Lecture 1: Course logistics, homework 0

STATS 202: Data mining and analysis

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September 24, 2018

Syllabus

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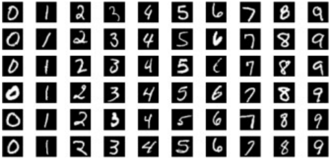
- **Class website:** stats202.stanford.edu. If you are auditing the class (not registered on Axess), email us your SUNet ID in order to gain access to the lectures and homework.

Prediction challenges

The MNIST dataset is a library of handwritten digits.



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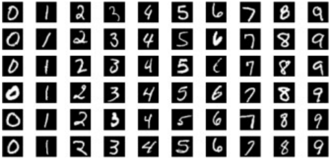

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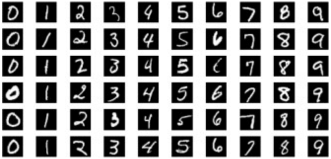

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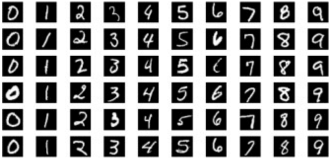


In a prediction challenge, you are given a training set of images of handwritten digits, which are labeled from 0 to 9.

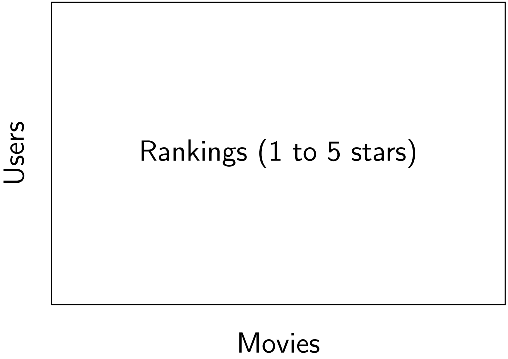
You are also given a test set of handwritten digits, which are not identified.

Your job is to assign a digit to each image in the test set.

The Netflix prize

Netflix popularized prediction challenges by organizing an open, blind contest to improve its recommendation system.

The prize was $1 million.



Users

Rankings (1 to 5 stars)

Movies

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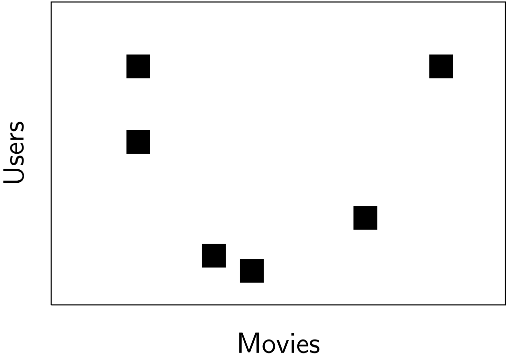

Some rankings were hidden in the training data

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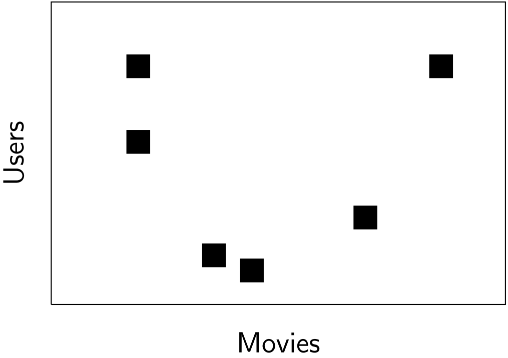
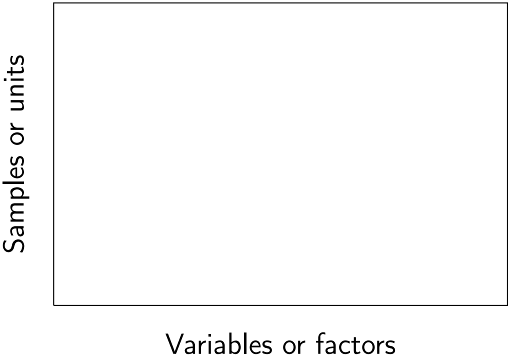


The challenge was to predict those rankings

Supervised vs. unsupervised learning

In **unsupervised learning** we start with a data matrix:



Samples or units

Variables or factors

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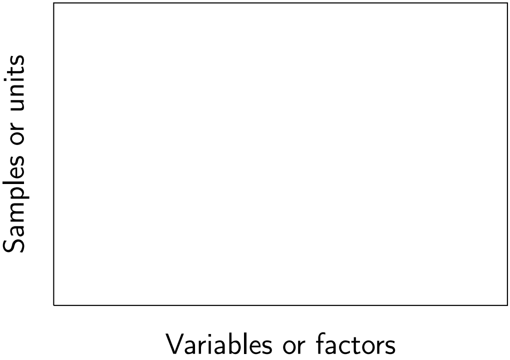

Samples or units

Variables or factors

Quantitative, eg. weight, height, number of children, ...

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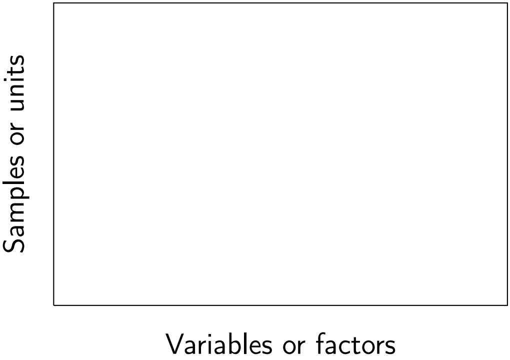

Samples or units

Variables or factors

Qualitative, eg. college major, profession, gender, ...

Supervised vs. unsupervised learning

In **unsupervised learning** we start with a data matrix:

Our goal is to:

- Find meaningful relationships between the variables or units.

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In **unsupervised learning** we start with a data matrix:

Our goal is to:

- Find meaningful relationships between the variables or units. Correlation analysis.
- Find low-dimensional representations of the data which make it easy to visualize the variables and units. PCA, ICA, isomap, locally linear embeddings, etc.
- Find meaningful groupings of the data. Clustering.

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Unsupervised learning is also known in Statistics as **exploratory data analysis**.

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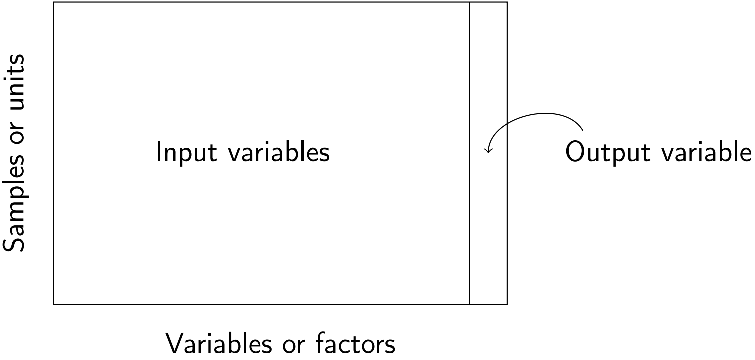
In **supervised learning**, there are *input* variables, and *output* variables:



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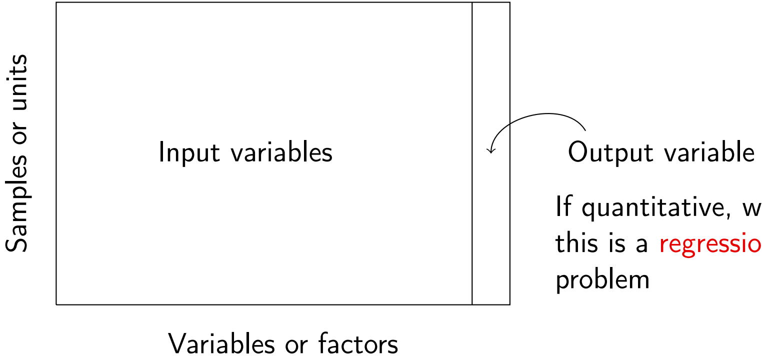

Samples or units

Input variables

Output variable

Variables or factors

If quantitative, we say this is a regression problem

Supervised vs. unsupervised learning

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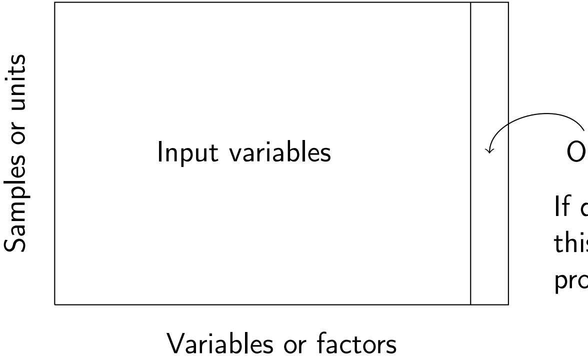

Samples or units

Input variables

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If qualitative, we say this is a classification problem

Supervised vs. unsupervised learning

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If X is the vector of inputs for a particular sample. The output variable is modeled by:

$$Y = f(X) + \underbrace{\varepsilon}_{\text{Random error}}$$

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Our goal is to learn the function f, using a set of training samples.

Supervised vs. unsupervised learning

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Motivations:

- **Prediction:** Useful when the input variable is readily available, but the output variable is not.

  Example: Predict stock prices next month using data from last year.

Supervised vs. unsupervised learning

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Motivations:

- **Prediction:** Useful when the input variable is readily available, but the output variable is not.
- **Inference:** A model for f can help us understand the structure of the data — which variables influence the output, and which don't? What is the relationship between each variable and the output, e.g. linear, non-linear?

  Example: What is the influence of genetic variations on the incidence of heart disease.

Kaggle

Business model:

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Kaggle-in-class is a competition engine offered to degree-granting institutions for free. Stats 202 was the first class to use it!

A sample Kaggle challenge

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This year's competition coming soon!