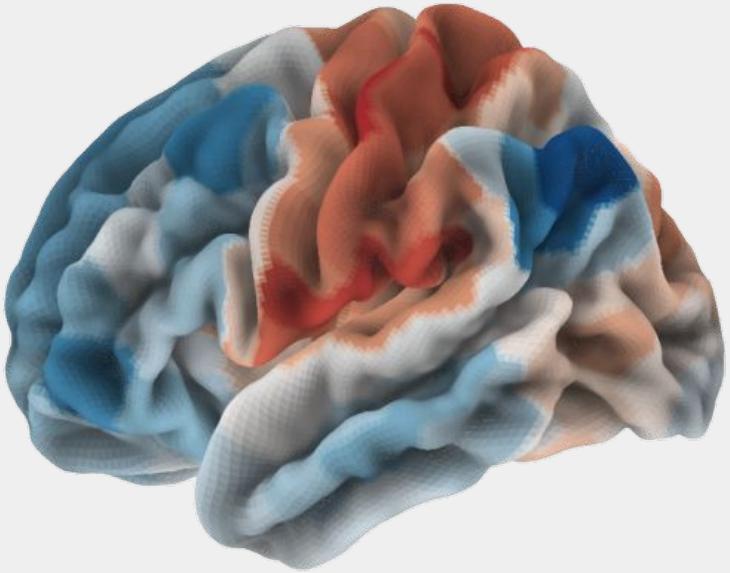
Fundamentals of fMRI data analysis

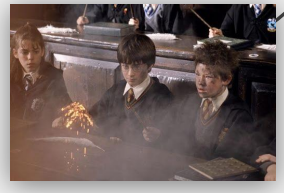


Karolina Finc

Centre for Modern Interdisciplinary Technologies Nicolaus Copernicus University in Toruń

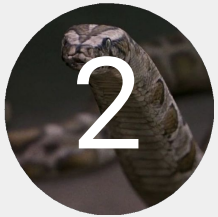
COURSE #5: Machine learning | 1st February 2021

Study plan



BEFORE

Open science & neuroimaging



fMRI data manipulation in python

fMRI data preprocessing

General Linear Model

Functional connectivity

Machine Learning on fMRI data

AFTER

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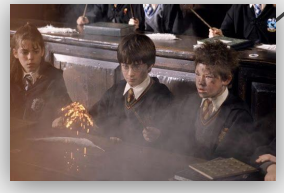

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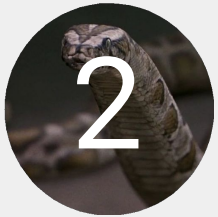

fMRI data manipulation in python

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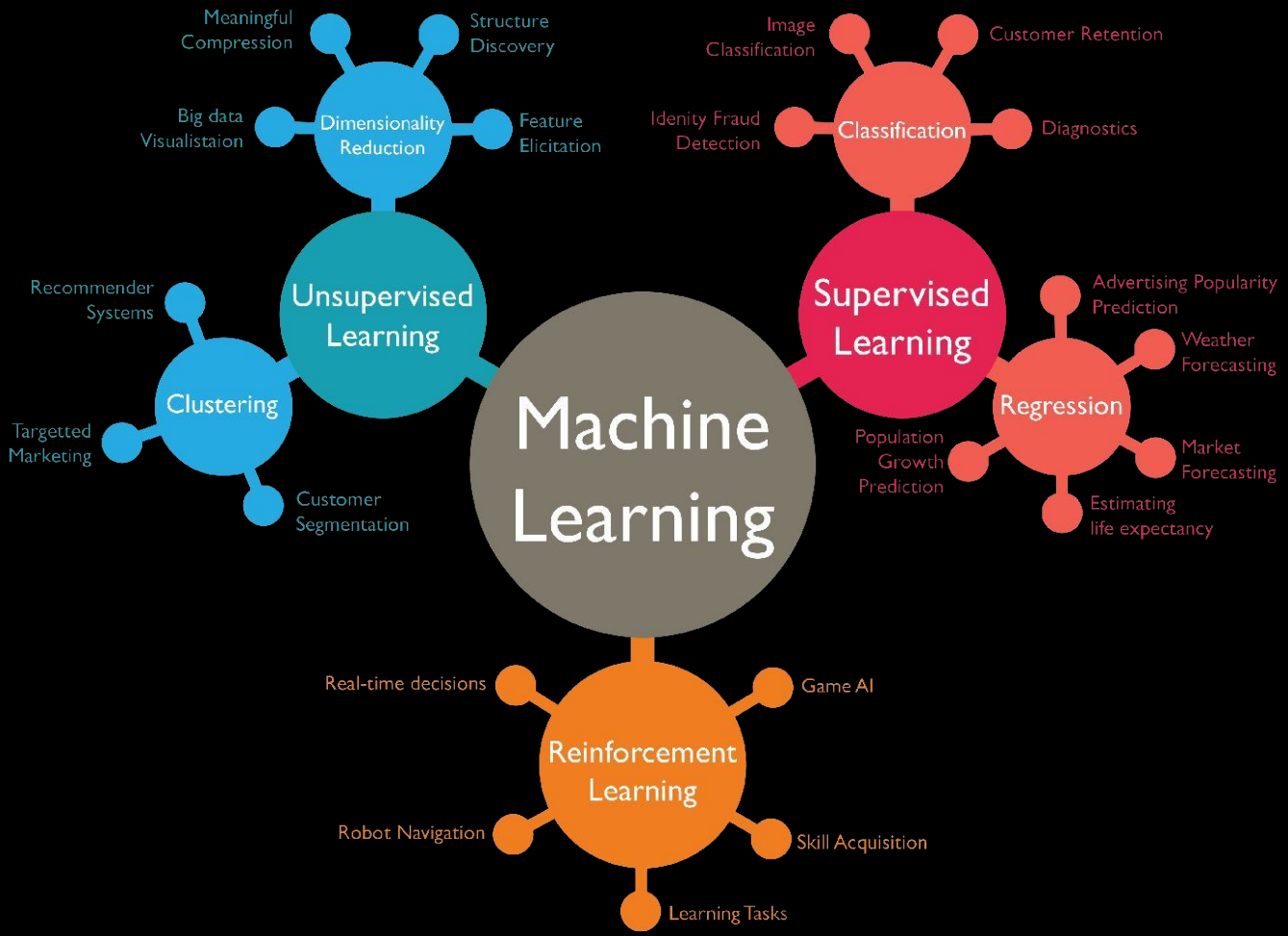
AFTER

What’s machine learning?

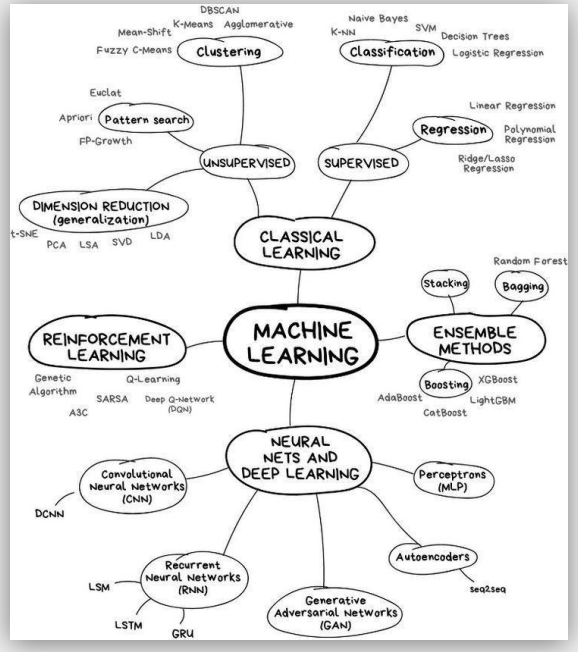
Machine learning - the art and science of giving computers the ability to learn to make decisions from data, without being explicitly programmed.


What kind of questions can be answered when applying ML to fMRI data?


Machine Learning
Unsupervised Learning
Dimensionality Reduction
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Clustering
Recommender Systems
Targetted Marketing
Customer Segmentation
Supervised Learning
Classification
Image Classification
Customer Retention
Idenity Fraud Detection
Diagnostics
Regression
Advertising Popularity Prediction
Weather Forecasting
Market Forecasting
Estimating life expectancy
Population Growth Prediction
Reinforcement Learning
Real-time decisions
Game AI
Robot Navigation
Skill Acquisition
Learning Tasks

Types machine learning

Supervised learning - predicting the target variable, given the predictor variables (labeled data)



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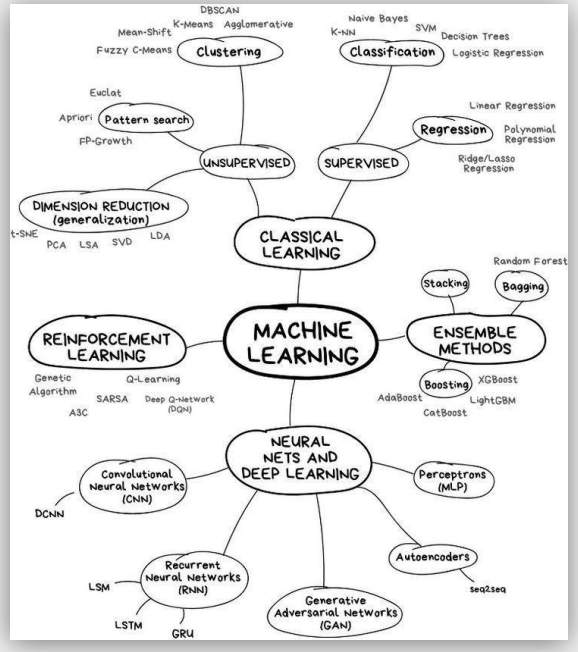

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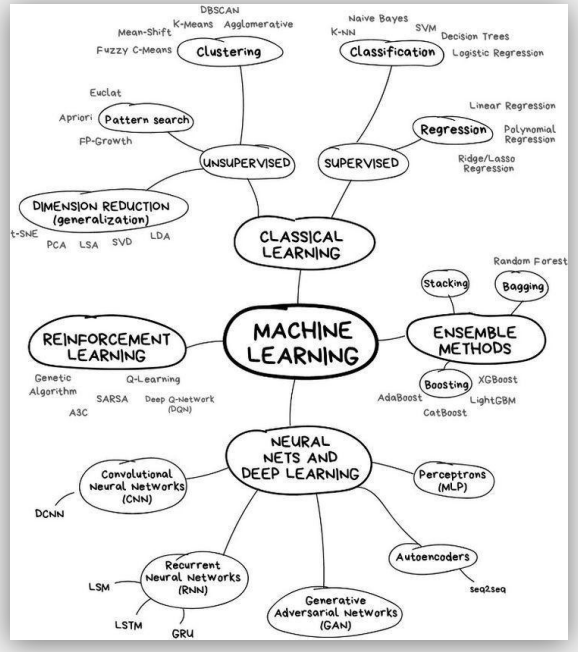

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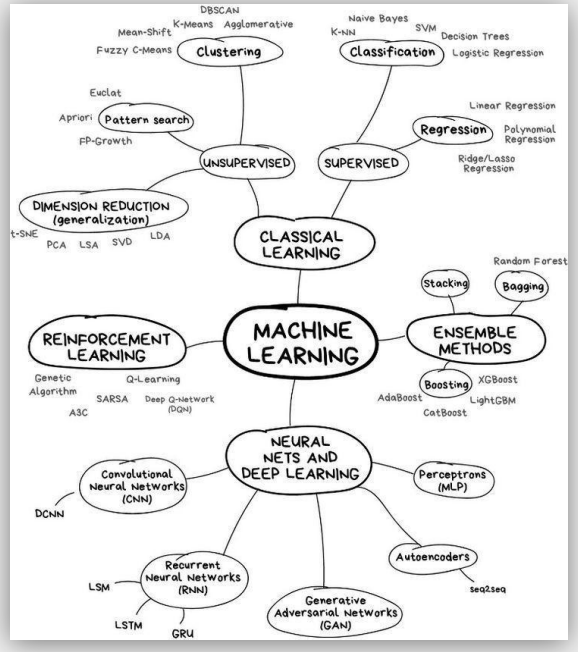
Unsupervised learning - uncovering hidden structures and patterns (unlabeled data)



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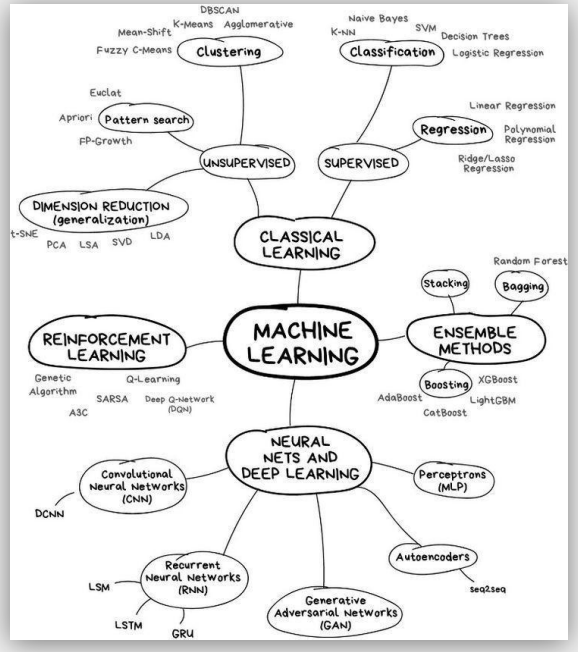
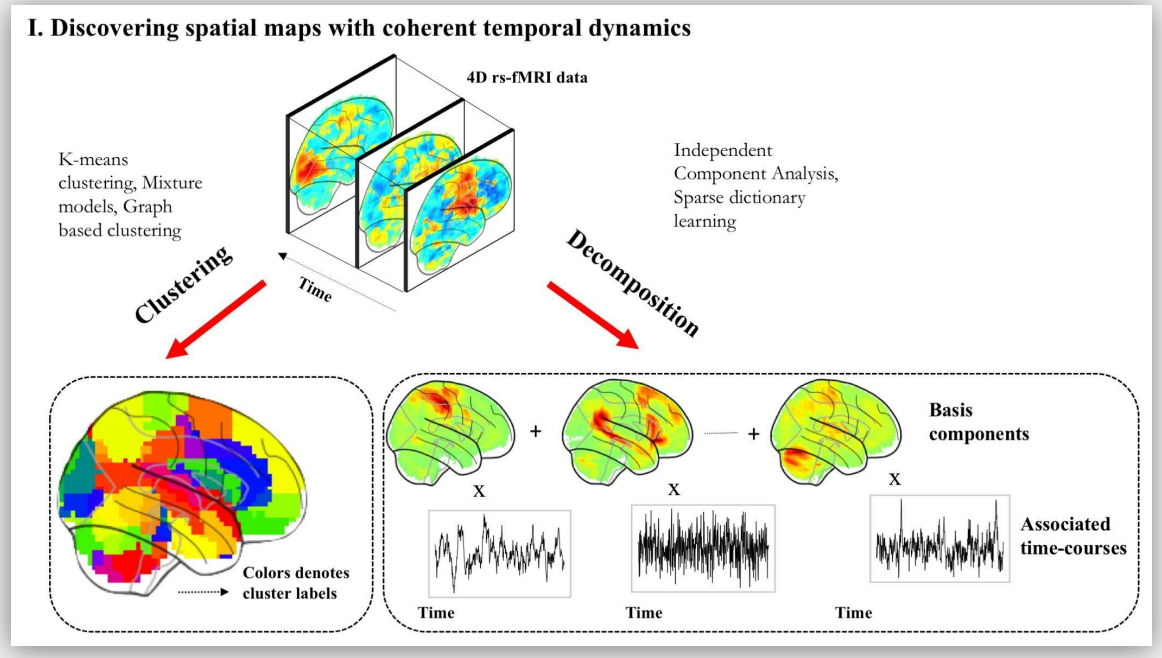
Unsupervised learning - uncovering hidden structures and patterns (unlabeled data)

- **Clustering** - grouping data points into distinct categories (for example fMRI time-series into distinct brain states)



Other use-cases



Feature selection

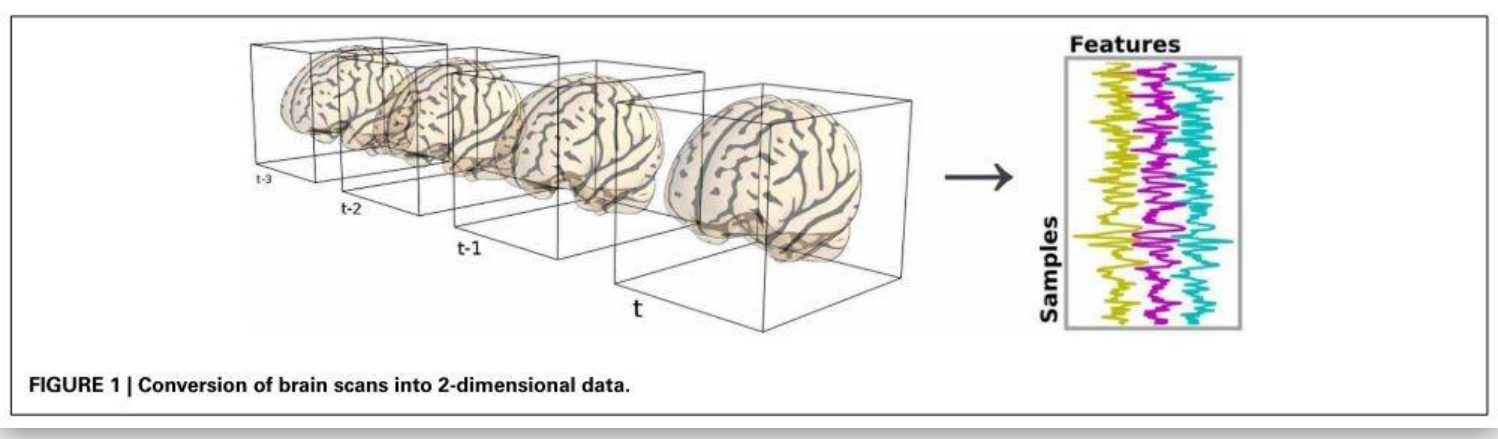
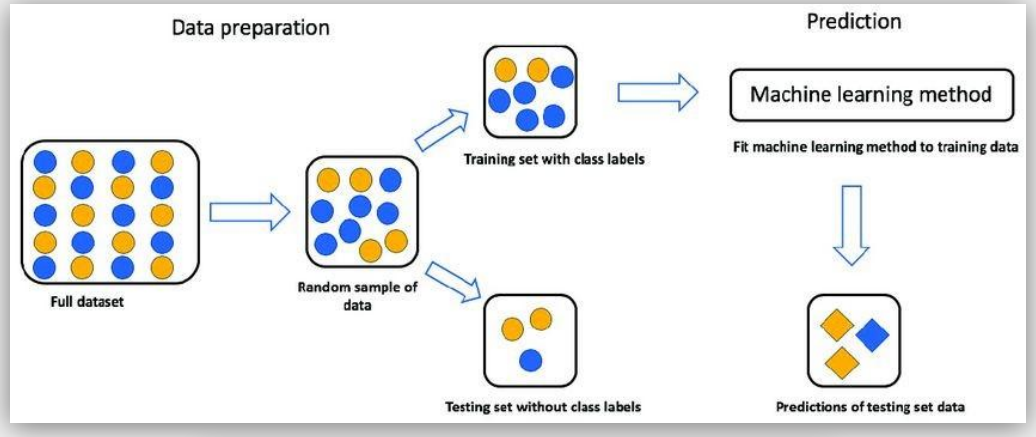
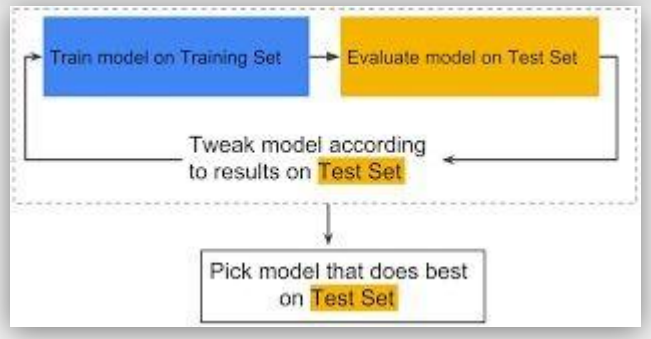


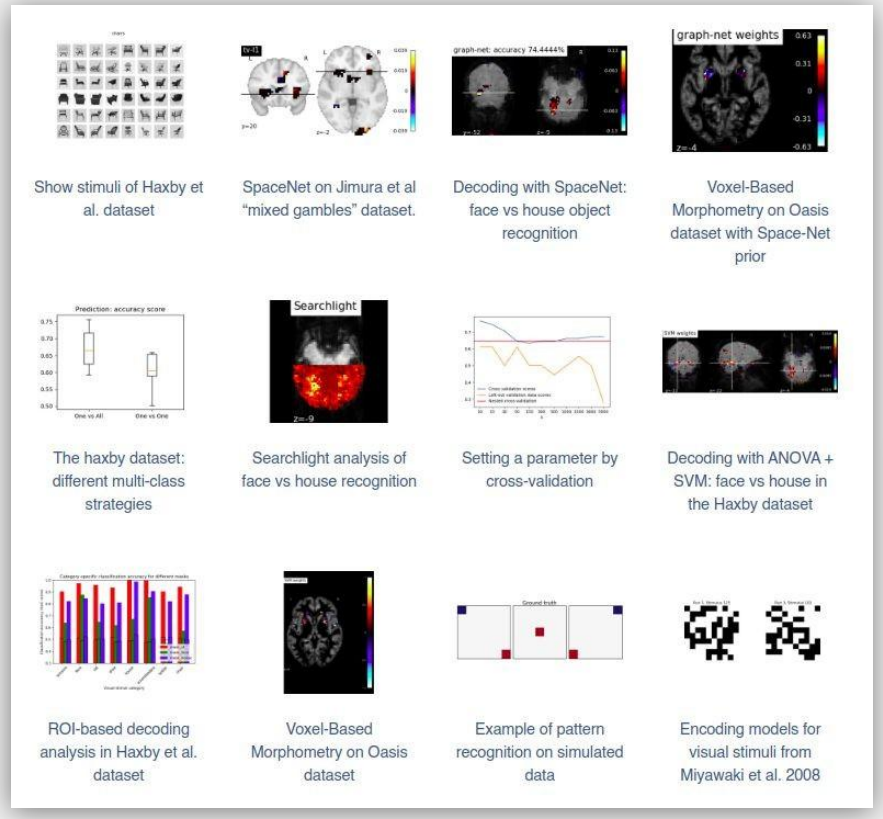
FIGURE 1 | Conversion of brain scans into 2-dimensional data.

Training & test set

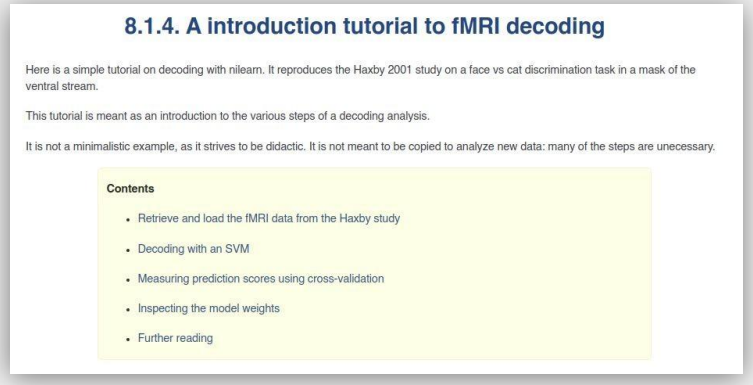




Nilearn tutorials



scikit learn



8.1.4. A introduction tutorial to fMRI decoding

Here is a simple tutorial on decoding with nilearn. It reproduces the Haxby 2001 study on a face vs cat discrimination task in a mask of the ventral stream.

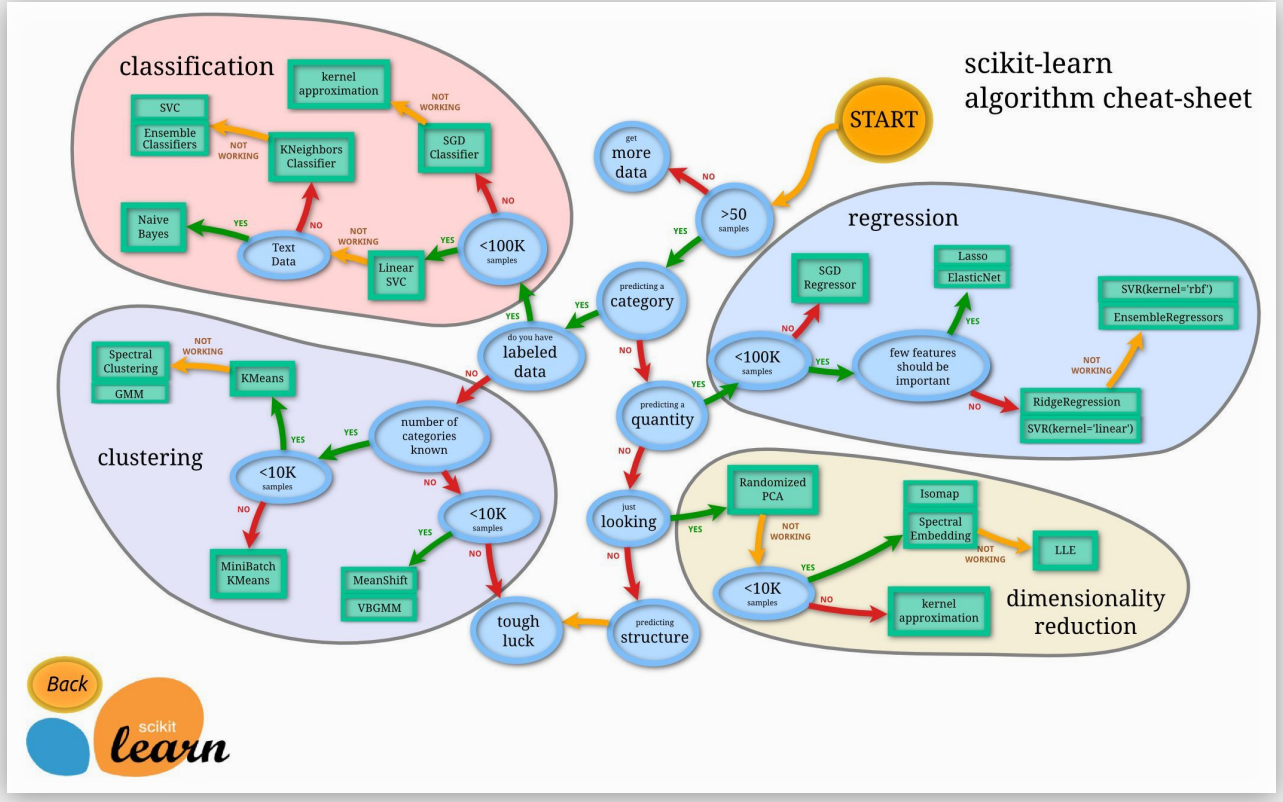
This tutorial is meant as an introduction to the various steps of a decoding analysis.

It is not a minimalistic example, as it strives to be didactic. It is not meant to be copied to analyze new data: many of the steps are unecessary.

Contents

- Retrieve and load the fMRI data from the Haxby study
- Decoding with an SVM
- Measuring prediction scores using cross-validation
- Inspecting the model weights
- Further reading

Sklearn cheat sheet



Poster for extra points!

Analysis of fMRI data

Author

Logo

What I did and why?

My results

How I did it?

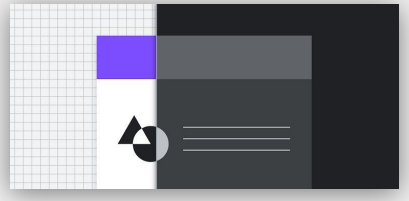
Some conclusions

References

Rules:

Be visual: use less text, more pictures

Follow a good design rules and avoid clutter



https://material.io/design