

Machine learning basics

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Machine learning

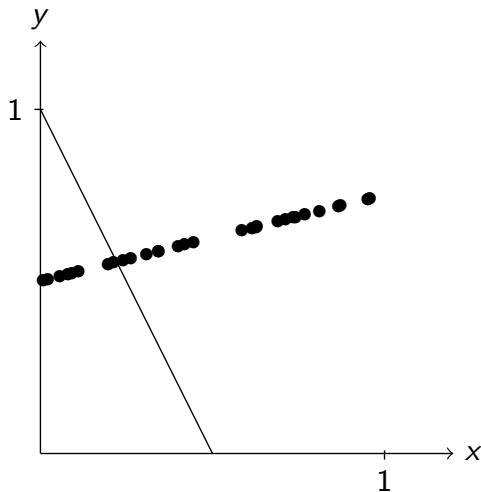
Machine learning (ML) is a subfield of artificial intelligence.

Intuitively We want to *learn from* and *make predictions on* data.

Technically We want to update the parameters of a model to make it describe our training data as well as possible (“well” being defined by a *loss function*).

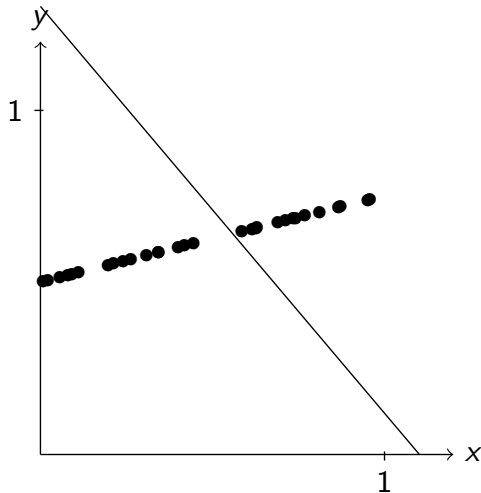
Model example

Linear regression



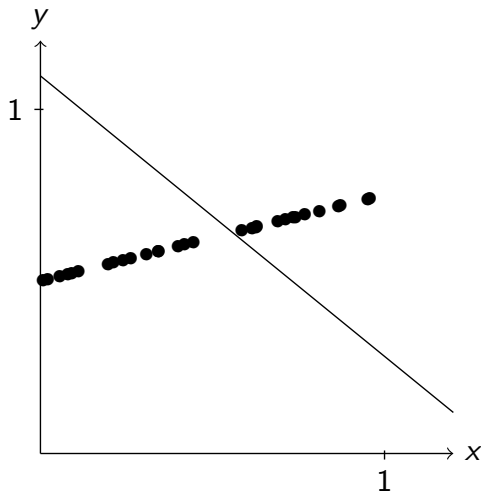
Model example

Linear regression



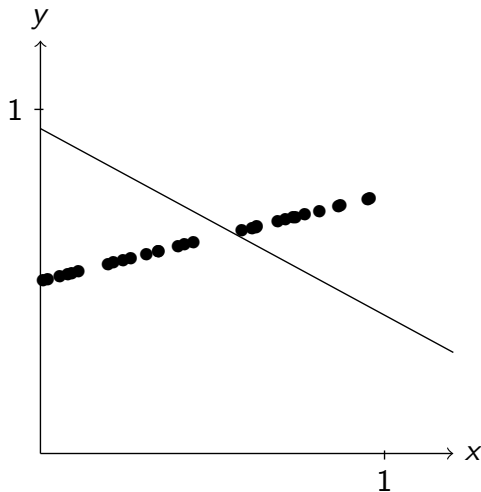
Model example

Linear regression



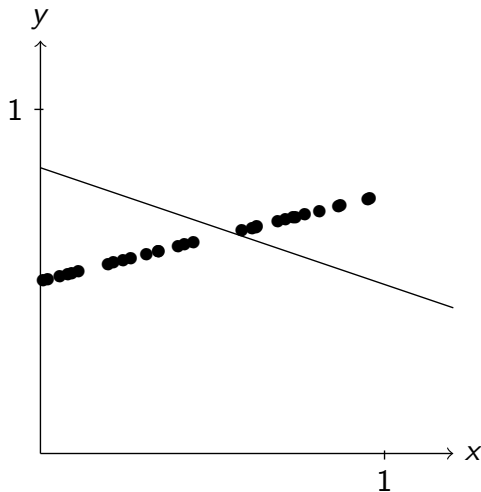
Model example

Linear regression



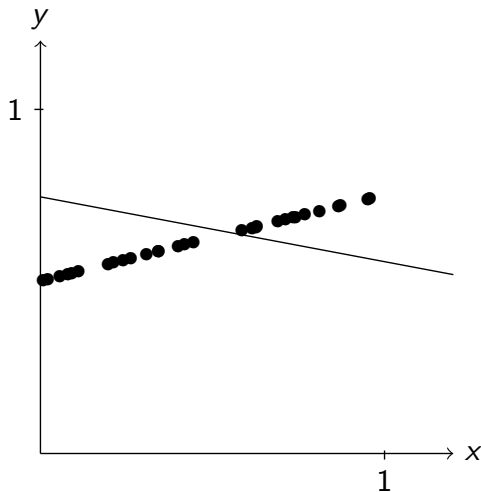
Model example

Linear regression



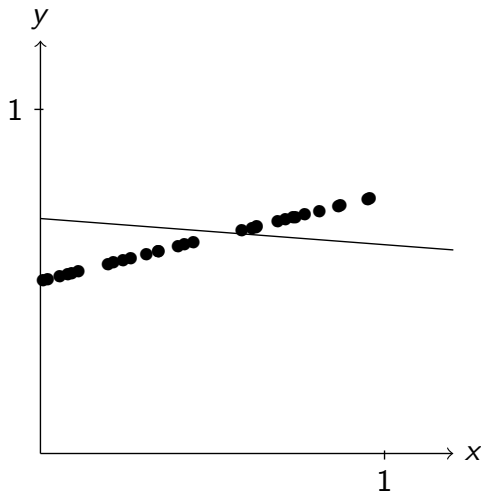
Model example

Linear regression



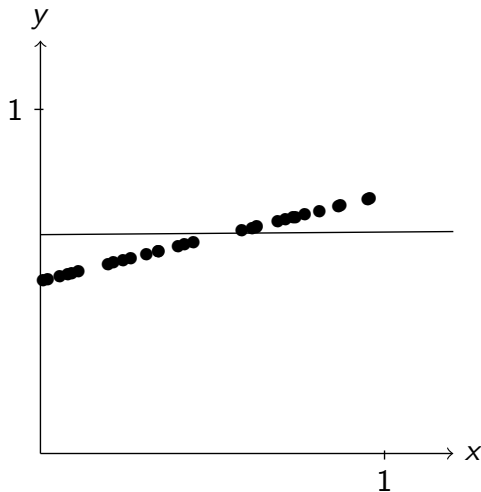
Model example

Linear regression



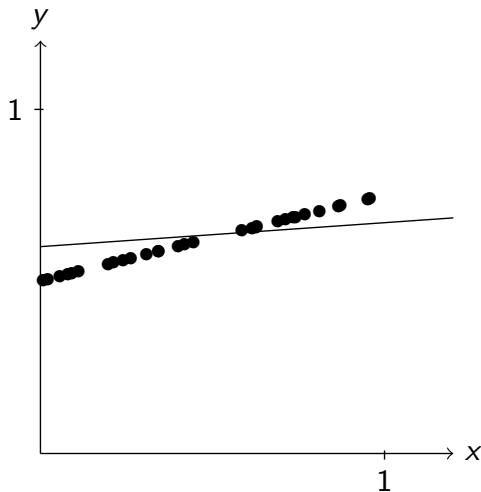
Model example

Linear regression



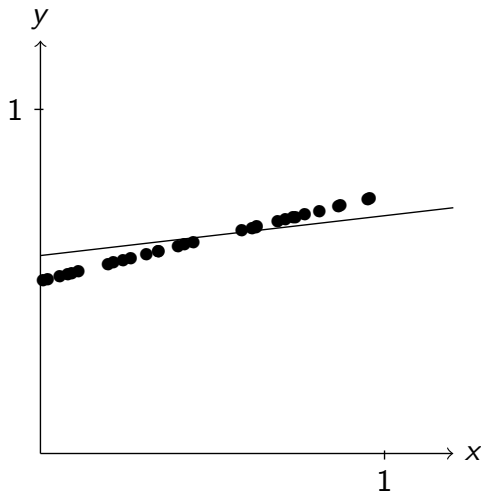
Model example

Linear regression



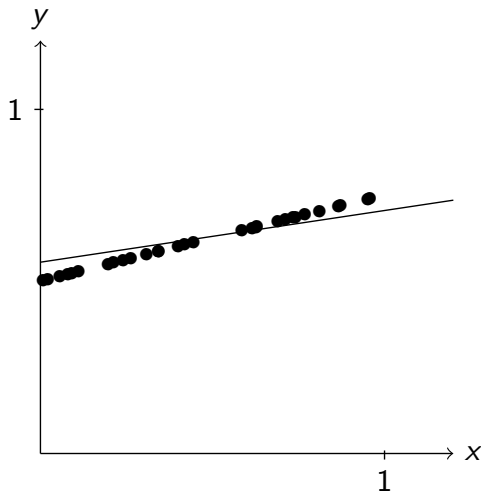
Model example

Linear regression



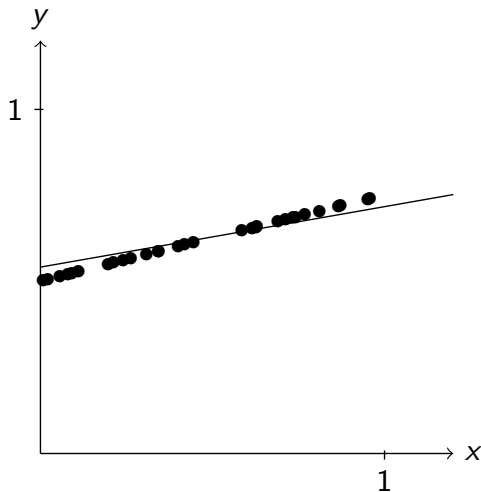
Model example

Linear regression



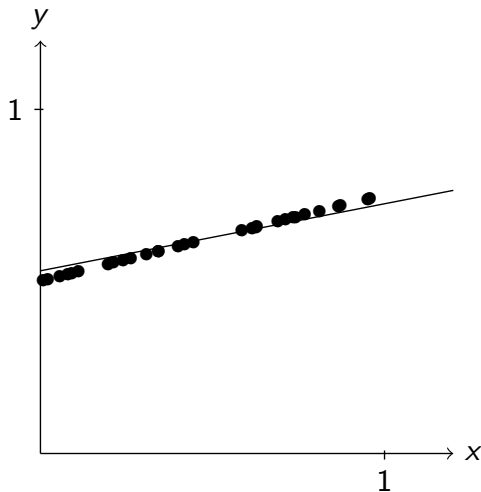
Model example

Linear regression



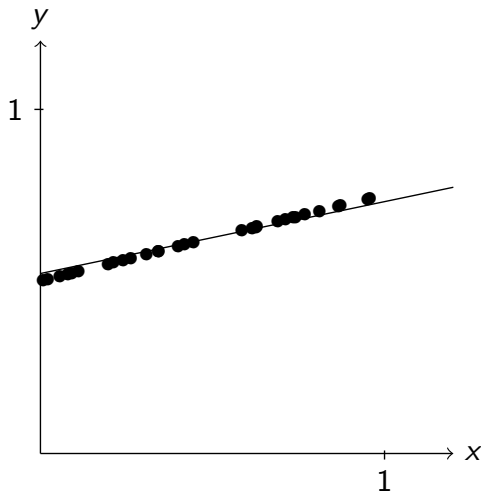
Model example

Linear regression



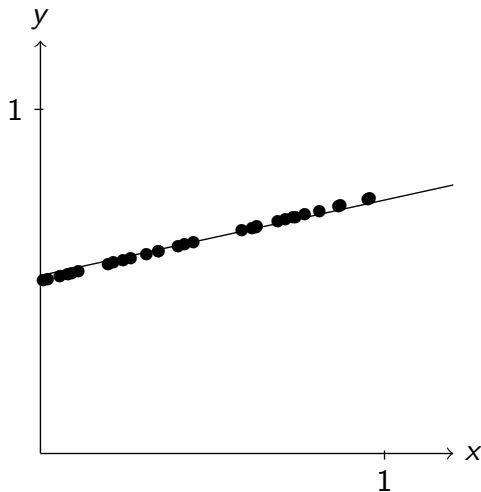
Model example

Linear regression



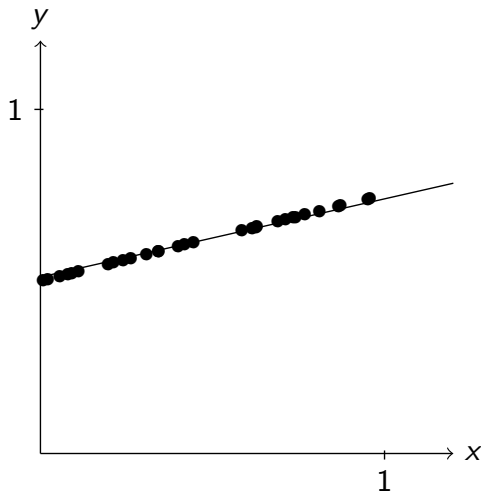
Model example

Linear regression



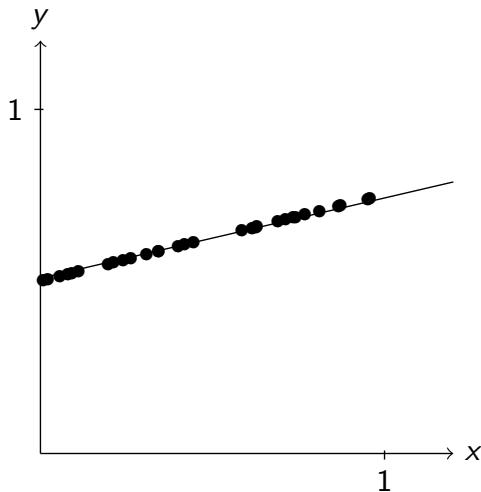
Model example

Linear regression



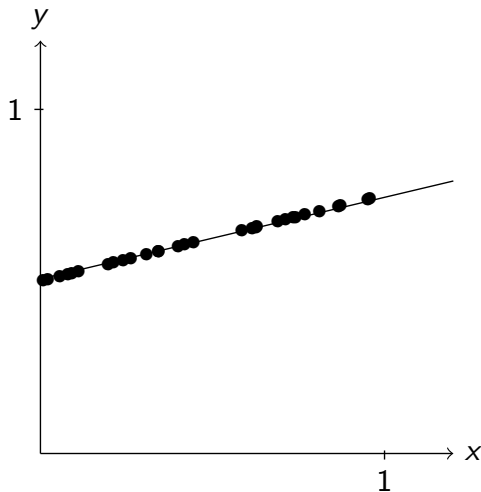
Model example

Linear regression



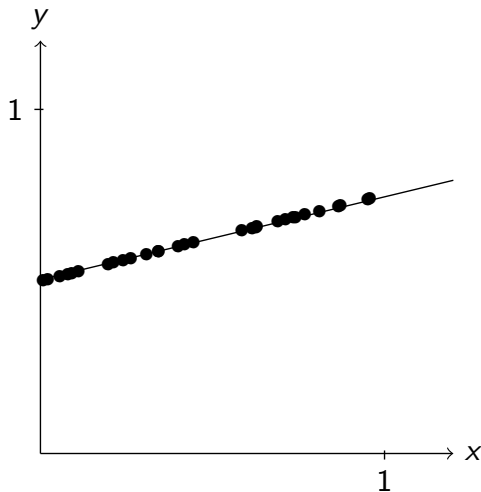
Model example

Linear regression



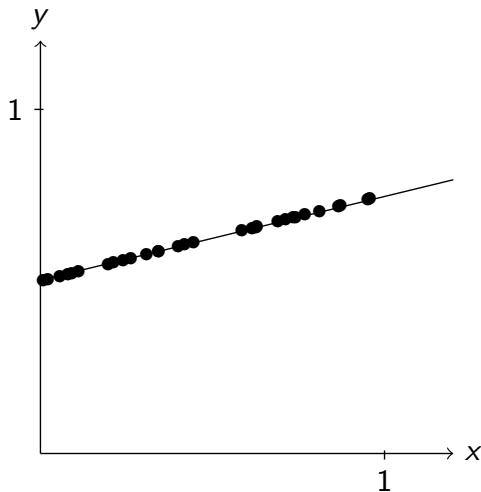
Model example

Linear regression



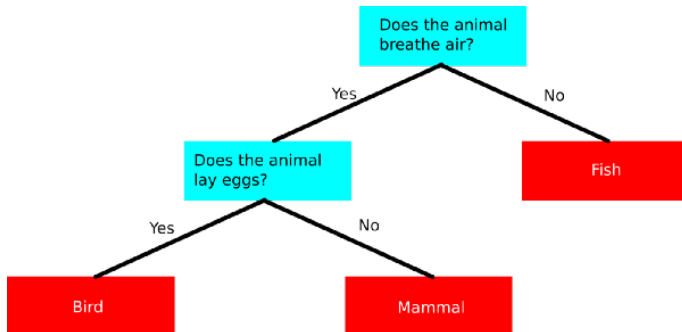
Model example

Linear regression



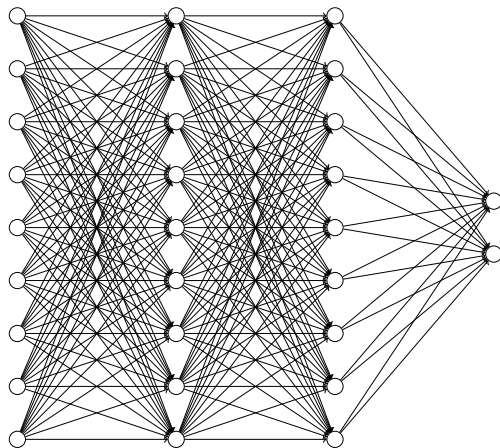
Model example

Decision tree



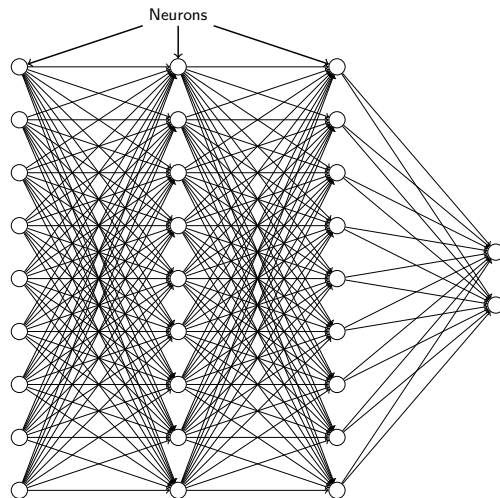
Model example

Neural network (deep learning)



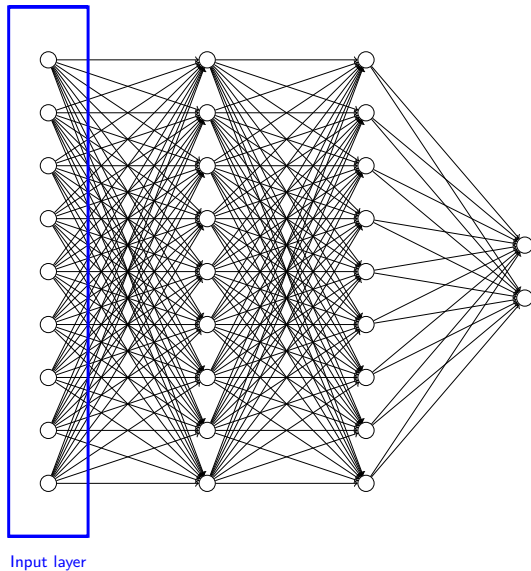
Model example

Neural network (deep learning)



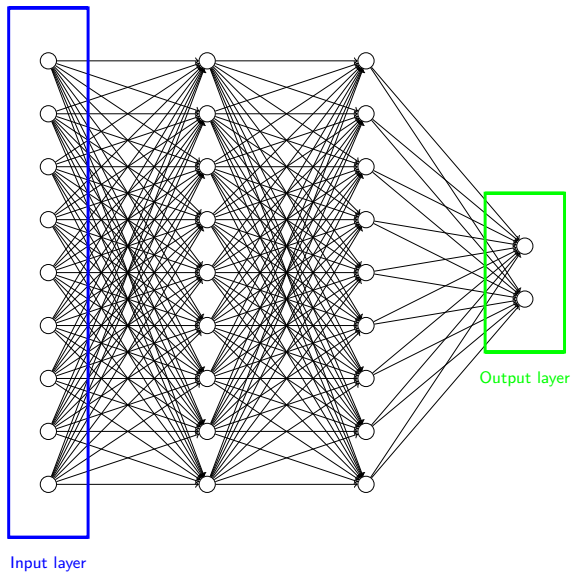
Model example

Neural network (deep learning)



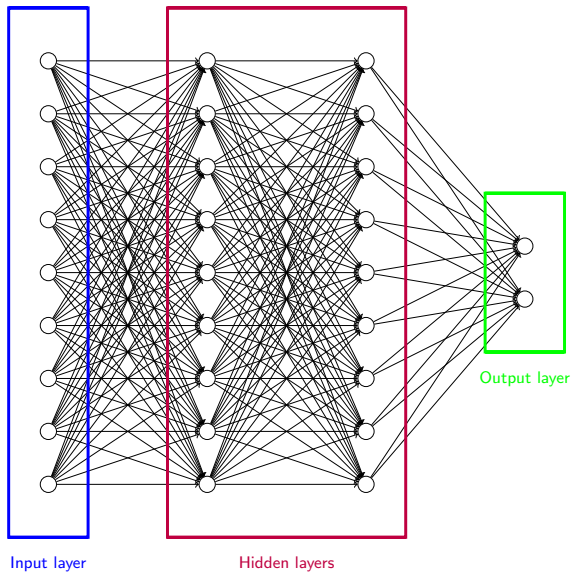
Model example

Neural network (deep learning)



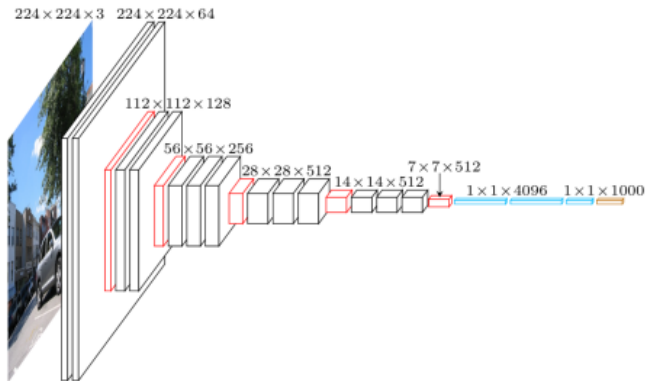
Model example

Neural network (deep learning)



Deep learning architecture

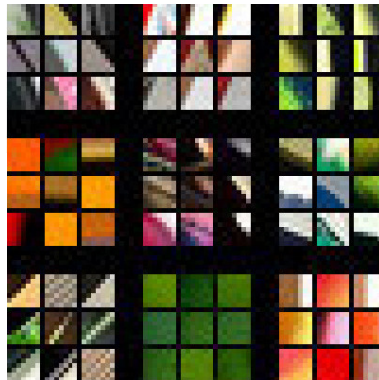
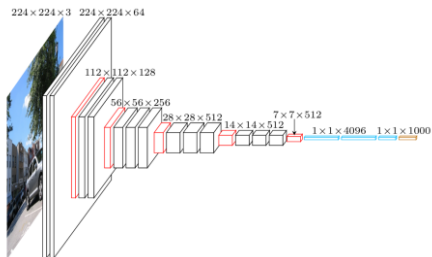
Image recognition (VGG 16)



Deep learning architecture

Hierarchized pattern recognition

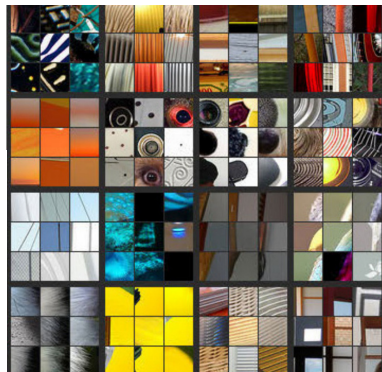
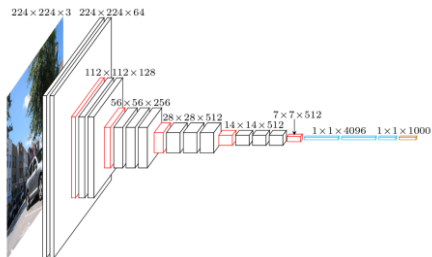
Layer 1



Deep learning architecture

Hierarchized pattern recognition

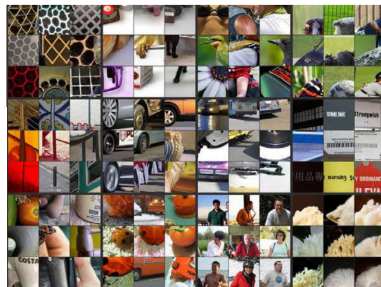
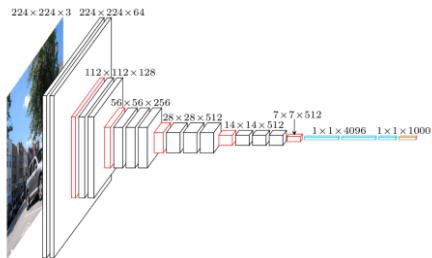
Layer 2



Deep learning architecture

Hierarchized pattern recognition

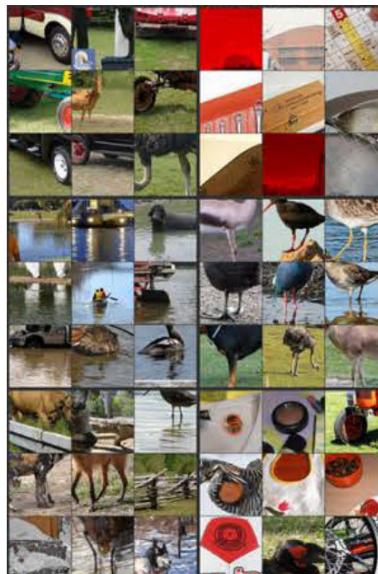
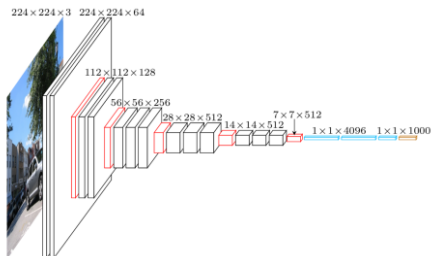
Layer 3



Deep learning architecture

Hierarchized pattern recognition

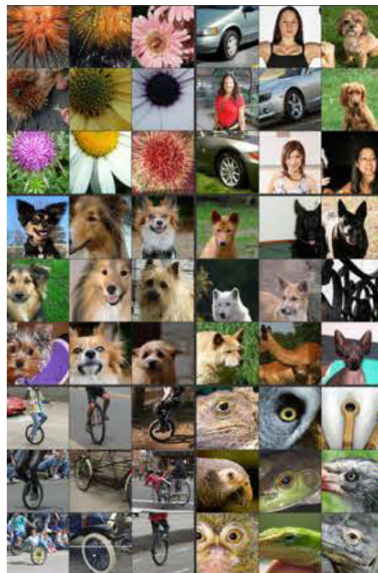
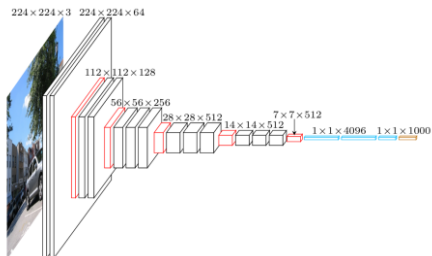
Layer 4



Deep learning architecture

Hierarchized pattern recognition

Layer 5



Application examples

Supervised learning

- Supervised tasks

- ▶ Regression

Recommender system

(user, book) → rating

House price

(surface, nb rooms, city) → price

- ▶ Classification

Image classification

pixel values → cat or dog

Text classification

list of words → spam or valid email

- Unsupervised tasks

- ▶ Clustering

Group clients by interests

- ▶ Anomaly detection

Detect unusual and strange events

Deep Natural Language Processing (NLP)

Main ideas

- Learning the **semantic meaning** of words,

Deep Natural Language Processing (NLP)

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- Understanding the **information hierarchy** related to the task at hand,

Deep Natural Language Processing (NLP)

Main ideas

- Learning the **semantic meaning** of words,
- Understanding the **information hierarchy** related to the task at hand,
- Ability to make use of **huge amounts of data**.

Word embeddings

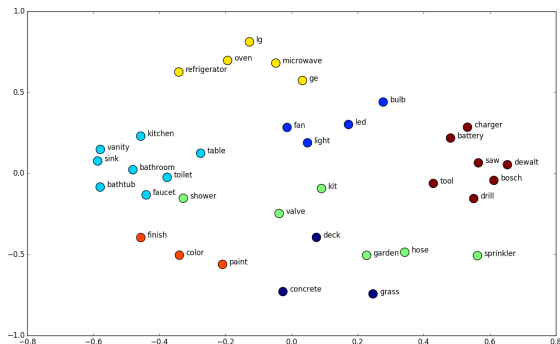
Semantic vectors

We associate to each word of the vocabulary a vector which represents its **meaning**.

Oven $[-0.2, 0.6]$

Microwave $[-0.05, 0.57]$

Garden $[0.22, -0.5]$

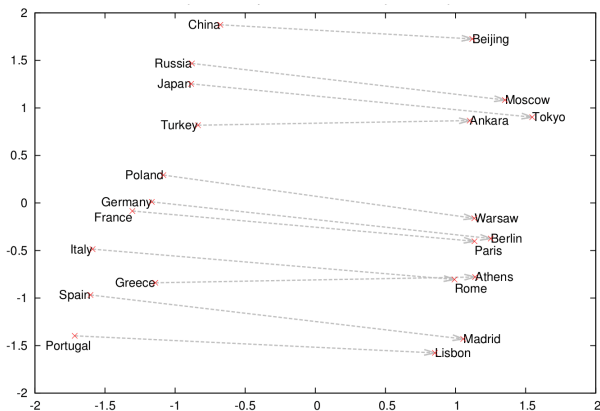


In real applications word embedding have 100 to 300 dimensions

Word embeddings

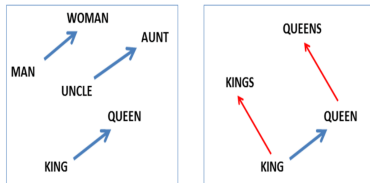
Links between concepts

When word embeddings are created using a large enough dataset, a lot of information is encoded in **differences** between vectors.



Word embeddings

Arithmetic and fuzzy matching



$$\text{king} - \text{man} + \text{woman} = \text{queen}$$



Automatized analysis of an item public perception:

- Negative

- ▶ Even fans of Ismail Merchant's work, I suspect, would have a hard time sitting through this one.
- ▶ Every conceivable mistake a director could make in filming opera has been perpetrated here.
- ▶ Cheap, vulgar dialogue and a plot that crawls along at a snail's pace.
- ▶ The material and the production itself are little more than routine.

- Positive

- ▶ A rare and lightly entertaining look behind the curtain that separates comics from the people laughing in the crowd.
- ▶ Rarely, indeed almost never, is such high-wattage brainpower coupled with pitch-perfect acting and an exquisite, unfakable sense of cinema.
- ▶ Easily the most thoughtful fictional examination of the root causes of anti-Semitism ever seen on screen.

Automatic tagging of documents, articles or books.

- Supervised way using classification (using past labels):
 - ▶ Harry Potter: Child book, Fantasy, Adventure, ...
 - ▶ Lord Of The Rings: Fantasy, Adventure, ...
 - ▶ Algorithms To Live By: Computer science, Textbook, ...
- Unsupervised way using clustering (grouping books that looks the same):
 - ▶ Cluster 1: Harry potter, Lord Of The Rings, ...
 - ▶ Cluster 2: Algorithms To Live By, The Art of Computer Programming, ...
 - ▶ Cluster 3: Tofu from Scratch, Okinawa Diet

NLP tasks

Search engine

NLP tasks

Automatic summarization

NLP tasks

Automatic summarization

NLP tasks

Automatic summarization

NLP tasks

Automatic summarization

NLP tasks

Automatic summarization