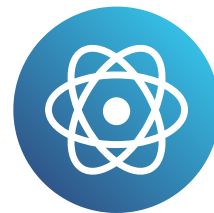


# Supervised machine learning

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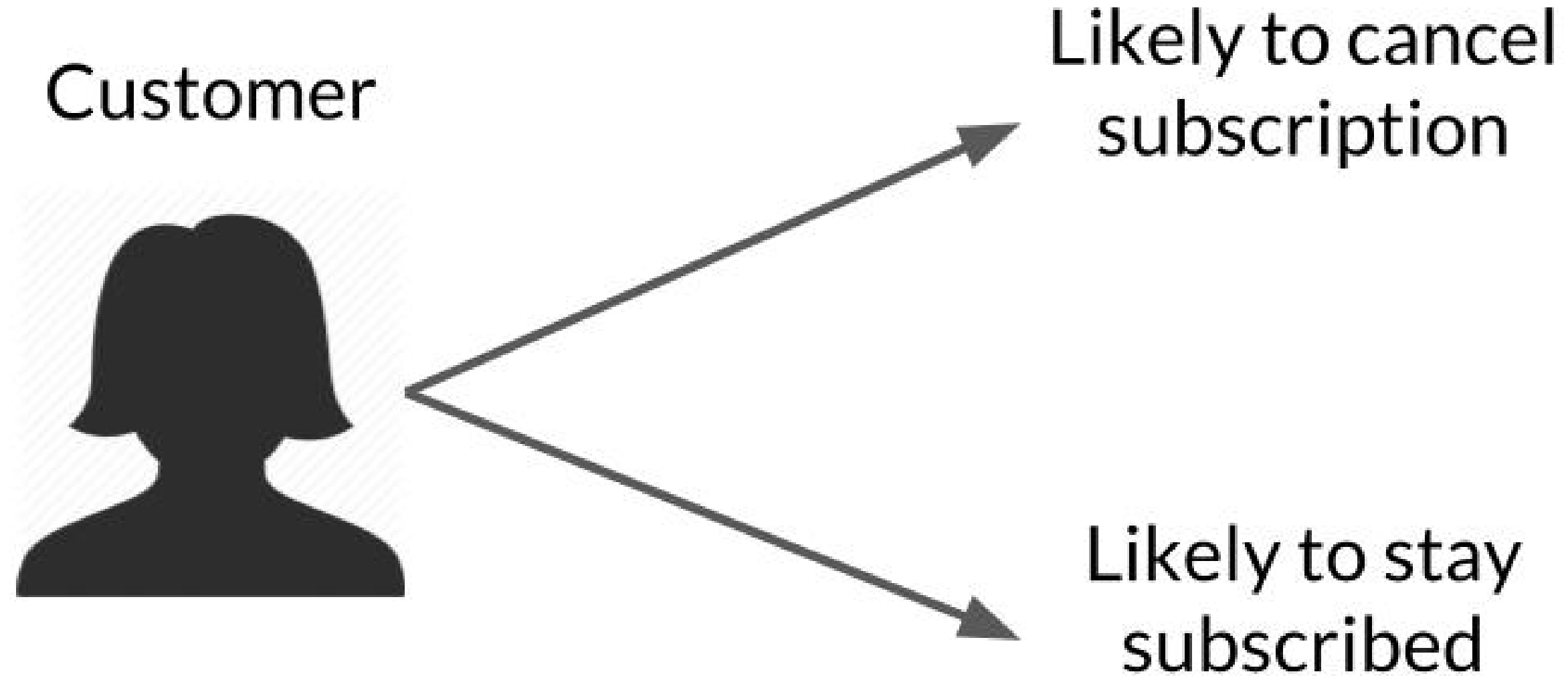
**Ramnath Vaidyanathan**

VP of Product Research, DataCamp

# What is supervised machine learning?

- Machine learning: Predictions from data
- ***Supervised machine learning***: Predictions from data with *labels* and *features*
  - Recommendation systems
  - Email subject optimization
  - Churn prediction

# Case study: churn prediction



# Case study: churn prediction

**Training  
Data:**  
Customers









# Case study: churn prediction



**Labels**  
Customer  
outcomes

churn
subscribe
subscribe
churn
subscribe
churn

# Case study: churn prediction

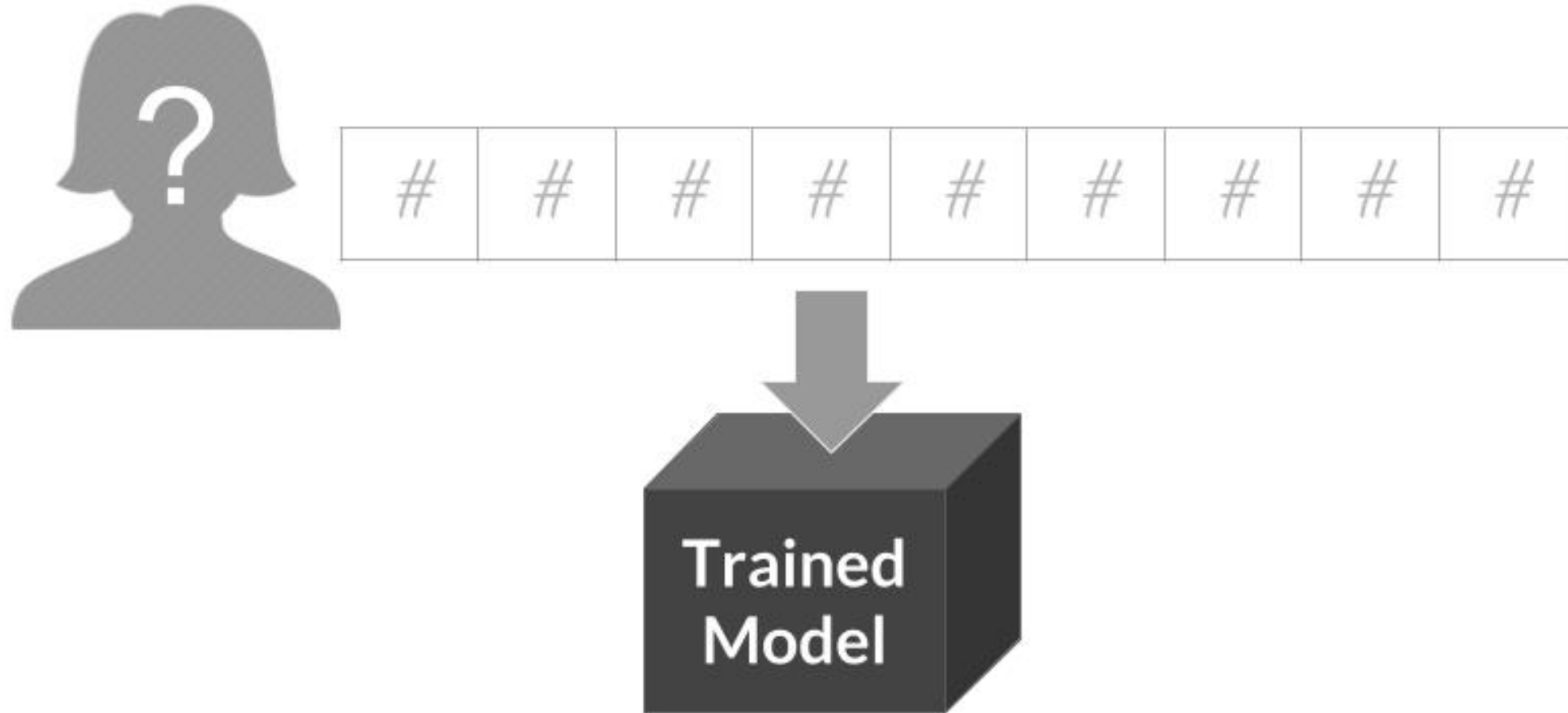
	Age	Gender	Date of last purchase?	Date of last visit?	Likes cats?	Household \$\$	Location	Number of Kids	Profession	
										churn
										subscribe
										subscribe
										churn
										subscribe
										churn

**Features:**  
Collected customer data

# Case study: churn prediction

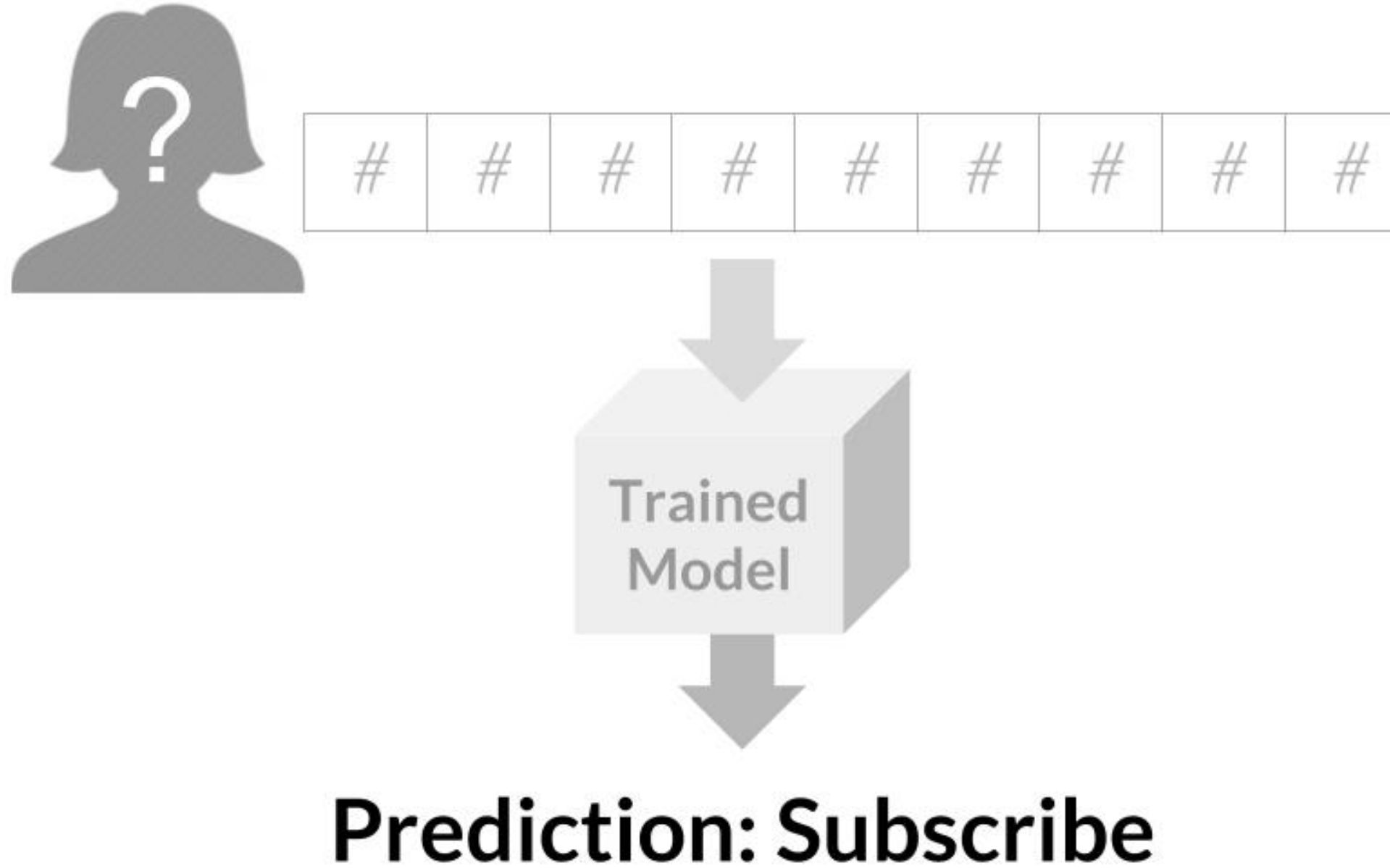


# Case study: churn prediction





# Case study: churn prediction



# Recap

- Make a prediction based on data
- Data has *features* and *labels*
  - Label: what we want to predict
  - Features: data that might predict the label
- Trained model can make predictions

# Model evaluation

Split historical data into training and testing sets



# Model evaluation

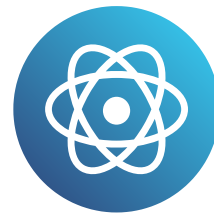
	Prediction	Reality
Churn	0%	3%
Remain	100%	97%

# Let's practice!

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# Clustering

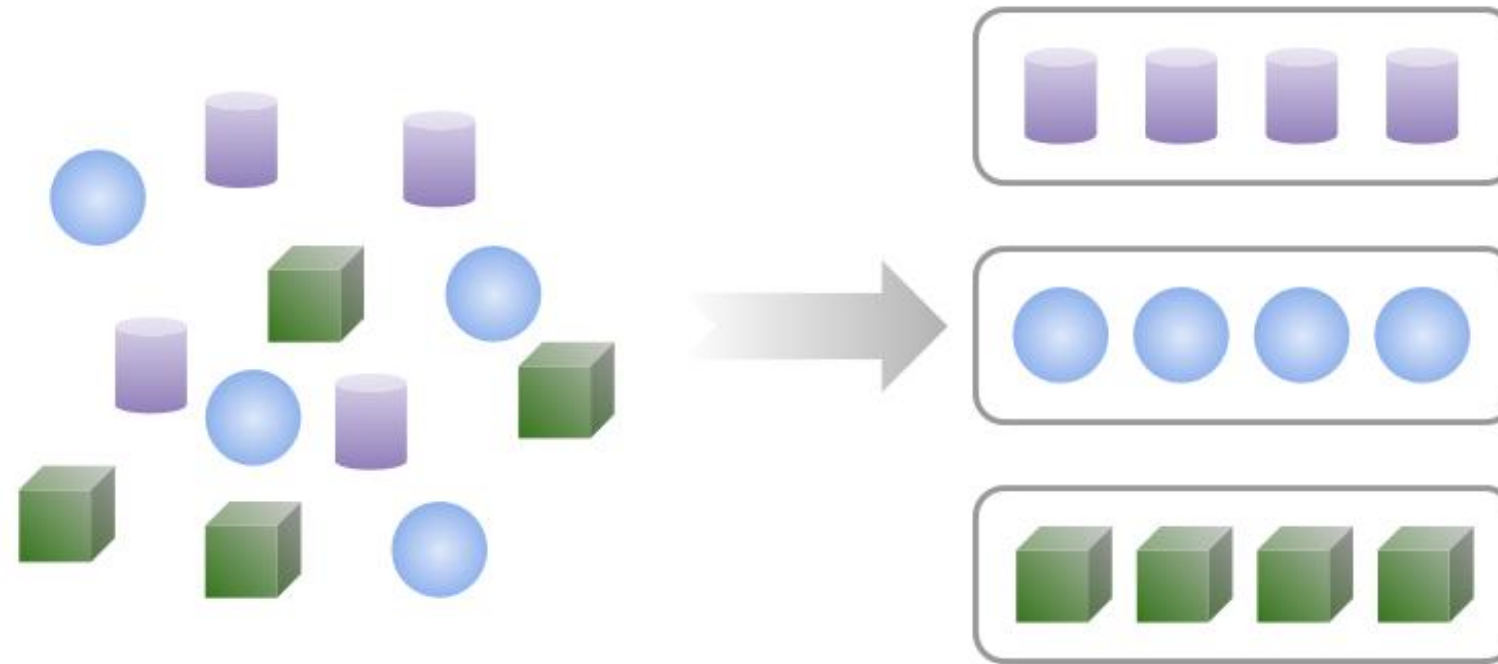
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# What is clustering?



- Divide data into categories
- Use cases
  - Customer segmentation
  - Image segmentation
  - Anomaly detection

# Supervised Machine Learning

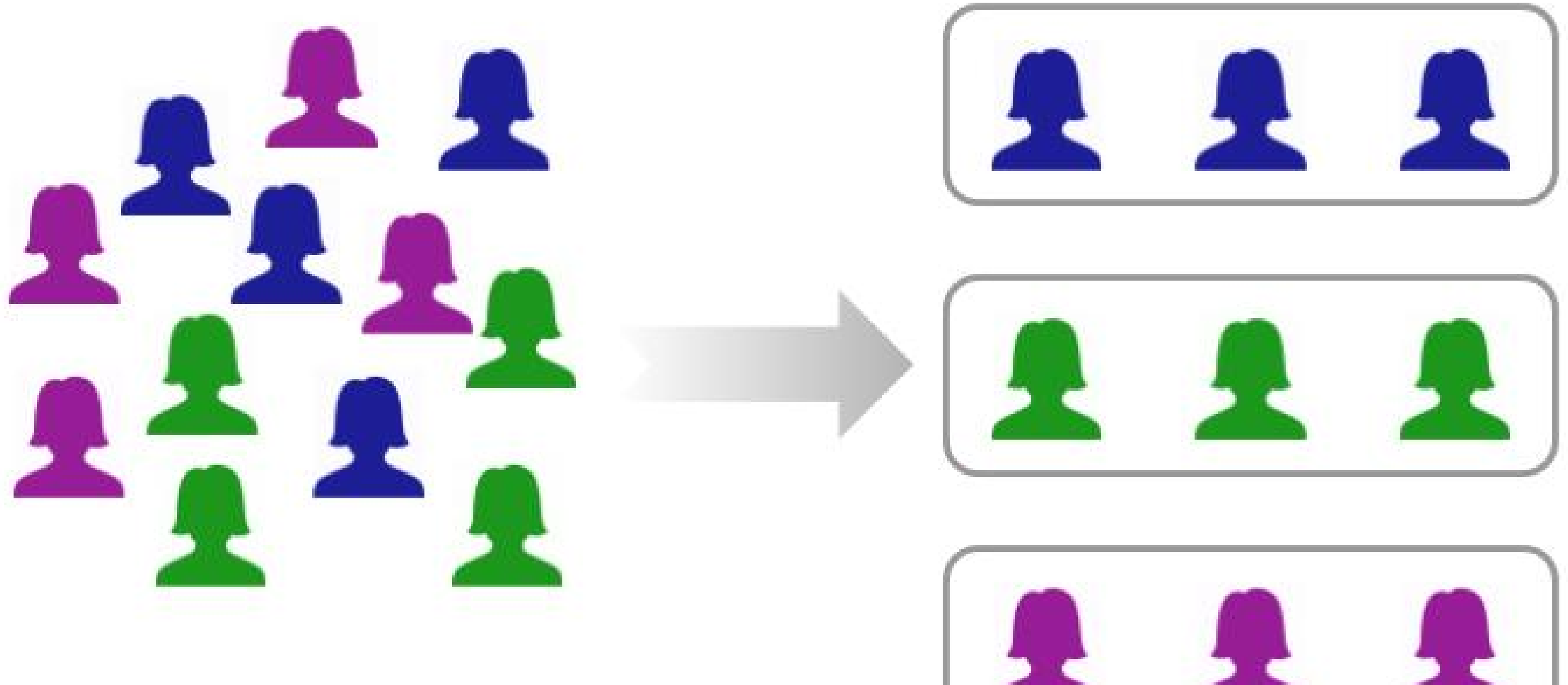
	Age	Gender	Date of last purchase?	Date of last visit?	Likes cats?	Household \$\$	Location	Number of Kids	Profession	
										churn
										subscribe
										subscribe
										churn
										subscribe
										churn

# Unsupervised Machine Learning

	Age	Gender	Date of last purchase?	Date of last visit?	Likes cats?	Household \$\$	Location	Number of Kids	Profession
									
									
									
									
									
									



# Case study: customer segmentation



# Case study: customer segmentation

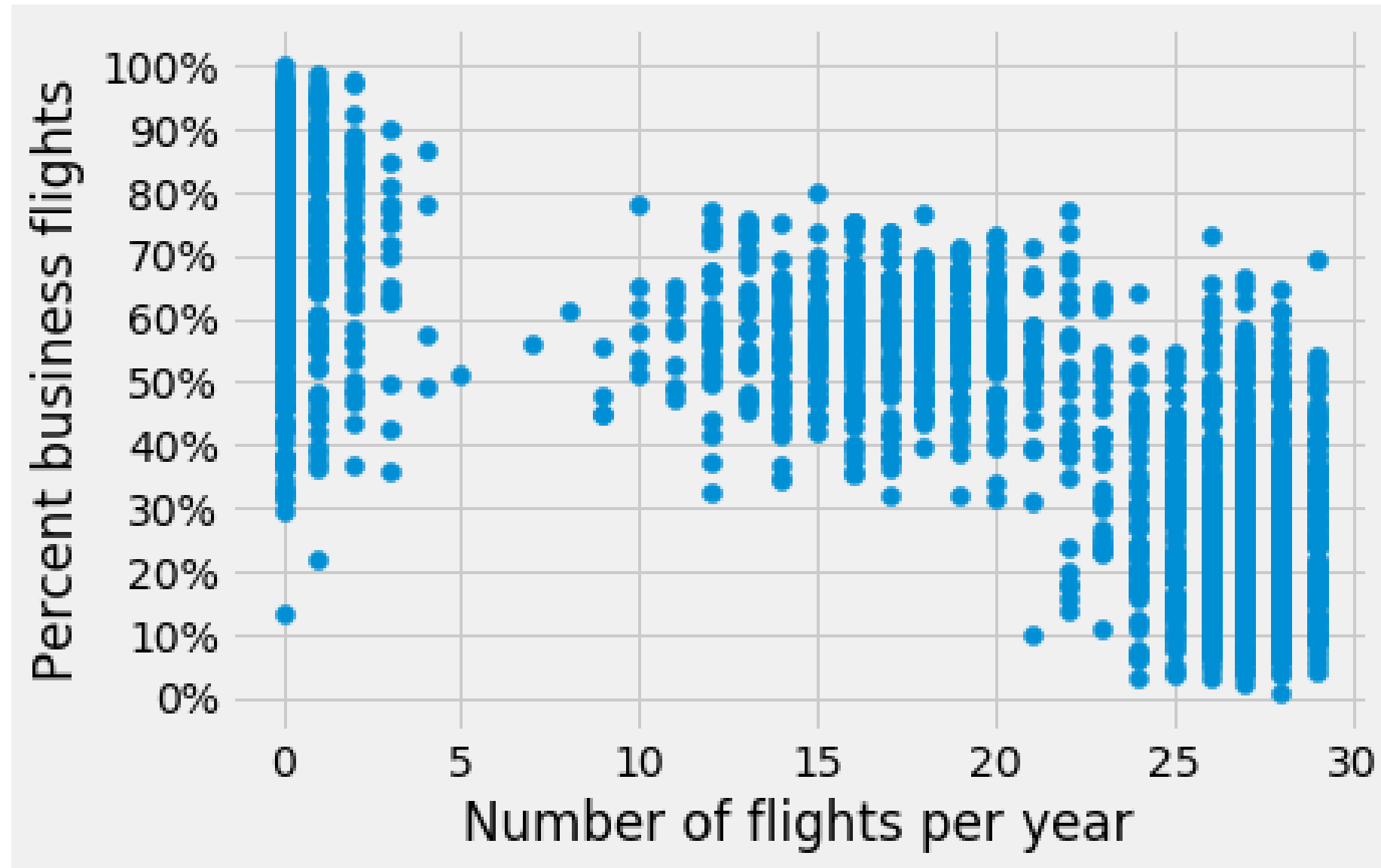
## Define features

- Number of flights in the past year
- Percent international
- Advanced planning
- Percent business class

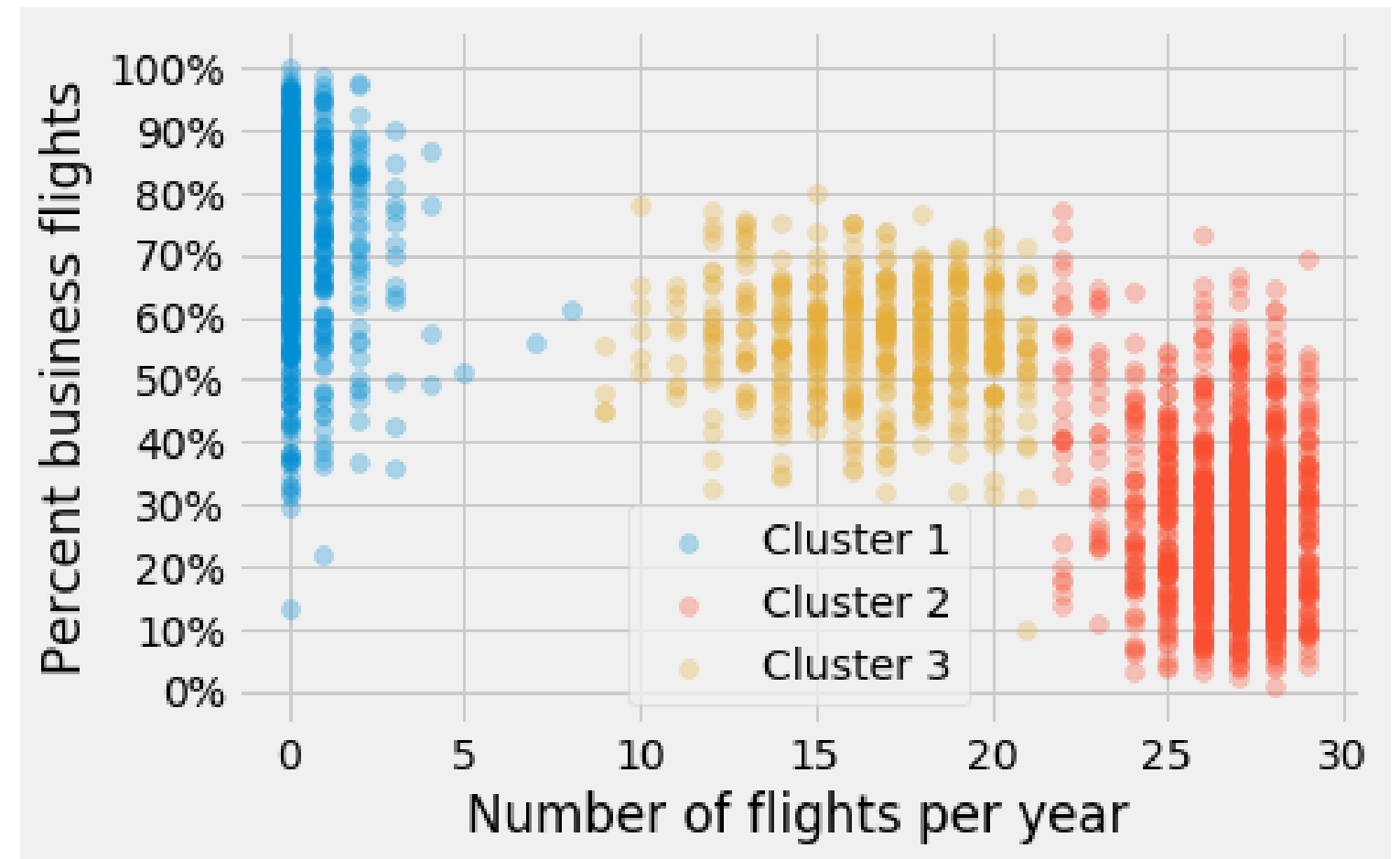
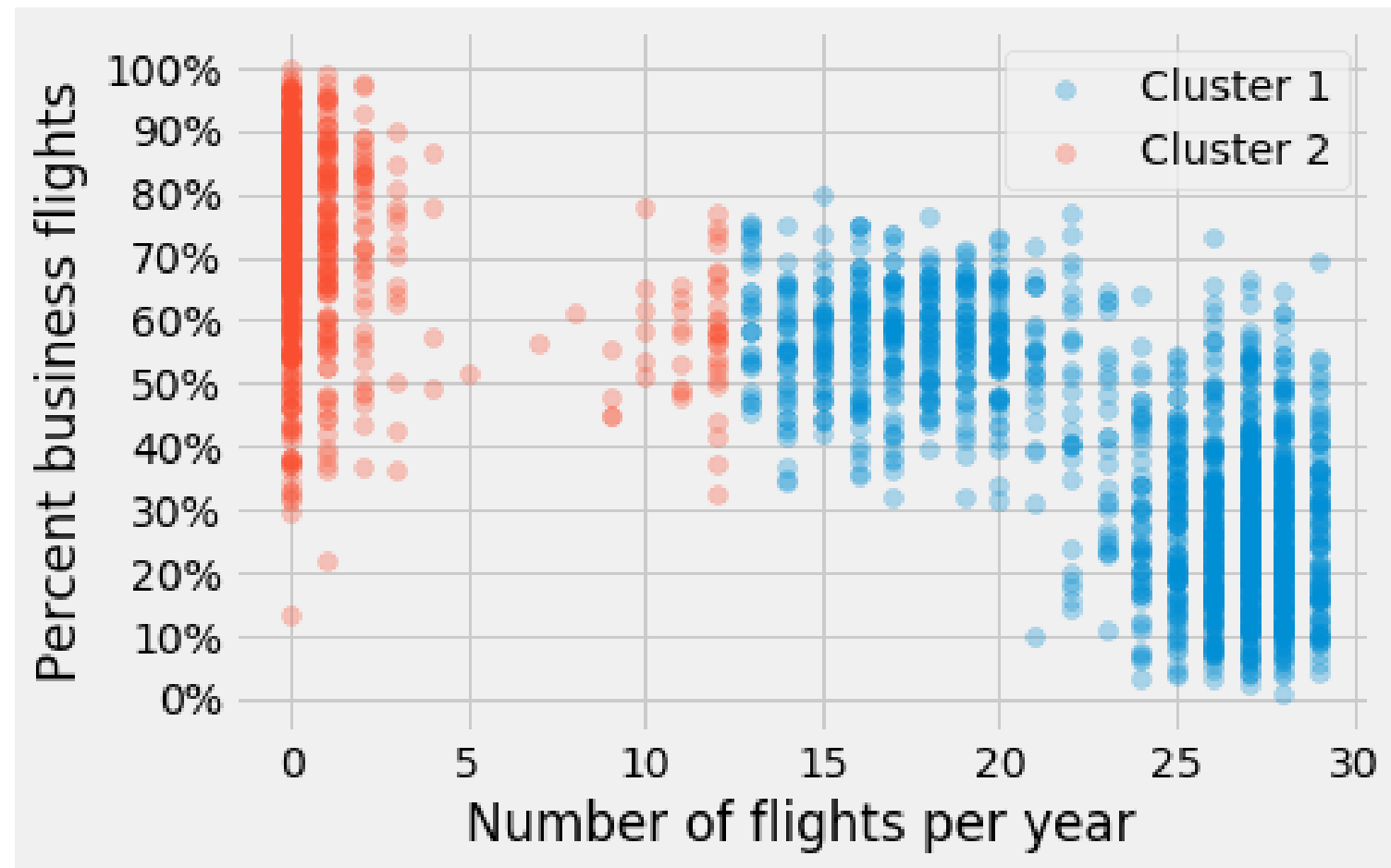


# Case study: customer segmentation

- Define number of clusters



# Case study: customer segmentation



# Clustering review

## Definition

- Divide unlabeled dataset into different categories

## Steps

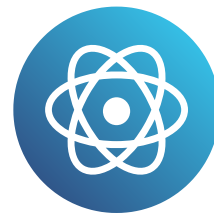
- Select features
- Select number of clusters
- Use clusters to solve business problems

# Let's practice!

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# Special topics in Machine Learning

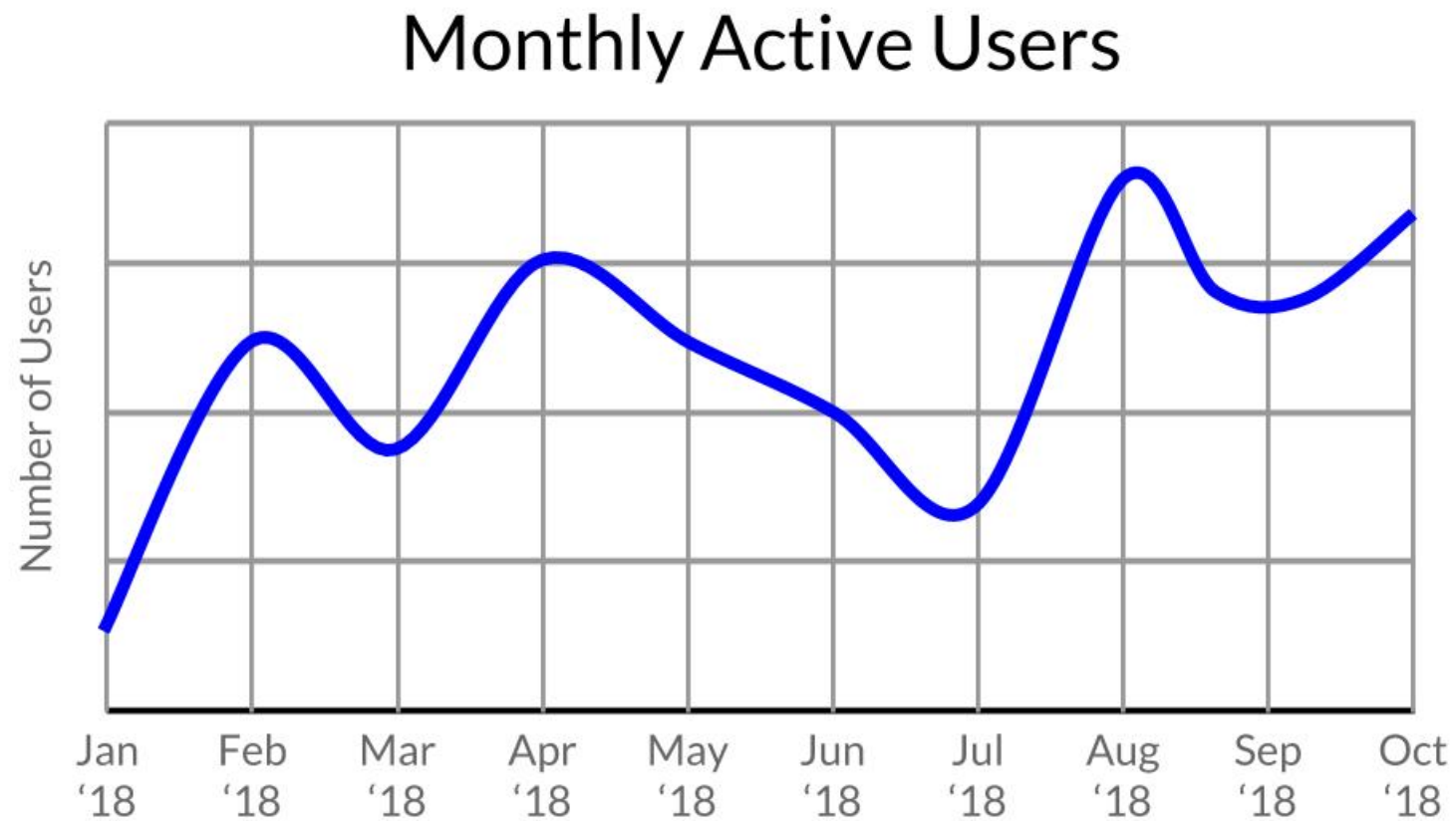
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# Time series forecasting



- Time is a feature
- Accounts for weekly, monthly, or yearly trends



# Seasonality

- **Weekly:** Lower television viewership on Fridays
- **Monthly:** Higher spending at end of pay periods
- **Yearly:** Less ice cream in the winter



# Natural Language Processing

- Dataset is text
  - Customer reviews
  - Tweets
  - Medical records
  - Email subjects
- Possible uses
  - Classifying sentiment
  - Clustering medical records



# Word counts

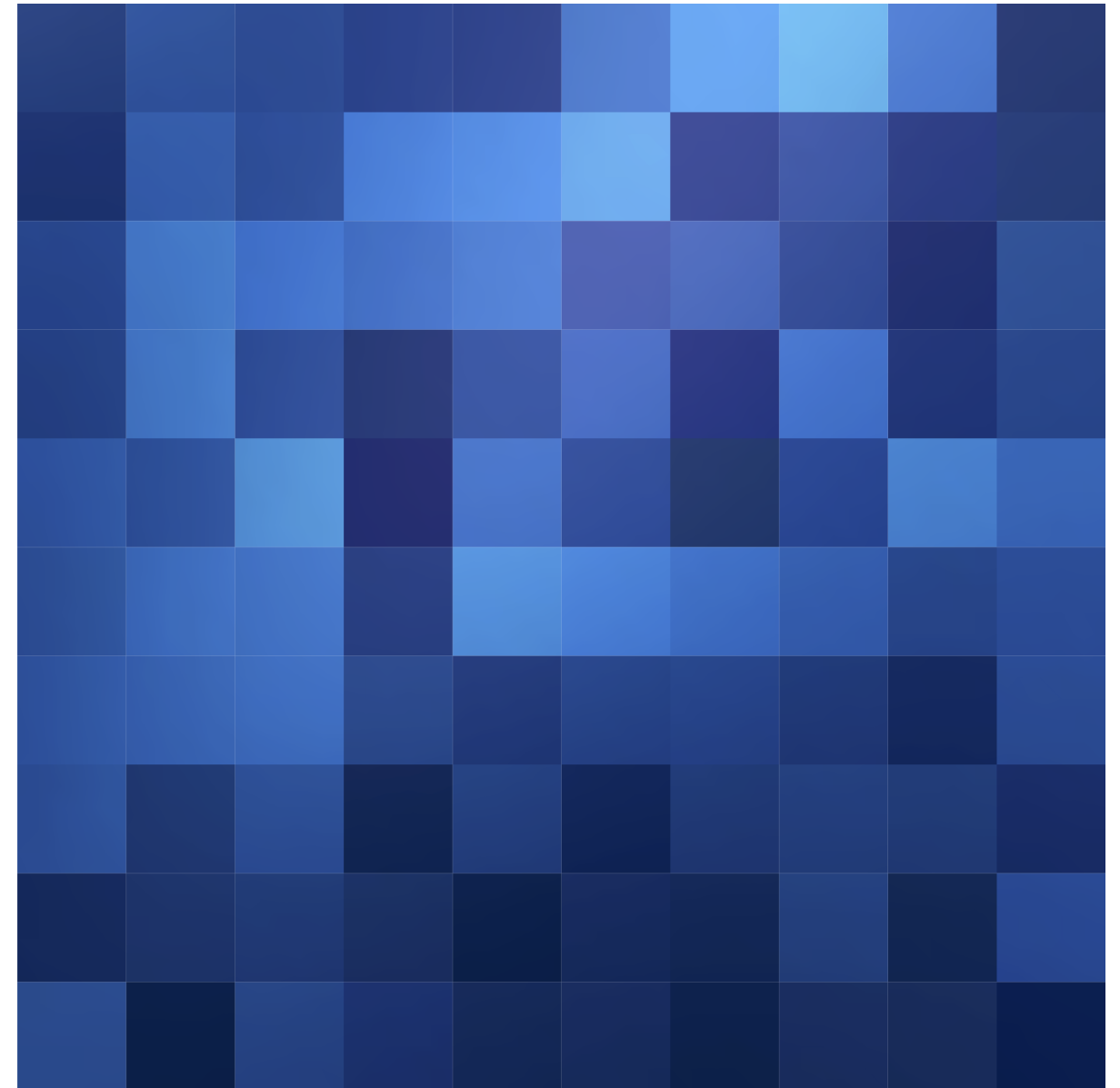
Sentence	Texans	Giants	football	great
The Texans are a great football team.	1	0	1	1
The Giants are a great football team.	0	1	1	1

# Problems with word counts: negation

Sentence	Texans	Giants	football	great	not
The Giants are a great football team.	0	1	1	1	0
The Giants are not a great football team.	0	1	1	1	1

# Word counts and synonyms

- Word counts don't help us consider synonyms
- Example: "blue"
  - "sky-blue"
  - "aqua"
  - "cerulean"
- Want to group as a single feature



# Word embeddings

- Create features that group similar words
- Features have a mathematical meaning:

`king - man + woman = queen`

# Review

- **Time series forecasting**
  - Time is a feature
  - Seasonality
- **Natural Language Processing (NLP)**
  - Text as input data
  - Word counts
  - Word embeddings

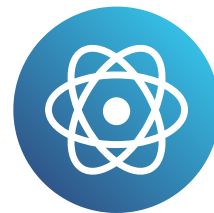
# Let's practice!

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# Deep Learning and Explainable AI

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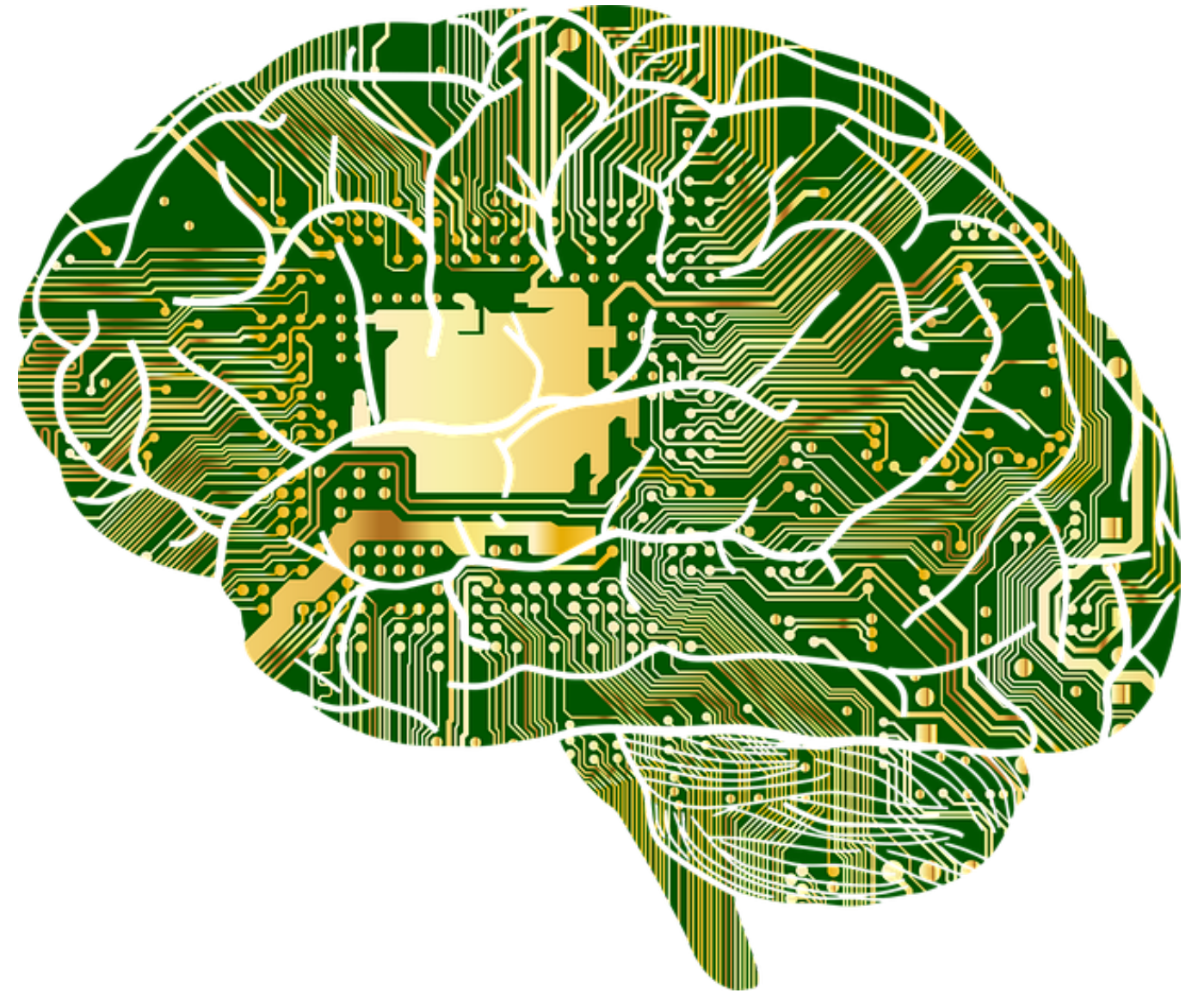


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# What is Deep Learning?

- AKA: Neural Networks or Neural Nets
- Special area of Machine Learning
- Requires more data
- Best when inputs that are images or text

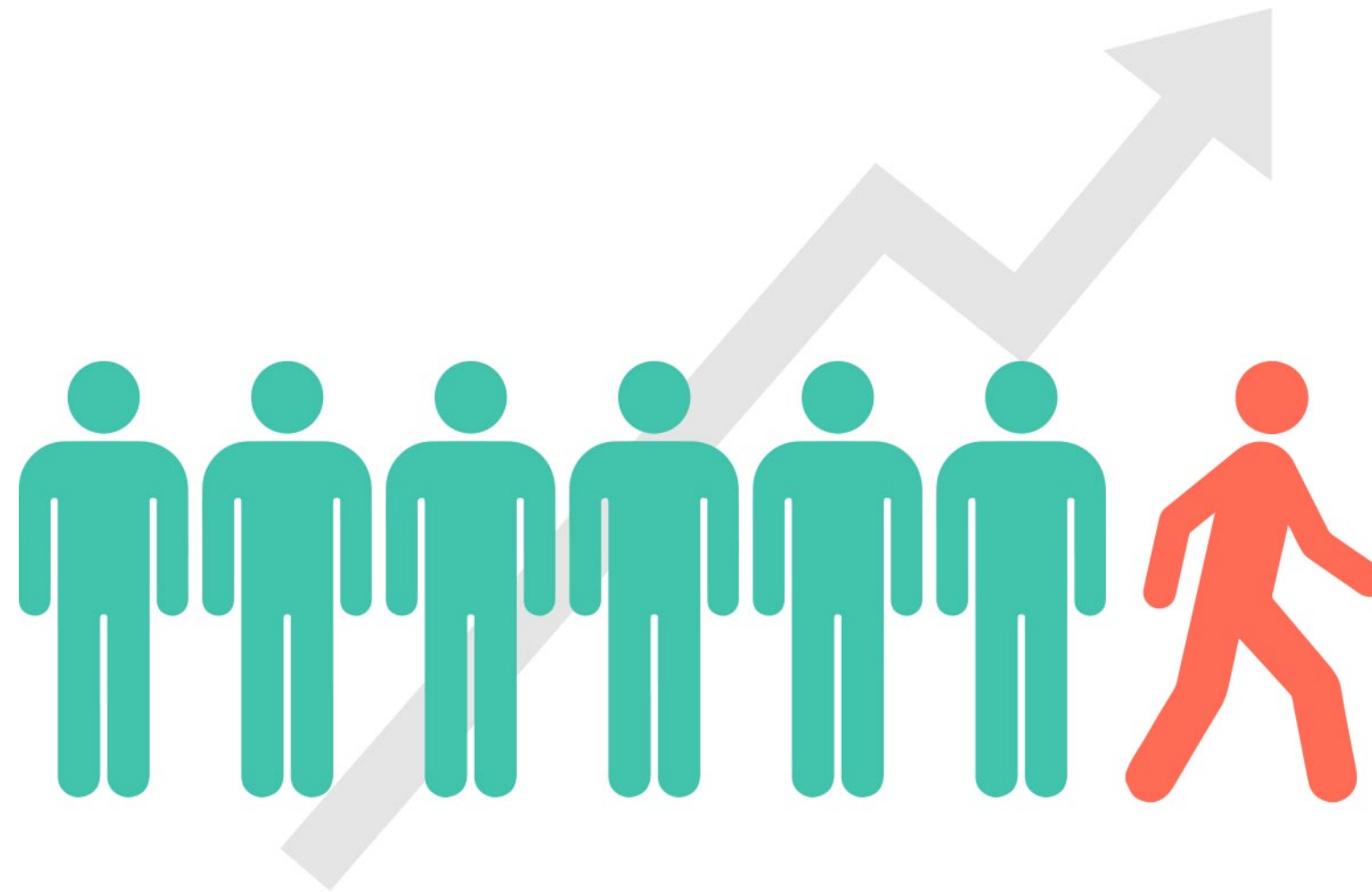


# Explainable AI

Deep Learning	Explainable AI
Highly accurate predictions	Understandable by humans
Better for "What?"	Better for "Why?"

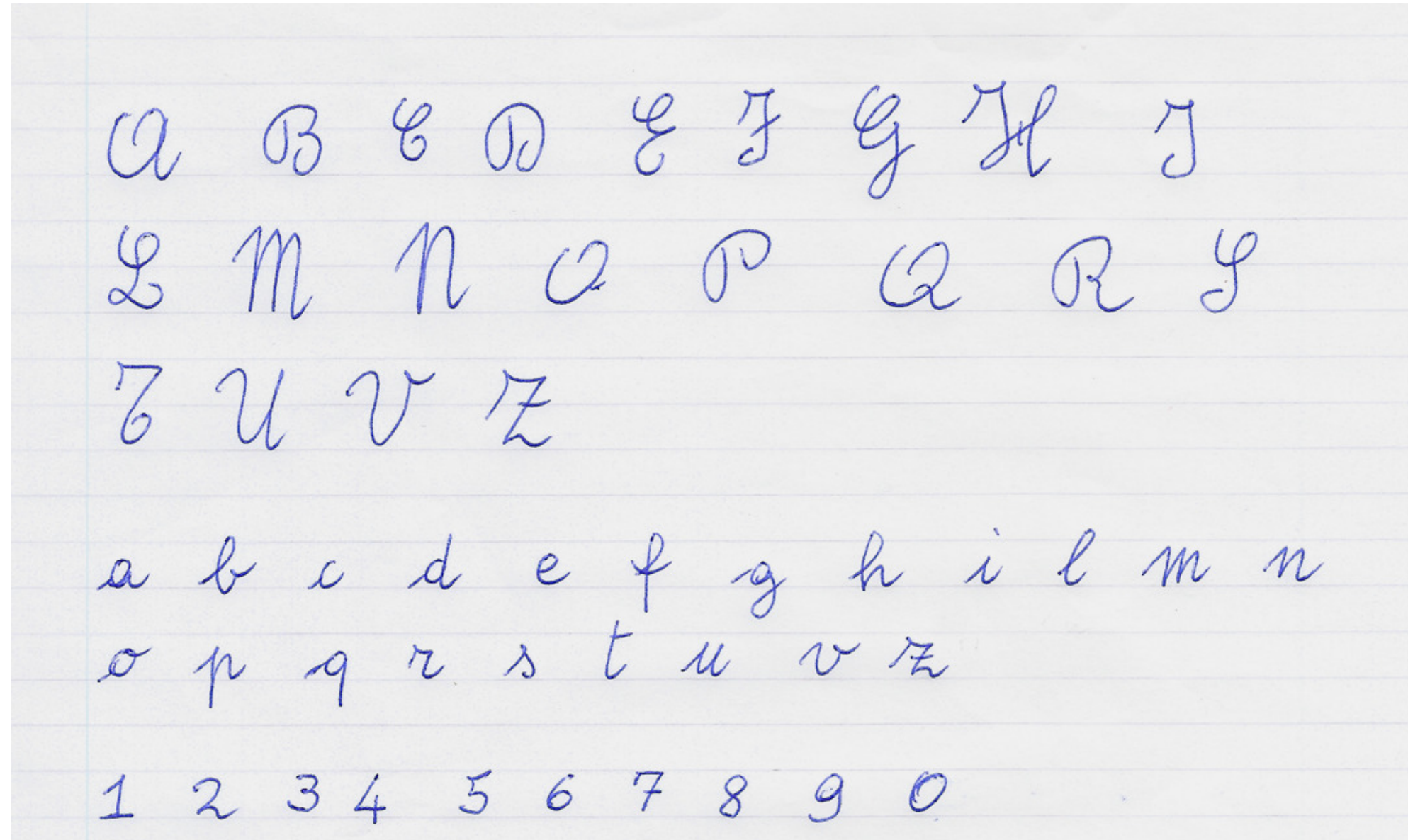
# Case Study: Explainable AI

1. **Prediction:** What a customer is likely to do
2. **Explanation:** Why a customer is likely to do it



# Case Study: Inexplicable AI

Prediction only: Which letter is this likely to be?





# When to use Deep Learning

1. Is the training data complex?
2. Do we have a very large amount of training data?
3. Does the model need to be predictive or explanatory?

# Let's practice!

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