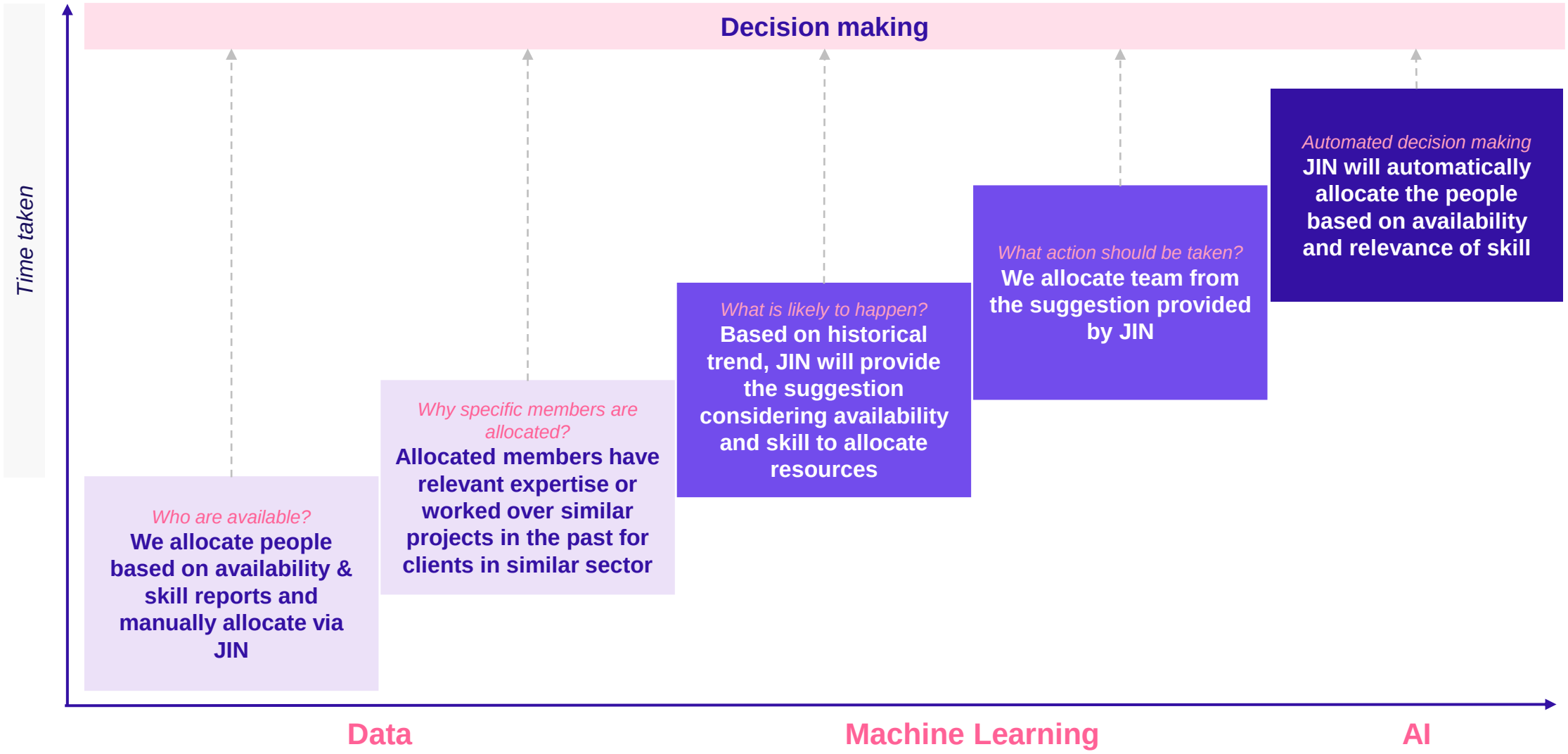
DS - Introduction

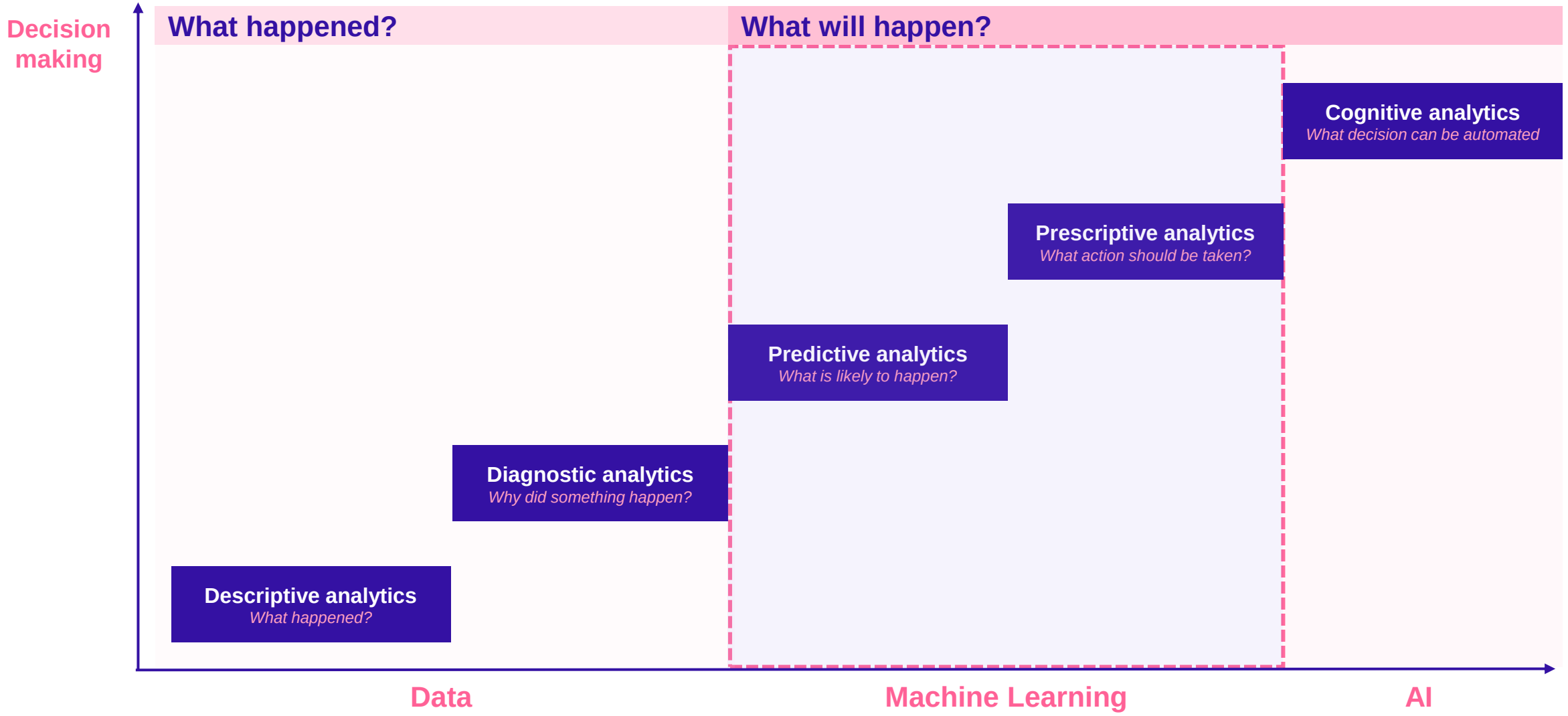
Data Science Sessions

1. Introduction & EDA
2. Feature Engineering & Selection
3. Model Training & Evaluation
4. ML through commercial lens
5. ML Ops
6. NLP

We have a request to allocate 5 member team for churn analysis project, how does an effective resourcing process take place?



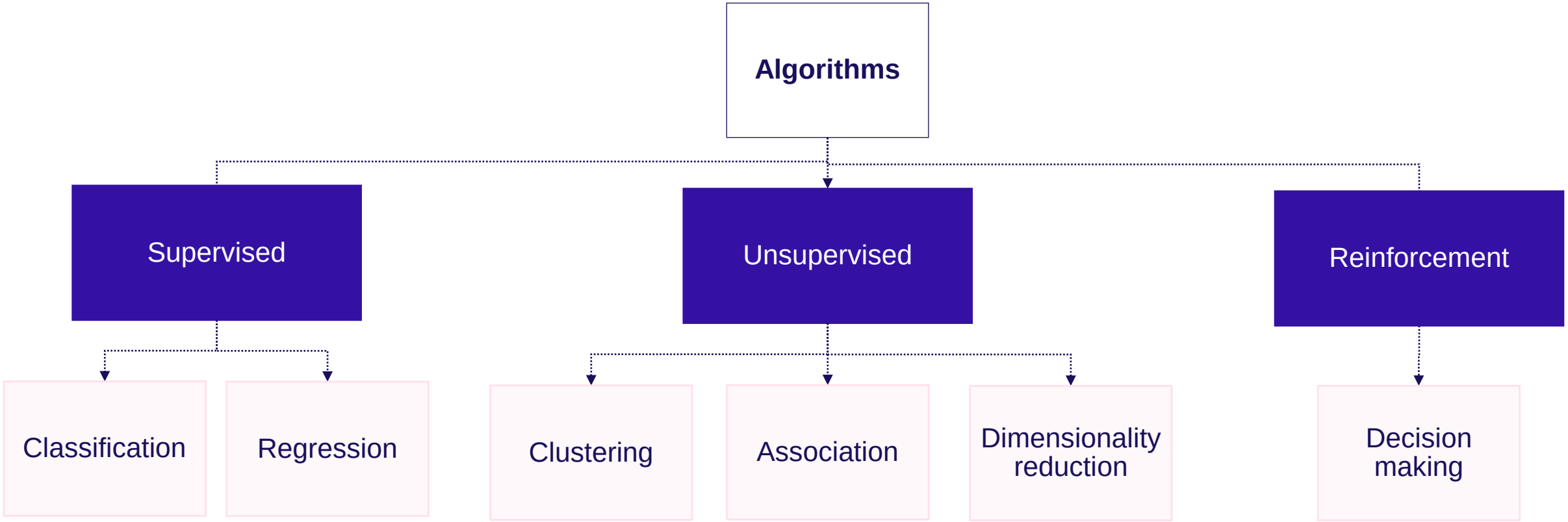
Machine learning is one step further from data warehouse to automate decision making



Why machine learning?

Machines can learn from data to **identify patterns** and **behaviours**, which can then be used to make **logical decisions** with less **human intervention**

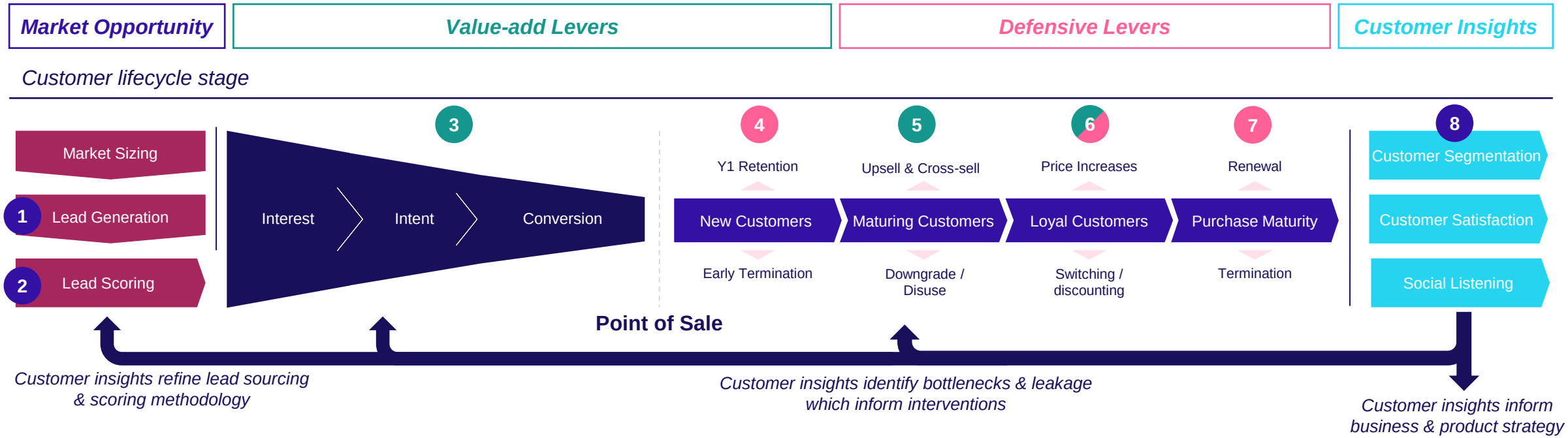
Machine learning algorithms can be broadly classified into three areas: supervised learning, unsupervised learning, and reinforcement learning



Use cases so far JMAN solved in machine learning

	Use case	*Approach*
1	**Churn prediction and compliance**	**Classification**
2	**Revenue forecasting**	**Regression**
3	**Lead conversion**	**Classification**
4	**Promotion analysis**	**Classification**
5	**Customer life-time value**	**Regression**

We build analytical solutions that deliver ROI across the customer lifecycle, using AI and machine learning to generate actionable insights



Where JMAN tools can support

1 *Lead Generation*
Extract information from external sources / websites to support efficient lead generation & audience segments

2 *Lead Scoring*
Identify priority leads for marketing & sales, supporting deployment of sales resources using e.g. page impressions

3 *Conversion Optimization*
Calculation of conversion & funnel statistics (i.e., LTV, CAC) by customer seg. geography & other key splits

4 *Y1 Retention*
Identify customers at risk of churn, informing onboarding and providing teams with a clear path for mitigation

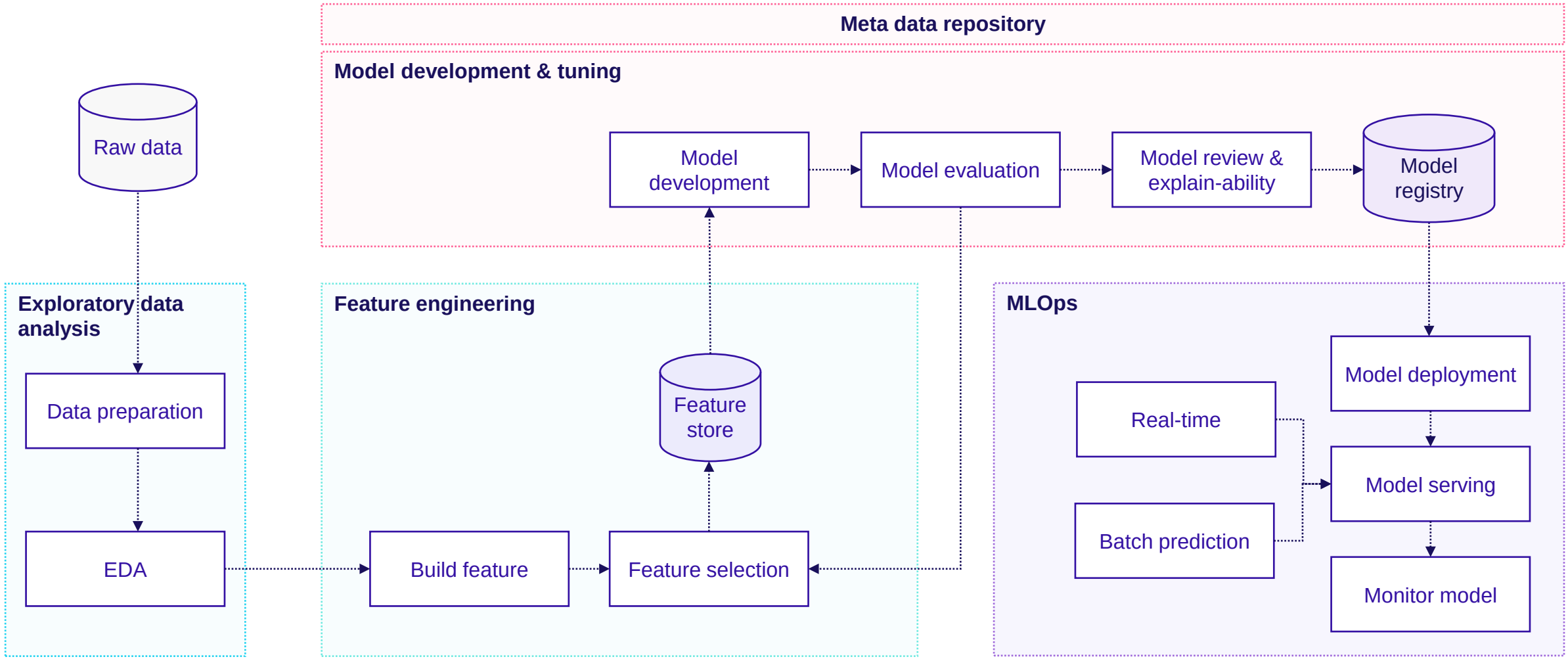
5 *Upsell & Cross-sell*
Drive growth in existing customer base, opportunities for cross-sell & upsell, e.g editorial vs events vs data

6 *Price Increases*
Optimize pricing strategy, identifying customer groups where there is opportunity to raise prices vs do nothing

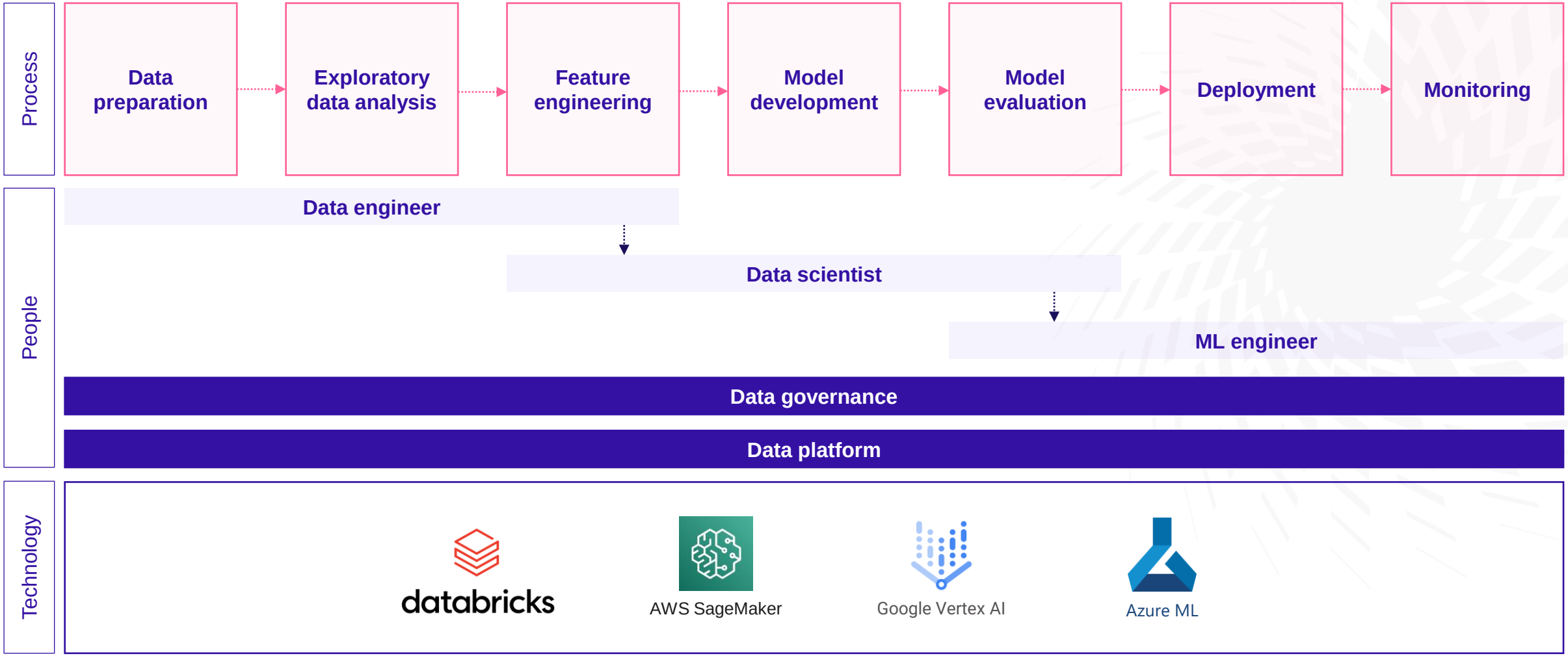
7 *Renewal Retention (Churn)*
Flag customers at risk of not renewing, providing a playbook for retention through engagement and offers

8 *Customer Insight*
Develop customer personas using core characteristics & usage, feeding insights back to the business

Machine learning end-to-end components



Process, People & Technology



JMAN GROUP

Exploratory Data Analysis

Context

1 Introduction

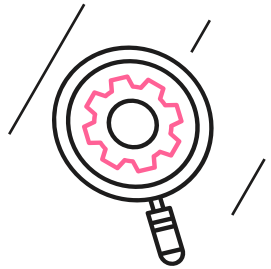
2 Data Preparation

3 Exploratory Data Analysis

4 About the data (Problem Statement)

What is EDA?

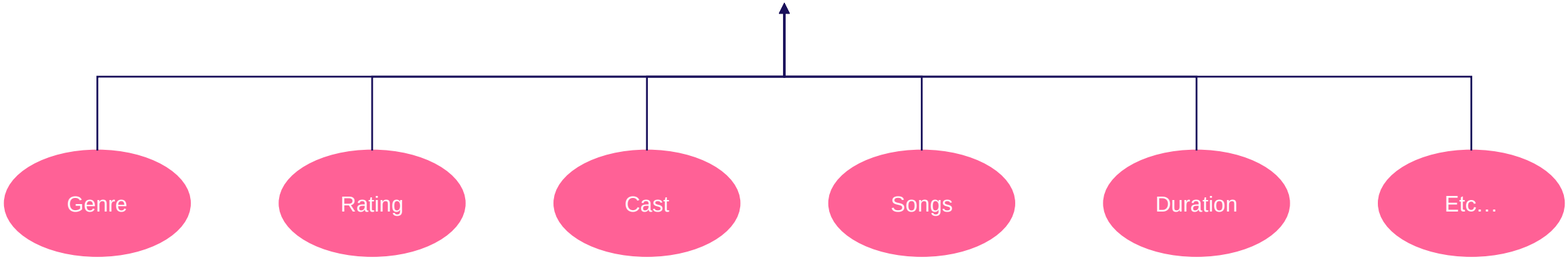
Exploratory Data Analysis (EDA) in data science is the process of examining and visualizing a dataset to understand its main characteristics, patterns, and relationships. It involves using statistical methods and visualizations to uncover insights, identify outliers, and inform subsequent steps in data analysis.



Why we need EDA?

EDA helps in making helpful decisions

Scenario: You are planning a movie night and want to pick a movie everyone will enjoy. Each of them have a listed their potential movies everyone will like, and you want to make a decision based on certain criteria.



All the question mentioned above helps us in building a hypothesis on which movie will be best for the occasion and guess what this called **Exploratory Data Analysis (EDA)**

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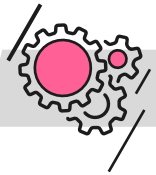
Target and features variables



Feature

- Features are crucial for any machine learning task as they encode the information needed for the model to learn patterns and make predictions.
- For example, for describing a fruit we might use its **color**, **shape**, and **size** which will be knows as feature in this case .
- In the sense of data is nothing just **columns** in the dataset.
  - Example – all columns in our dataset except Churn, and Customer Id.

Target

- The target variable is the **variable of interest**, and it represents the outcome or result that the model is trained to predict.
- In the given dataset our target variable is **Churn.** Which represents whether a customer has left the company service or still using the service.

Types of features variables

Columns in the data are referred as feature in ML

1

Categorial Feature

Categorical features are data attributes with specific groups or labels, like names or numbers, used to group data into distinct categories.

Examples:

- Gender - Male/Female
- Whether the customer churned or not (Yes or No)

2

Numerical Feature

Numerical features represent values across a range, aiding in predicting or describing continuous data and phenomena with versatile precision.

Examples:

- The total amount charged to the customer
- The amount charged to the customer monthly

3

Date Time Feature

A date-time feature is a variable that represents a point in time, typically expressed as a combination of year, month, day, hour, minute, and second.

Examples:

Order placement date and time, e.g. "2022-02-17 14:30:00", is a date-time feature in a customer order dataset, enabling ML algorithms to identify patterns and relations in order timing.

Note: *We will be covering features in more details in upcoming sessions*

Data cleaning is essential for building correct assumptions on data

What is data cleaning?

- Cleaning and pre-processing data involves deleting null values and duplicates to assure the dataset's quality and accuracy.

Ways to do data cleaning:

- Analyse the proportion of null values and duplicates in relation to the total size of the dataset.
- Consider the possibility of data loss if a large amount of your data is missing or duplicated.
- Identify and handle outliers to prevent them from skewing analysis results.

Why is Data cleaning required?

- High-quality data leads to better model performance in machine learning and analytics tasks.
- Guarantees that the dataset is free from errors or inconsistencies, which can otherwise lead to incorrect insights.

Removing Null Values(Missing Data)

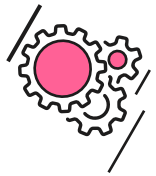
Removing Duplicate Values

Data Imputation

Technique used in Data pre-processing to fill in missing or incomplete values in a dataset

Mean, Median, Mode Imputation

- Replace missing values in the same feature/column with the mean (average), median (middle value), or mode (most frequent value).
- This method is straightforward and quick, but it may not capture complex data linkages.



Imputation using ML algorithms

- Missing values in sequential data can be interpolated using linear interpolation between nearby known values.
- Replace missing values in the feature space with values from the k-nearest neighbours.
- Using regression models trained on the remaining data, predict missing values.

Forward / Backward Fill

- To fill in missing values in time-series data, you can propagate the last observed value forward (forward fill) or the next observed value backward (backward fill).
- When missing values are likely to follow the trend of nearby data points, this function comes in handy.

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Hypothesis Building

A hypothesis is like a guess that you can check. It suggests a possible link between things, guiding your investigation during EDA by asking specific questions and looking for patterns in your data.

• **Understanding Data**	• EDA begins with the development of hypotheses to guide your analysis. • Hypotheses are educated estimates regarding data linkages, patterns, or trends.
• **Diving Insights**	• Hypotheses serve as road maps, directing your attention to key parts of the data. • Testing hypotheses can disclose useful information and guide further investigation.
• **Formulating Hypotheses**	• Specific, testable hypotheses based on domain expertise should be developed. • They frequently involve variable relationships or group comparisons.
• **Iterative Process**	• EDA is iterative, which means that hypotheses can change or evolve as new information is discovered.

Hypothesis Testing

• **Collecting Evidence**	• Gather data and explore visualizations during EDA to gather evidence for or against your hypothesis.
• **Visualization Tools**	• To identify patterns linked to your hypotheses, use histograms, scatter plots, box plots, and other visualizations.
• **Statistical Methods**	• To quantify relationships and establish the importance of your hypotheses, use proper statistical tests.
• **Interpretation**	• Based on the evidence collected, either accept or reject your hypotheses.
• **Refinement**	• If hypotheses are rejected, revise or reformulate them based on the analysis's new findings.

Data Visualization

Using graphical representations to communicate insights and patterns found within data

Helps in understanding complex data, identifying trends, and presenting information in a more understandable and actionable format.

1. **Bar Chart**
2. **Line Chart**
3. **Pie Chart**
4. **Histogram**
5. **Scatter Plot**
6. **Box Plot**

BAR CHART

When to Use?

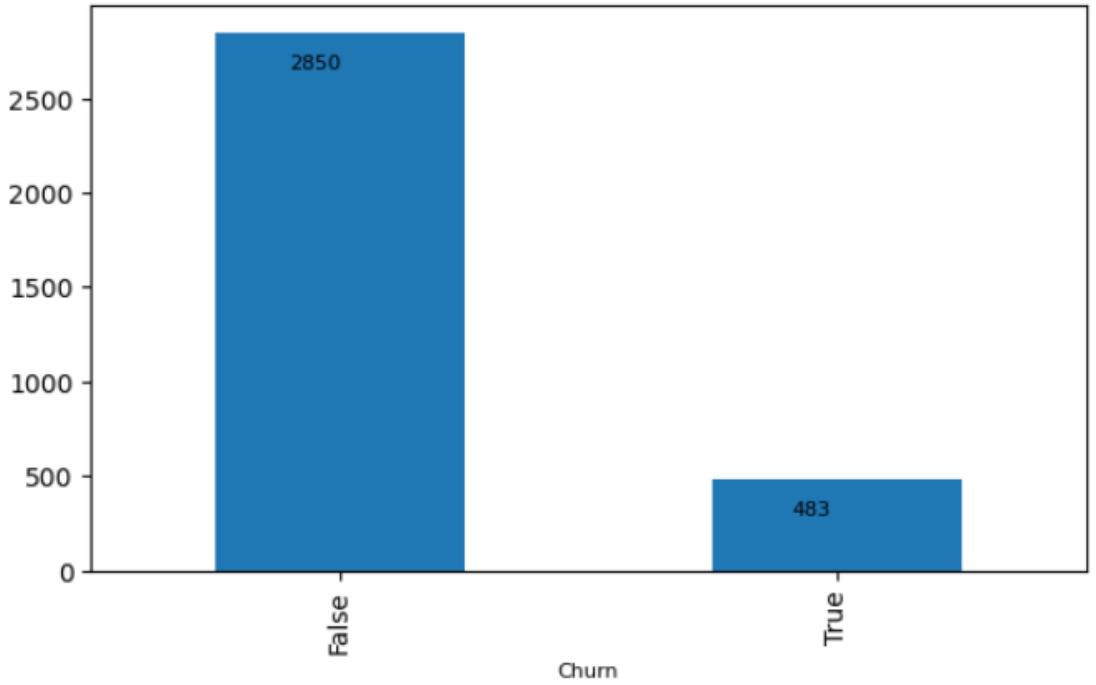
To compare the values of different categories. It is particularly useful for showing how different groups or items are distributed across categories.

Criteria for using a bar chart?

- Are you trying to compare the values of different categories?
- How many categories do you have?

Readability

- The vertical axis (y-axis) represents the values, while the horizontal axis (x-axis) displays the categories or items being compared.
- The length of each bar corresponds to the value it represents. Taller bars mean higher values.
- Categories are listed on the x-axis. Each bar is associated with a category.
- To compare values across categories, simply look at the height of the bars. Higher bars indicate larger values.



SCATTER PLOT

When to Use?

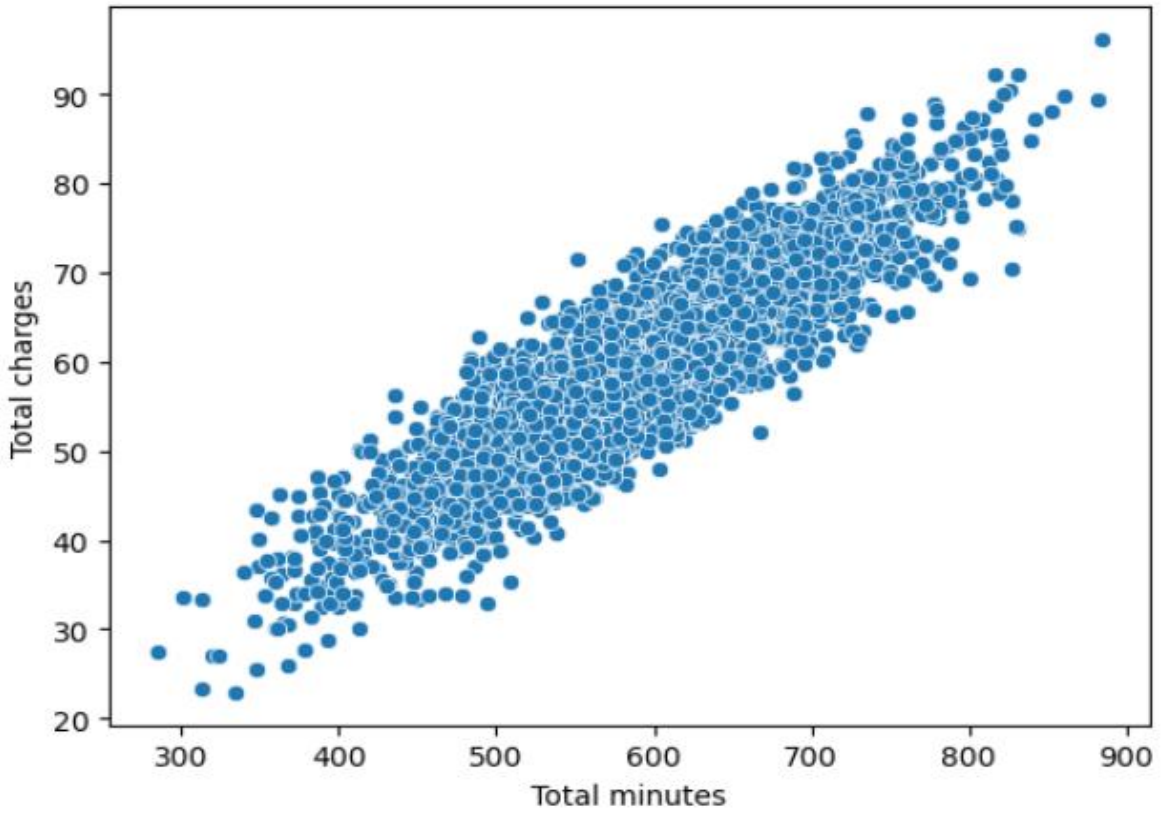
To visualize the strength and direction of a linear or nonlinear association between two variables.

Criteria for using a Scatter Plot?

- Are you trying to visualize how one variable affects another.?

Readability

- Direction: Check if points generally move upwards, indicating a positive relationship, downwards for a negative one, or are scattered with no clear trend for a lack of correlation.
- Spread: Assess how closely or widely points are distributed; a tight grouping suggests a strong correlation, while a more scattered arrangement indicates a weaker or no correlation.



BOX PLOT

When to Use?

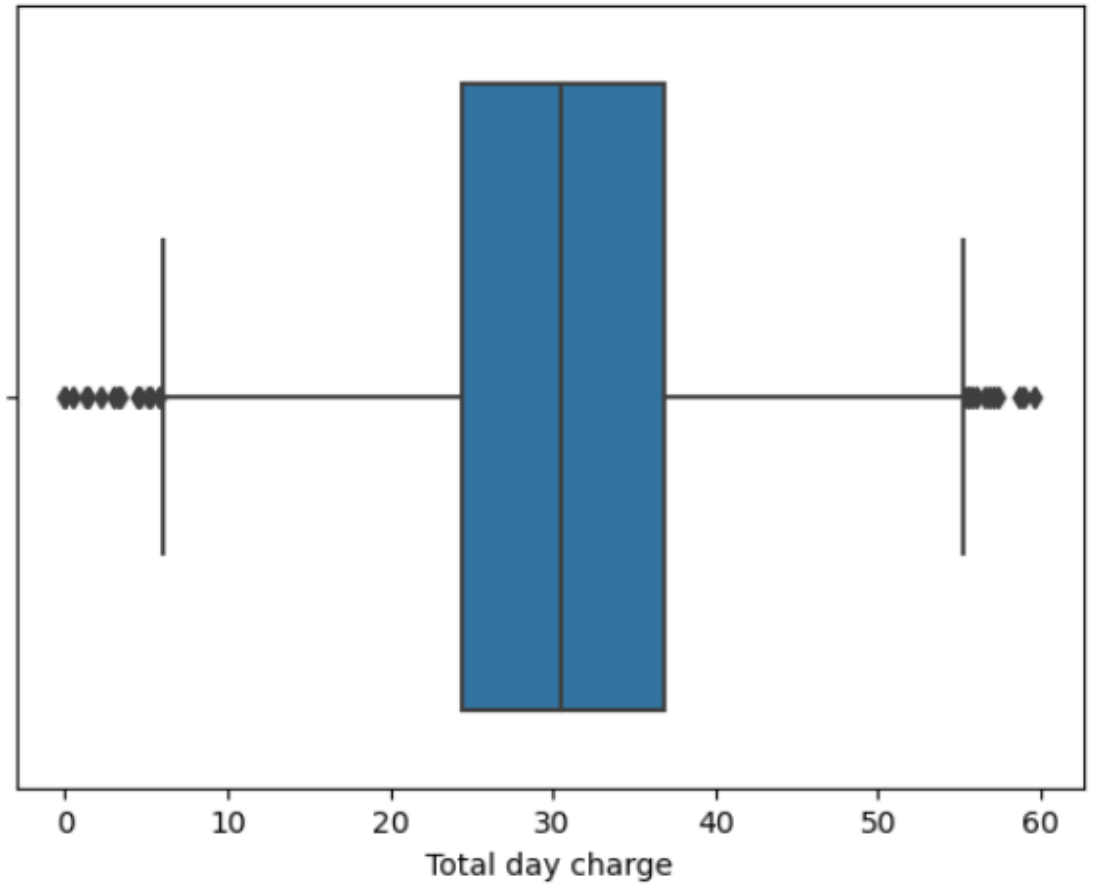
To visualize differences in the distribution of a variable between groups or to identify outliers within a group.

Criteria for using BOX PLOT?

- Are you trying to quickly identify outliers or unusual values in the data?

Readability

- Box: The box represents the interquartile range (IQR), containing the central 50% of the data points.
- Median Line: The line inside the box is the median, dividing the data into two equal halves.
- Whiskers: The lines extending from the box show the range of the data, excluding outliers.
- Outliers: Individual points outside the whiskers are potential outliers.



Problem statement

Telecom Churn analysis

Problem: The telecom industry faces a significant challenge with high customer churn rates, resulting in lost revenue and decreased market share.

The client have lots of data points which might be helpful to identify the customer behaviour. By understanding these drivers, we develop targeted interventions to retain customers and increase overall satisfaction.

Assumption

By looking at the Problem statement we can make few assumption on why customer could be churning:

- Customers who have been with the telecom company for a longer duration are less likely to churn.
- Customers who recently upgraded their plans or added new services are less likely to churn.
- Customers who have received special offers or discounts are less likely to churn.
- Churn rates vary between different service areas or regions.

It is essential to understand the business goals and objectives before selecting a machine learning approach

Problem: The company has observed a gradual decline in revenue over a period

Background

A subscription-based service company, experiencing a ***decrease in the revenue*** due to number of customers discontinuing the service, which is impacting business growth. The company wants to understand how they can retain the customer and increase ***Gross Retention Revenue (GRR)***

Objective

- Create a plan and set of actions to increase the revenue by increasing customer retention
  - Set of actions that needs to be automated to reduce the churn rate
    - Identify the external factors driving churn rate, if any
  - Identify the customer retention cost to compare with customer lifetime value

Questions to ask before make the decision of machine learning is fit for purpose

Business landscape	Data landscape	Existing playbook
What is the potential upside from reducing churn on ARR and EV?	*What data exists to test the hypotheses identified?*	*Is there an existing retention playbook?*
Why do we think customers churn?	*Is the data reliable?*	*Is it fit for purpose?*
Can we make interventions to impact this if we knew about it in advance?	*How far back does the data go?*	*What additional actions could we take to prevent churn?*
What is the significant amount of value and efficiency business can expect?	*Is the volume of churn/renewals significant enough to build a predictive model?*	*???*

Telco Customer Churn Dataset

The Dataset we will be using throughout this exercise is a Telco Customer Churn, below are the few information about the dataset:

- The Dataset contains the Customer details who left within the last month in the column called **Churn.**
- **Services that each customer** has signed up for example - phone, multiple lines, internet, online security, online backup, device protection, tech support, and streaming TV and movies
- Customer account information - how long they've been a customer, **contract**, **payment method, paperless billing**, **monthly charges**, and **total charges**
- Demographic info about customers **– gender, age range**, and if they have **partners** and **dependents**

Information about the dataset columns

Column	Data type	Description
customerID	String	Customer ID
gender	String	Whether the customer is a male or a female
SeniorCitizen	Boolean	Whether the customer is a senior citizen or not (1, 0)
Partner	Boolean	Whether the customer has a partner or not (Yes, No)
Dependents	Boolean	Whether the customer has dependents or not (Yes, No)
tenure	Integer	Number of months the customer has stayed with the company
PhoneService	Boolean	Whether the customer has a phone service or not (Yes, No)
MultipleLines	String	Whether the customer has multiple lines or not (Yes, No, No phone service)
InternetService	String	Customer’s internet service provider (DSL, Fiber optic, No)

Continue…

Column	Data type	Description
OnlineSecurity	String	Whether the customer has online security or not (Yes, No, No internet service)
OnlineBackup	String	Whether the customer has online backup or not (Yes, No, No internet service)
DeviceProtection	String	Whether the customer has device protection or not (Yes, No, No internet service)
TechSupport	String	Whether the customer has tech support or not (Yes, No, No internet service)
StreamingTV	String	Whether the customer has streaming TV or not (Yes, No, No internet service)
StreamingMovies	String	Whether the customer has streaming movies or not (Yes, No, No internet service)
Contract	String	The contract term of the customer (Month-to-month, One year, Two year)
PaperlessBilling	Boolean	Whether the customer has paperless billing or not (Yes, No)
PaymentMethod	String	The customer's payment method (Electronic check, Mailed check, Bank transfer (automatic), Credit card (automatic))
MonthlyCharges	Decimal	The amount charged to the customer monthly
TotalCharges	Decimal	The total amount charged to the customer
Churn	String	Whether the customer churned or not (Yes or No)

Preview of telco customer churn dataset

customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	OnlineBackup	DeviceProtection	TechSupport	StreamingTV	StreamingMovies	Contract	PaperlessBilling	PaymentMethod	MonthlyCharges	TotalCharges	Churn
7590-VHVEG	Female	0	Yes	No	1	No	No phone service	DSL	No	Yes	No	No	No	No	Month-to-month	Yes	Electronic check	29.85	29.85	No
5575-GNVDE	Male	0	No	No	34	Yes	No	DSL	Yes	No	Yes	No	No	No	One year	No	Mailed check	56.95	1889.5	No
3668-QPYBK	Male	0	No	No	2	Yes	No	DSL	Yes	Yes	No	No	No	No	Month-to-month	Yes	Mailed check	53.85	108.15	Yes
7795-CFOCW	Male	0	No	No	45	No	No phone service	DSL	Yes	No	Yes	Yes	No	No	One year	No	Bank transfer (automatic)	42.3	1840.75	No
9237-HQITU	Female	0	No	No	2	Yes	No	Fiber optic	No	No	No	No	No	No	Month-to-month	Yes	Electronic check	70.7	151.65	Yes
9305-CDSKC	Female	0	No	No	8	Yes	Yes	Fiber optic	No	No	Yes	No	Yes	Yes	Month-to-month	Yes	Electronic check	99.65	820.5	Yes
1452-KIOVK	Male	0	No	Yes	22	Yes	Yes	Fiber optic	No	Yes	No	No	Yes	No	Month-to-month	Yes	Credit card (automatic)	89.1	1949.4	No
6713-OKOMC	Female	0	No	No	10	No	No phone service	DSL	Yes	No	No	No	No	No	Month-to-month	No	Mailed check	29.75	301.9	No
7892-POOKP	Female	0	Yes	No	28	Yes	Yes	Fiber optic	No	No	Yes	Yes	Yes	Yes	Month-to-month	Yes	Electronic check	104.8	3046.05	Yes
6388-TABGU	Male	0	No	Yes	62	Yes	No	DSL	Yes	Yes	No	No	No	No	One year	No	Bank transfer (automatic)	56.15	3487.95	No
9763-GRSKD	Male	0	Yes	Yes	13	Yes	No	DSL	Yes	No	No	No	No	No	Month-to-month	Yes	Mailed check	49.95	587.45	No
7469-LKBCI	Male	0	No	No	16	Yes	No	No	No internet service	No internet service	No internet service	No internet service	No internet service	No internet service	Two year	No	Credit card (automatic)	18.95	326.8	No
8091-TTVAX	Male	0	Yes	No	58	Yes	Yes	Fiber optic	No	No	Yes	No	Yes	Yes	One year	No	Credit card (automatic)	100.35	5681.1	No
0280-XJGEX	Male	0	No	No	49	Yes	Yes	Fiber optic	No	Yes	Yes	No	Yes	Yes	Month-to-month	Yes	Bank transfer (automatic)	103.7	5036.3	Yes

A well-implemented churn prediction model can provide businesses with a wealth of valuable insights, allowing to take proactive steps to retain customers

Retention strategy

- The company can proactively identify at-risk customers and develop targeted retention strategies to prevent churn (Customer Relation Manager (CRM) Playbook)
- Validating if the action from the Playbook is working as expected
- Identifying the action which can be automated to reduce the churn risk

Cost saving & efficiency

- By focusing on retaining existing customers, the company can reduce the cost of acquiring new customers to replace those who churn.

Revenue increase

- By reducing churn, the company can retain more customers and increase overall revenue **(GRR)**.