

A/B Testing

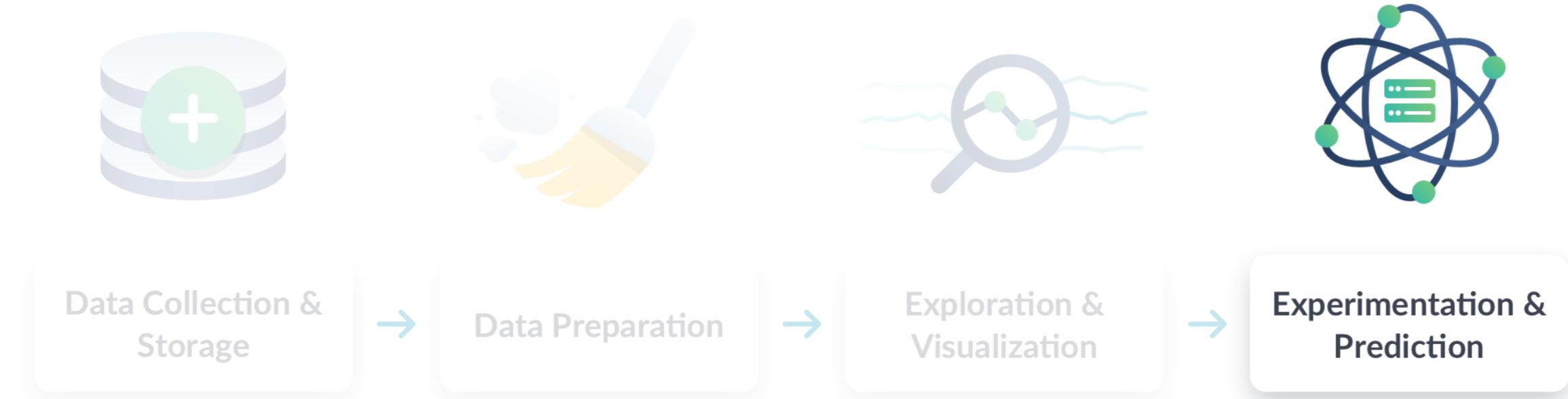
DATA SCIENCE FOR EVERYONE



Lis Sulmont

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Data science workflow



What are experiments in data science?

Experiments help drive decisions and draw conclusions

1. Form a question
2. Form a hypothesis
3. Collect data
4. Test the hypothesis with a statistical test
5. Interpret results

Case study: which is the better blog post title?

Form a question: Does blog title A or blog title B result in more clicks?

Form a hypothesis: Blog title A and blog title B result in the same amount of clicks.

Collect data:

- 50% users will see blog title A
- 50% users will see blog title B
- Track click-through rate until sample size reached

A

Become an expert Data Scientist with this one weird trick!



B

You won't believe these tips for becoming a Data Scientist!



Case study: which is the better blog post title?

Test the hypothesis with a statistical test: Is the difference in titles' click-through rates significant?

Interpret results:

- Choose a title
- Or ask more questions and design another experiment!

A

Become an expert Data Scientist with this one weird trick!



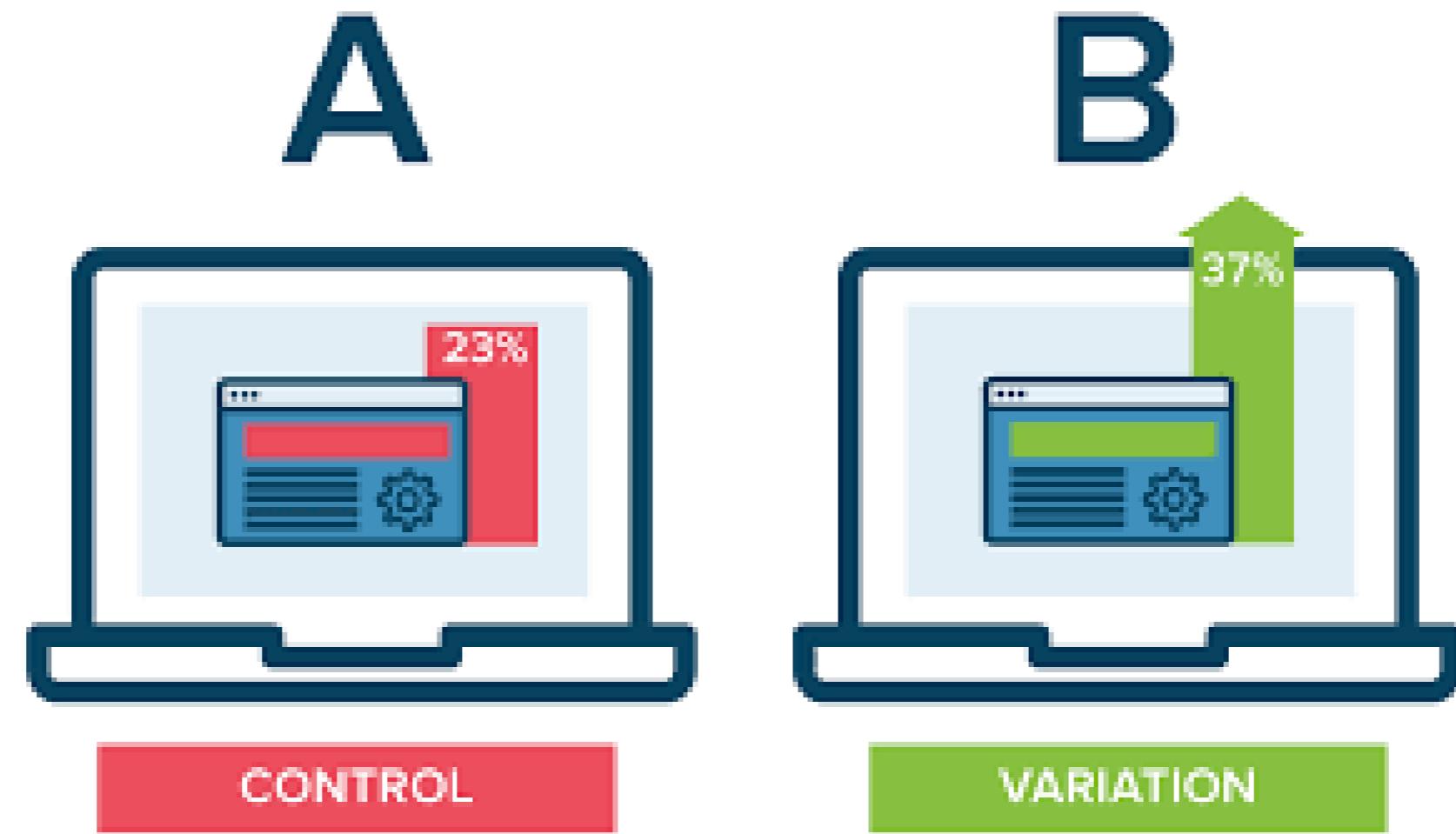
B

You won't believe these tips for becoming a Data Scientist!



What is A/B Testing?

AKA Champion/Challenger Testing



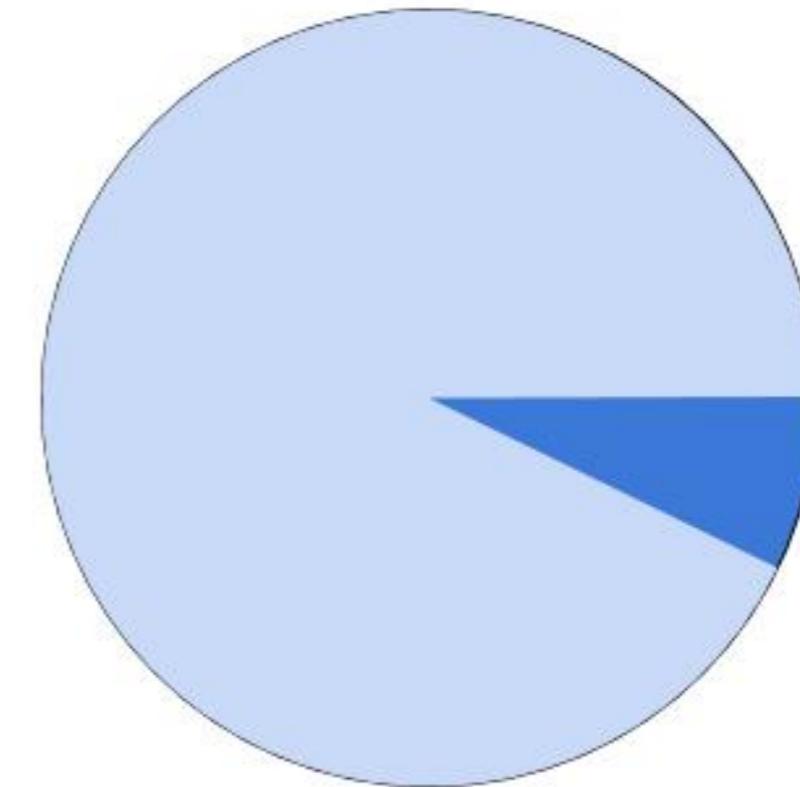
Terminology Review

- **Sample size:** number of data points used
- **Statistical significance:** result is likely not due to chance
 - Given assumptions of statistical model
 - Use **statistical tests** to calculate this:
 - e.g., t-test, Z-test, ANOVA, Chi-square test

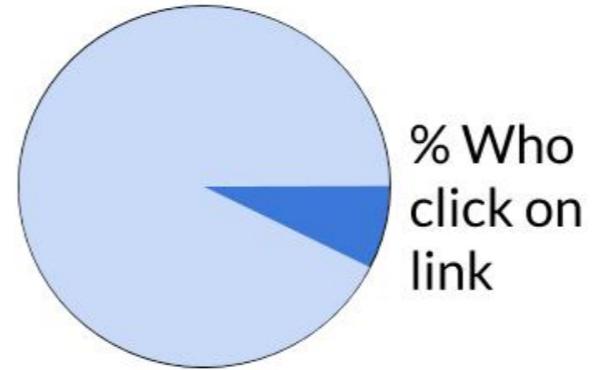
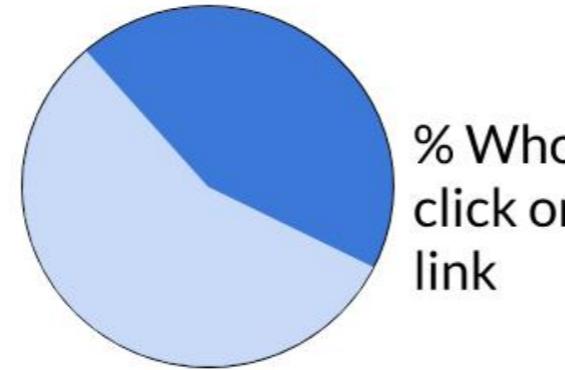
A/B Testing Steps

- Picking a metric to track
- Calculating sample size
- Running the experiment
- Checking for significance

Pick a metric to track: click-through rate

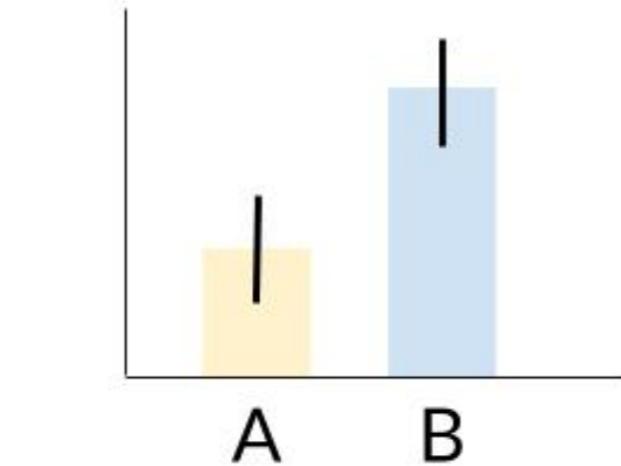


% Who
click on
link

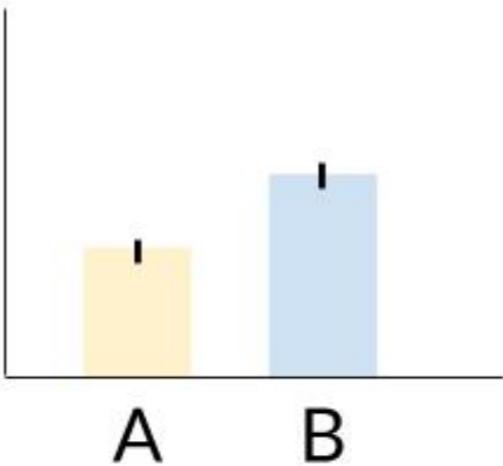


- Baseline metric to gauge any changes
 - *How often people generally click on a link to our blogs*
- If the rate is much larger or smaller than 50%, we need a large sample size
 - Click rate is typically small (<3%)

Low sensitivity, detects
large differences



High sensitivity, detects
small differences



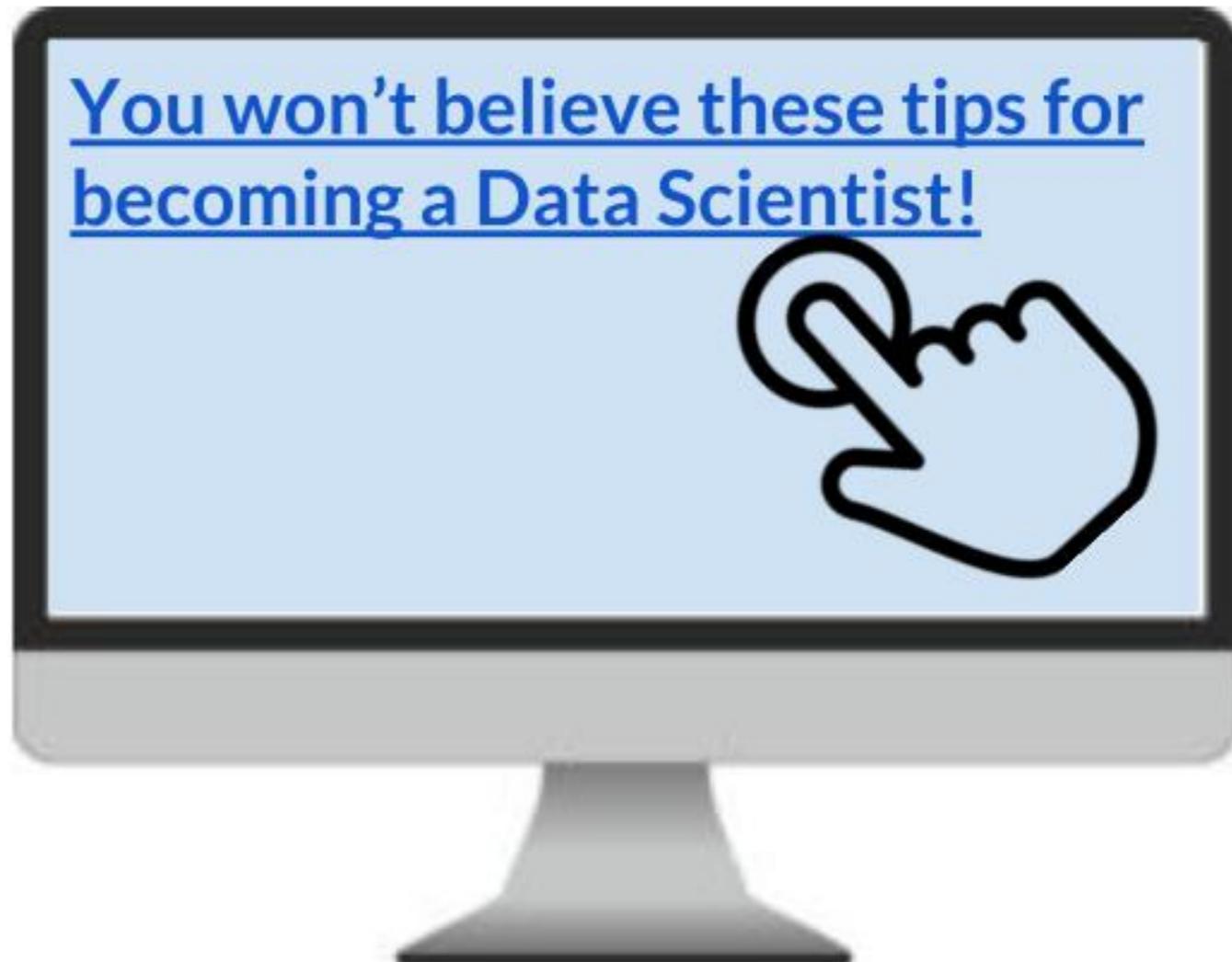
Larger sample sizes allow us to detect smaller changes

Run your experiment

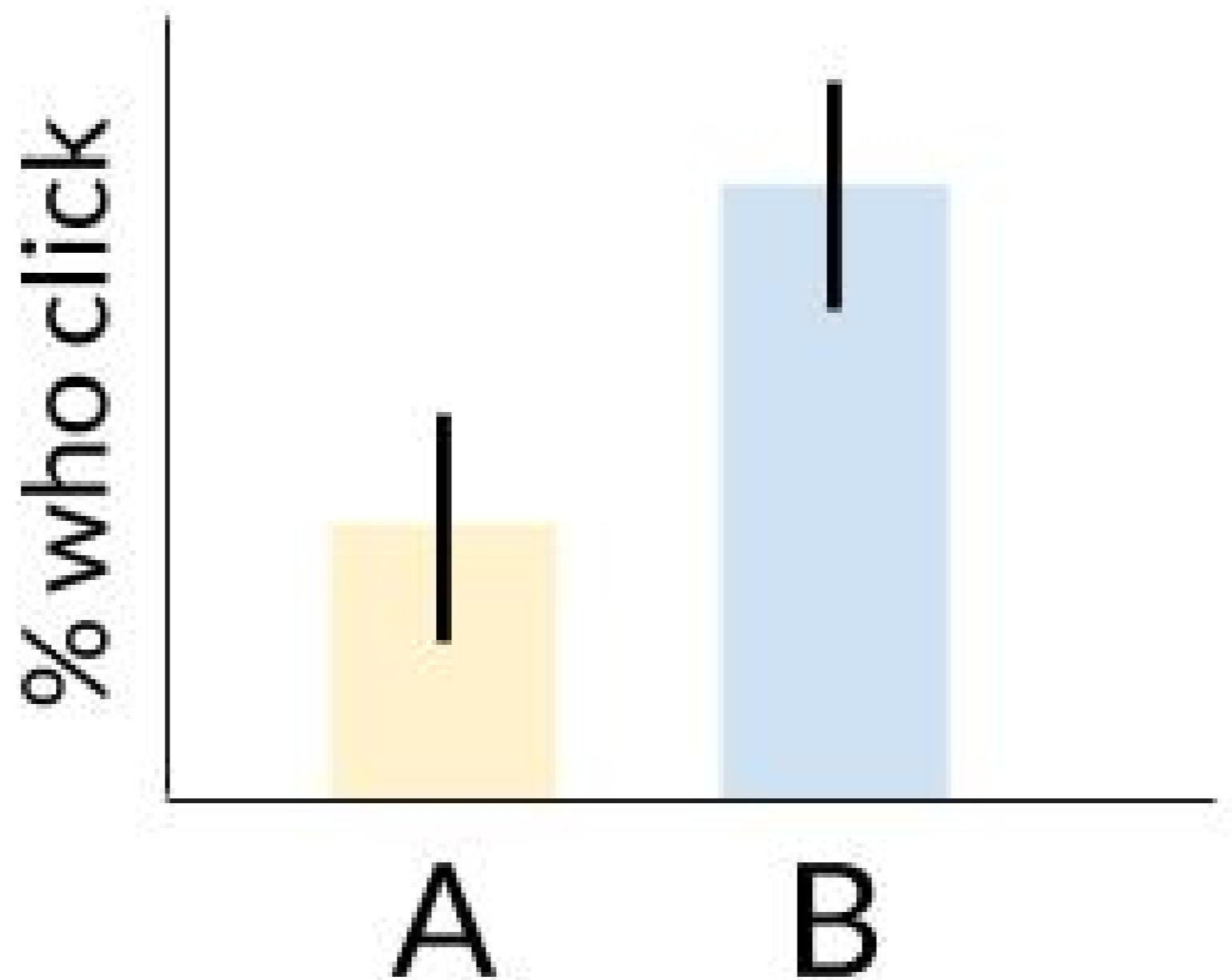
A



B



Check for significance



What if the results aren't significant?

- Difference is smaller than the threshold we chose
- Running our test longer won't help
- Still might be a difference; it's just small and insignificant to us

Let's practice!

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Time series forecasting

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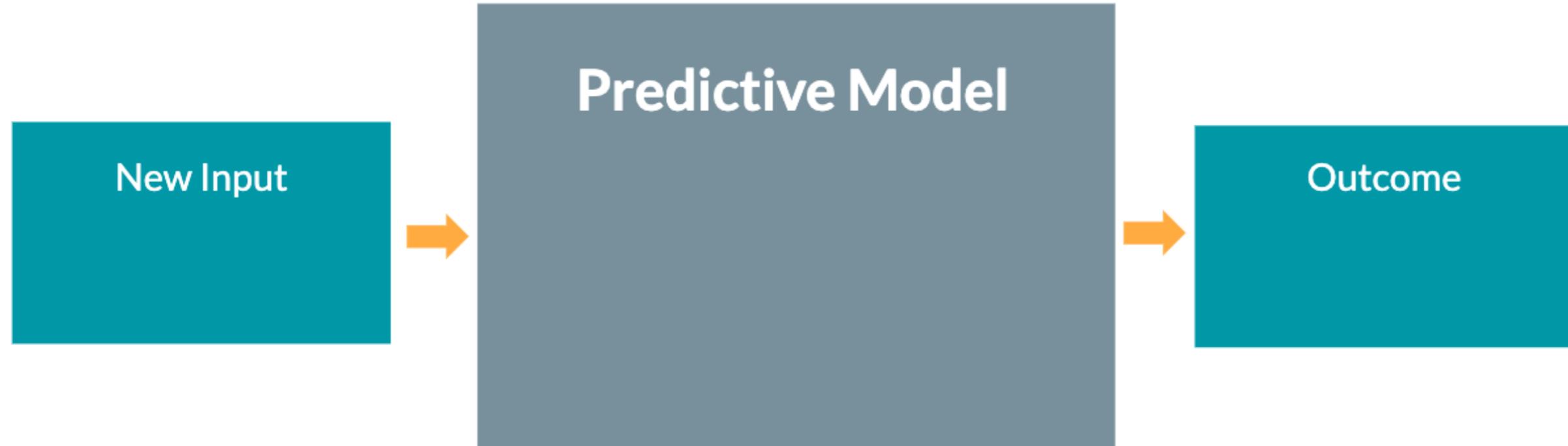
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Curriculum Manager

Modeling in data science

What is a statistical model?

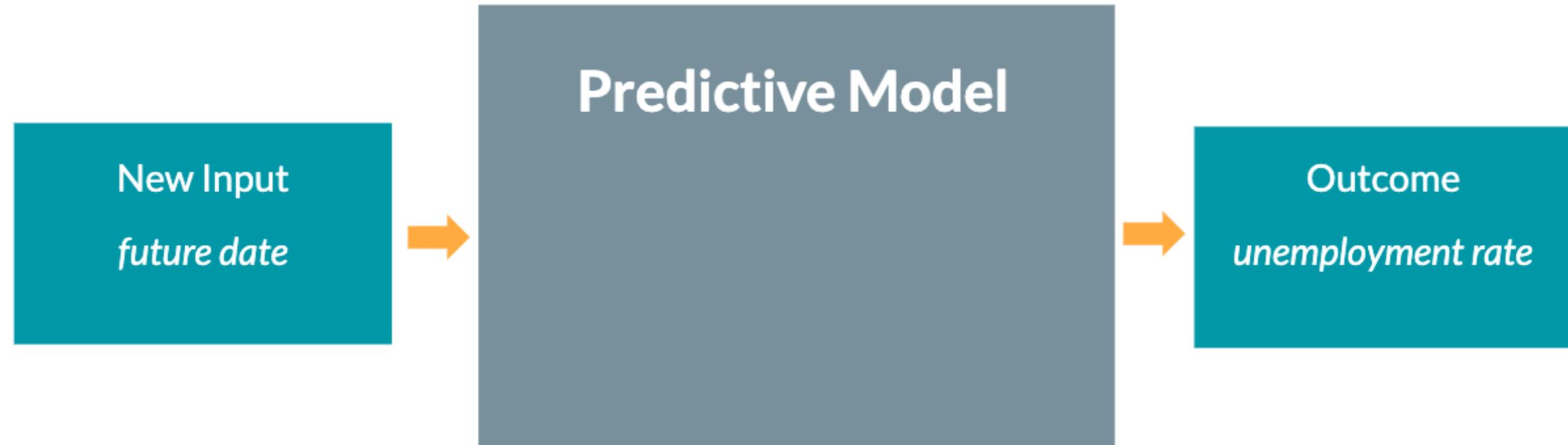
- Represent a real-world process with statistics
- Mathematical relationships between variables, including random variables
- Based on statistical assumptions and historical data

Predictive modeling



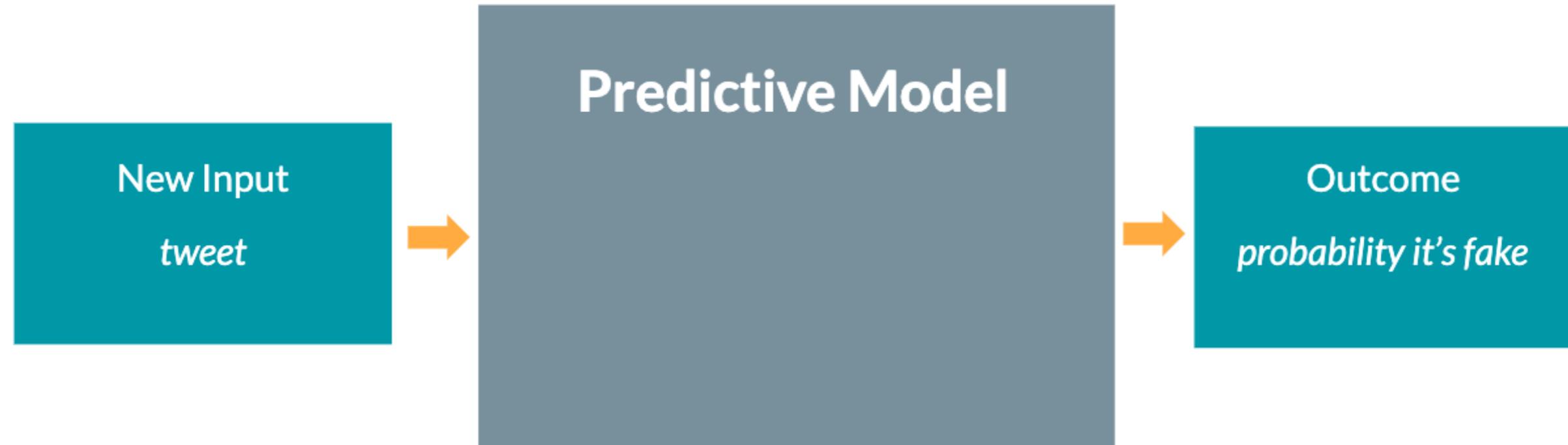
- Enter new input(s) and model predicts an outcome

Predictive modeling



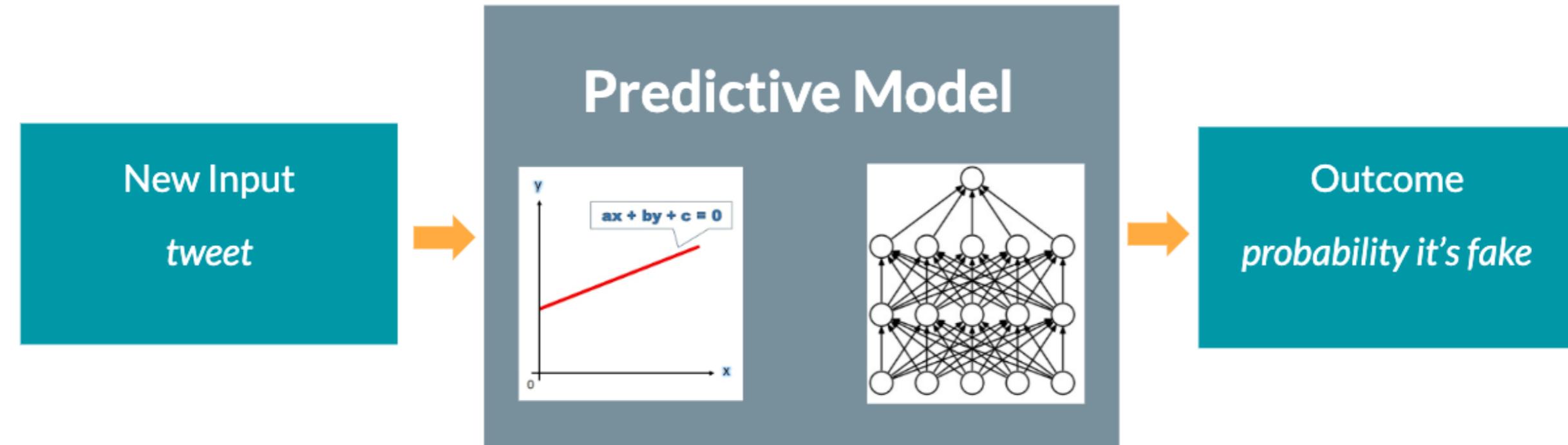
- Enter new input(s) and model predicts an outcome

Predictive modeling



- Enter new input(s) and model predicts an outcome
 - Probability of an outcome

Predictive modeling

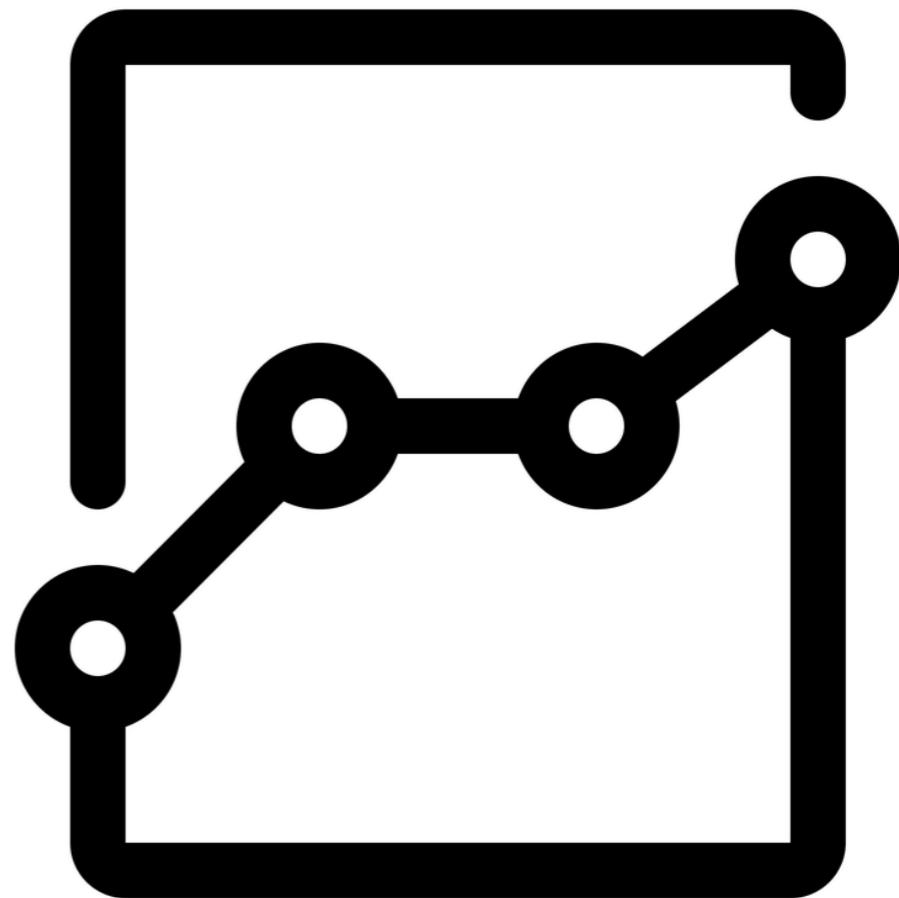


- Enter new input(s) and model predicts an outcome
 - Probability of an outcome
- Ranges in complexity, from a linear equation to a deep learning algorithm

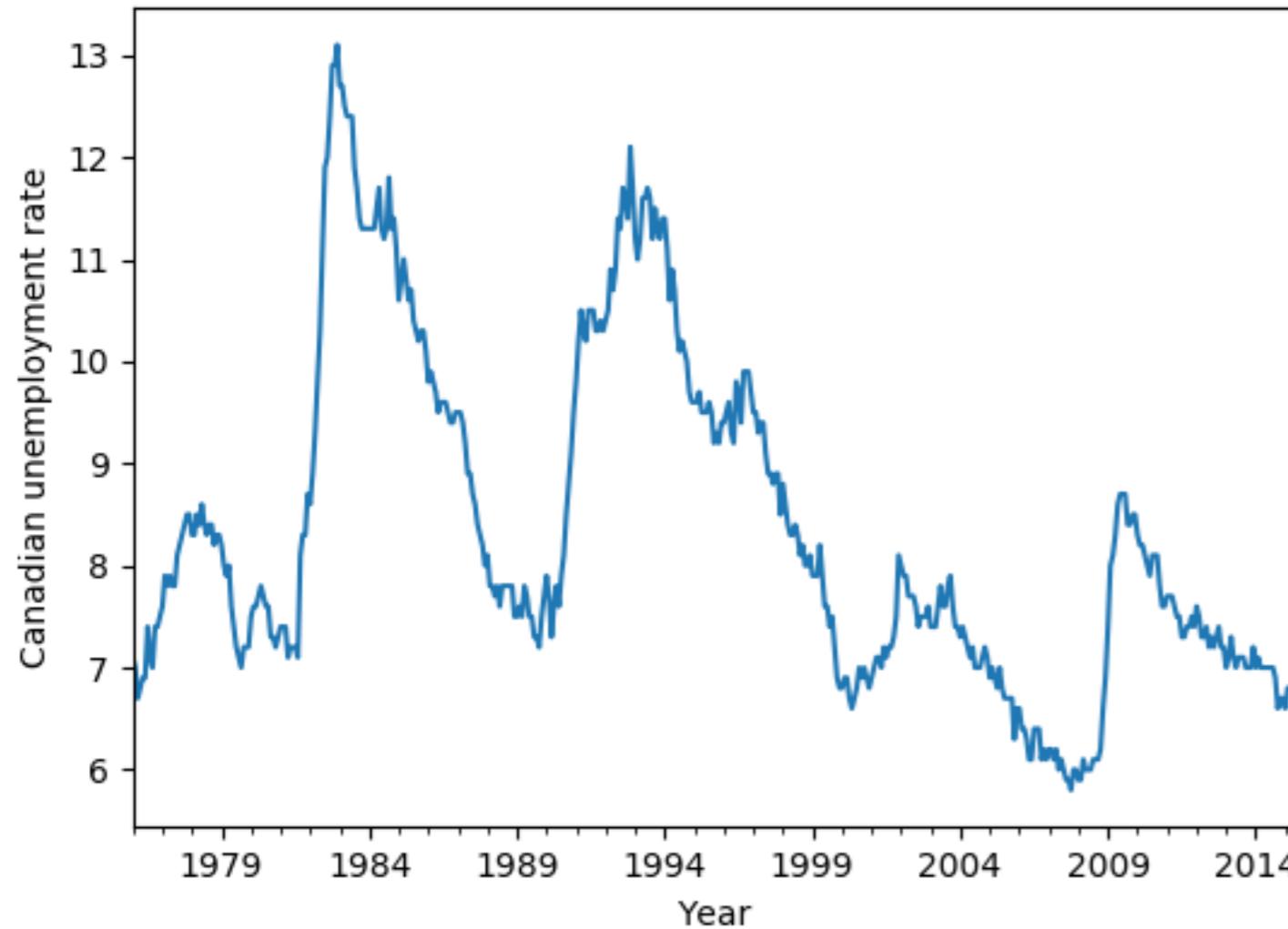
Time series data

A series of data points sequenced by time

- Stock prices
- Gas prices
- Unemployment rates
- Heart rate
- CO2 levels
- Height of ocean tides

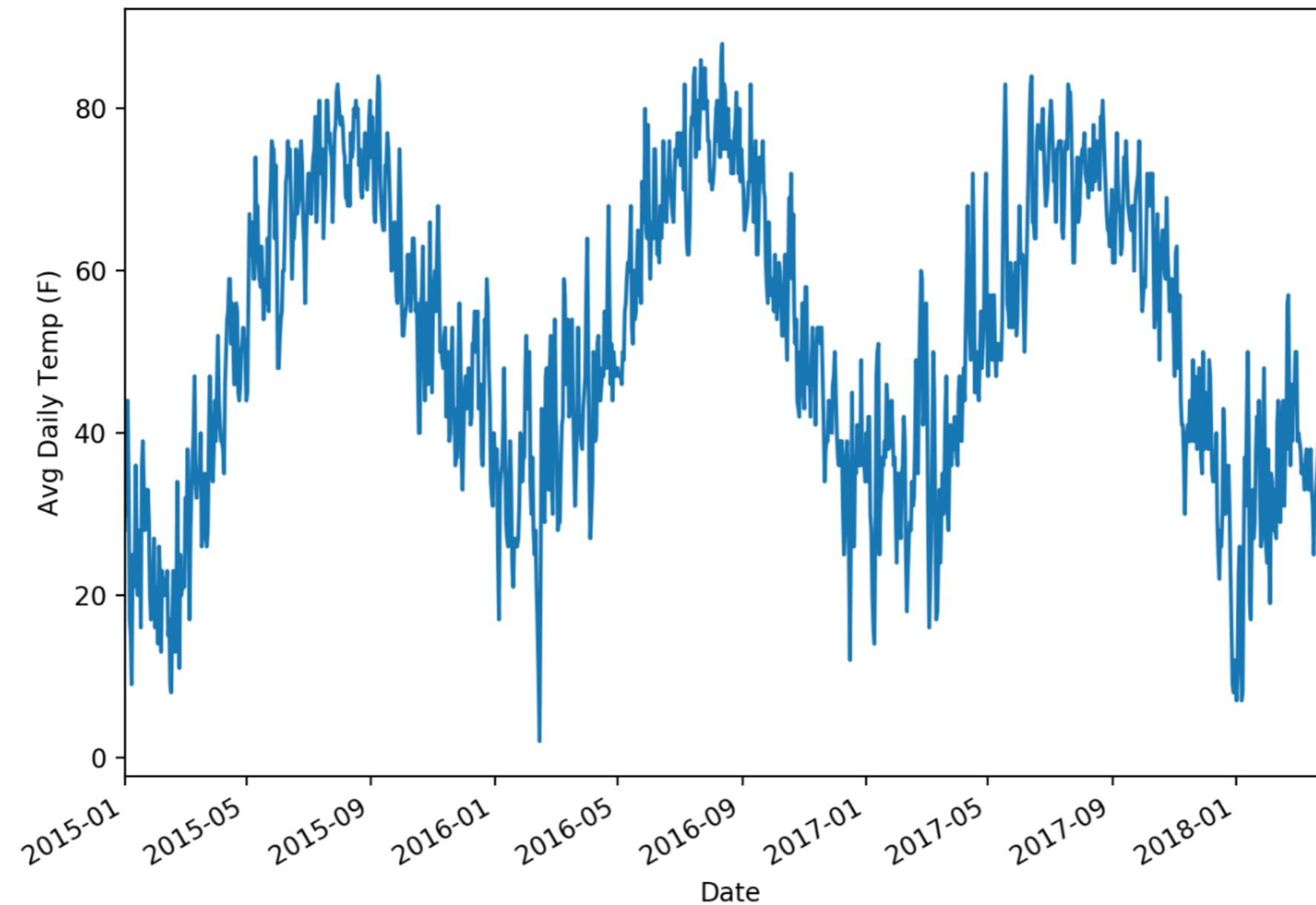


Plotting time series data

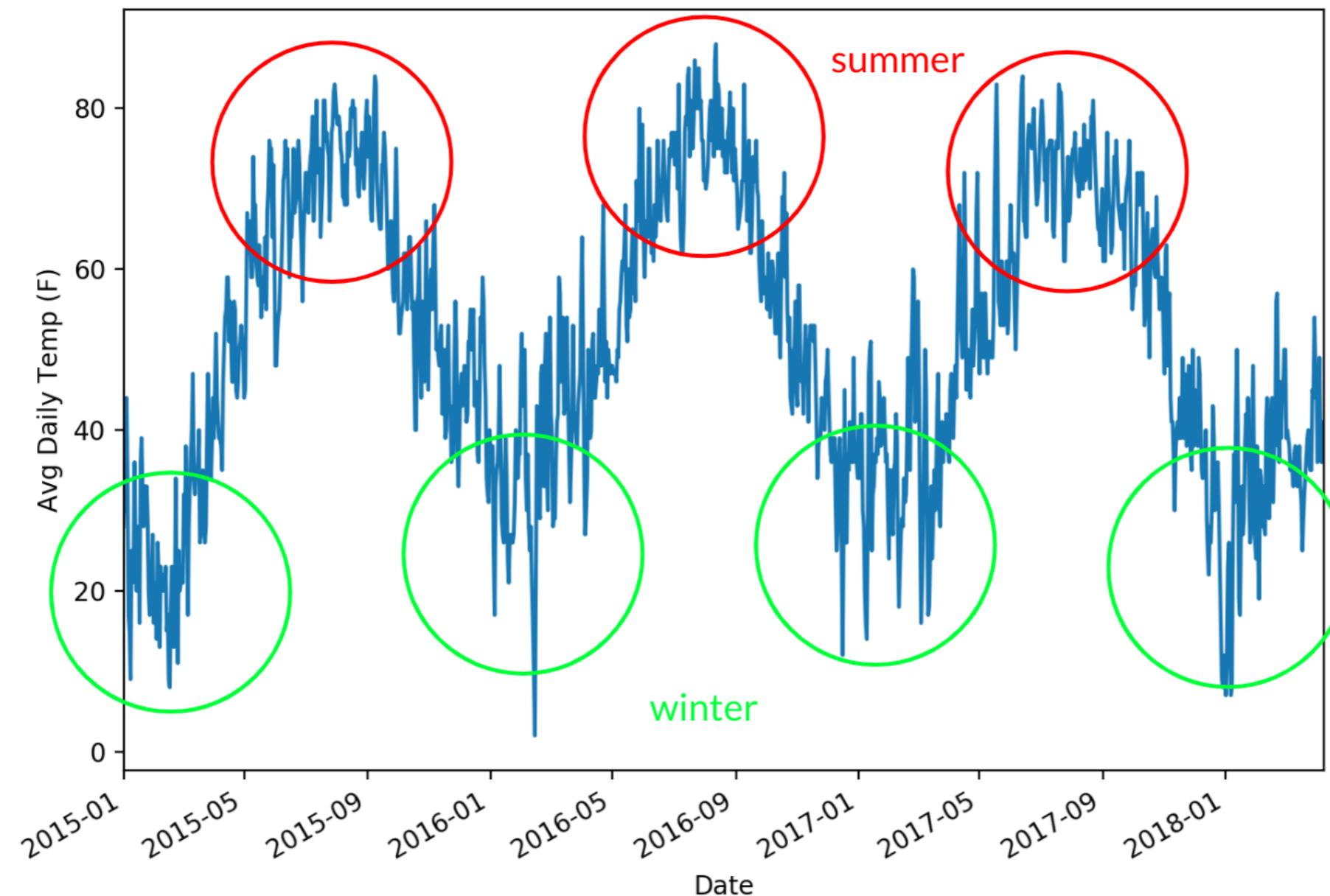


Date	Rate
1976-01-01	7.1
1976-02-01	7
...	
1991-01-01	10.3
...	
2015-04-01	6.8
2015-05-01	6.8

Seasonality in time series



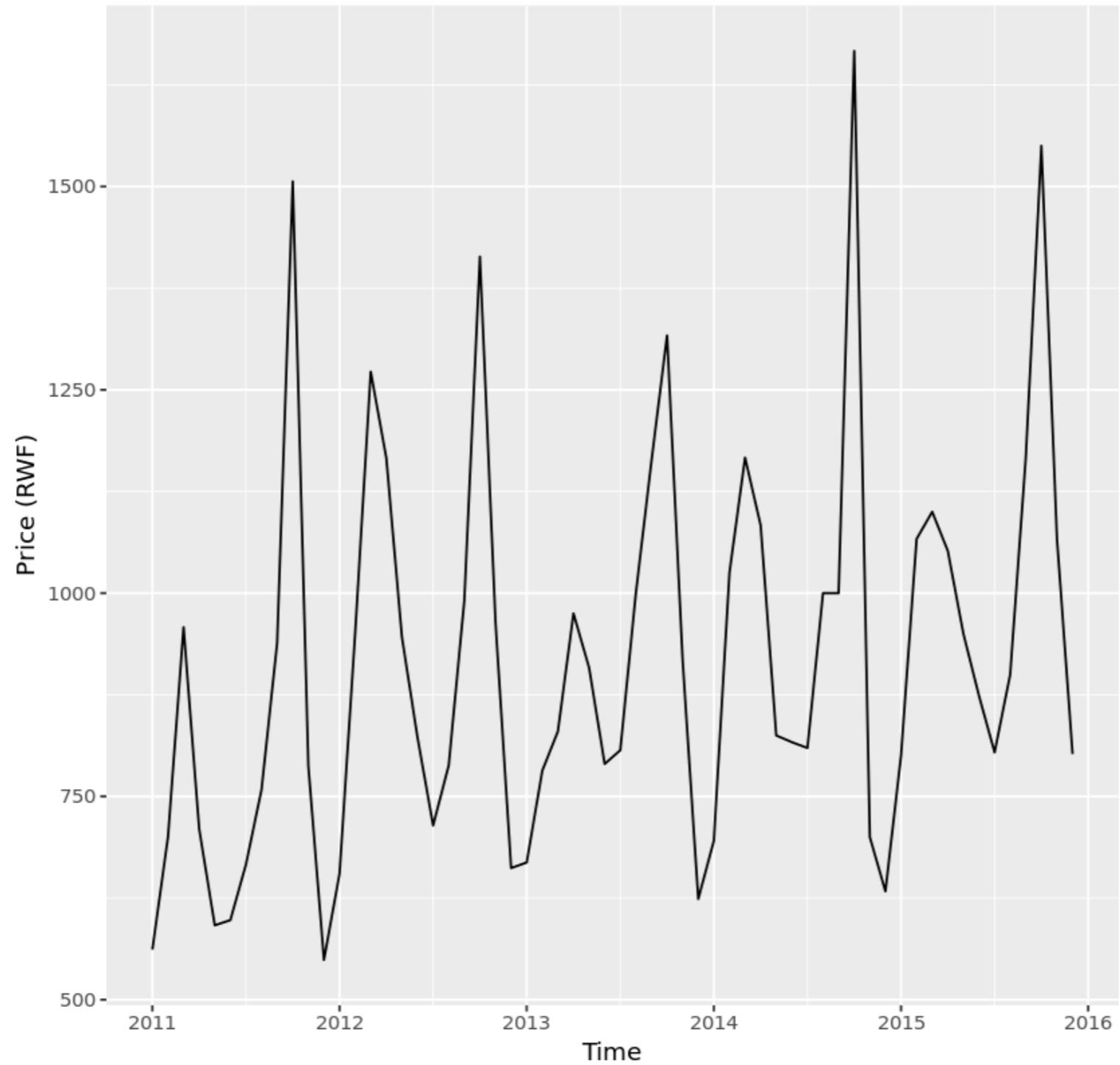
Seasonality in time series



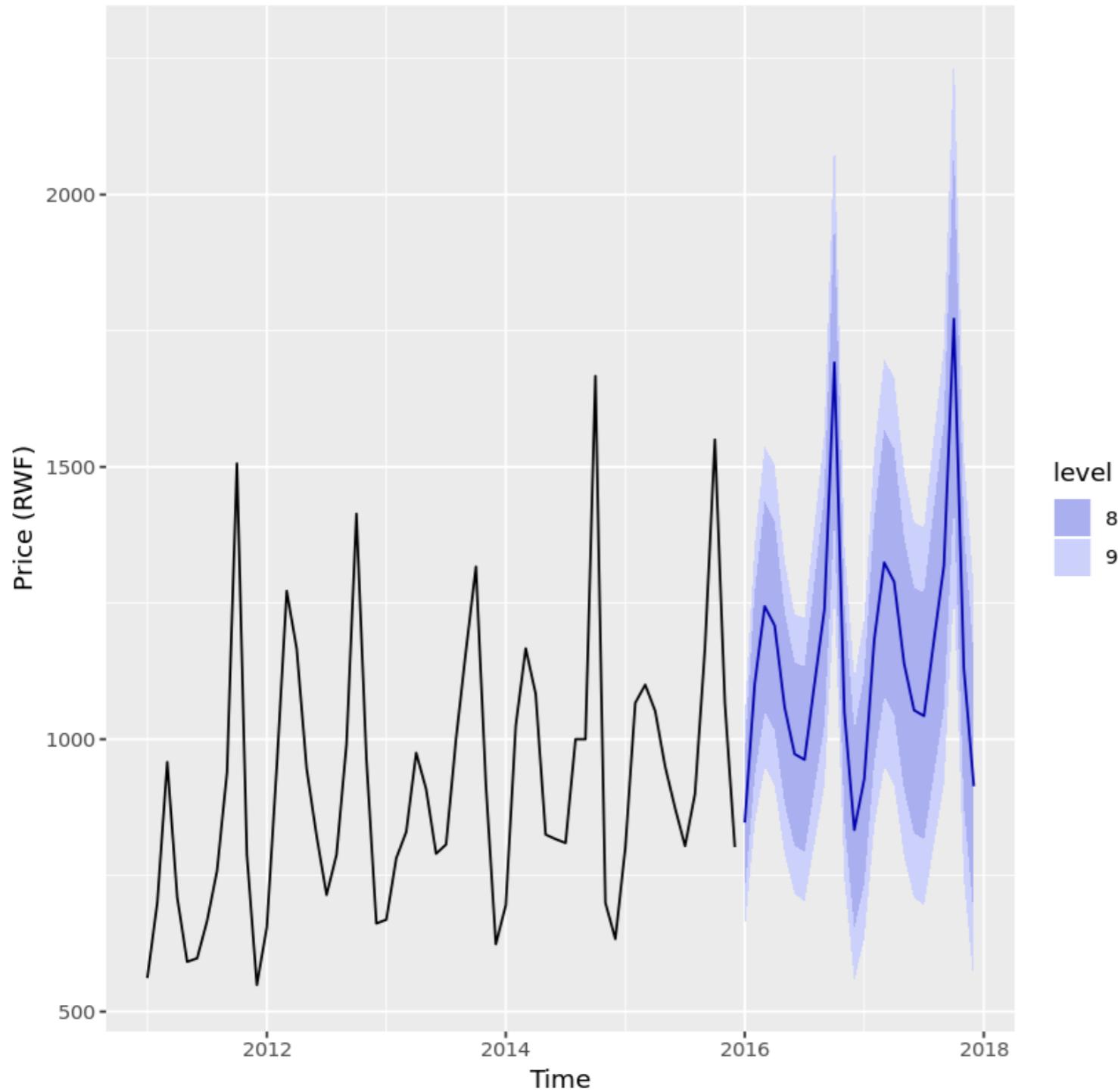
Forecasting time series

- *Examples:*
 - How much rainfall will we get next month?
 - Will traffic ease up in the next half hour?
 - How will the stock market move in the next six hours?
 - What will be earth's population in 20 years?
- Derive a model from historical data to generate predictions
- Modeling methods use a combination of statistical and machine learning methods

Pea Prices in Rwanda



Pea price forecast



Confidence intervals

Model is X% sure that the true value will fall in this area

level
80
95

Let's practice!

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Supervised machine learning

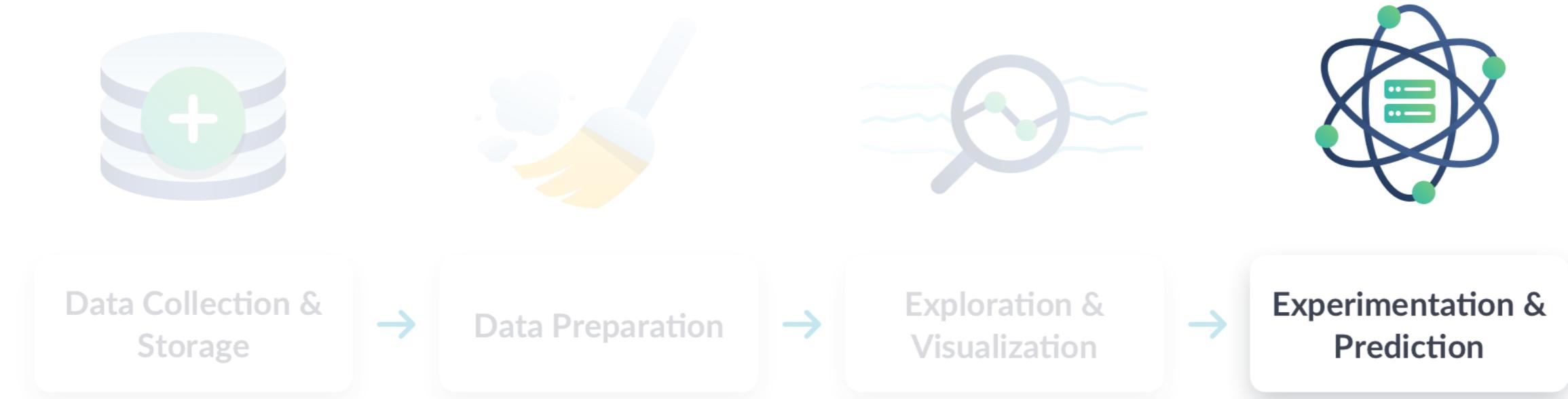
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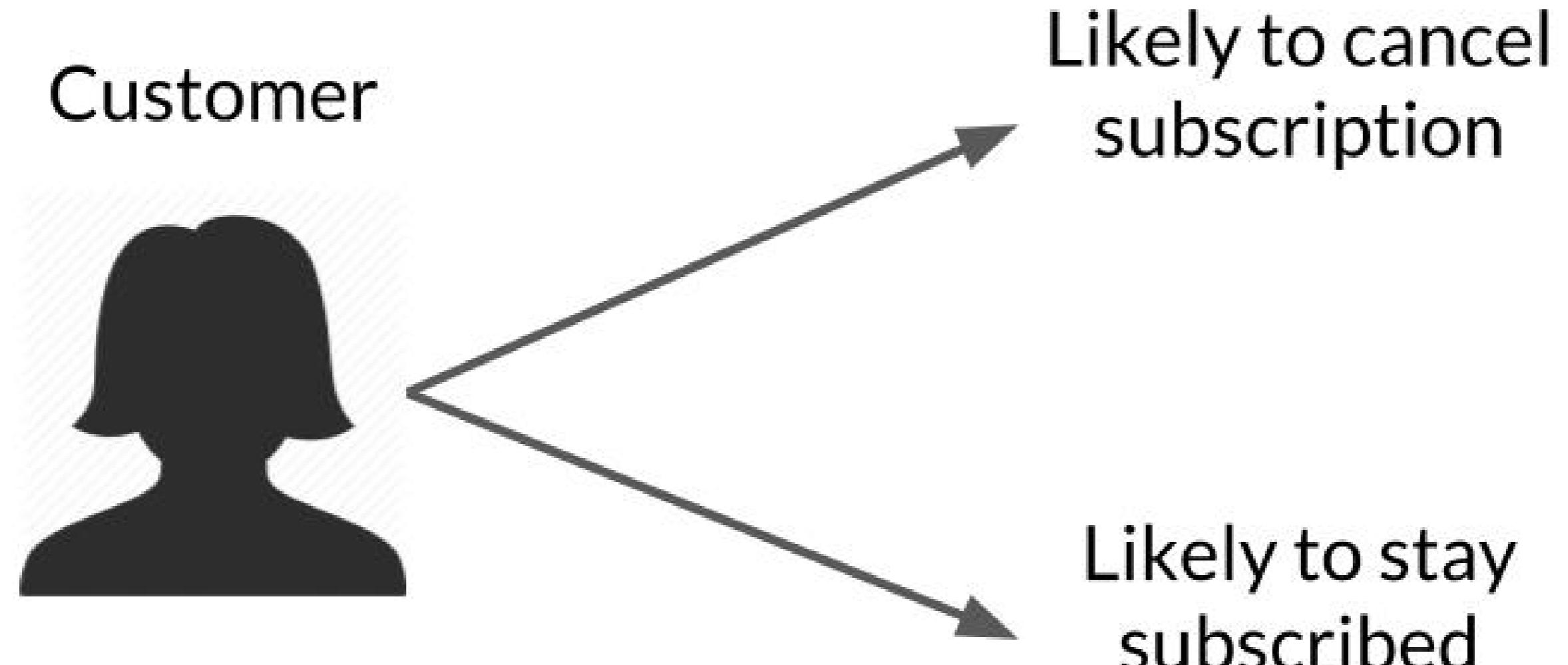
Data science workflow



What is supervised machine learning?

- **Machine learning:** Predictions from data
- ***Supervised machine* learning:** Predictions from data with *labels* and *features*
 - Recommendation systems
 - Diagnosing biomedical images
 - Recognizing hand-written digits
 - Predicting customer churn

Case study: churn prediction



Case study: churn prediction

Training
Data:
Customers



Case study: churn prediction

Labels

Customer outcomes



Labels Customer outcomes
churn
subscribe
subscribe
churn
subscribe
churn

Case study: churn prediction

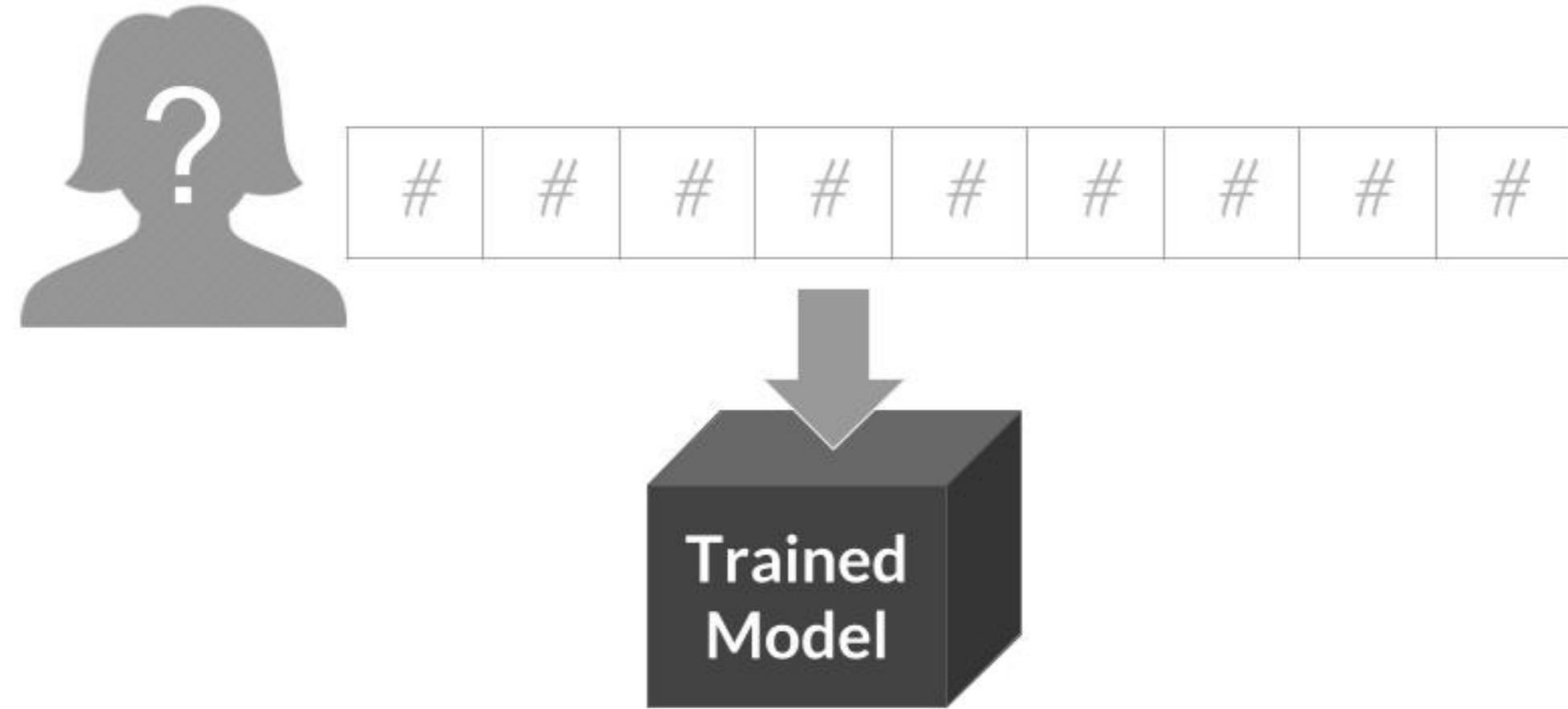
	Age	Gender	Date of last purchase?	Date of last visit?	Likes cats?	Household \$\$	Location	Number of Kids	Profession	
										churn
										subscribe
										subscribe
										churn
										subscribe
										churn

Case study: churn prediction

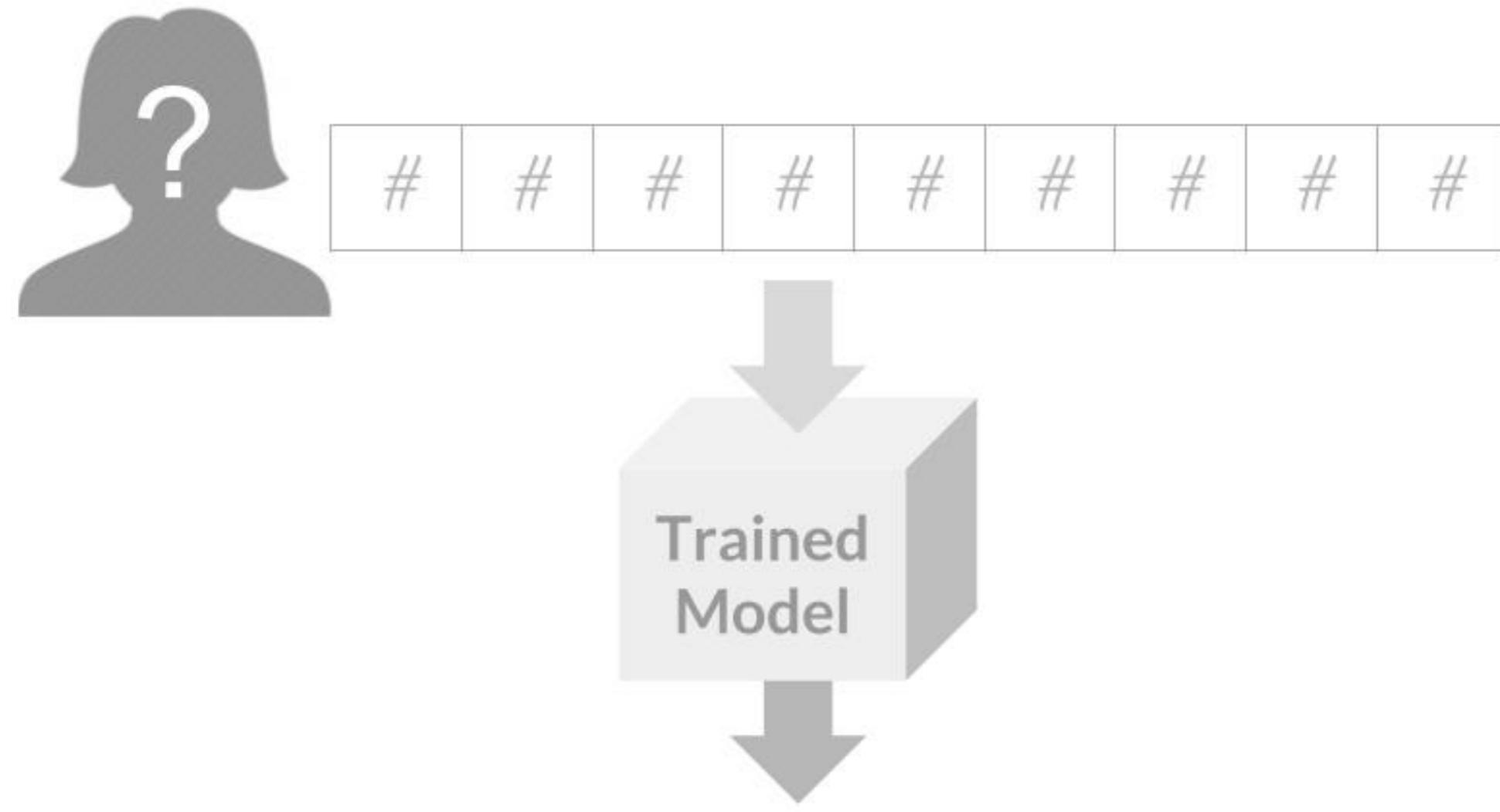


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Case study: churn prediction



Case study: churn prediction



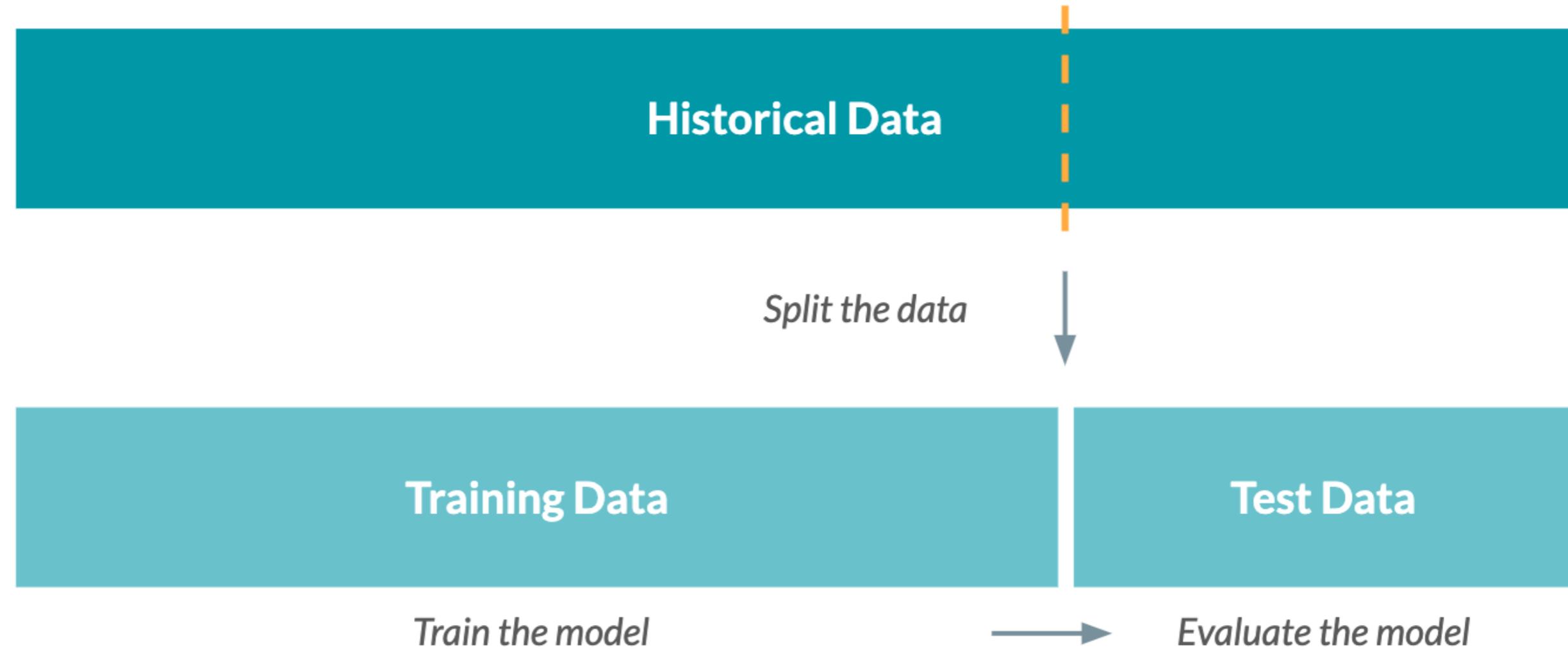
Prediction: Subscribe

Supervised machine learning 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

Possible Labels	True Labels	Model Prediction	Model Accuracy
<i>Customer remains</i>	970		
<i>Customer churns</i>	30		

Model Evaluation

Possible Labels	True Labels	Model Prediction	Model Accuracy
<i>Customer remains</i>	970	1000	
<i>Customer churns</i>	30	0	

Model Evaluation

Possible Labels	True Labels	Model Prediction	Model Accuracy
<i>Customer remains</i>	970	1000	# of correct predictions / # of predictions =
<i>Customer churns</i>	30	0	$970/1000 =$ 97%

- Checking both outcomes is important for rare events
- Model has 0% accuracy at predicting an actual churn outcome

Let's practice!

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Clustering

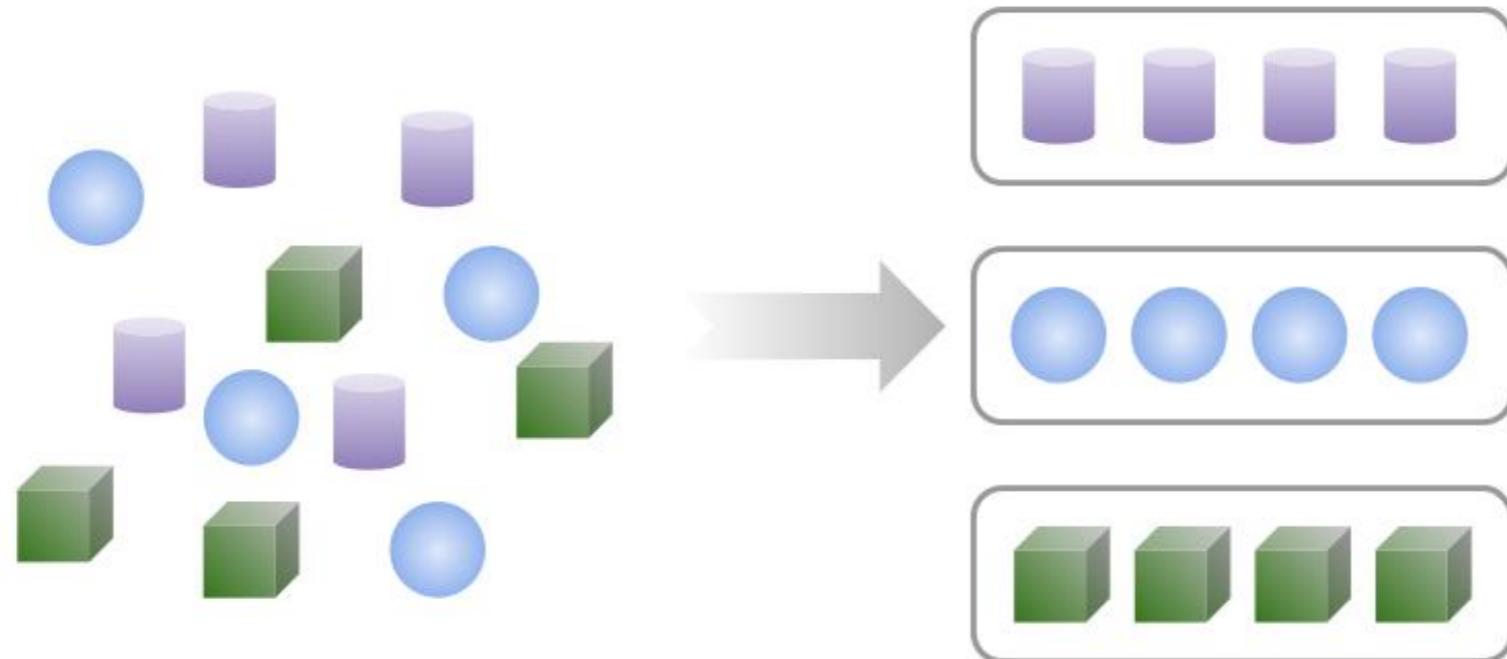
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What is clustering?



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

Supervised Machine Learning



Unsupervised Machine Learning

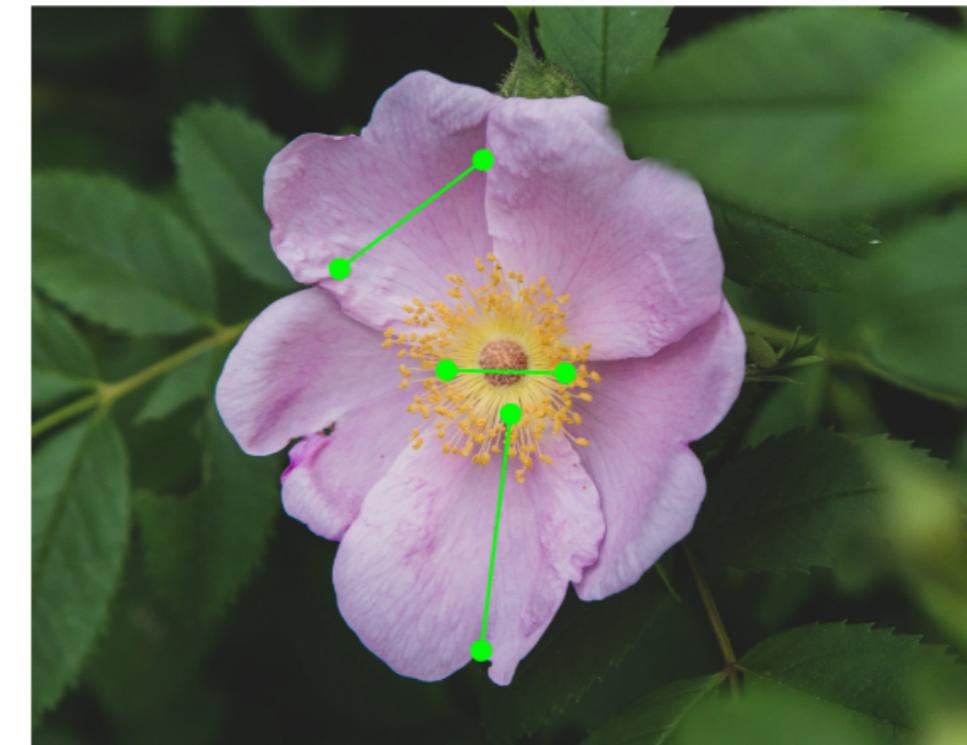
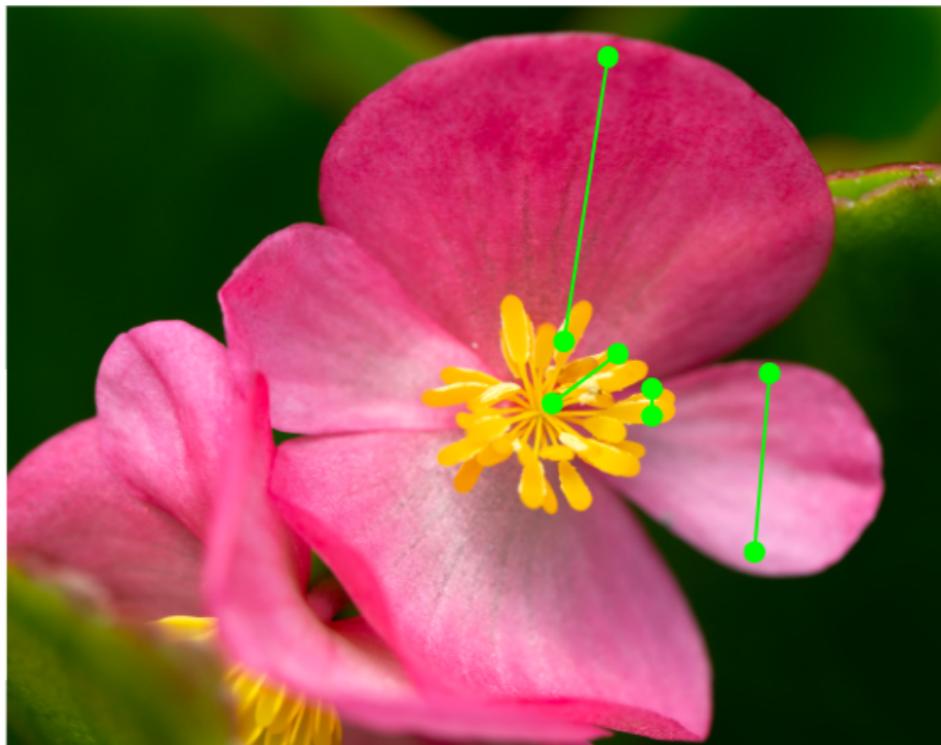


Case study: discovering new species

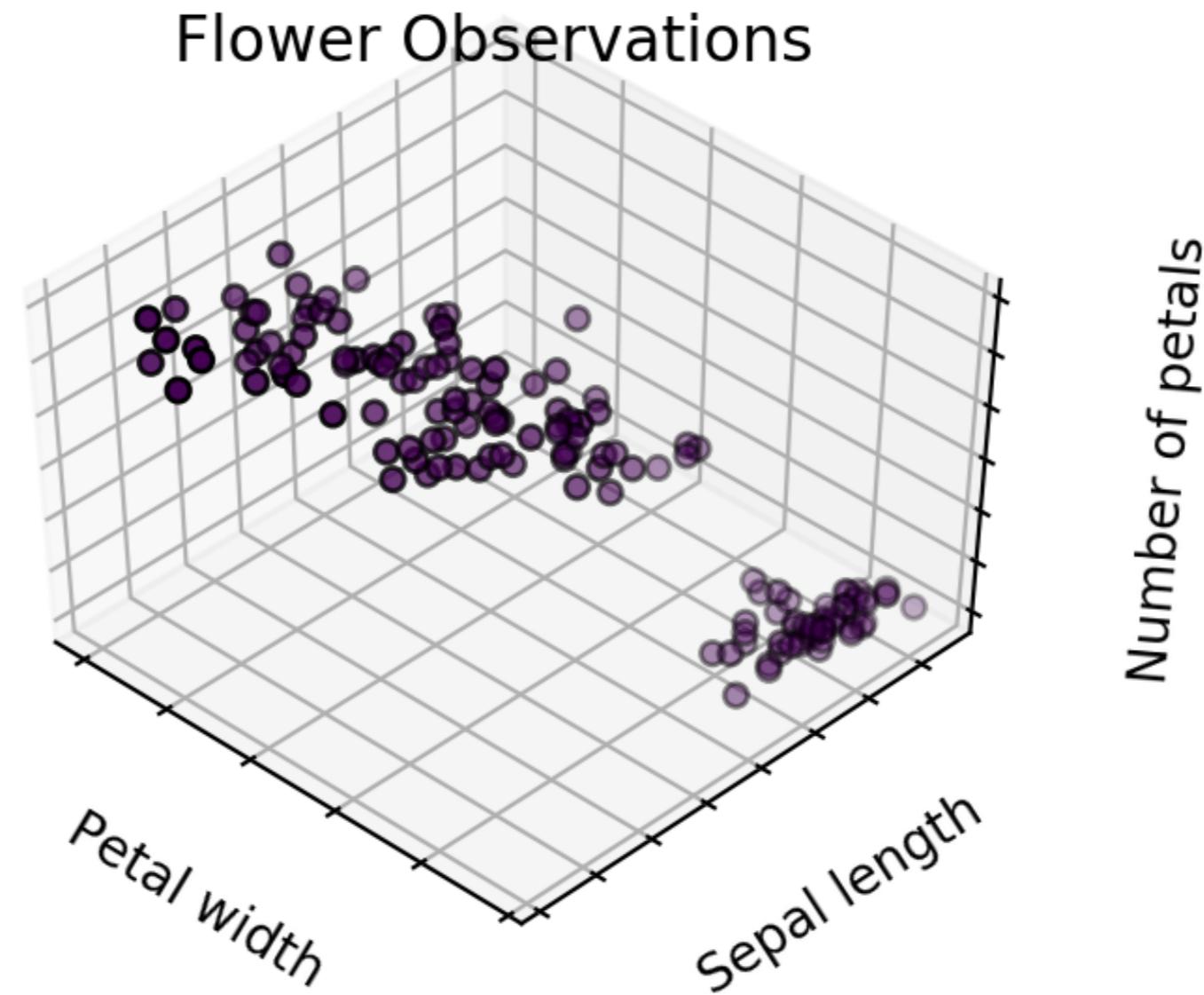


Defining features

- Flower colors
- Petal length and width
- Sepal length and width
- Number of petals

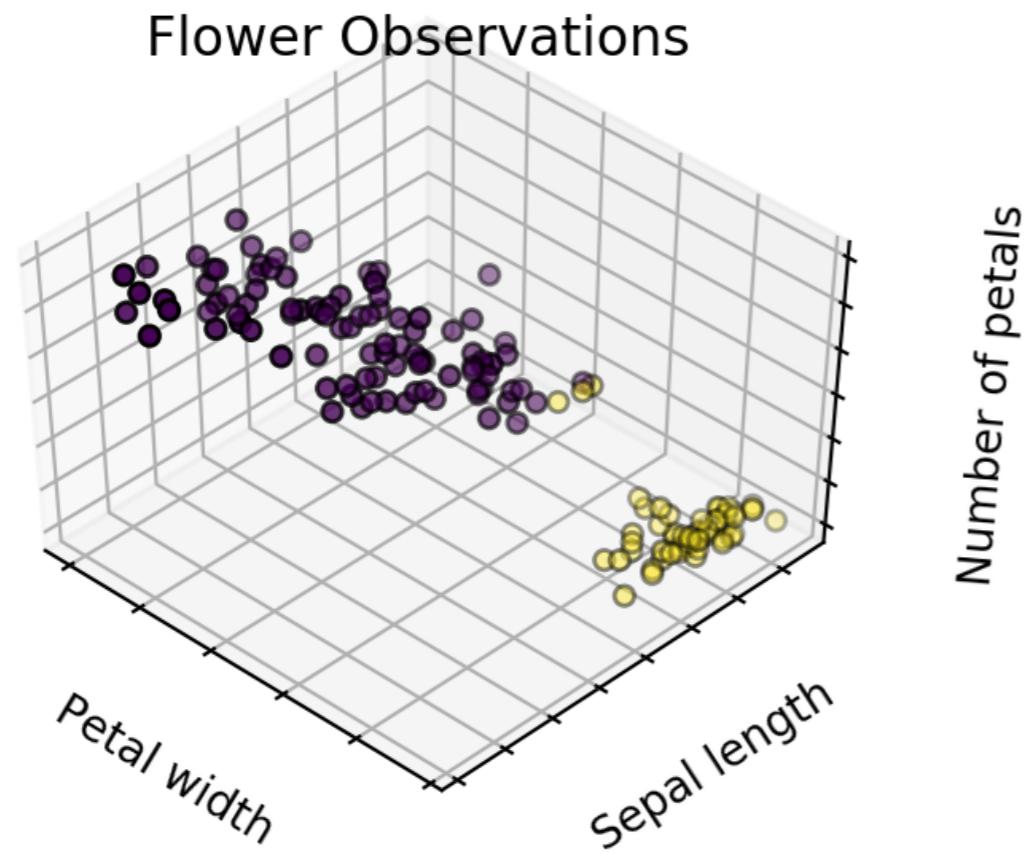


Defining number of clusters

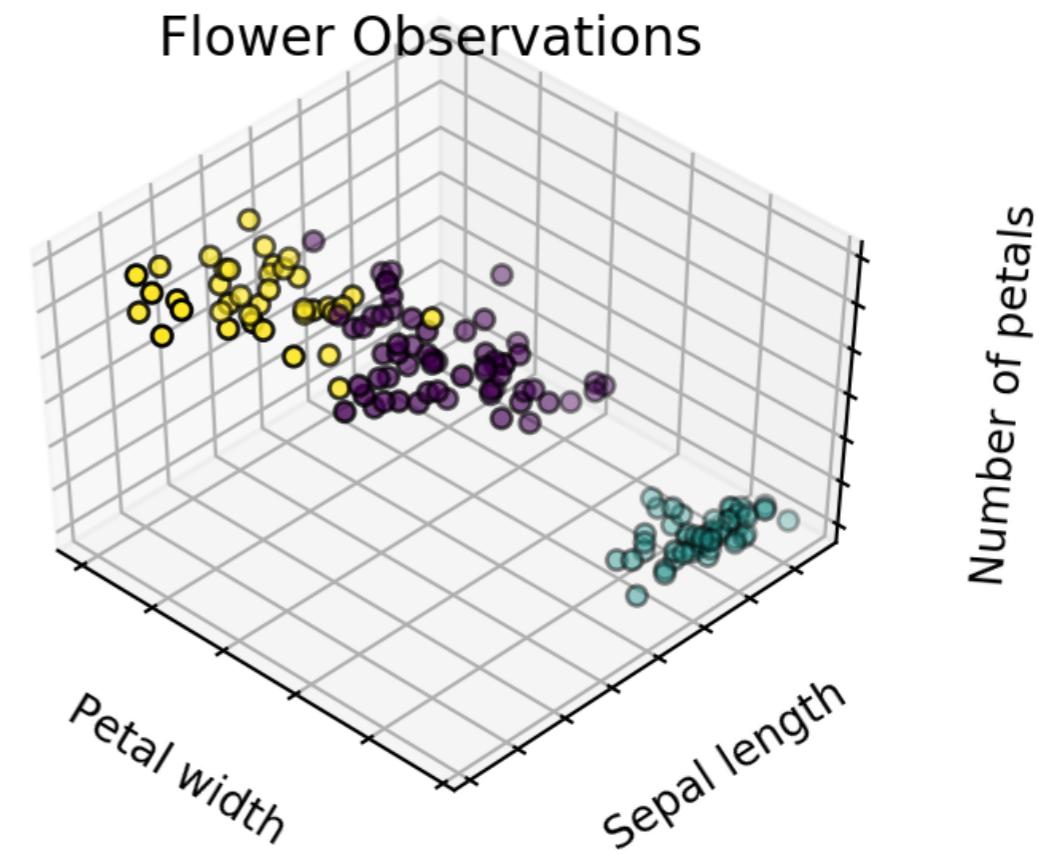


Comparing number of clusters

Two clusters:

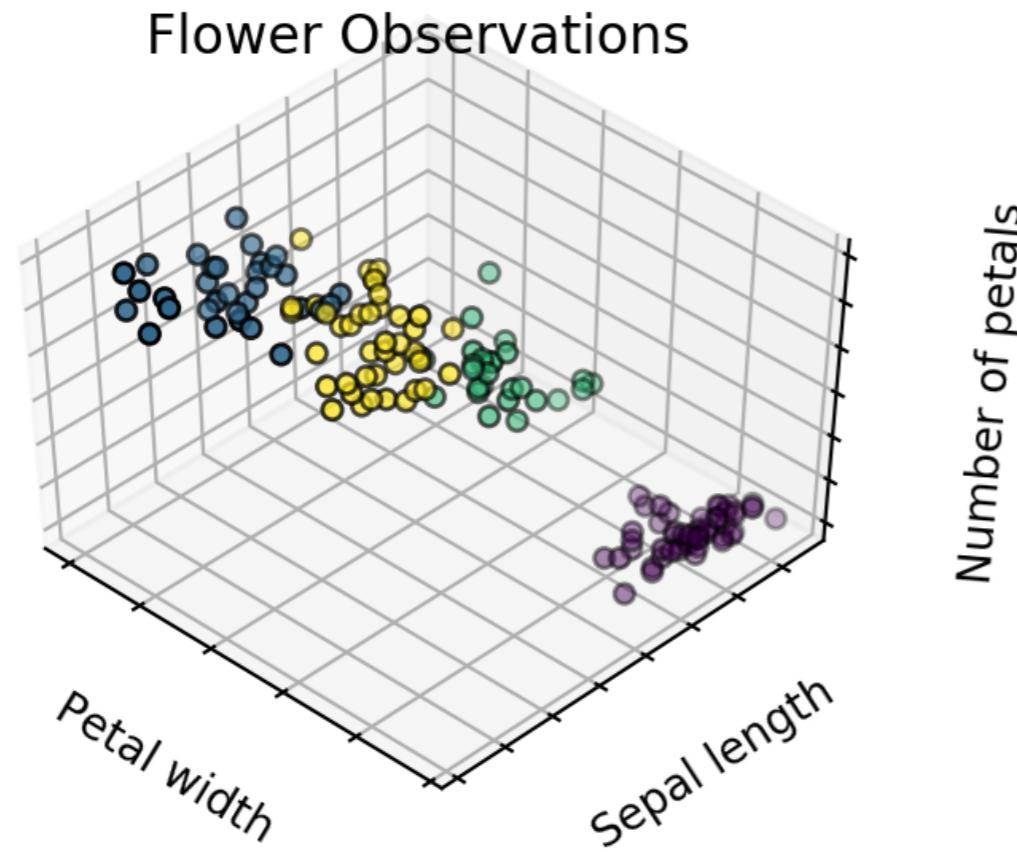


Three clusters:

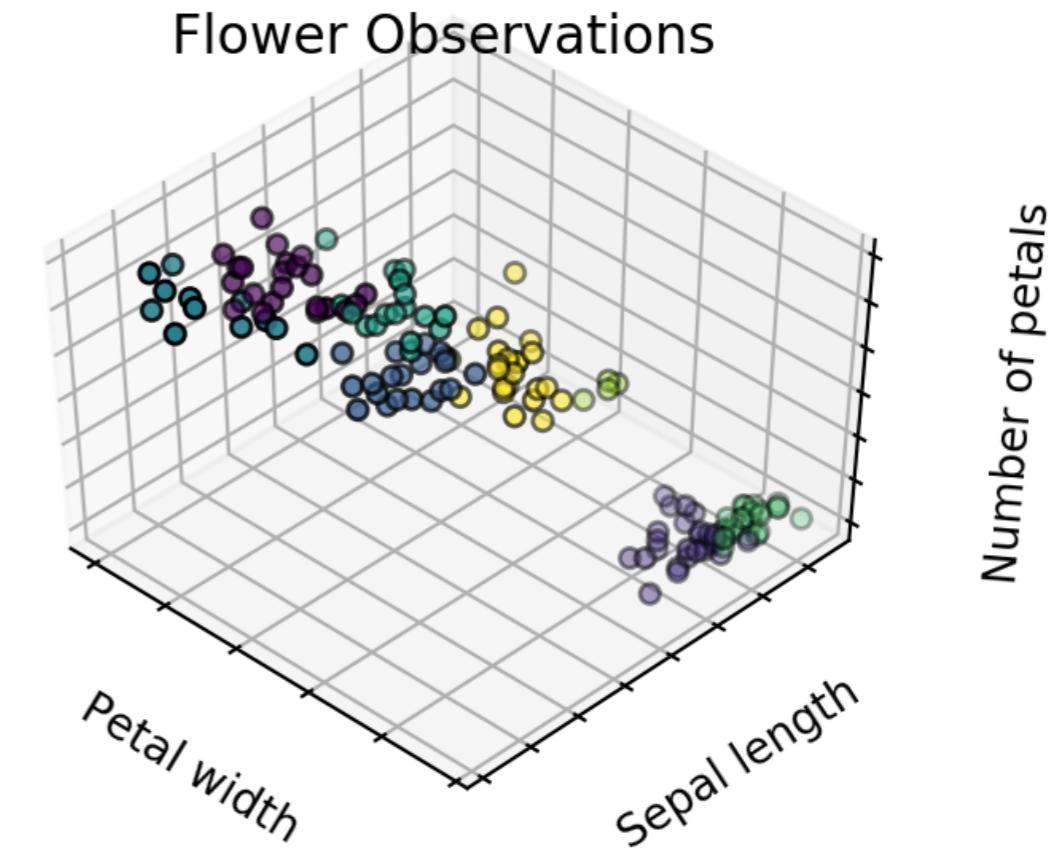


Comparing number of clusters

Four clusters:



Eight clusters:



Comparing number of clusters

- Up to you to decide on final number of clusters
- Use domain knowledge to help decide

Clustering review

Definition

- Divide unlabeled dataset into different categories

Steps

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

Let's practice!

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Congratulations!

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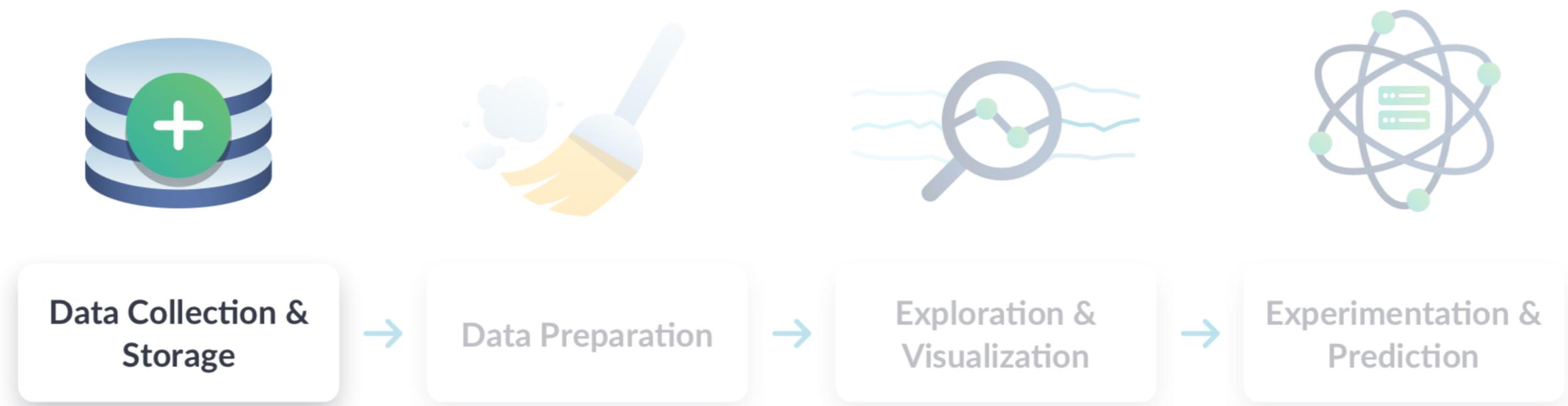
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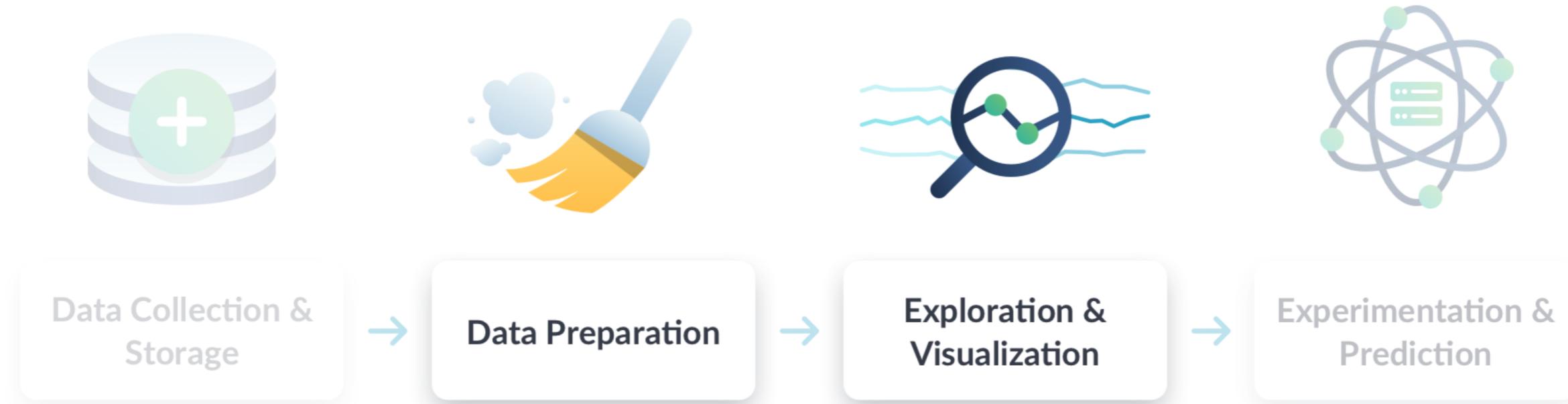
Chap 1: Introduction to Data Science



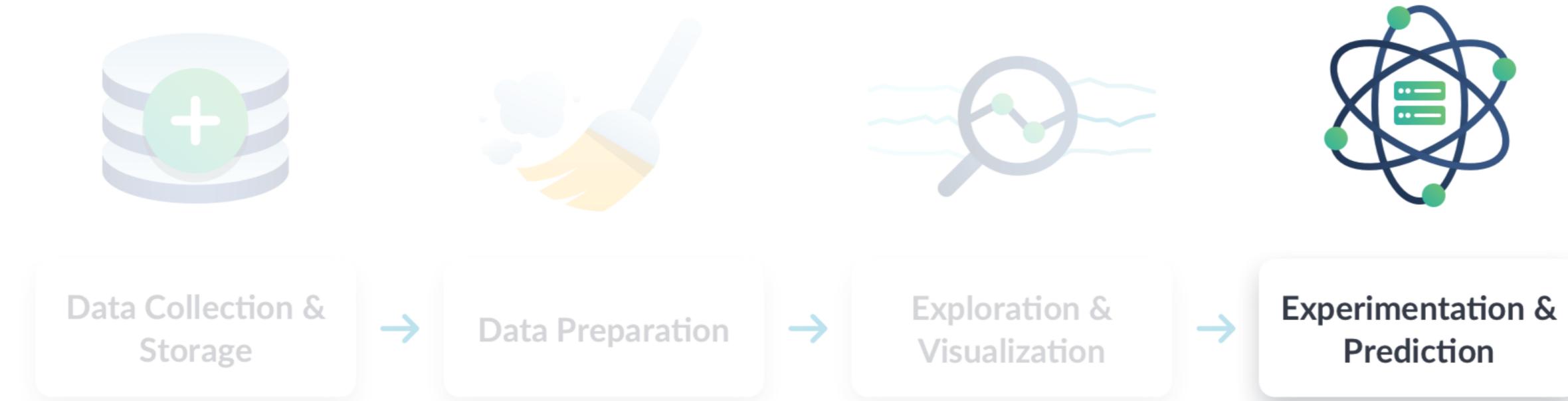
Chap 2: Data Collection and Storage



Chap 3: Preparation, Exploration & Visualization



Chap 4: Experimentation and Prediction



What's next?

- **Introduction to Python**
 - Code your first lines of Python to do data science
- **Data Literacy Fundamentals Skill Track**
 - More "For Everyone" courses on other data topics



Congratulations!

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