Machine Learning 101

kNN Speed Run

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Agenda

- What is ML?
- What is kNN?
- Let's Do It!

What is Machine Learning?

"Learn" from data to
infer/generalize/predict
labels for new data.

- ***Supervised***: **Label** new data given a labeled **dataset** from a set of **features**.
  - Ex: Regression (linear), Classification (kNN, ...), Decision Trees, SVM
- ***Unsupervised***: **Label** new data based on similarity/difference to a unlabeled **dataset** from a set of **features**.
  - Ex: Clustering (k-means, PCA)
- ***Reinforcement***: Create a **policy** to achieve a **goal** through **rewards**.
  - Ex: NNs (CNN, RNN,), aka "AI"

https://ischool.syracuse.edu/what-is-machine-learning/

What is kNN?

It is a classification algorithm.

> A machine learning (ML) algorithm whereby data is "classified", ie: *labeled*, using existing labeled data.

What is Classification?

Dataset

Classify This!

Ready?

tire

donut

Classification Level: Extreme!

Ready?

Let's Do It!

We are going to classify penguins!

Define Your Question

Lost Penguin!!!

I found this penguin, who are their pals?

00:00

Penguin Dataset

The penguin dataset is the "Hello World" for kNN learning.

penguins_raw.csv

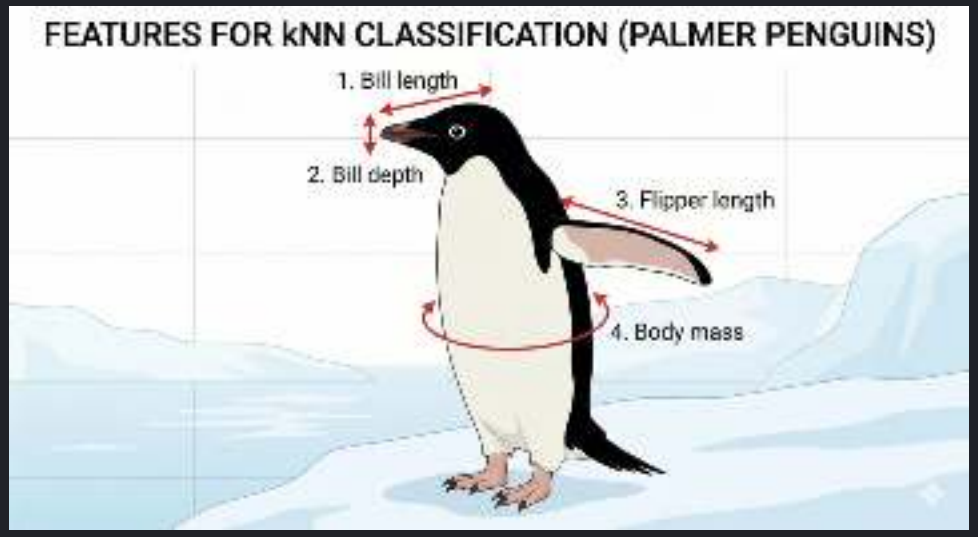
(Good repo for ML datasets: https://archive.ics.uci.edu/)

00:00

Extract Features & Clean

Extract 4 features,
2 of your choice:

1. Species
2. Sex
3. *Choice 1*
4. *Choice 2*



Clean file: `penguins_clean.csv`

00:00

Divide Your Data

You need 3 datasets in ML projects:

- ***Training***: This is your known good data to build your model on/with.
  - 70% of your records
- ***Validation***: This the small subset of known good data to verify your model's goodness.
  - 20% of your records
- ***Test***: This the data for your model to label/predict.
  - 10% of your records

00:00

Visualize Your Validation Data

Explore your validation data:

- https://plotly.com/python/px-arguments/#passing-dictionaries-or-arraylikes-as-the-dataframe-argument
- https://plotly.com/python/line-and-scatter/#setting-size-and-color-with-column-names

Start here: viz.py viz.csv

kNN: The Intuition

“You are who you are nearest.”

“Birds of a feather flock together.”

kNN: The Math

When a new entity is to be classified
via the **features** under consideration
"distance" implies similarity.

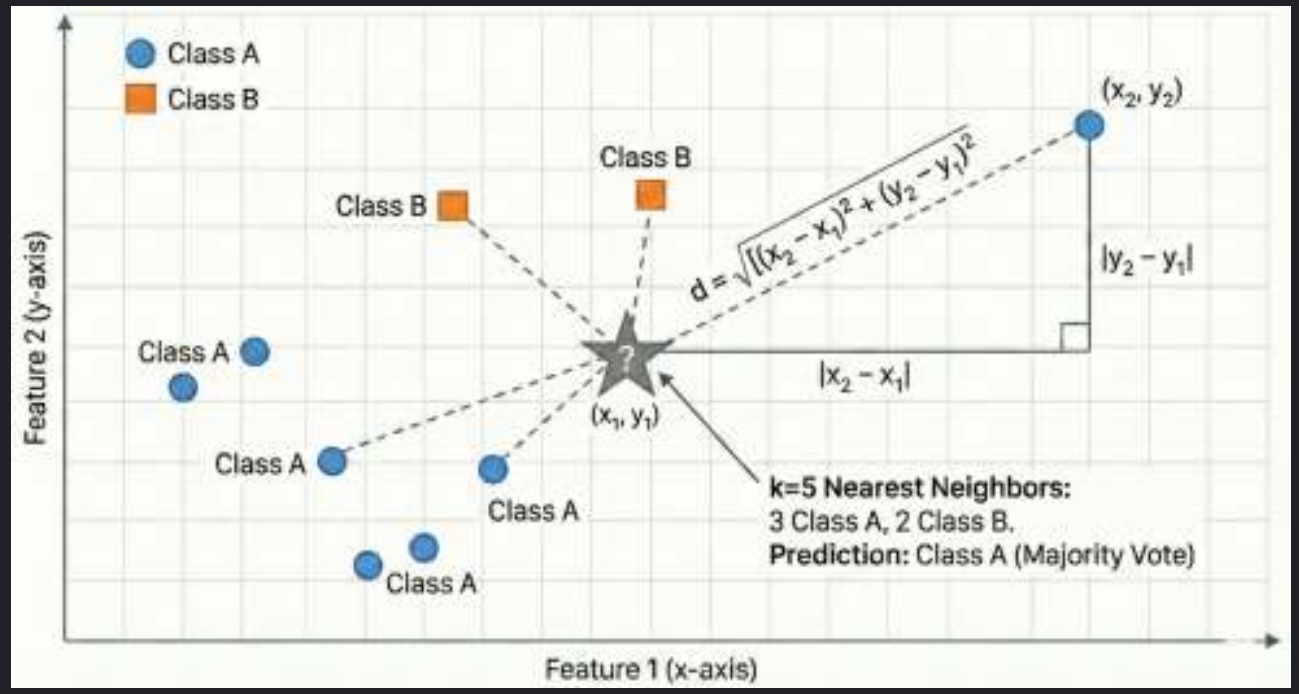
Euclidean distance

$$\overline{dist_x} = \sqrt{\sum_n (\vec{x} - \vec{y_n})^2}$$

Manhattan distance

$$\overline{dist_x} = \sum_n |\vec{x} - \vec{y_n}|$$

kNN: Vizualized



00:00

Classify Your Validation Data

Classify your validation against the training data.

Code Your Distance Function.

Compare (text or visual) against original validation.

Start here: `classify.py lost_penguin.csv`

00:00

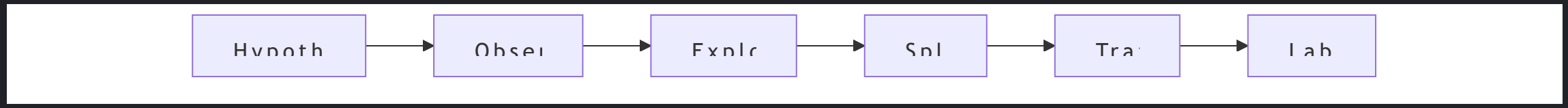
Classify Your Test Data

Now time to classify your test data.

Plot training and classified test data and analyze.

E N D

A Data Science Project



Readings

PDFs

- This presentation ml101.pdf
- Early paper hinting towards kNN 1951-NonparametricDiscriminationConsistencyProperties-FixHodges.pdf
- First paper on kNN 1967-NearestNeighborPatternClassification-Cover.pdf
- 2023-KNNClassificationAReview-SyriopoulosKalampalikis.pdf

More Presentations

- DS 101
- kNN 101

Topics

- Machine Learning (ML): https://en.wikipedia.org/wiki/Machine_learning
  - https://developers.google.com/machine-learning/crash-course
  - https://www.coursera.org/articles/what-is-machine-learning
  - https://www.geeksforgeeks.org/machine-learning/ml-machine-learning/
- kNN: https://en.wikipedia.org/wiki/K-nearest_neighbors_algorithm
  - https://www.geeksforgeeks.org/machine-learning/k-nearest-neighbours/
  - https://towardsdatascience.com/k-nearest-neighbor-classifier-explained-a-visual-guide-with-code-examples-for-beginners-a3d85cad00e1/
- `plotly`: https://plotly.com/
- `panda`: https://pandas.pydata.org/
- Scatter plot: https://en.wikipedia.org/wiki/Scatter_plot