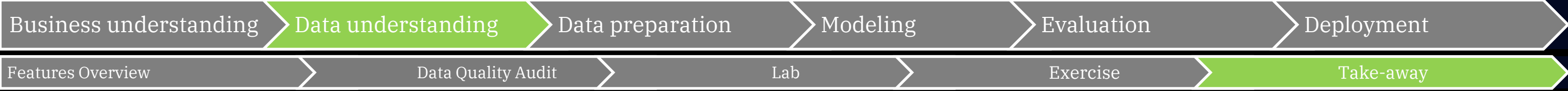
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✓ **Introduction to Notebook, load packages, and verify the versions**

✓ **Explore the data set and perform quality audit**

Business understanding	Data understanding	Data preparation	Modeling	Evaluation	Deployment

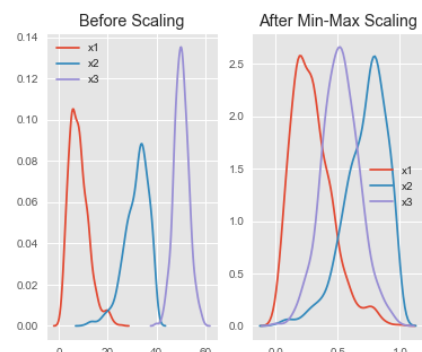| Extract	Scale	Select	Lab	Exercise	Take-away

Extract, Scale, and Select Features (1 of 2)

Feature Extraction

One Hot Encoding

Other Techniques:
- OrdinalEncoding
- LabelEncoder
- BinaryEncoder
- Hashing Encoder
- Target/Mean Encoding
- Autoencoders

Feature Scaling

Other Techniques:
- StandardScaler
- RobustScaler
- Normalizer

Feature Selection

Dimensionality Reduction

Other Techniques:
- Pairwise Correlation
- Multi- collinearity
- Principal Component Analysis,
- Cluster Analysis, Correlation (with the target)
- Forward/ Backward/ Stepwise selection
- LASSO
- Tree-based selection

The Hitchhiker's Guide to Feature Extraction, Feature Scaling with scikit-learn by Ken Keen, and A Practical Guide to Dimensionality Reduction Techniques

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Extract, Scale, and Select Features (2 of 3)

Why (a, b, and c) and (x, y, and z) are commonly used as mathematical placeholders?

The letters at the end of the alphabet, viz., x, y, z, etc. are to denote unknown variables, while those at the start of the alphabet, a, b, c, etc. denote constants, was first highlighted in La Géométrie in year 1637.

Extract, Scale, and Select Features (3 of 3)

Why are the input variables denoted by an upper-case 'X' whereas the target variable is a lower-case 'y'?

In terms of Linear Algebra, it is extremely common to use capital Latin letters for matrices (e.g., design matrix X) and lowercase Latin letters for vectors (response vector y).

A vector is a list of numbers (can be in a row or column), A matrix is an array of numbers (one or more rows, one or more columns).

Source: Brief Introduction to Vectors and Matrices

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Lab: Instructions

4. Feature Extraction

5. Feature Scaling

6. Feature Selection

Exercise

3. How would you prepare the dataset and what challenges do you foresee?

Now, as you have shortlisted the input features to prepare a data model, document the transformation steps (extract, scale, and select) you would apply on features to prepare the data-set.

Take away

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✓ **Extract, scale, and select features for the data model**

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Machine Learning Algorithm Selection (1 of 2)
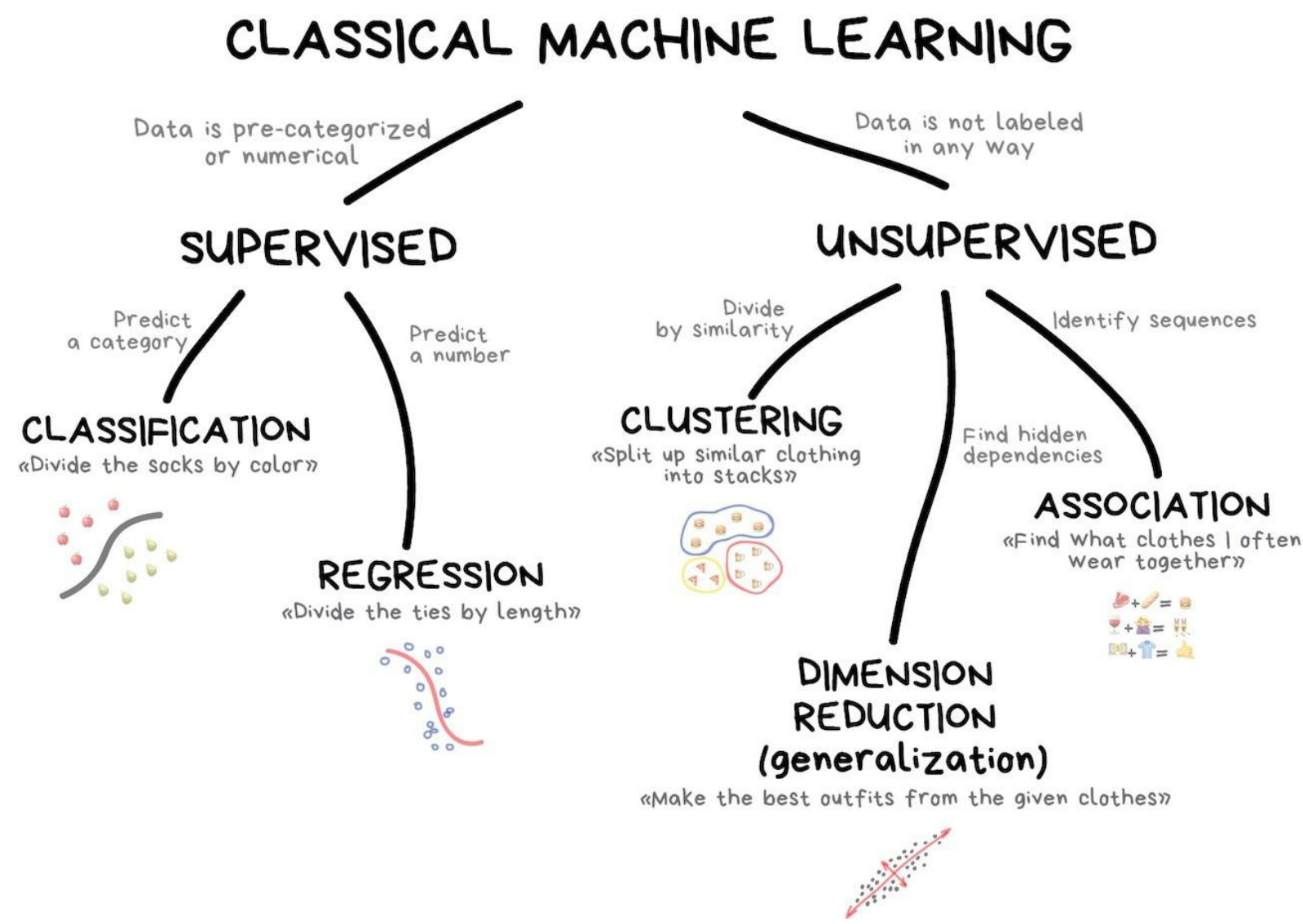
Source: Machine Learning for Everyone

Machine Learning Algorithm Selection (2 of 2)

Supervised Learning		Unsupervised Learning		
Classification	Regression	Clustering	Dimensionality Reduction	Association

1. Spam filtering

2. Fraud detection

3. Stock price forecasts

4. House Price

5. Customer Segmentation

6. Topic modeling and similar document search

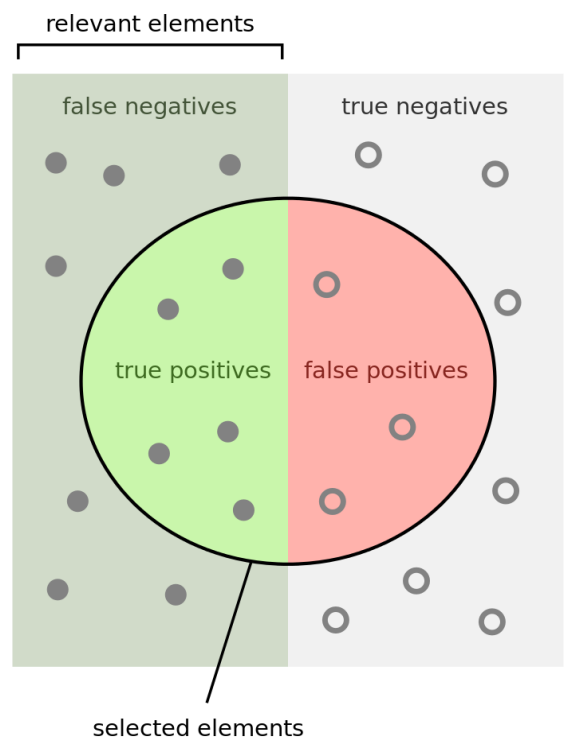7. To place the products on the shelves

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Machine Learning Algorithm Selection (2 of 2)

| Supervised Learning		Unsupervised Learning		
Classification	Regression	Clustering	Dimensionality Reduction	Association
Spam filtering Fraud detection	Stock price forecasts House Price	Customer Segmentation	Topic modeling and similar document search	To place the products on the shelves

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Measure Model Performance

relevant elements

false negatives

true negatives

true positives

false positives

selected elements

How many selected items are relevant?

How many relevant items are selected?

Precision =

Recall =

n=165	Predicted: NO	Predicted: YES	
Actual: NO	TN = 50	FP = 10	60
Actual: YES	FN = 5	TP = 100	105
	55	110	

What is Confusion Matrix?

Describes the performance of a classification model on a set of test data for which true values are known.

- **Accuracy:** Overall, how often is the classifier correct? (TP+TN)/total = (100+50)/165 = 0.91

- **Precision**: When it predicts yes, how often is it correct? (TP/predicted yes = 100/110 = 0.91)

- **Recall:** When it's yes, how often does it predict yes? (TP/actual yes = 100/105 = 0.95)

- **F1**: harmonic mean of precision and recall: (2 * precision * recall) / (precision + recall)
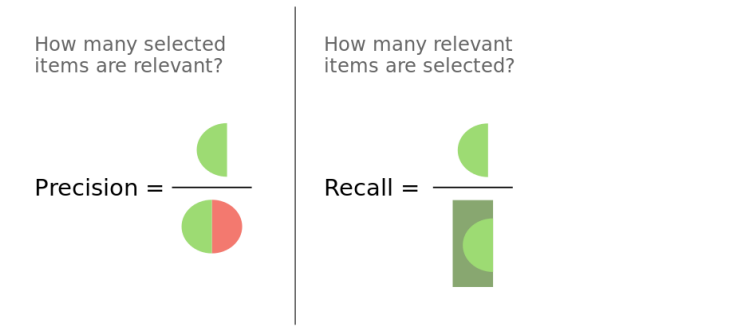
Source: Simple guide to confusion matrix terminology, Accuracy Paradox

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Model Evaluation

Model Name		Accuracy		Precision		Recall		F1 Score
	Metrics							
LogisticRegression	⬆	65%		63%		59%	↗	58%
SGDClassifier	⮕	55%		59%		58%	⮕	55%
SVM	↗	60%		59%		60%	↗	59%
KNeighborsClassifier	↗	56%		53%		53%	⮕	53%
GaussianProcessClassifier	⬆	62%		57%		55%	⮕	53%
MultinomialNB	⬆	62%		59%		57%	↗	57%
DecisionTreeClassifier	↗	56%		54%		54%	⮕	54%
RandomForestClassifier	↗	60%		55%		54%	⮕	53%
GradientBoostingClassifier	⬆	**67%**		**64%**		**62%**	⬆	**62%**
VotingClassifier	⬆	63%		59%		55%	⮕	52%
MLPClassifier	⬆	62%		31%		50%	⬇	38%

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Demonstration

The algorithm consumes multiple signals (time, geography, spend, and sentiments) and gives the non promoter predictions. The objective is to proactively identify poor customer experience and address customer issues.

Day 1   Day 10   Day 20   Day N (unknown)

Journey of a Customer Case (CS010XXXX)

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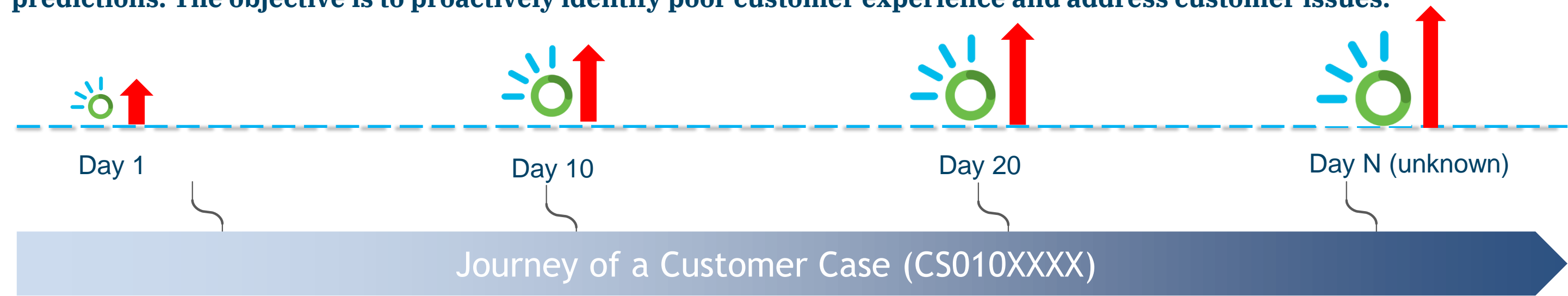
Lab: Instructions

Run the following section in the notebook.

7. Split data into train and test sets

8. Measure Model Performance

9. Evaluate and Select Model

Exercise

4. What modeling techniques would you attempt, and metrics would you use to evaluate the model performance?

Consider the type of output you are generating and choose an appropriate technique for the model. Remember, accuracy, precision, recall, F1 and think about "explainability" of the model results.

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Business understanding	Data understanding	Data preparation	Modeling	Evaluation	Deployment

Selection	Performance Metrics	Evaluation	Demonstration	Lab	Exercise	Take-away

Take away

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✓ Assess the situation, understand the methodology, identify the benchmarks, and define business objectives

✓ Introduction to Notebook, load packages and verify the versions

✓ Explore the data set and perform quality audit

✓ Extract, scale, and select features for the data model

✓ Split data into train & test sets, select model, evaluate performance metrics, and demonstrate
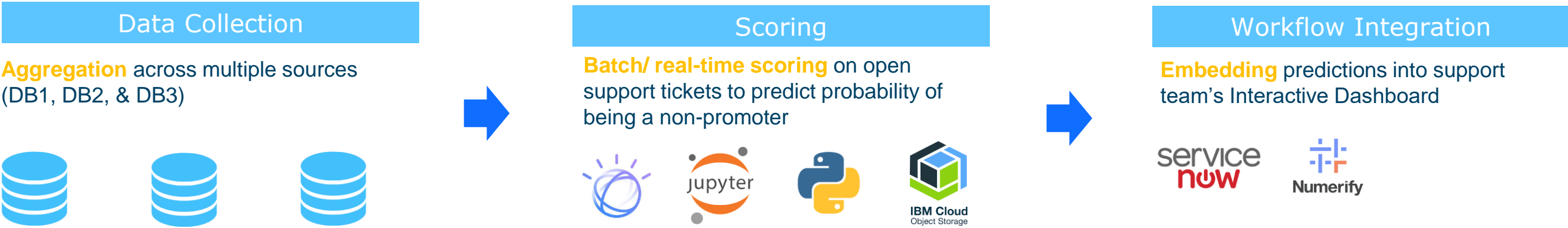
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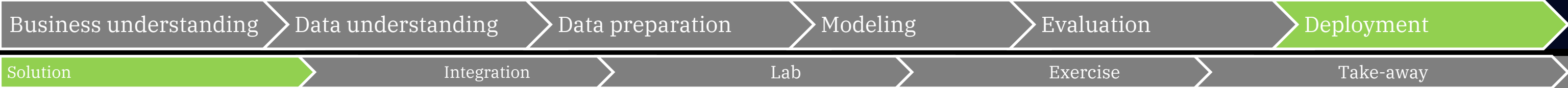
Proposed Solution

The model developed as a part of the hack uses artificial intelligence and machine learning to predict Non-Promoters on historical data pattern. Key aspects of approach include,
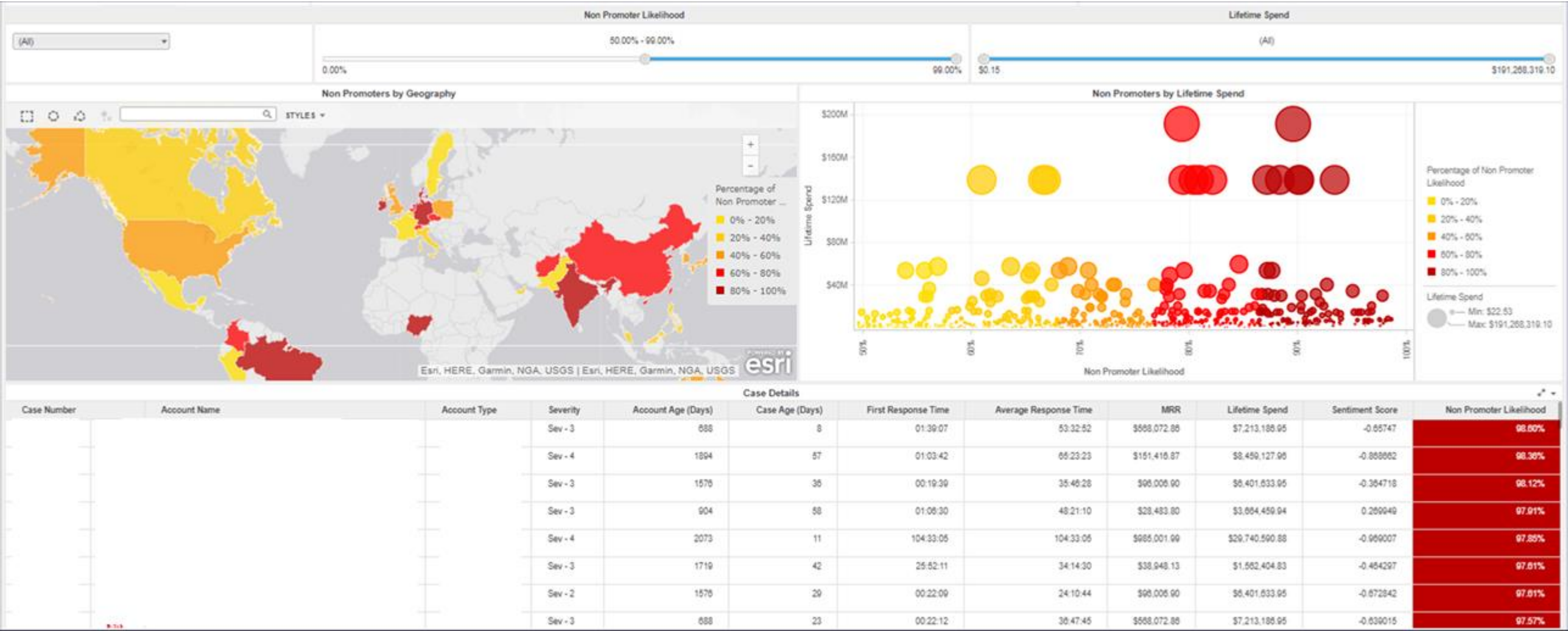
1. Watson NLP to create additional features from customer conversation logs

2. Machine Learning algorithms to produce the predictions

Data Collection

Aggregation across multiple sources (DB1, DB2, & DB3)

Scoring

Batch/ real-time scoring on open support tickets to predict probability of being a non-promoter

jupyter

IBM Cloud
Object Storage

Workflow Integration

Embedding predictions into support team's Interactive Dashboard

service now

Numerify

IBM

Solution Integration
"Ideas are easy, Execution is everything." John Doerr

NPS Predictions Board

Note: This visual highlighted above is crafted for workshop purpose.
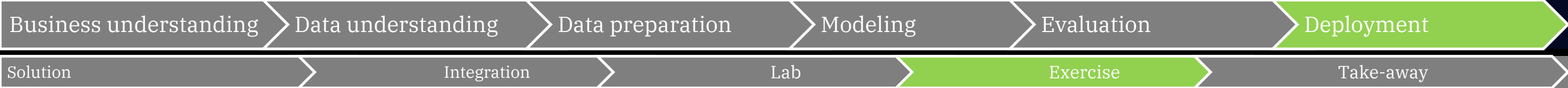
Lab: Instructions

Run the following section in the notebook.
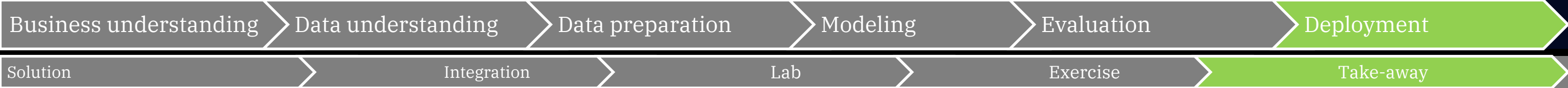
10. Save the Model

11. Deploy the Model

12. Predict Cases

Exercise

5. How do you plan to consume the outputs of model?

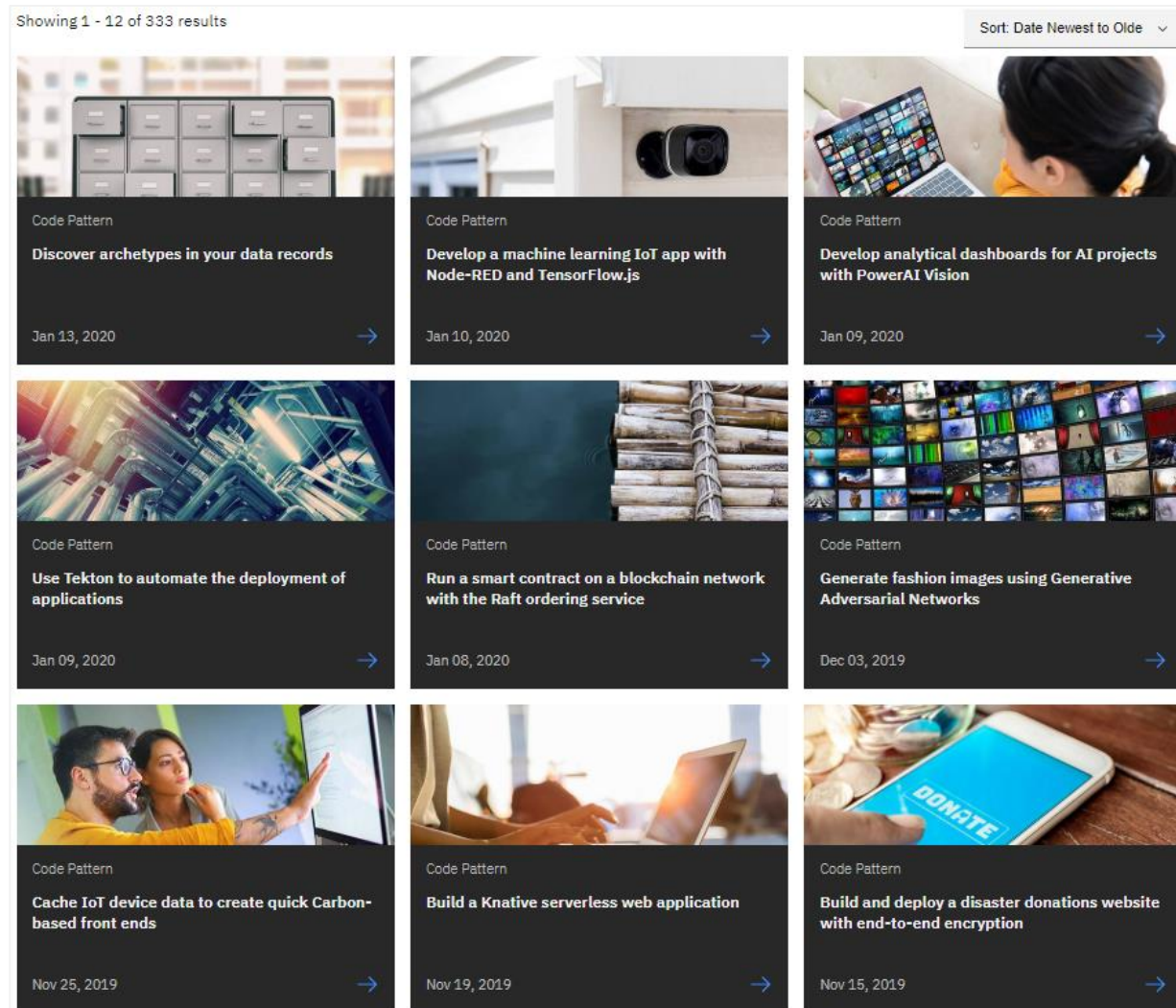**Consider dashboards, reports, visualizations or automated decisions. Describe how the end user interacts with results.**

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| Business understanding | > | Data understanding | > | Data preparation | > | Modeling | > | Evaluation | > | Deployment |

| Solution | > | Integration | > | Lab | > | Exercise | > | Take-away |

Take away

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✓ Extract, scale, and select features for the data model

✓ Split data into train & test sets, select model, evaluate performance metrics, and demonstrate

✓ **Generate ideas on how to consume the predictions and integrate solution in business systems**

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IBM Code Patterns

Link: https://developer.ibm.com/patterns/

Contact Us

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Thank you

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