Machine learning basics

G. Châtel
Disaitek

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Machine learning

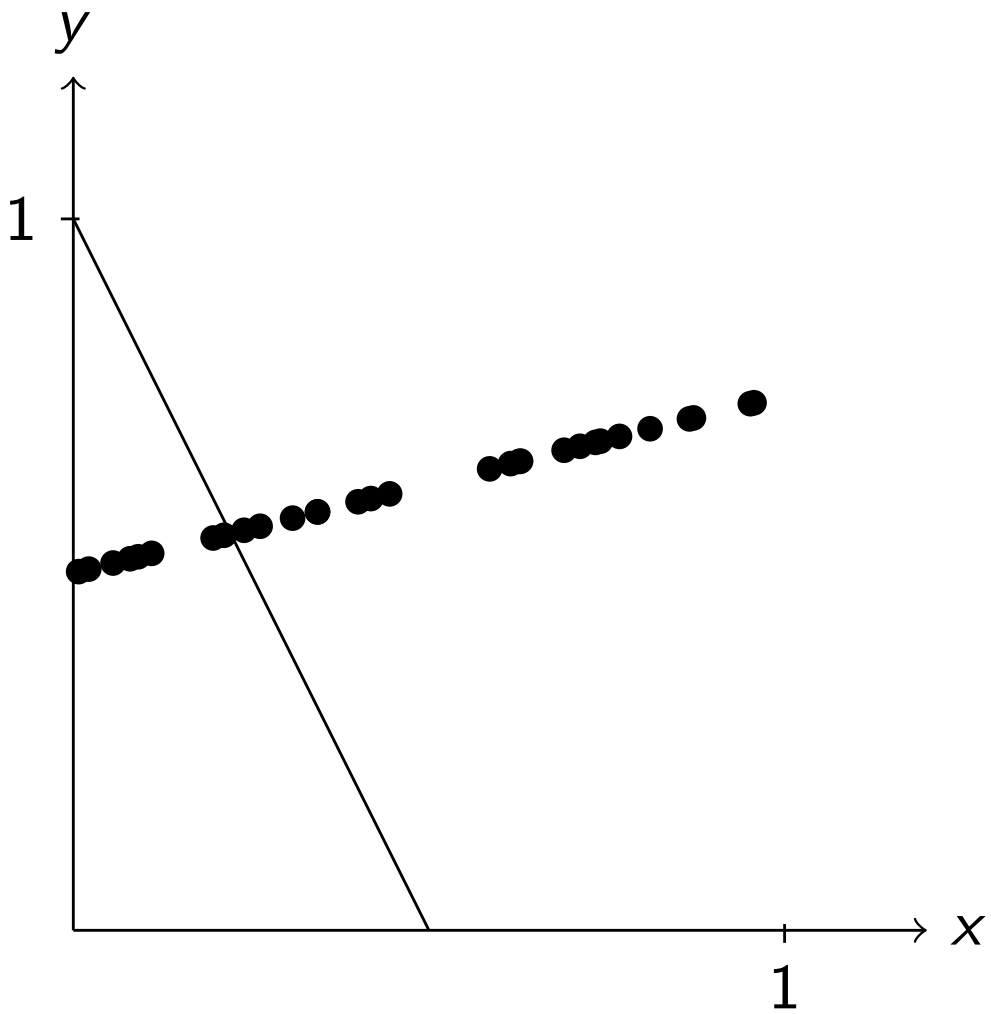
Machine learning (ML) is a subfield of artificial intelligence.

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



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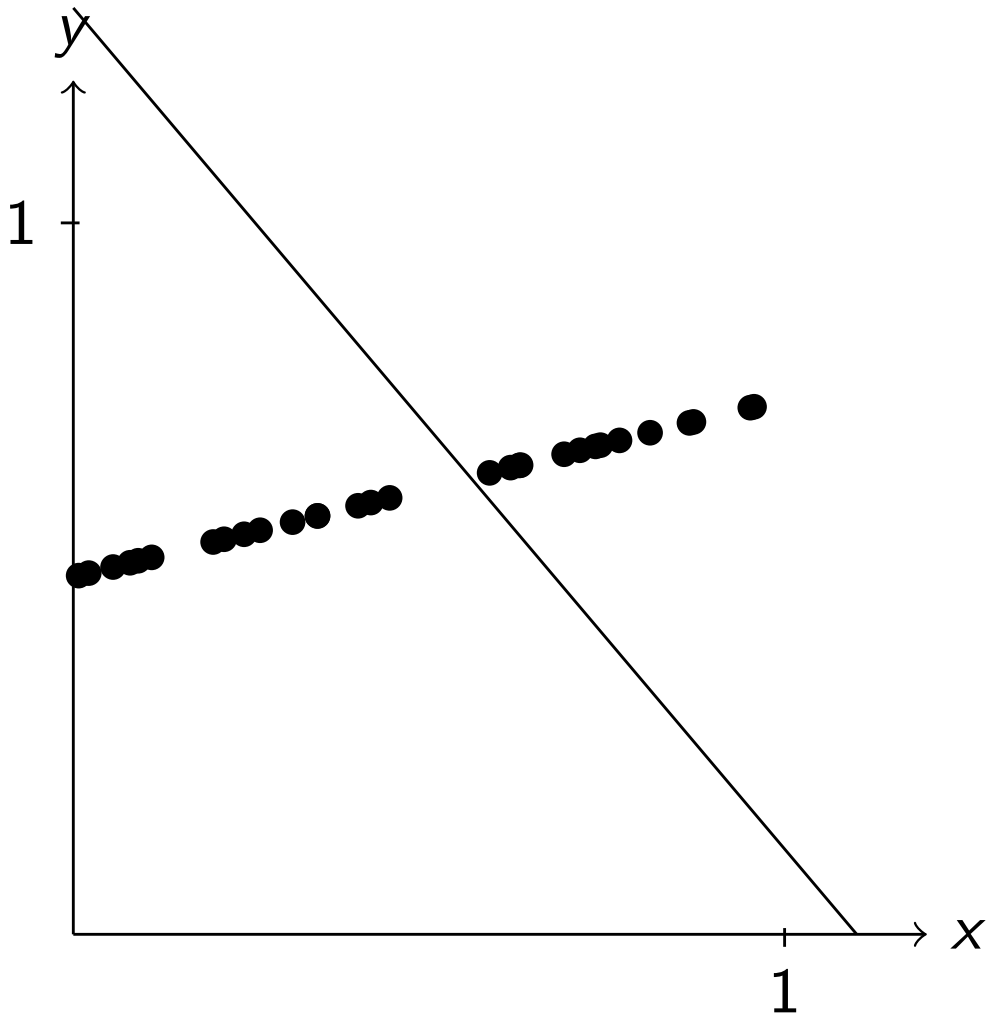

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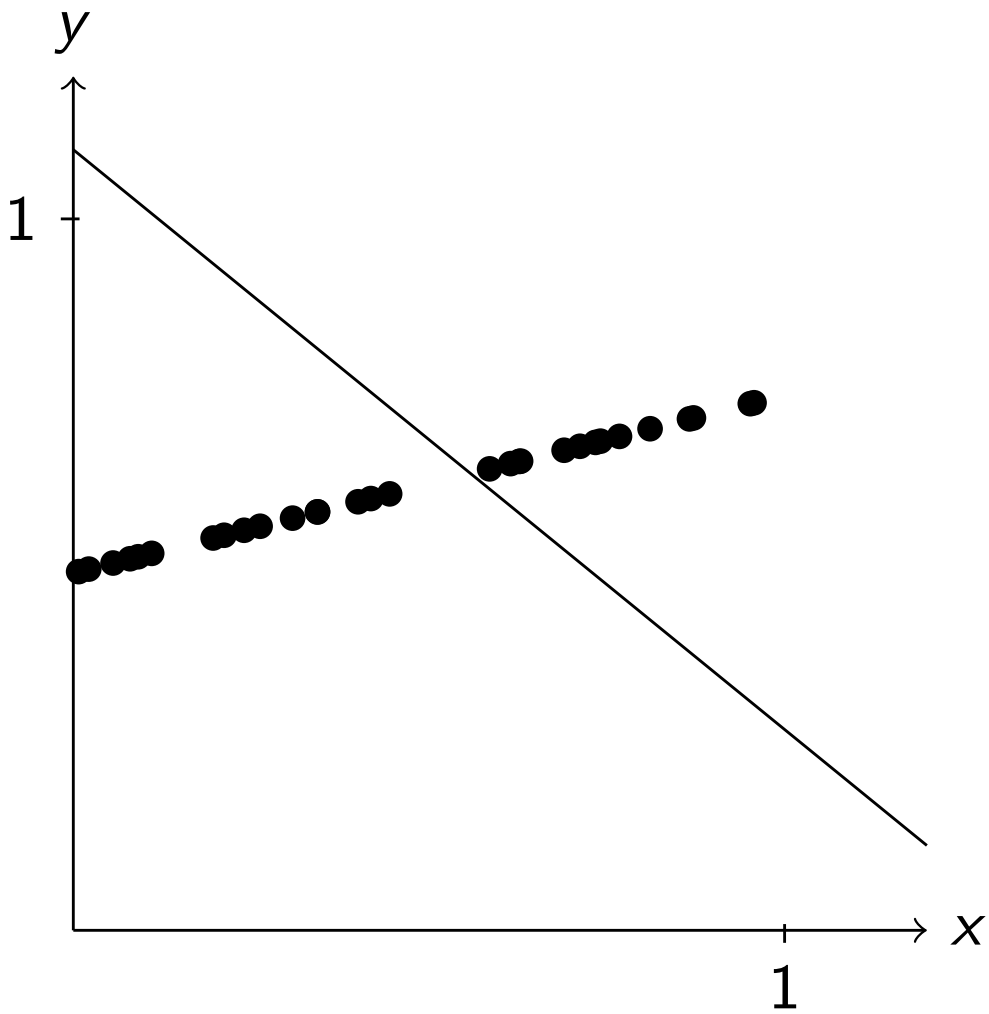

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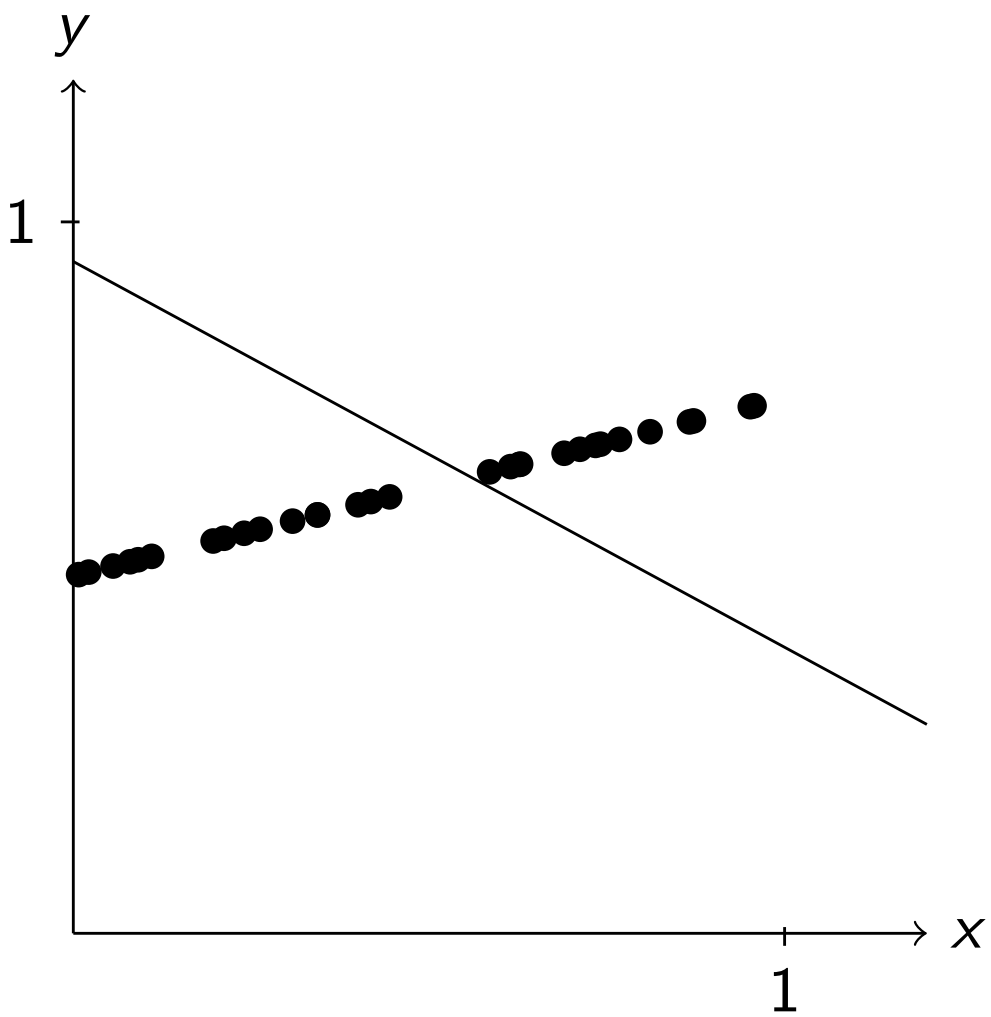

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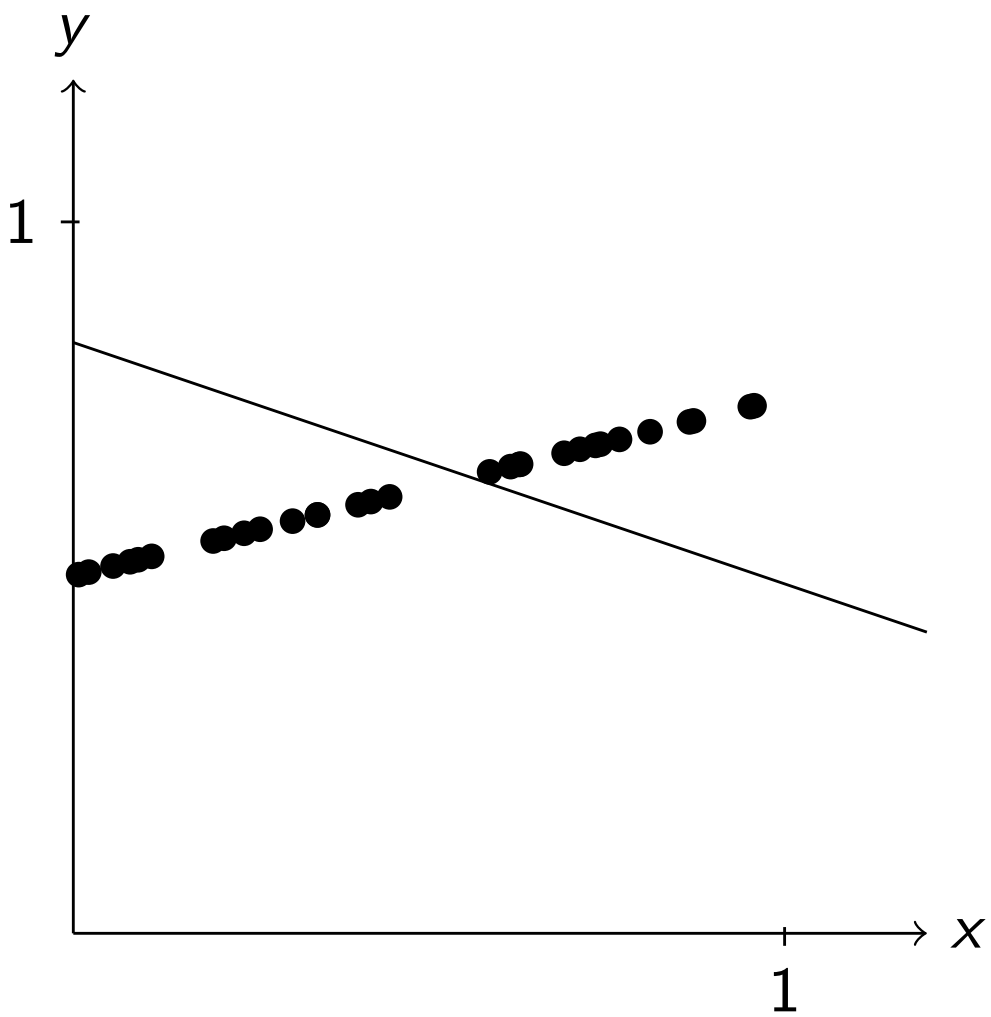

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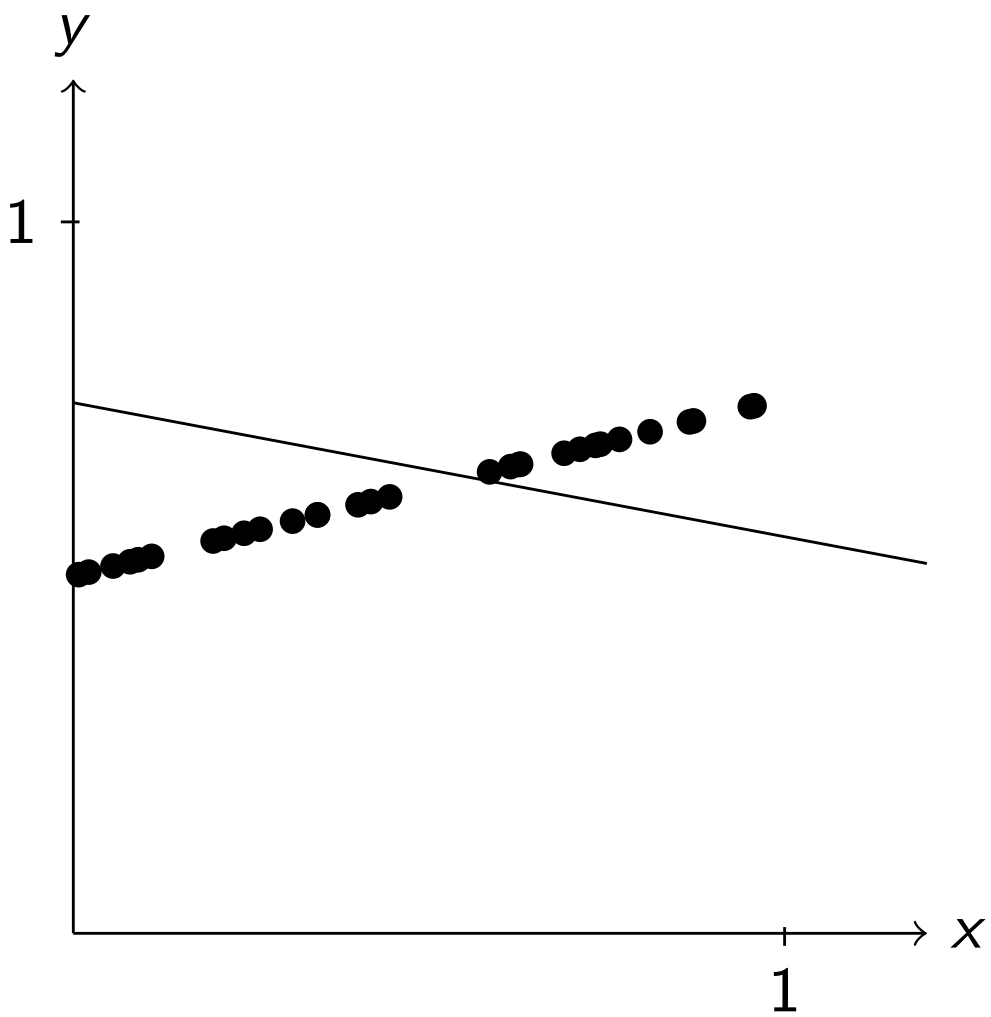

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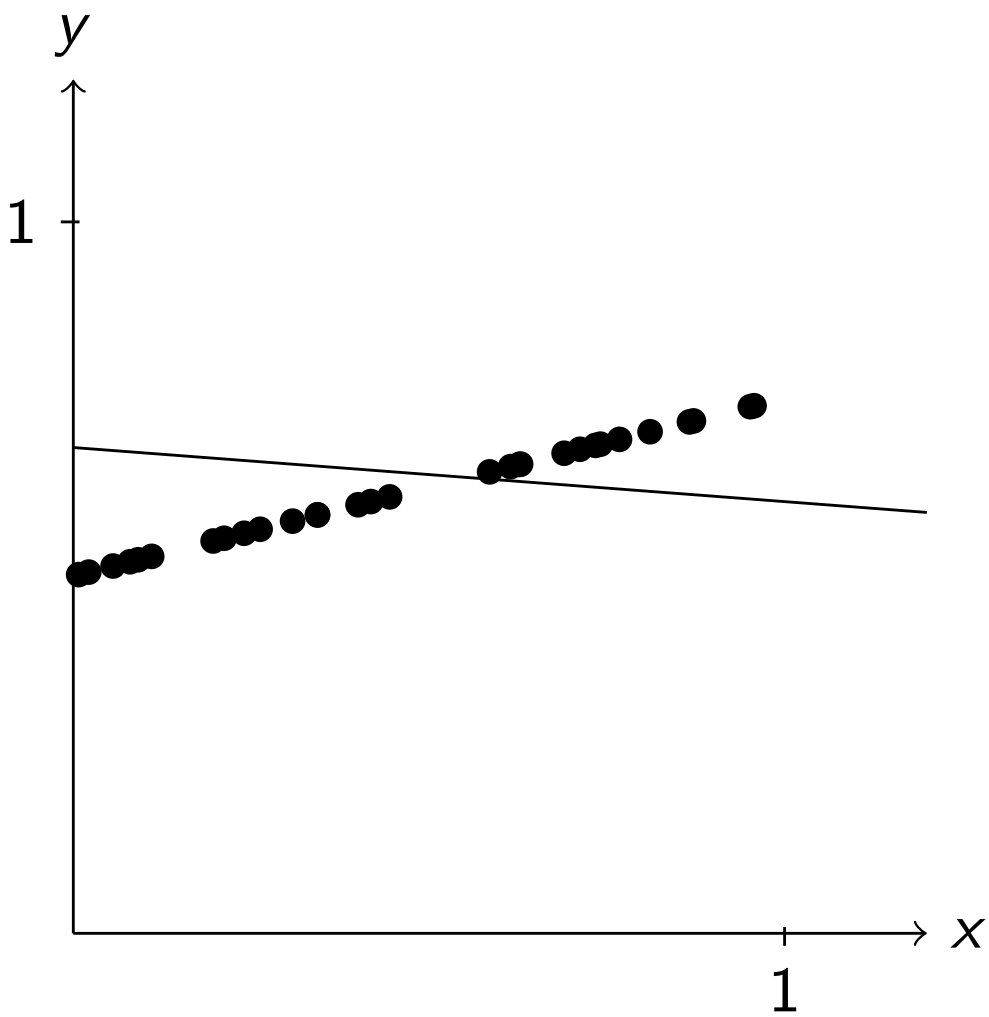

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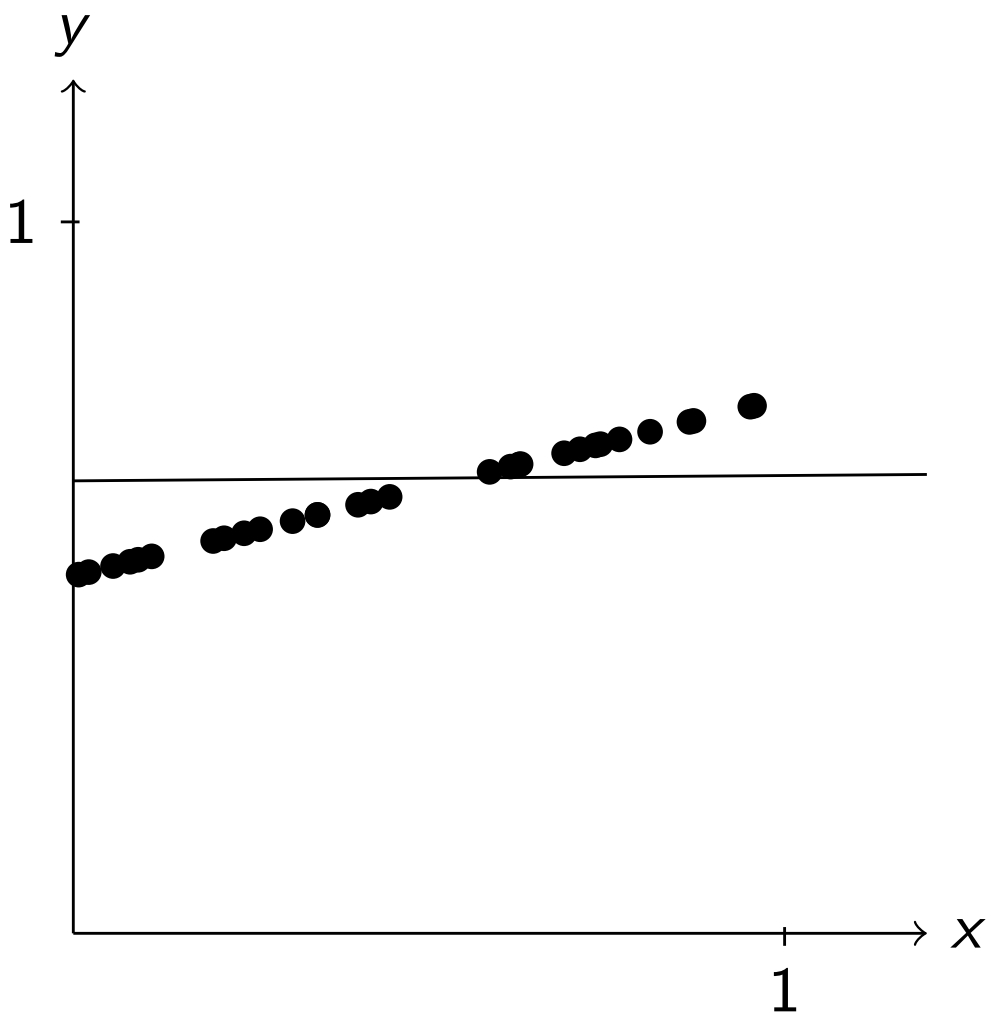

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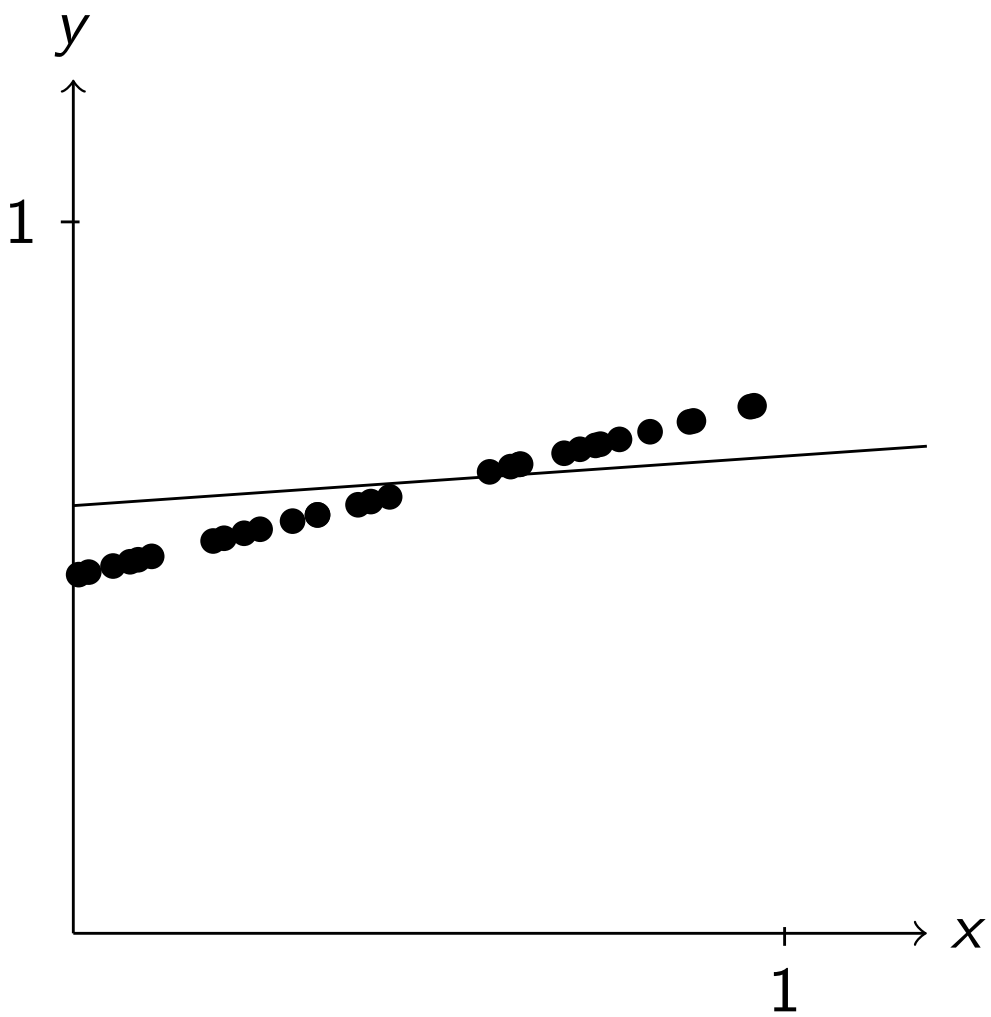

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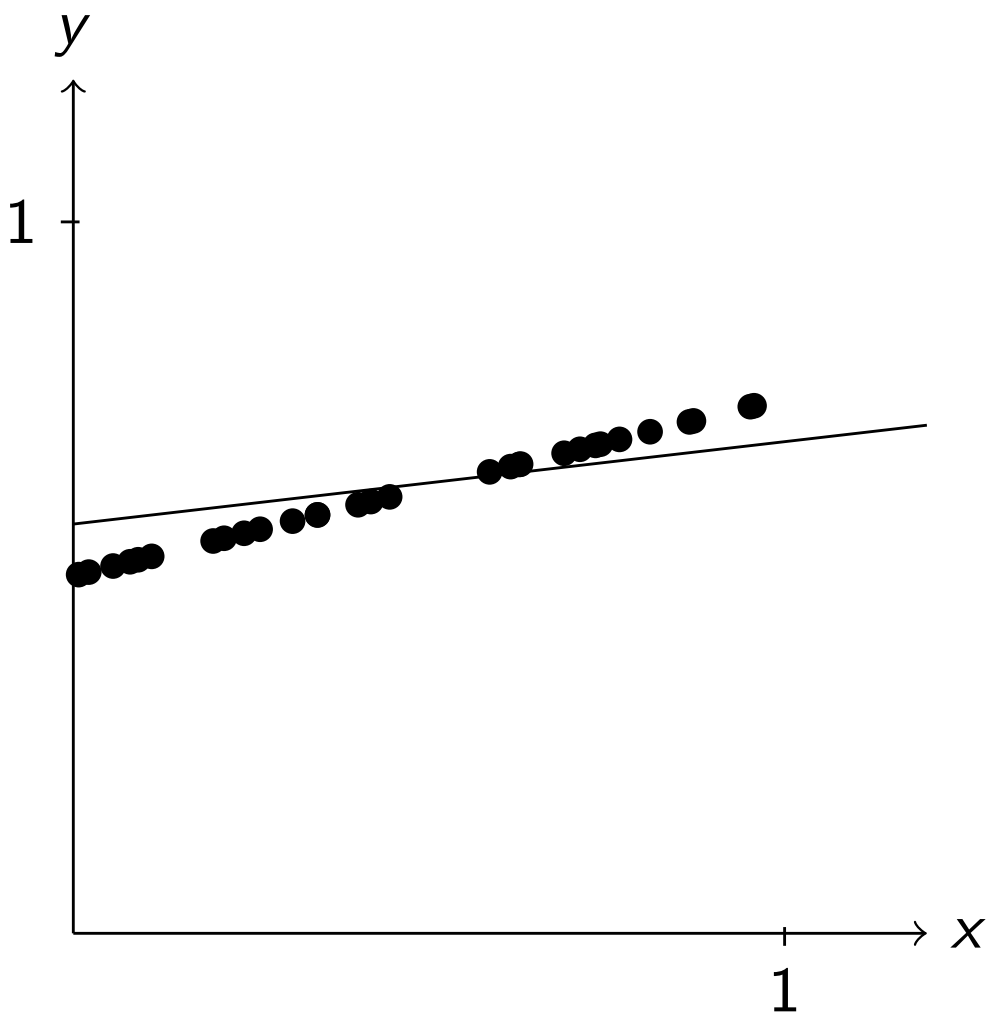

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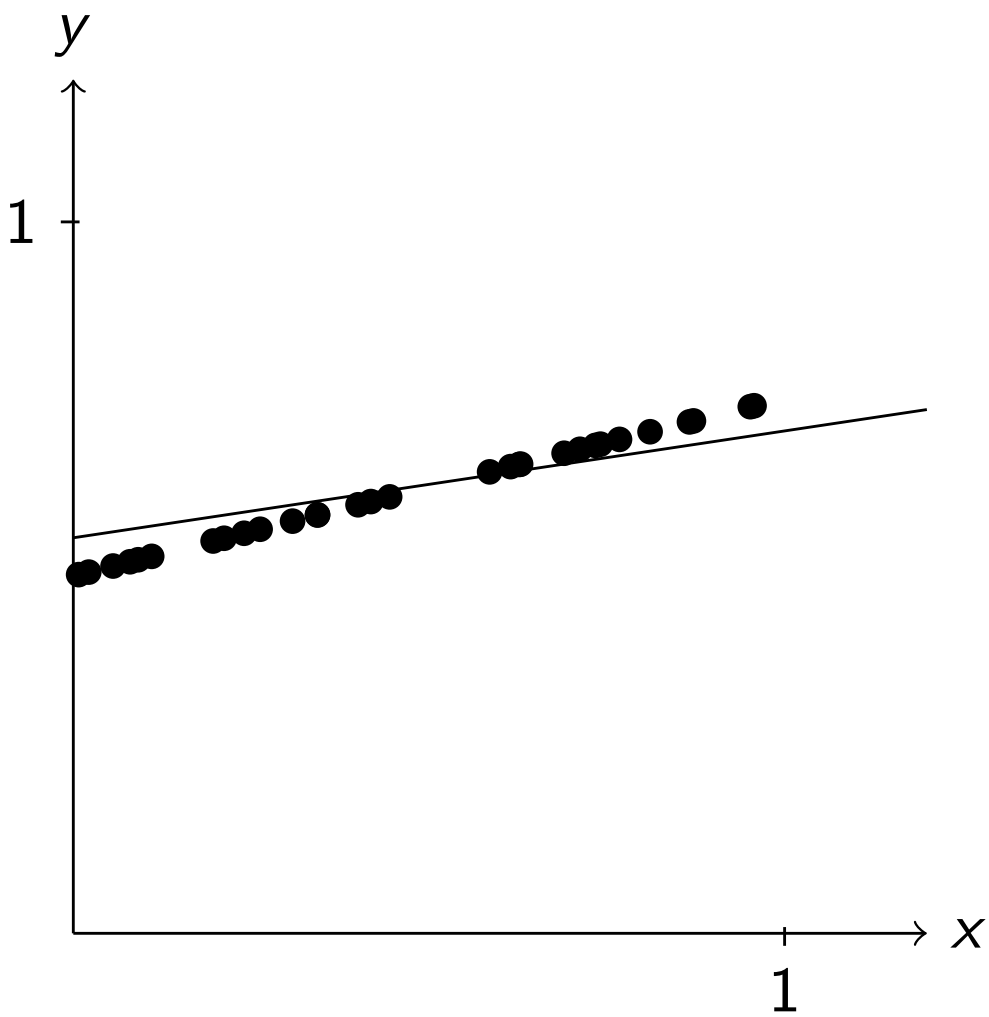

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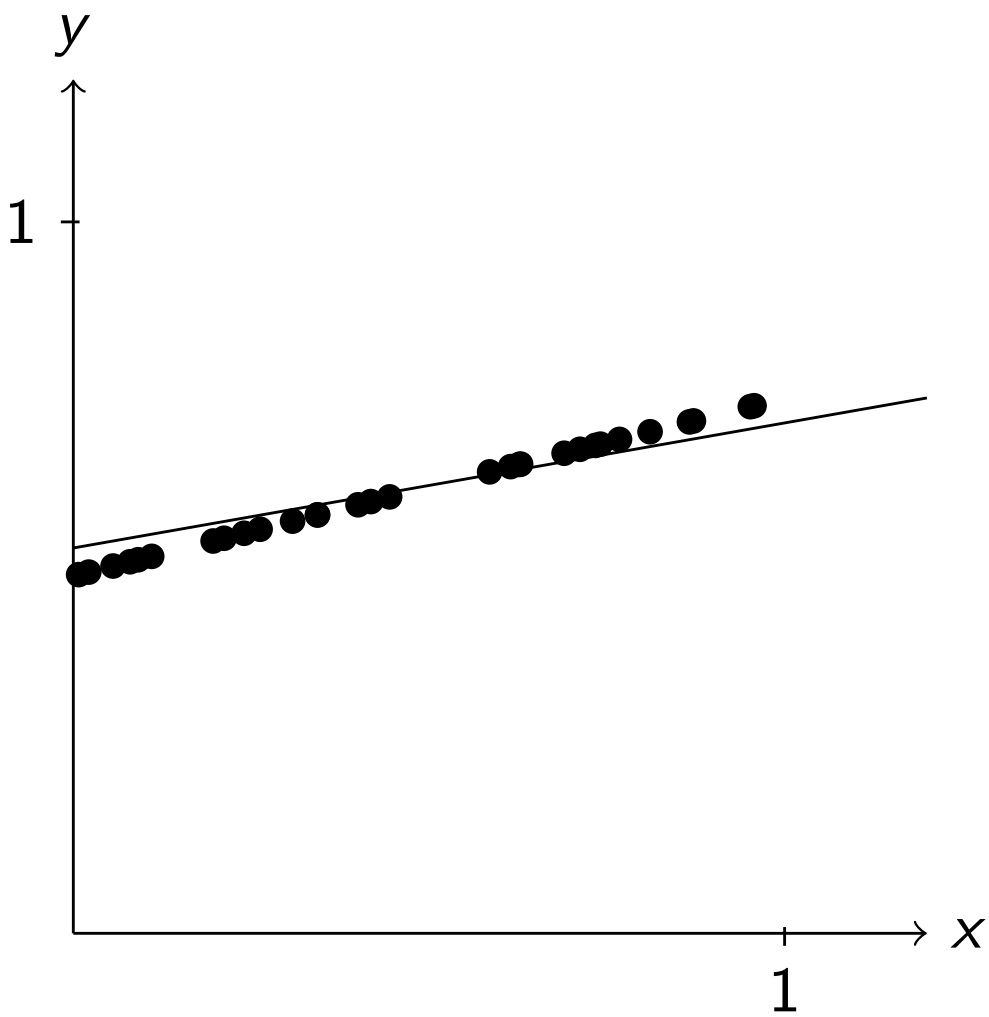

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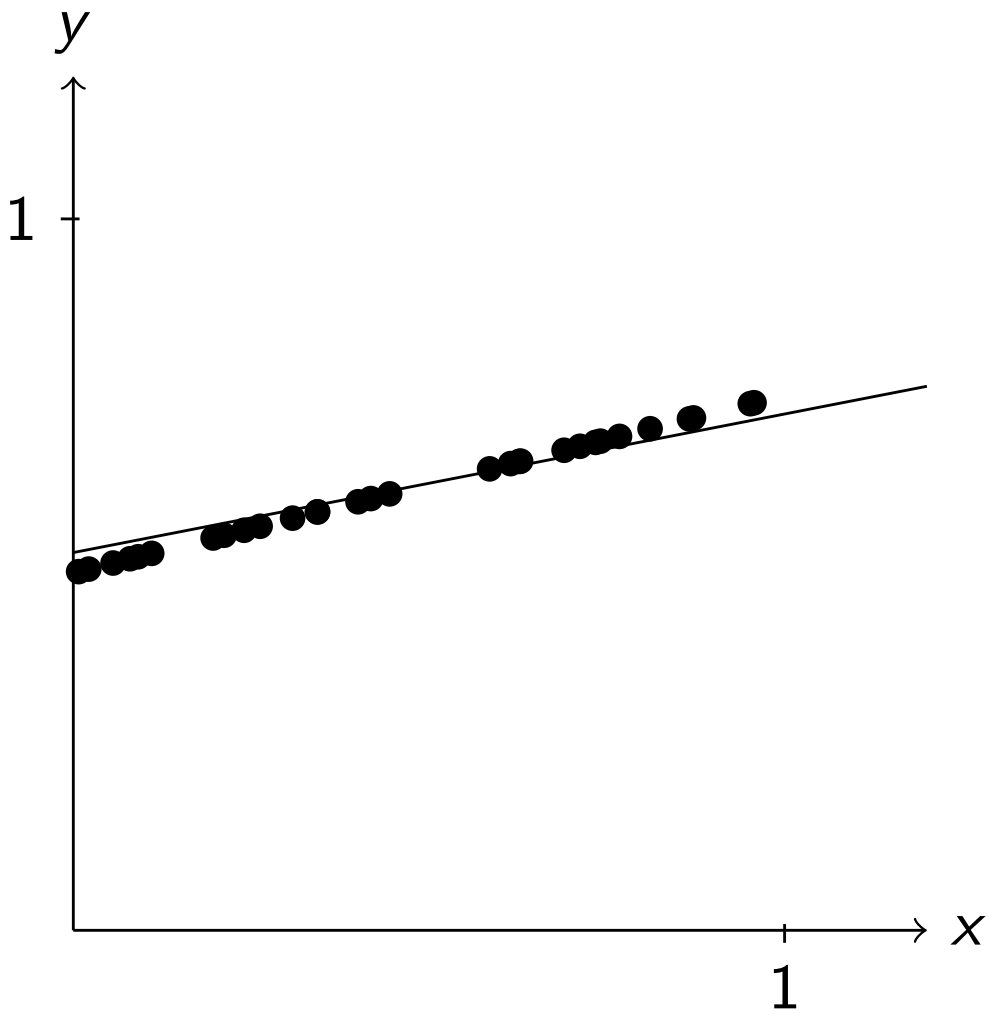

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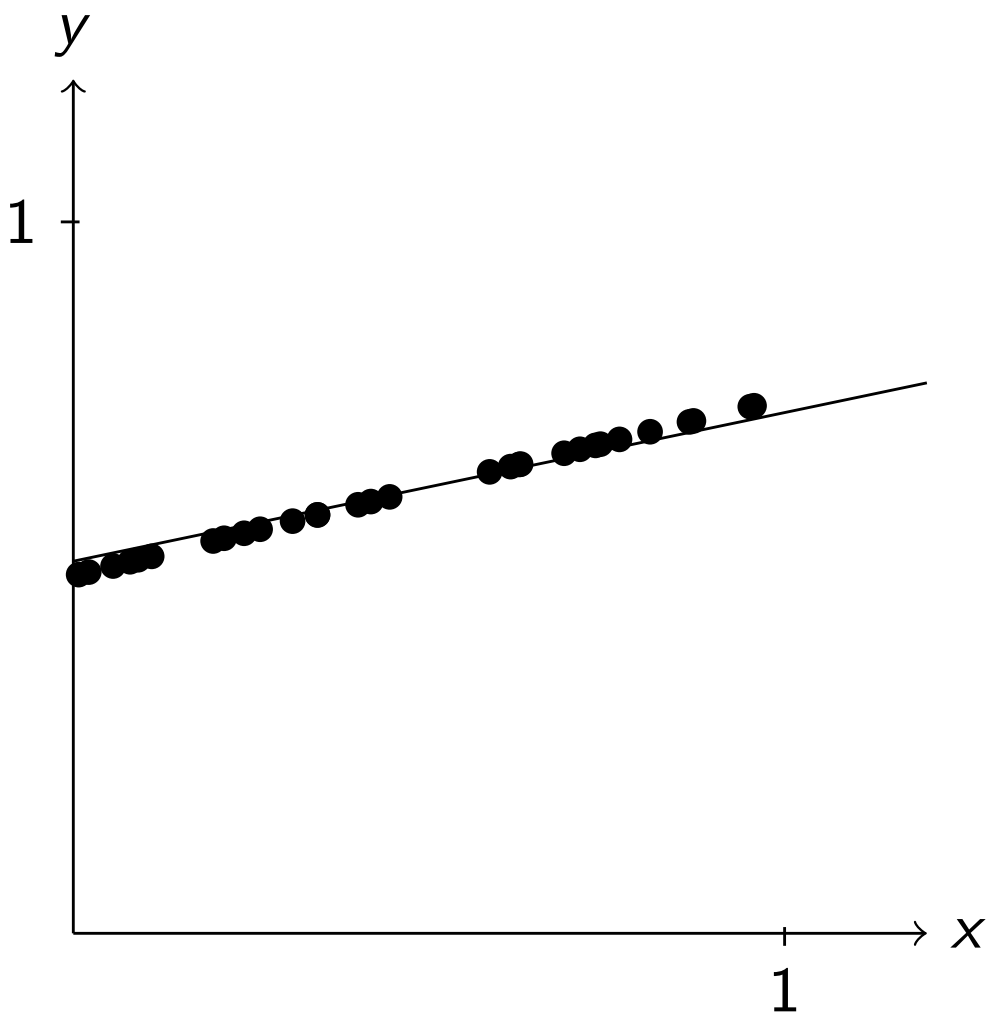

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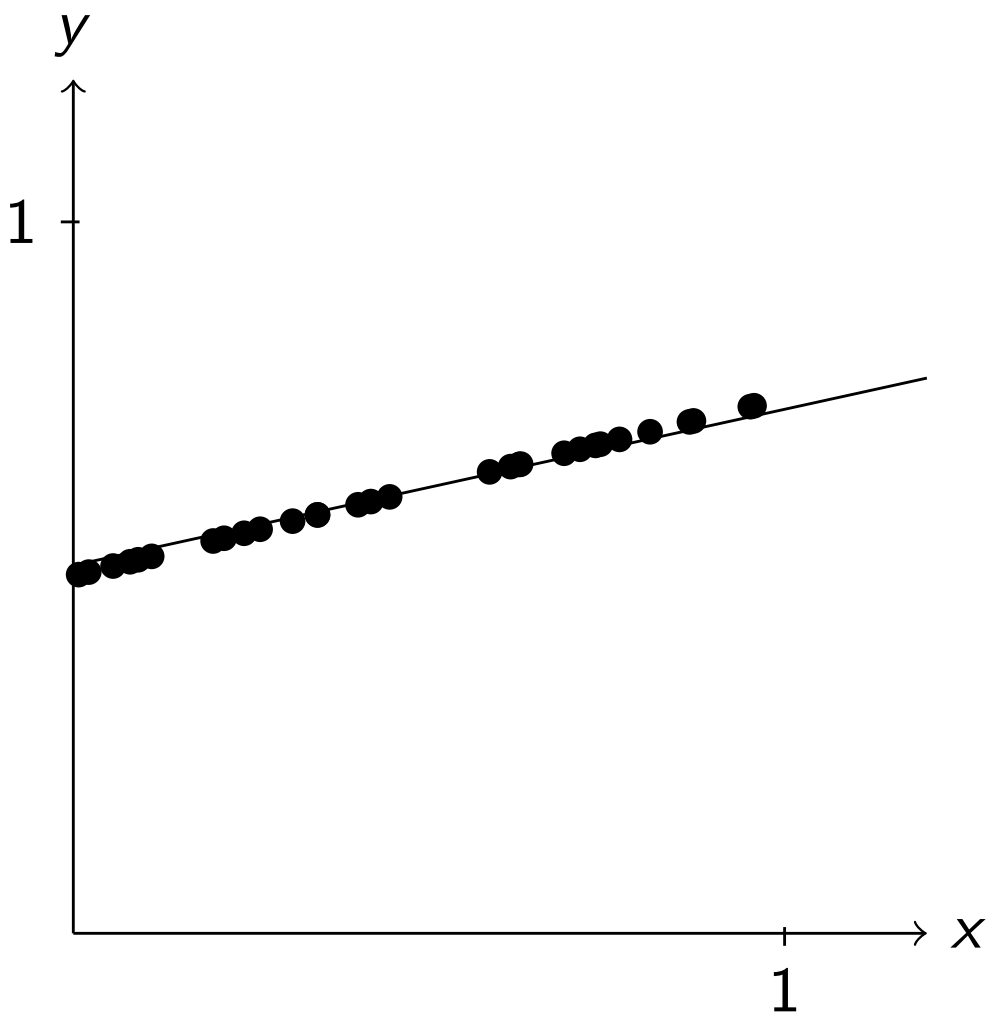

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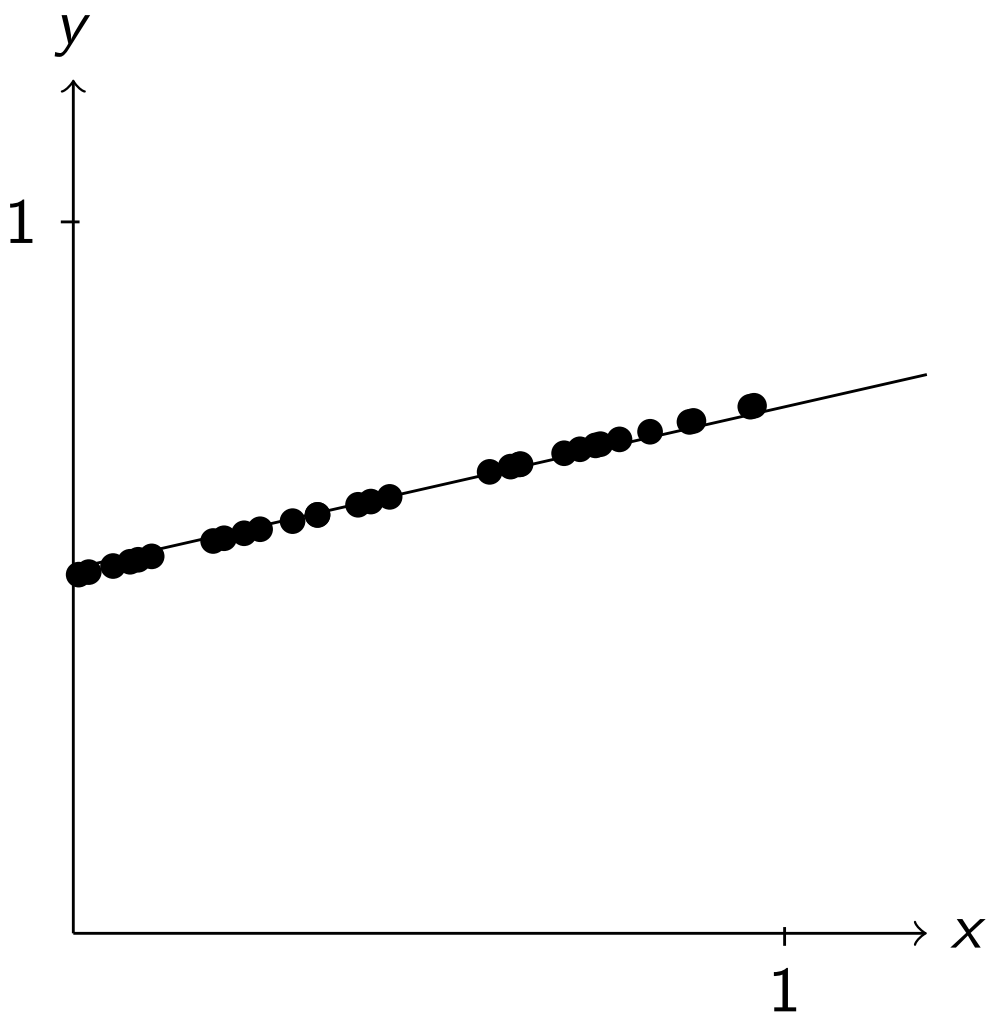

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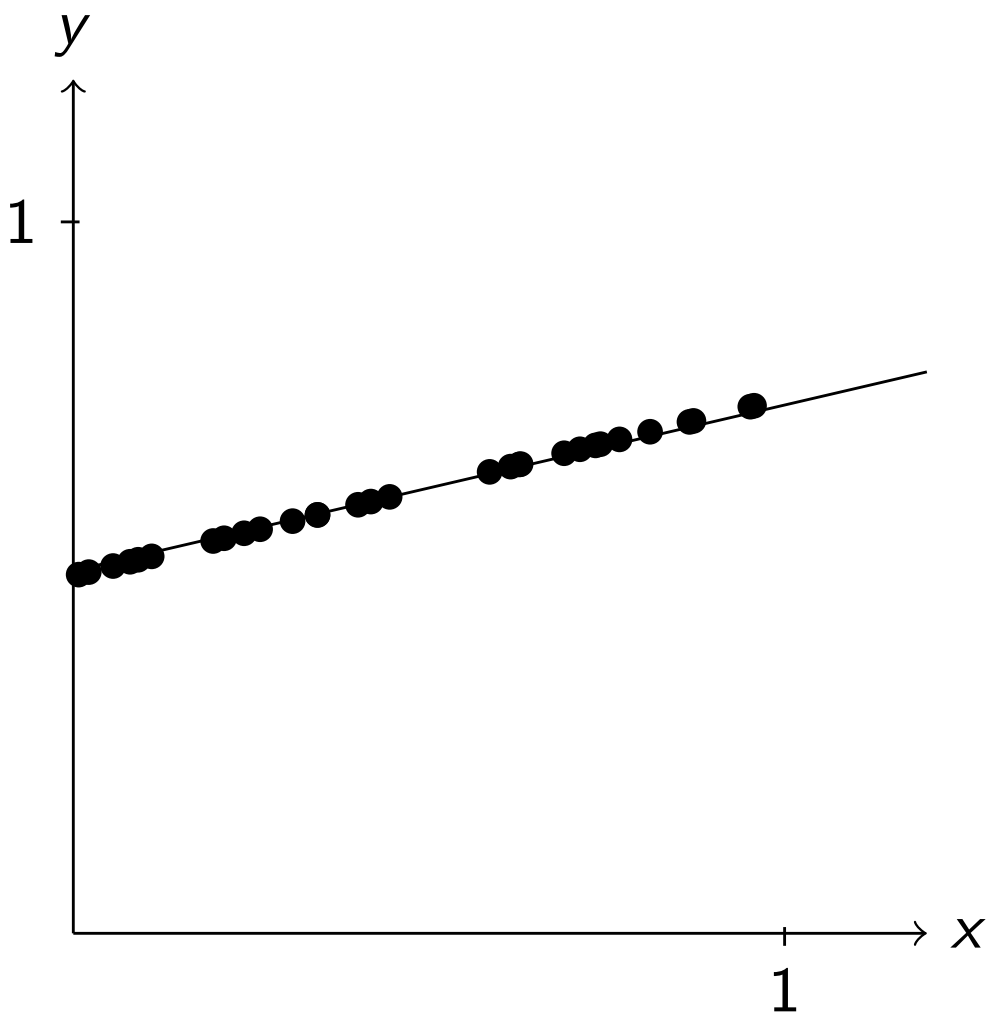

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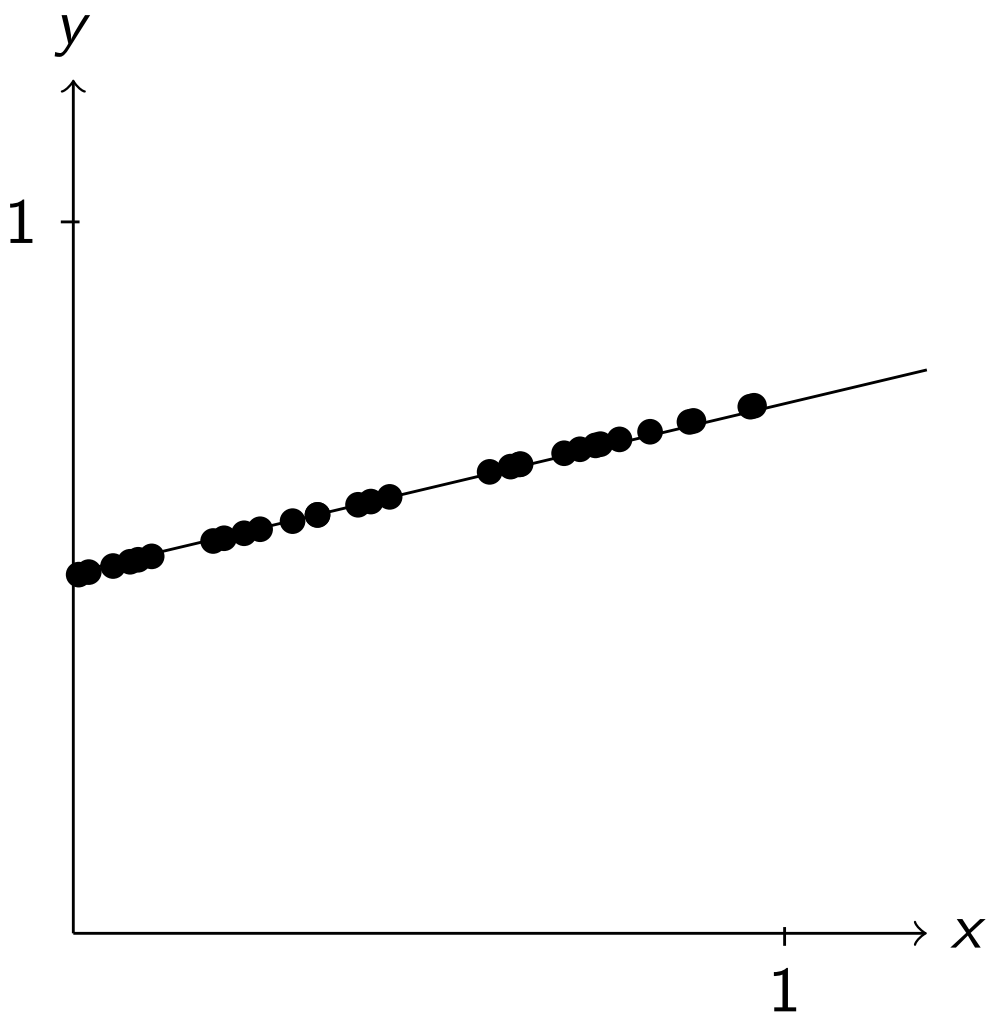

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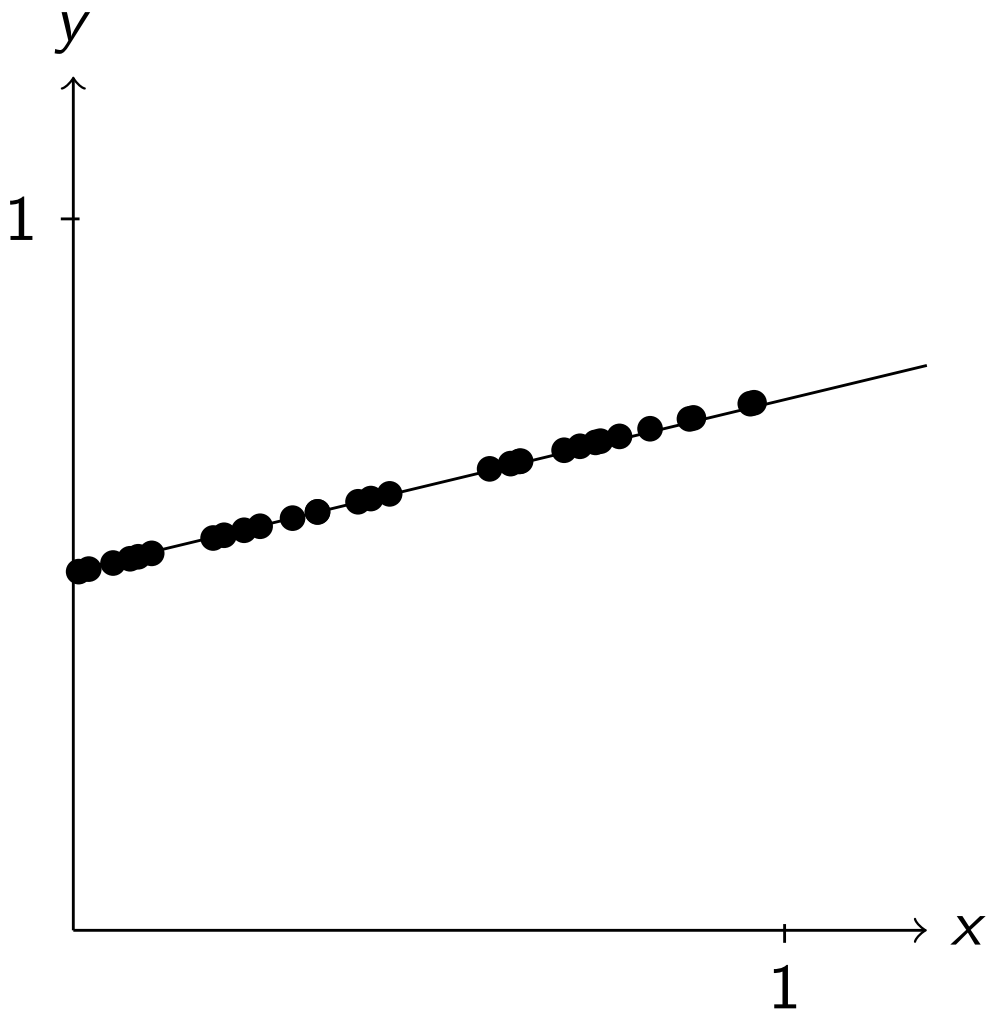

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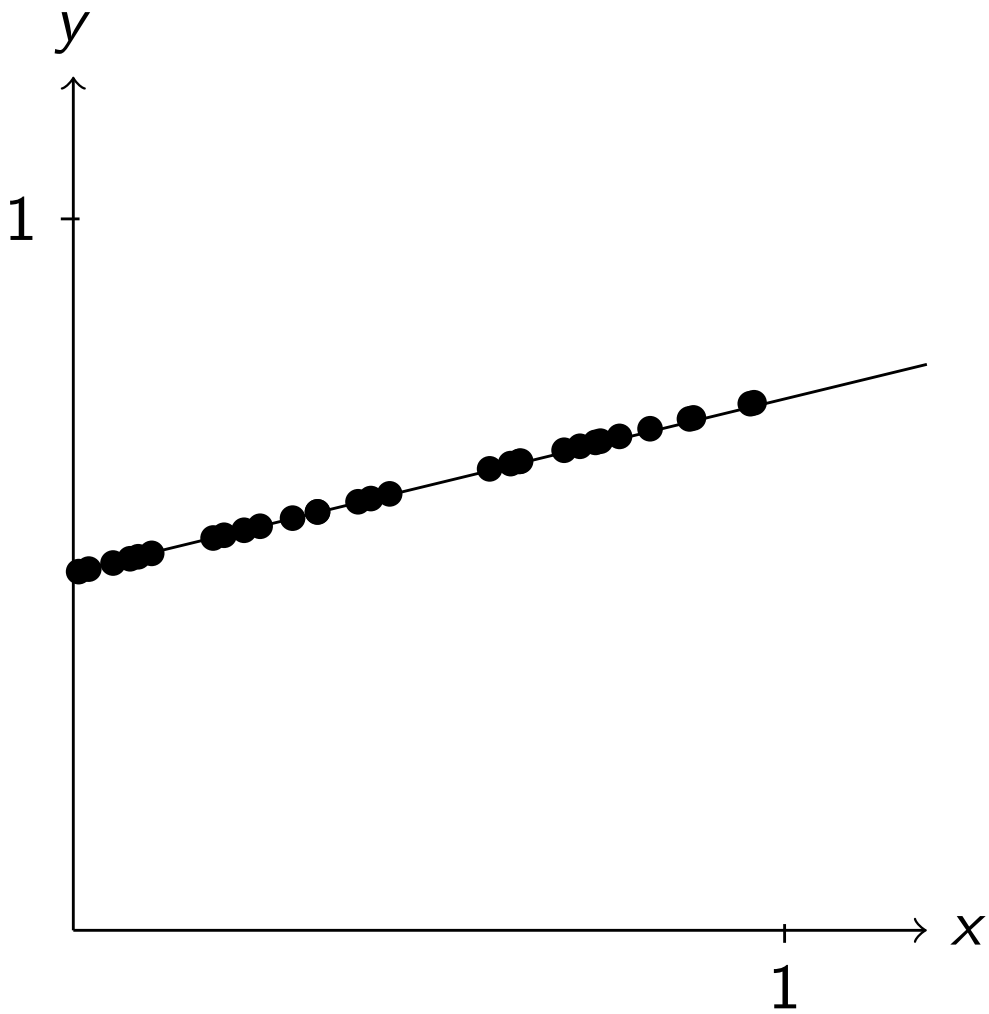
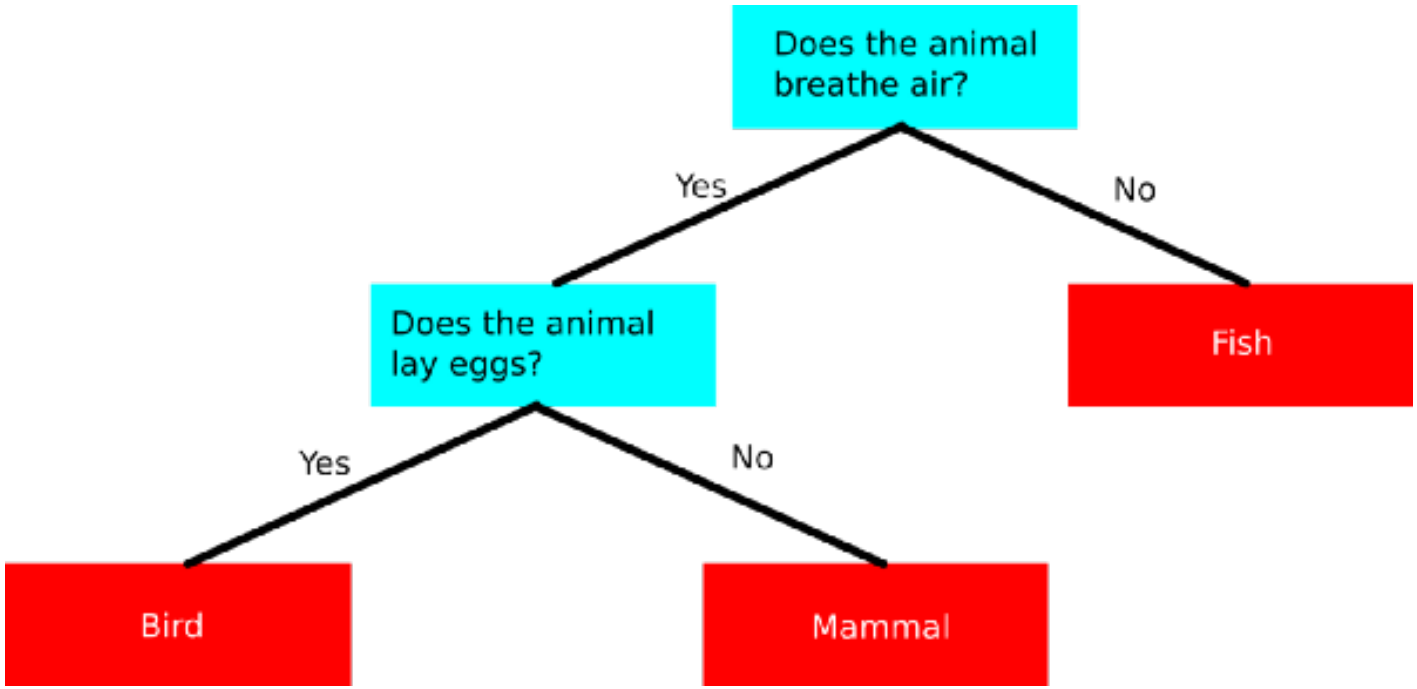


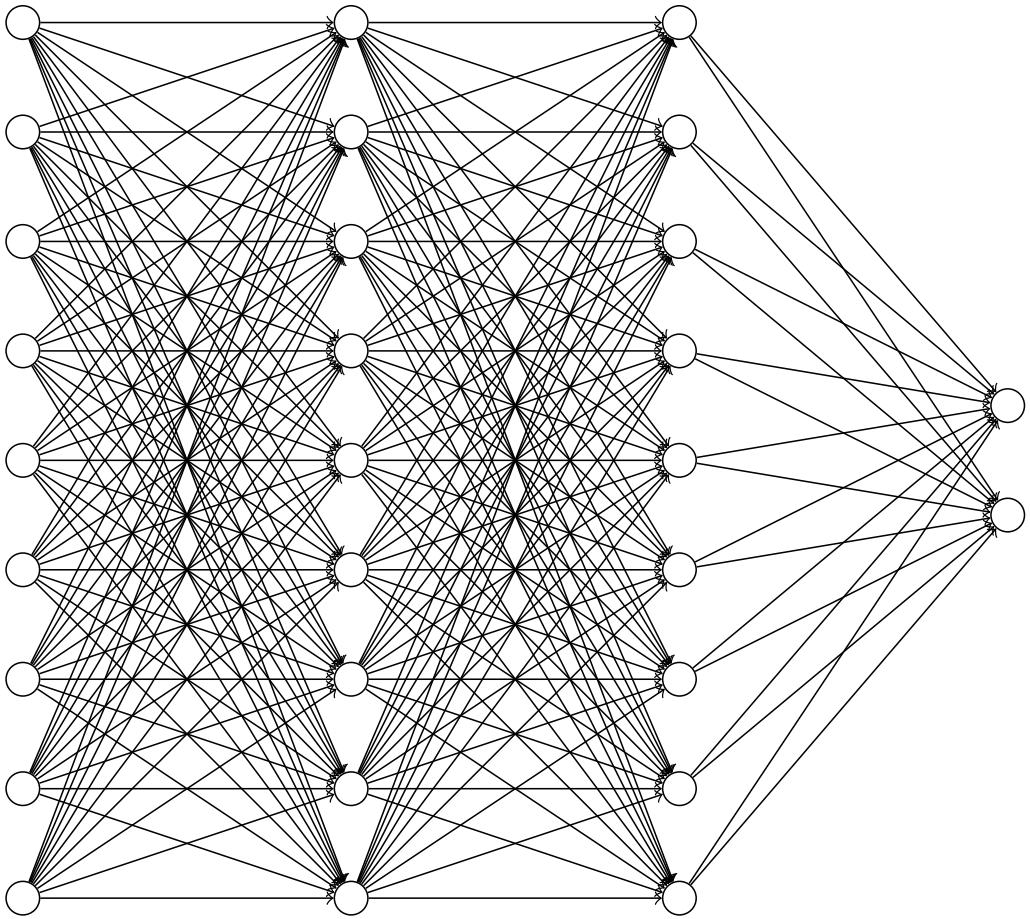
Model example

Decision tree



Model example

Neural network (deep learning)



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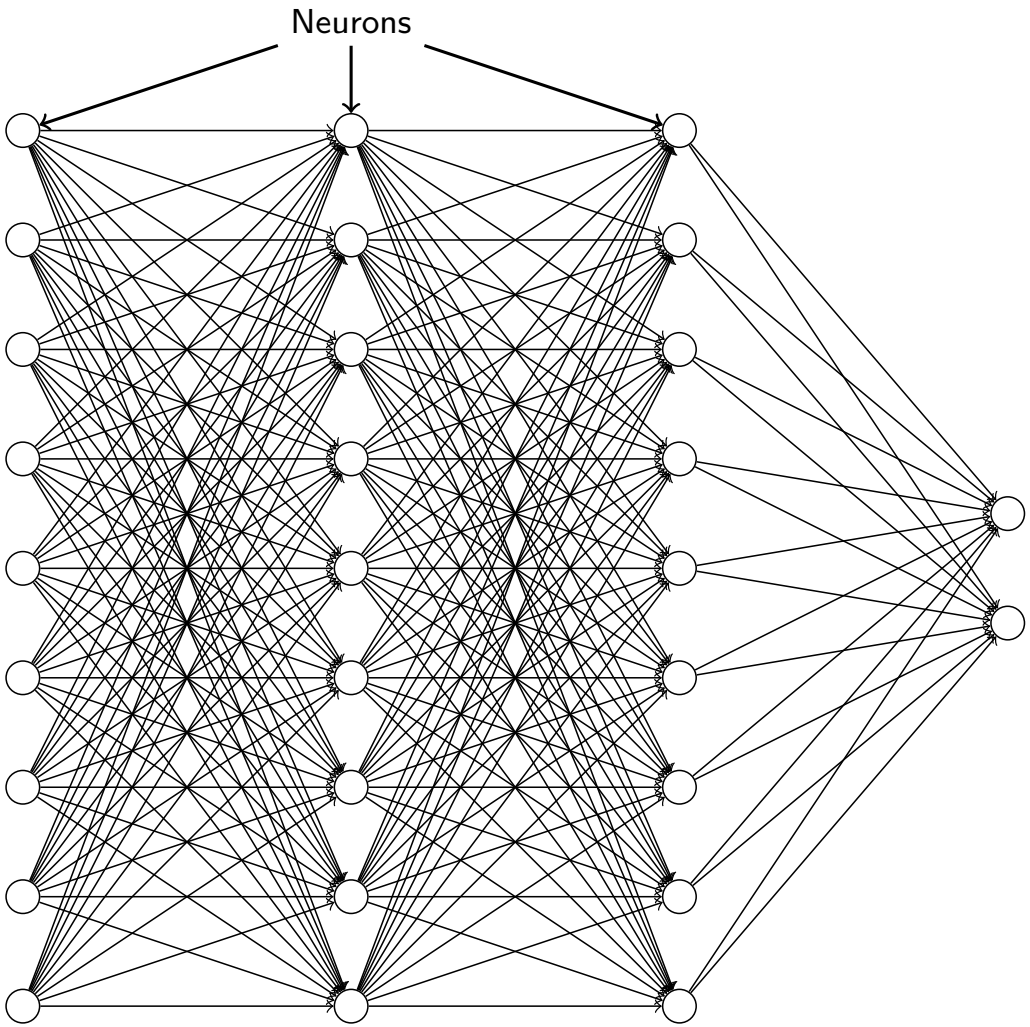

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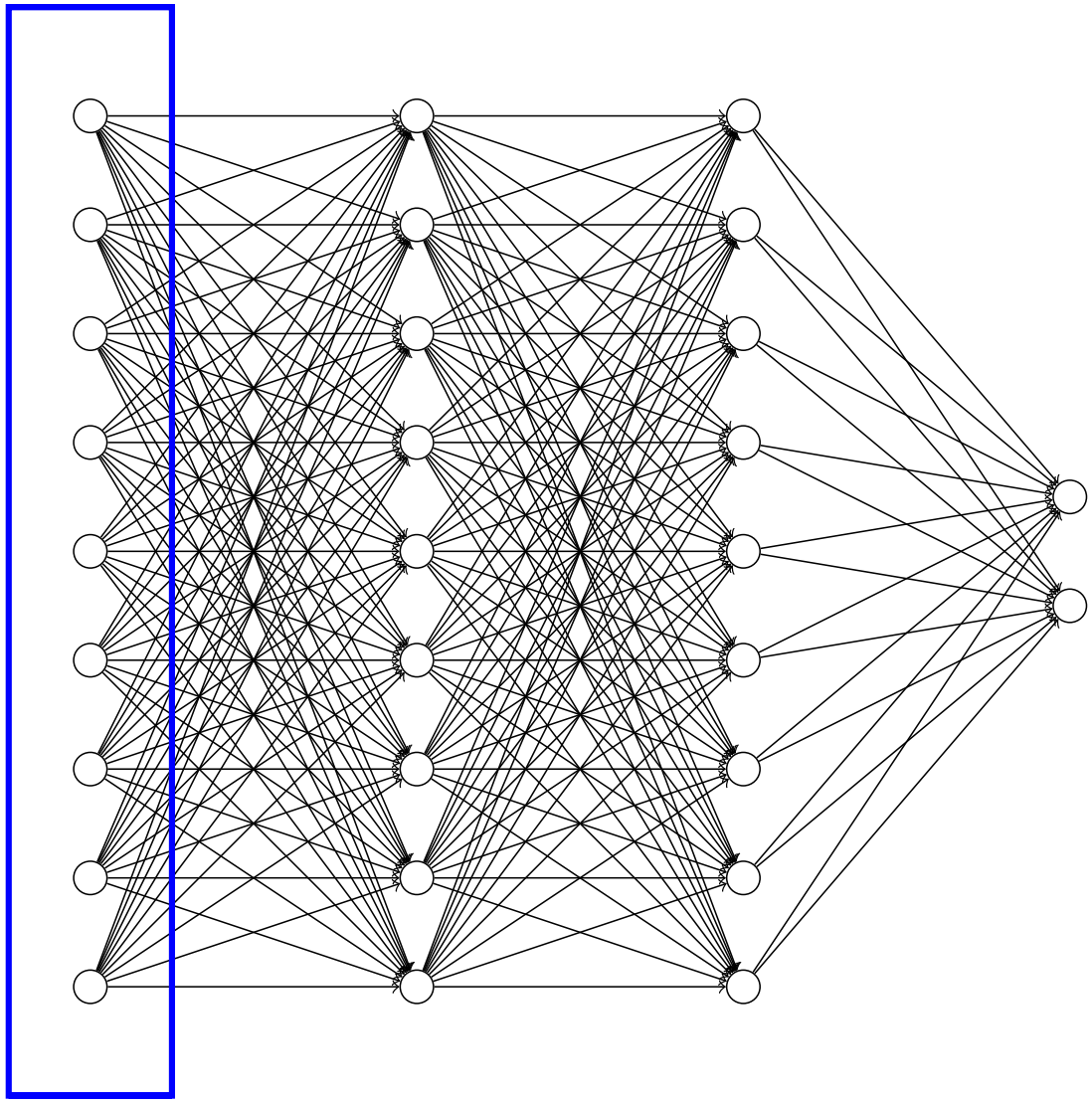
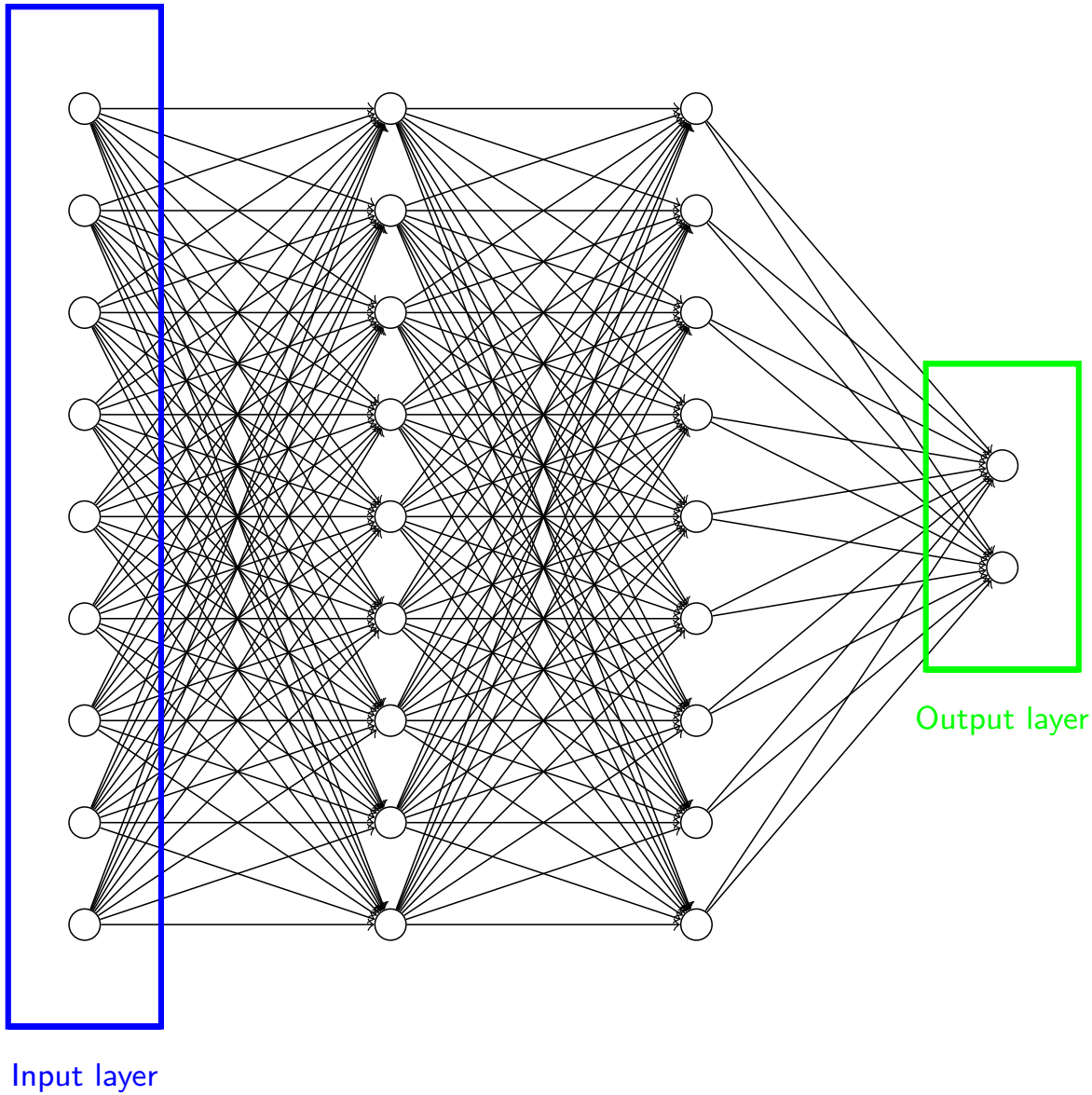


Input layer

Model example

Neural network (deep learning)



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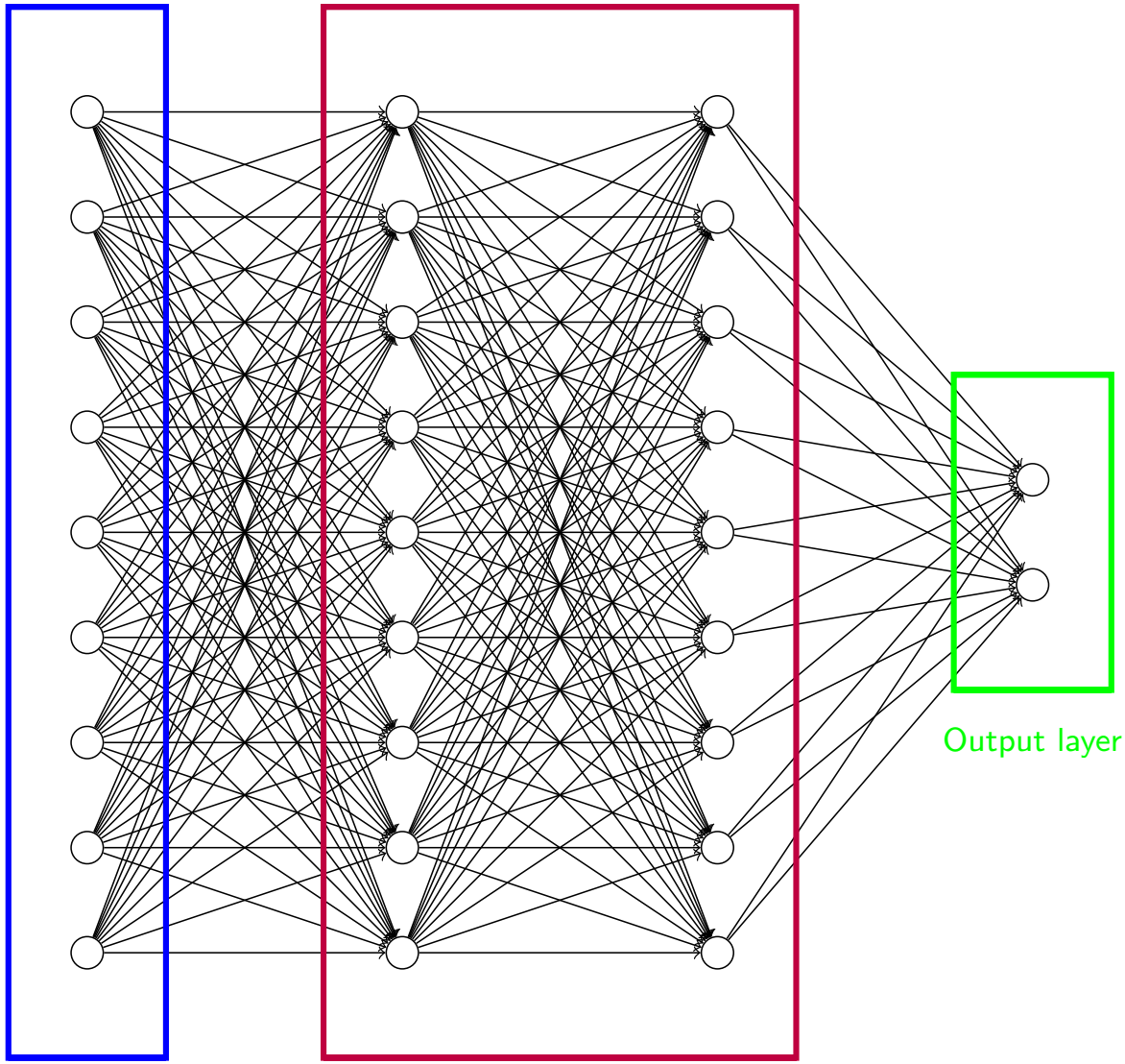
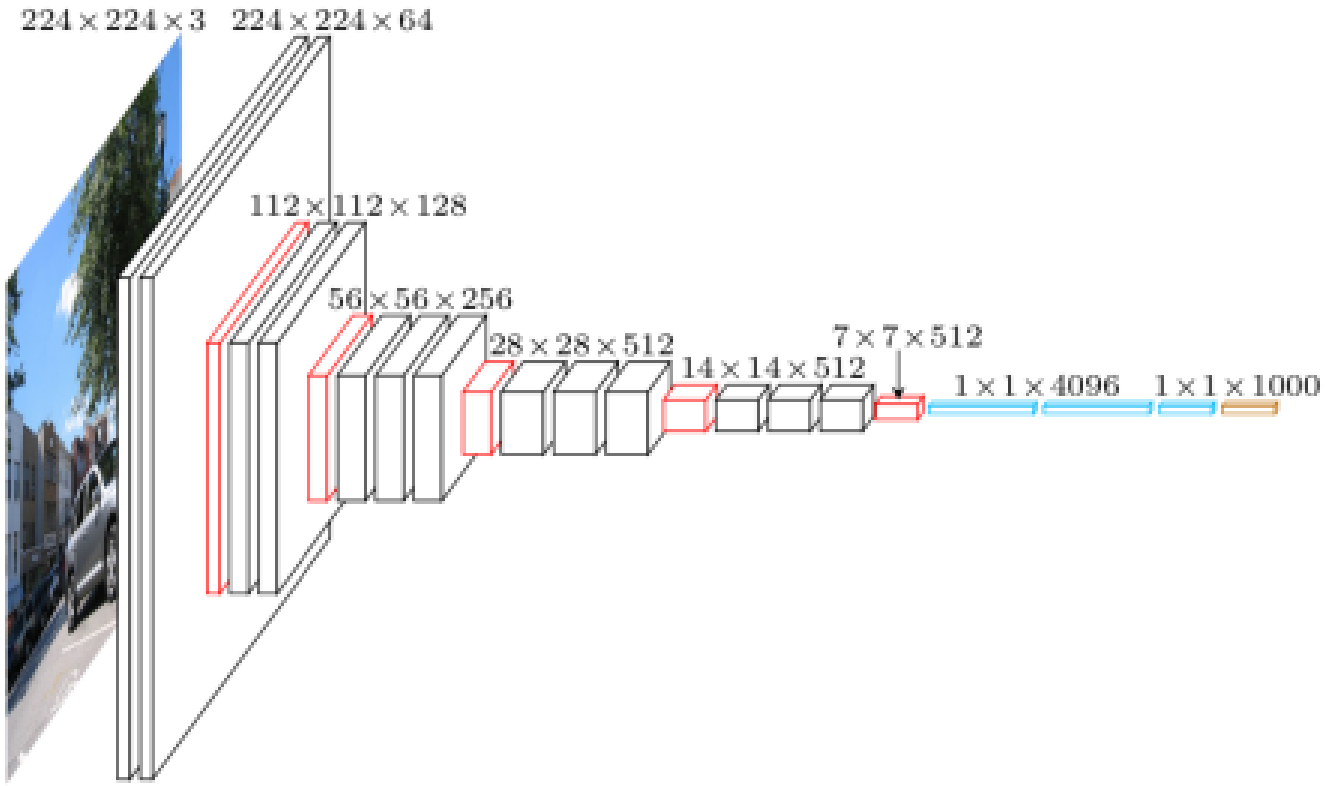


Deep learning architecture

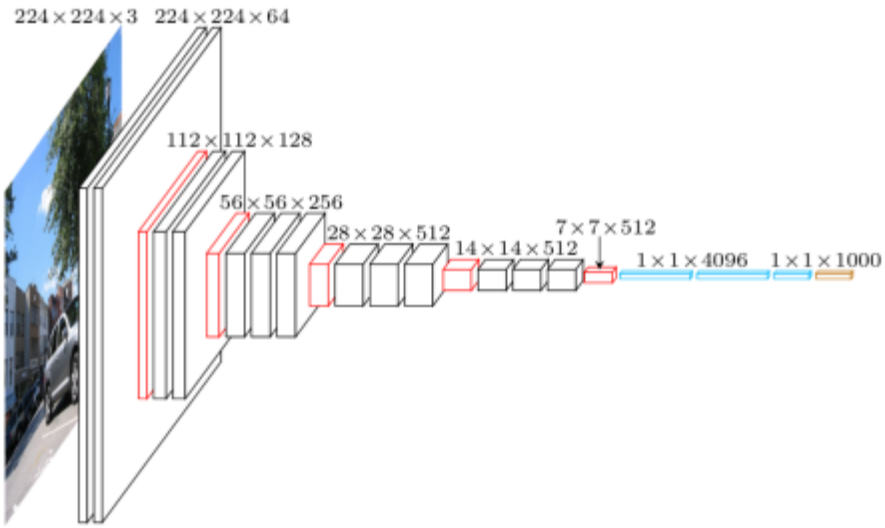
Image recognition (VGG 16)

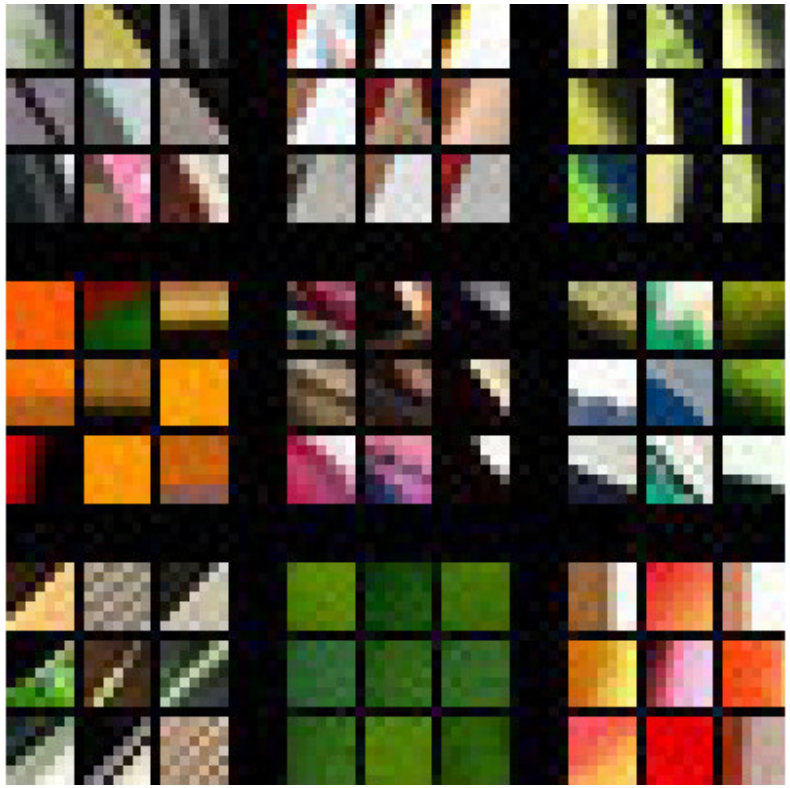


Deep learning architecture

Hierarchized pattern recognition

Layer 1

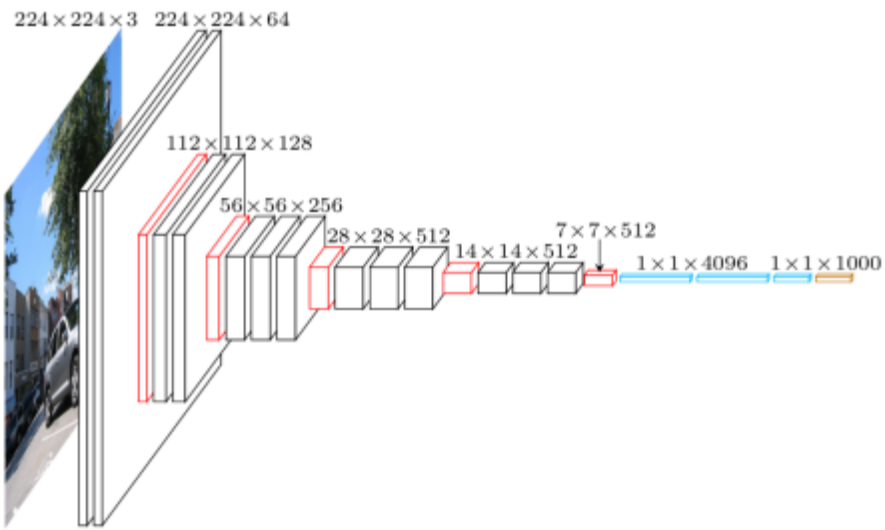


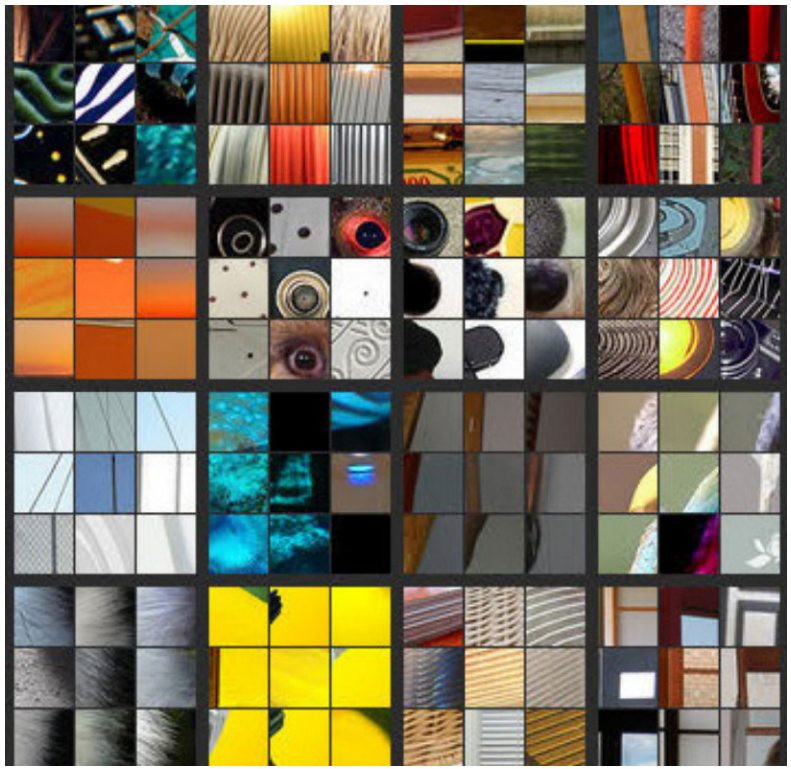


Deep learning architecture

Hierarchized pattern recognition

Layer 2





Deep learning architecture

Hierarchized pattern recognition

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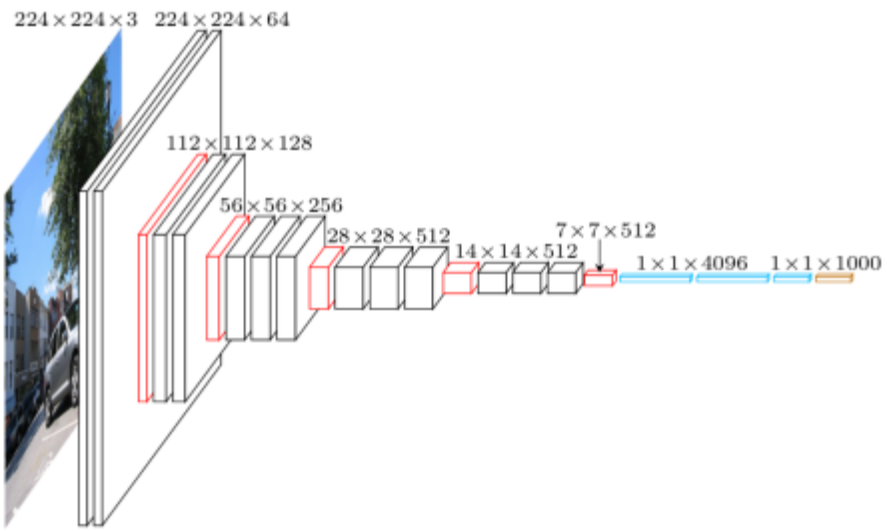
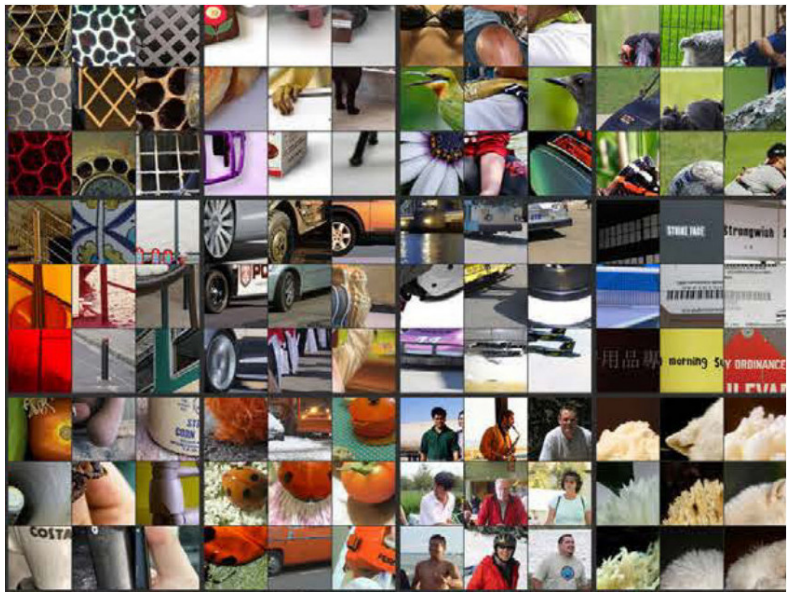
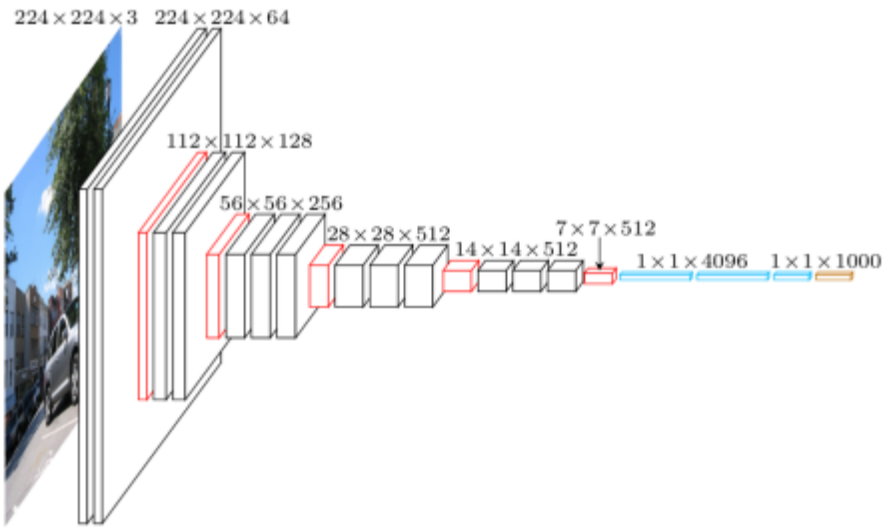


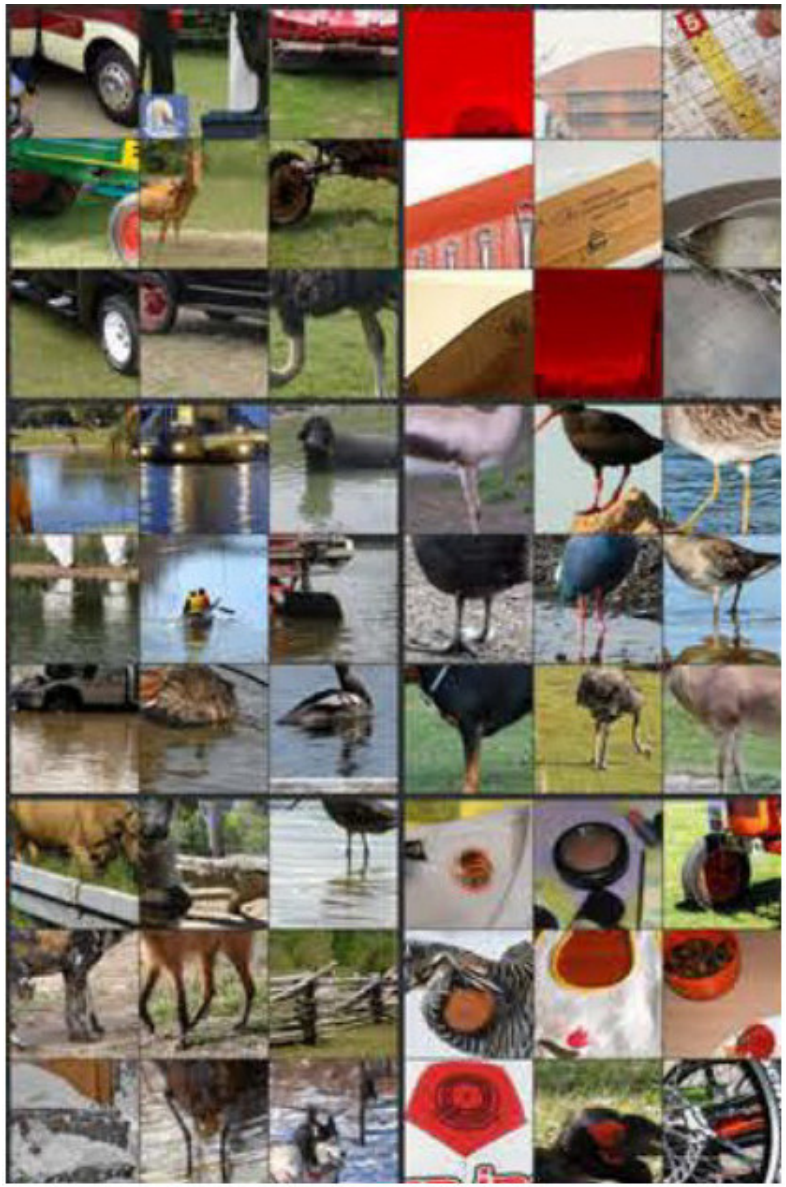


Deep learning architecture

Hierarchized pattern recognition

Layer 4

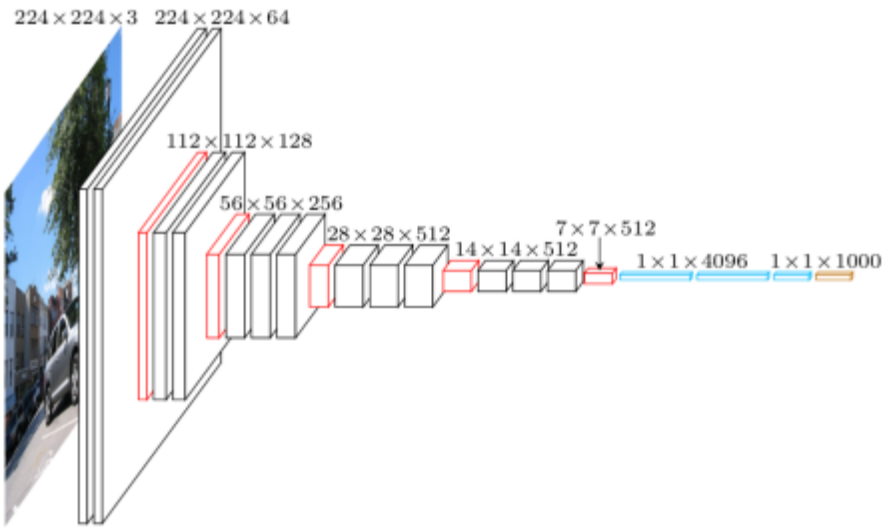


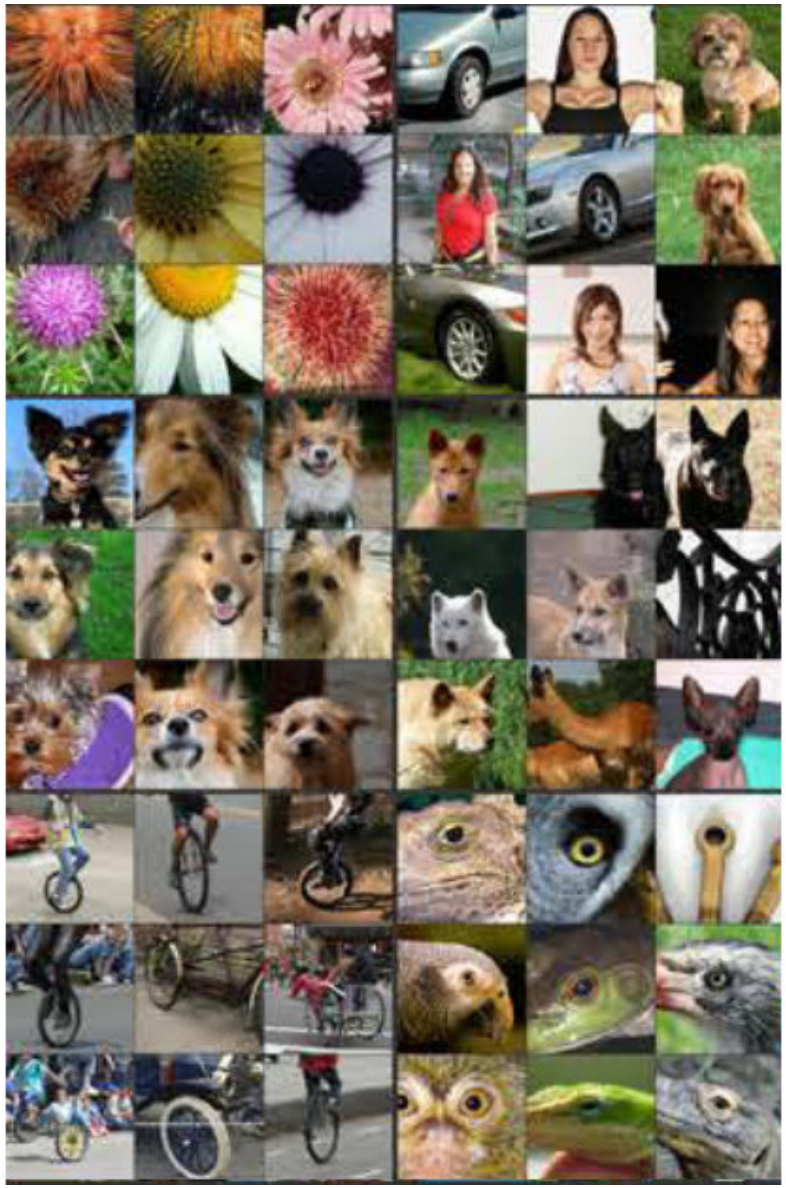


Deep learning architecture

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 taks
  - 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

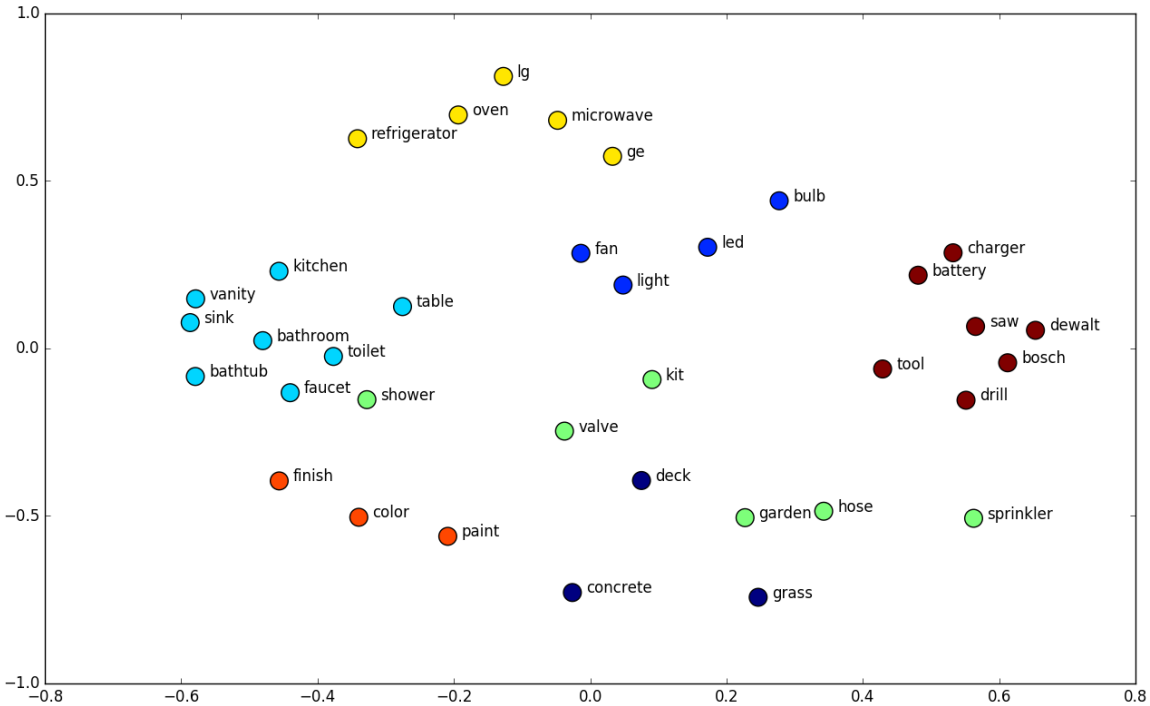
Semantic vectors

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 $[0.22, -0.5]$

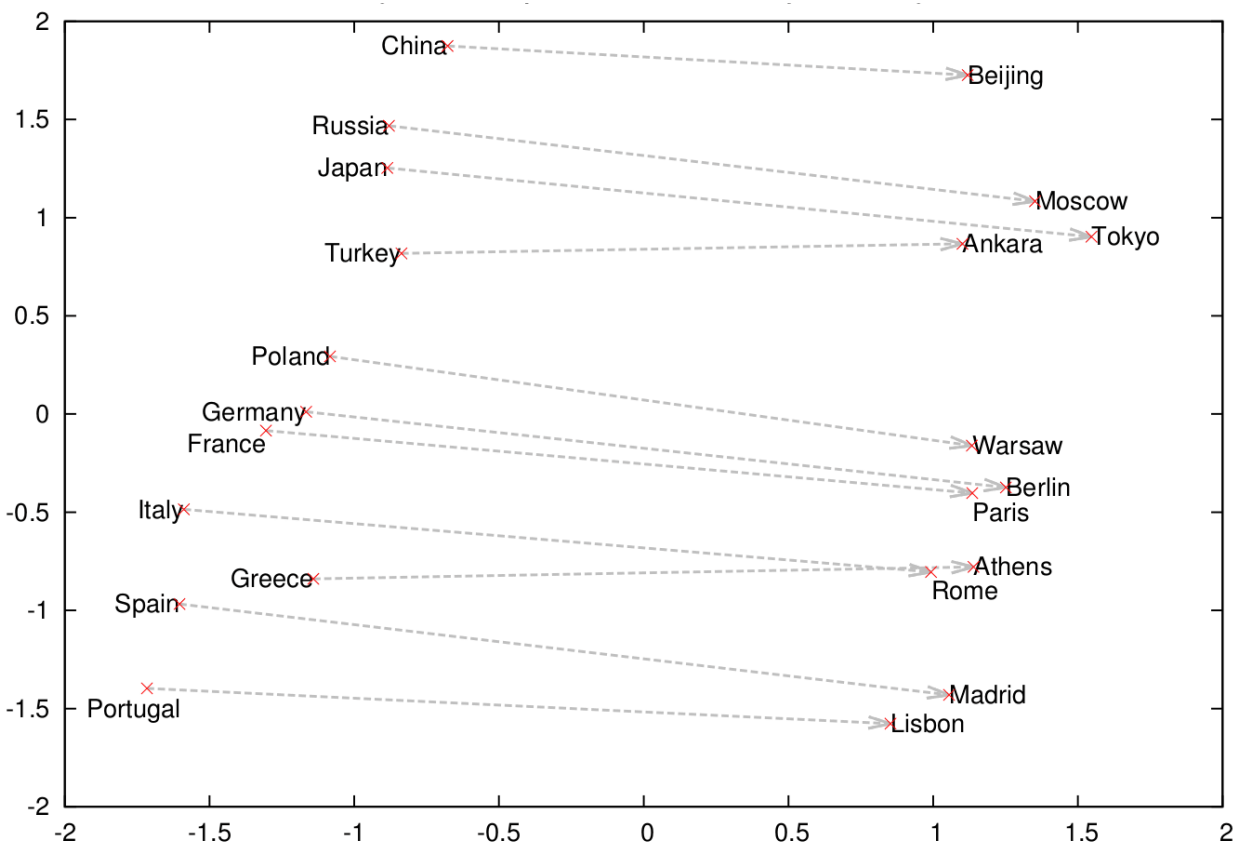


In real applications word embedding have 100 to 300 dimensions

Word embeddings

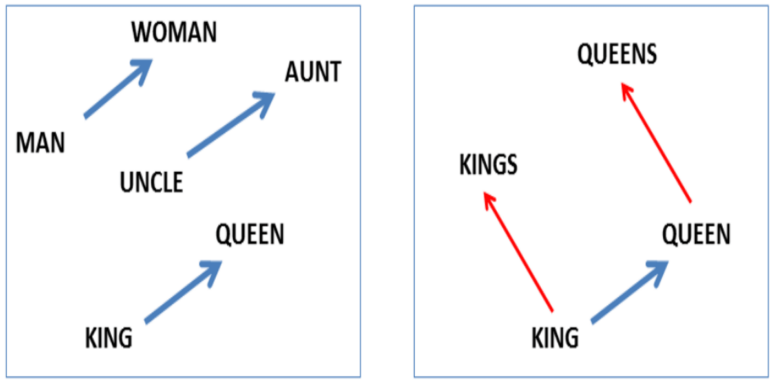
Links between concepts

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

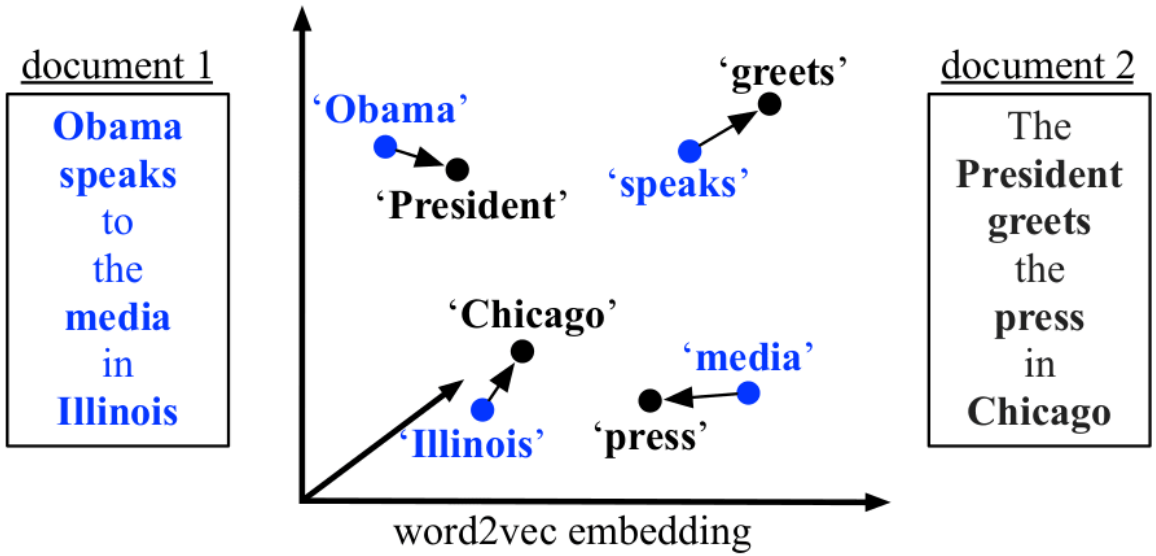


Word embeddings

Arithmetic and fuzzy matching



$$king - man + woman = queen$$



NLP tasks

Sentiment analysis

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, Aventure, ...
  - Lord Of The Rings: Fantasy, Aventure, ...
  - 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, ...

NLP tasks

Search engine

NLP tasks

Automatic summarization

NLP tasks

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NLP tasks

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