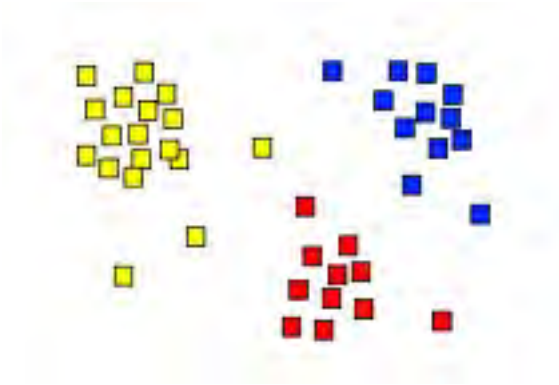
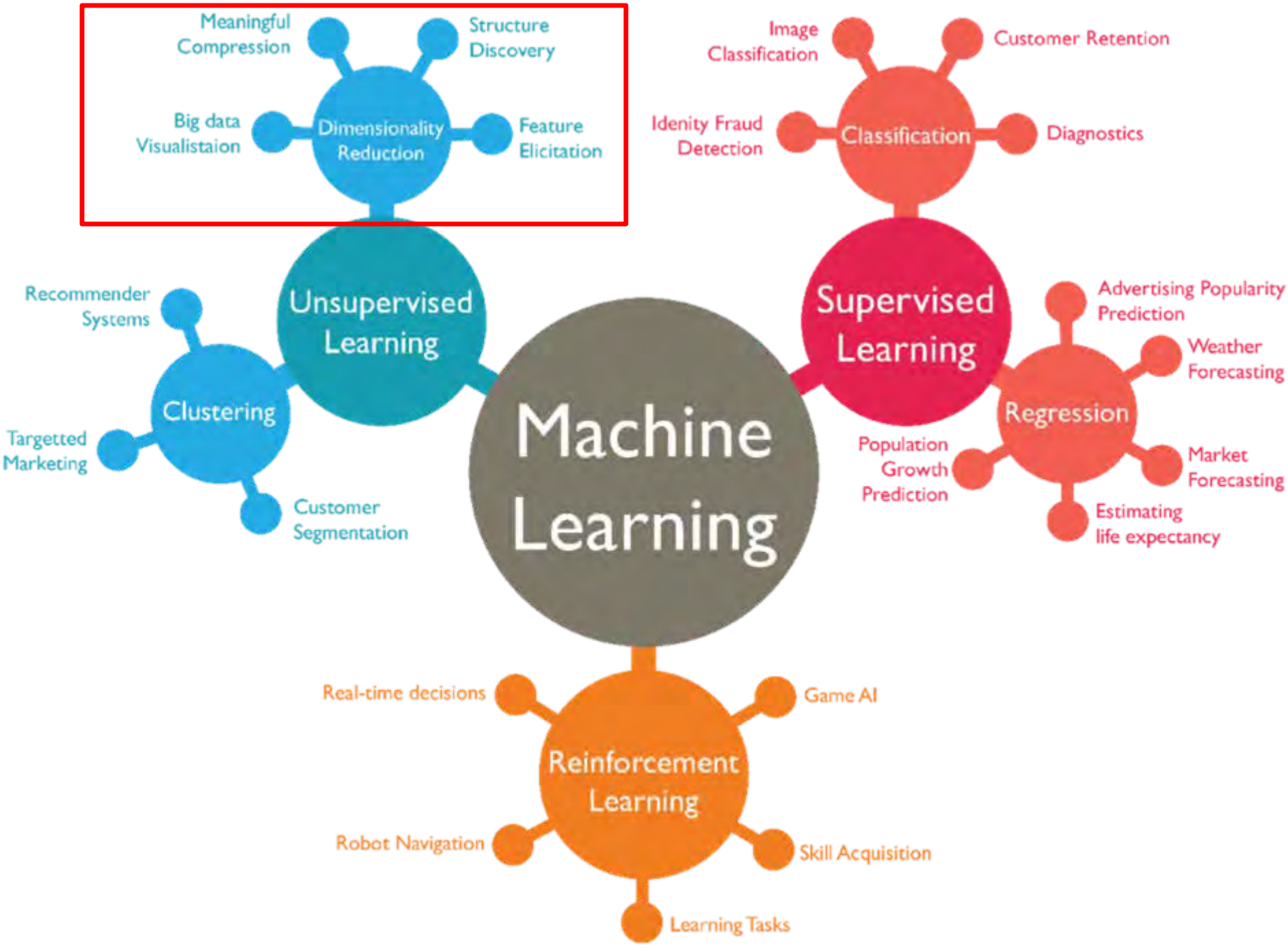
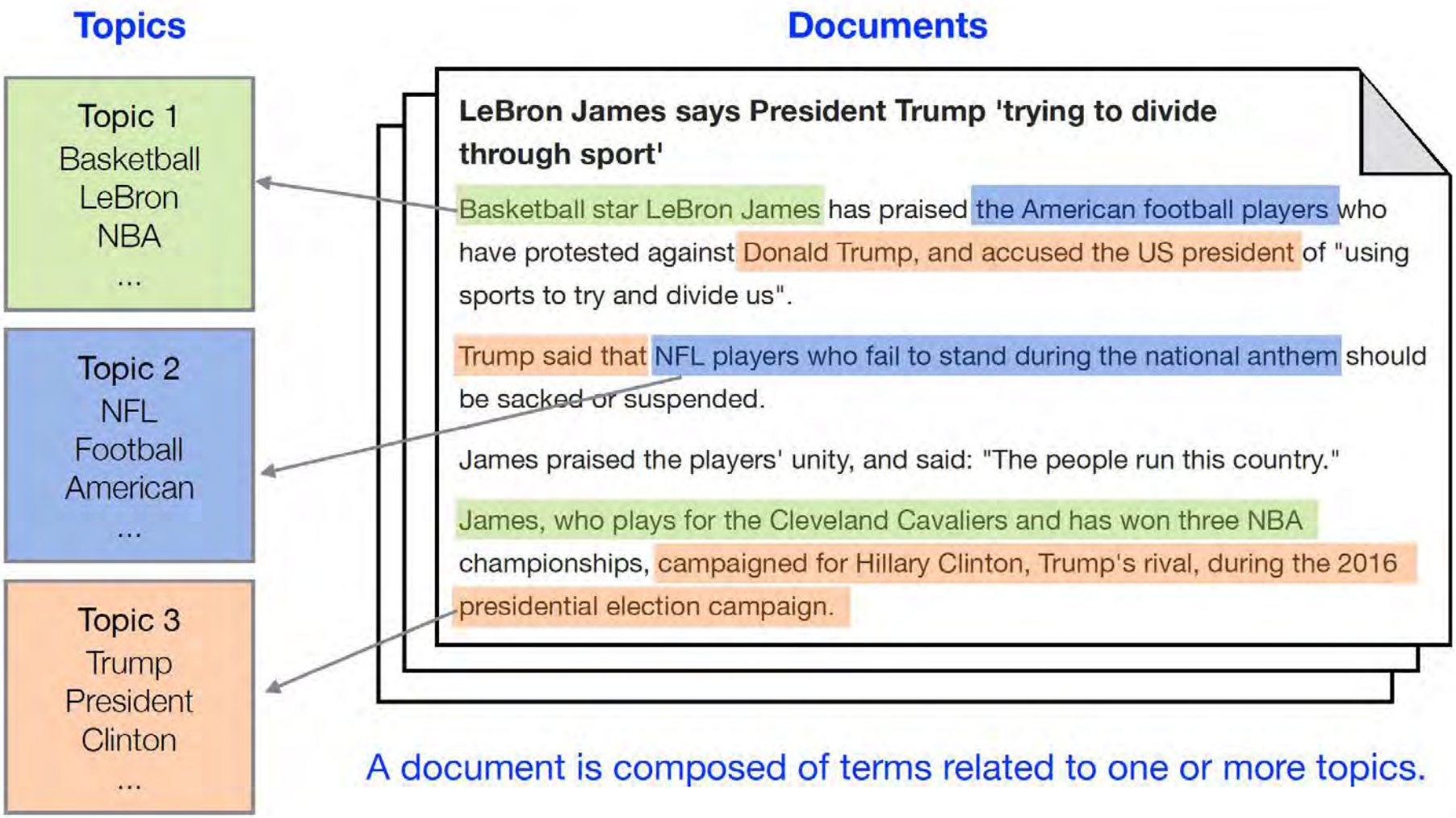


Unsupervised Learning: Topic Modeling

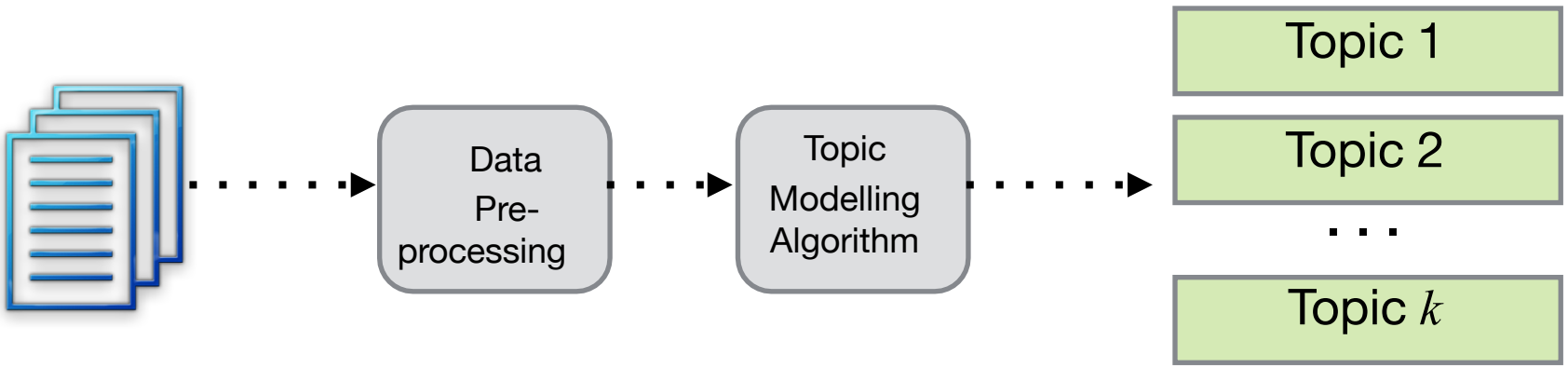

Machine Learning
Unsupervised Learning
Dimensionality Reduction
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Clustering
Recommender Systems
Targetted Marketing
Customer Segmentation
Supervised Learning
Classification
Image Classification
Customer Retention
Idenity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

Documents cover multiple topics



A document is composed of terms related to one or more topics.

Topic Modeling



- Topic Modeling **induces** a set of topics from a document collection based on their words
- **Output:** A set of *k* topics, each of which is represented by
  - A descriptor, based on the top-ranked terms for the topic
  - Associations for documents relative to the topic.

Topic Modeling

- If we want five topics for a set of newswire articles, the topics might correspond to politics, sports, technology, business & entertainment
- Documents are represented as a vector of numbers (between 0.0 & 1.0) indicating how much of each topic it has
- Document similarity is measured by the cosign similarity of their vectors

Document-term matrix

- Given collection of documents, find all the unique words in them
  - Eliminate common stopwords (e.g., the, and, a) that carry little meaning and very infrequent words
- Represent each word as an integer and construct document-term matrix
- Cell values are term frequency (tf), number of times word occurs
- Alternatively: use tf-idf to give less weight to very common words

10,000 words

1000 documents

	W1	W2	W3	Wn
D1	0	2	1	3
D2	1	4	0	0
D3	0	2	3	1
Dn	1	1	3	0

Dimensionality reduction

- A dimensionality-reduction algorithm converts this matrix into the product of two smaller matrices
  - *Documents to topics* and *topics to words*
- Document represented as a vector of topics
- Understand what K_3 is about by looking at its words with the highest values
- Documents about topic K_3 are those with high values for K_3
- Documents similar to D_{43} will have similar topic vectors (use cosine similarity)

	W1	W2	W3	Wn
D1	0	2	1	3
D2	1	4	0	0
D3	0	2	3	1
Dn	1	1	3	0

n documents x m words

	K1	K2	K3	K
D1	1	0	0	1
D2	1	1	0	0
D3	1	0	0	1
Dn	1	0	1	0

n documents x k topics

X

	W1	W2	W3	Wm
K1	0	1	1	1
K2	1	1	1	0
K3	1	0	0	1
K	1	1	0	0

k topics x m words

Topic modeling with sklearn

See and try the notebooks and data in this [github repo]

data	8 minutes ago
NMFtm.ipynb	8 minutes ago
README.md	8 minutes ago
articles-model-nmf-k10.pkl	8 minutes ago
articles-raw.pkl	8 minutes ago
articles-tfidf.pkl	8 minutes ago
preprocessing.ipynb	8 minutes ago
stopwords.txt	8 minutes ago

Dimensionality reduction

- There are many dimensionality-reduction algorithms with different properties
- They are also used for word embeddings
- General idea: represent a thing (i.e., document, word, node in a graph) as a relatively short (e.g., 100-300) vector of numbers between 0.0 and 1.0
- Some information lost, but the size is manageable

Topic Modeling Summary

- Topic Modeling is an efficient way for identifying latent topics in a collection of documents
- The topics found are ones that are specific to the collection, which might be social media posts, medical journal articles or cybersecurity alerts
- It can be used to find documents on a topic, for document similarity metrics and other applications