

Data-driven approaches - Lecture 2

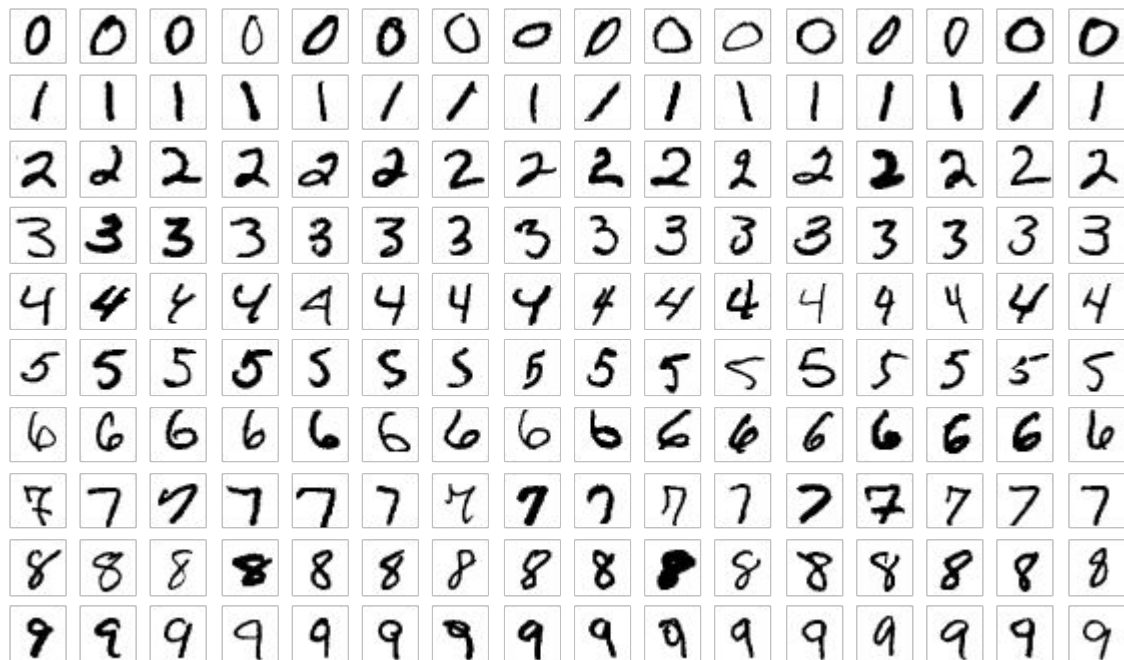
Alexey Sidnev, 2020.09.23

Administrative

1. Tutorial progress: <https://forms.gle/k1iZT23QqdHyyPGE7>
2. Practice?

Task 1 - MNIST classifier

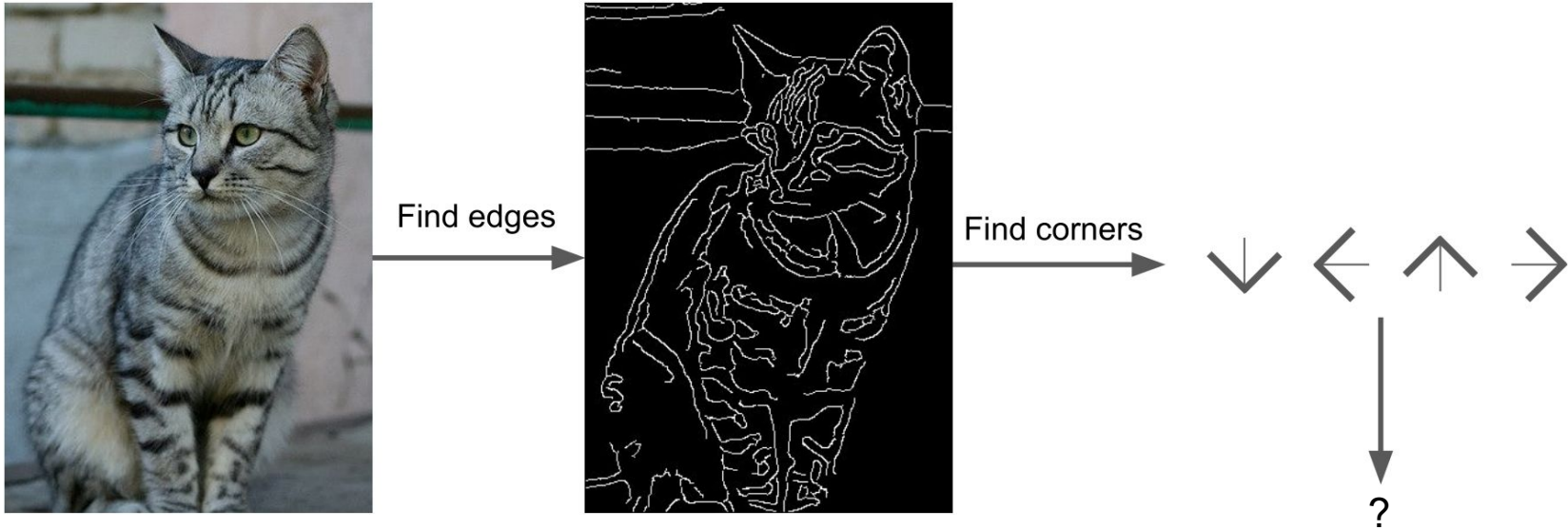
Handwritten digits between 0 and 9: 28×28 pixel grayscale images



Task 1 - MNIST classifier

1. The MNIST database of handwritten digits: <http://yann.lecun.com/exdb/mnist/>
2. MNIST in CSV: <https://www.kaggle.com/oddrational/mnist-in-csv>
3. Google Colab:
https://colab.research.google.com/drive/1rIPS5wCjcE-EhJBBKYzzsQB7ZLgmWwQ_#scrollTo=IB6PAstgKfp6
4. kNN: https://en.wikipedia.org/wiki/K-nearest_neighbors_algorithm
5. Deadline: **23:59 07.10.2020**
6. Competition:
 - a. Features?
 - b. Distance function?

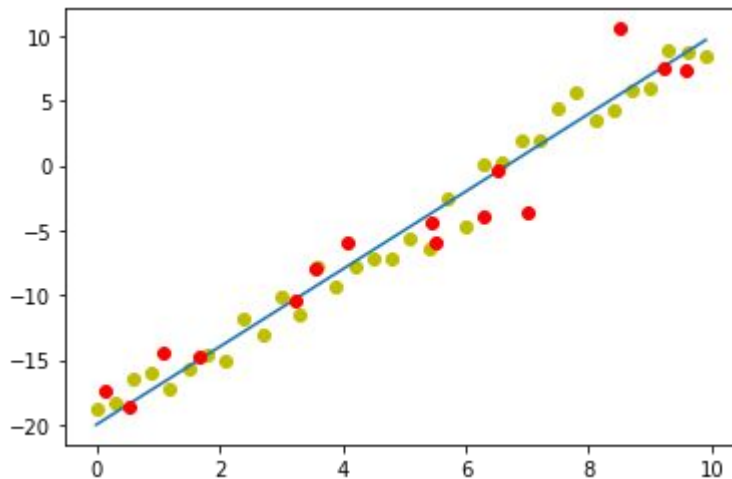
Why data-driven approach?



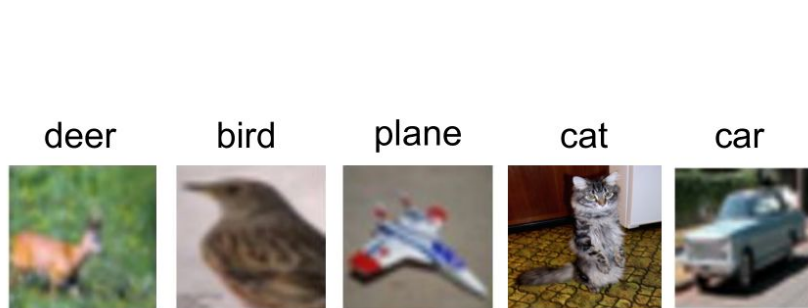
Data-driven approaches

Machine Learning:

1. Collect a dataset of features and labels
2. Use Machine Learning algorithms to train a classifier
3. Evaluate the classifier on new dataset



kNN: k-nearest neighbors



Training data with labels



query data

Distance Metric

$$\left| \begin{array}{c} \text{query cat} \end{array} , \begin{array}{c} \text{training cat} \end{array} \right| \rightarrow \mathbb{R}$$
The diagram shows the distance metric calculation. It features two images of cats: a grey and white tabby cat (query) and a grey and white cat sitting on a patterned rug (training). These are enclosed in vertical bars, separated by a comma, followed by an arrow pointing to the symbol for real numbers, R.

CIFAR-10 and kNN

airplane



automobile



bird



cat



deer



dog



frog



horse



ship



truck



kNN

- Distance metrics on pixels are not informative
- Very slow at test time

Original



Boxed



Shifted



Tinted



Setting Hyperparameters



Your Dataset

train

test

Setting Hyperparameters

Your Dataset

Cross-Validation: Split data into folds, try each fold as validation and average the results

fold 1

fold 2

fold 3

fold 4

fold 5

test

fold 1

fold 2

fold 3

fold 4

fold 5

test

fold 1

fold 2

fold 3

fold 4

fold 5

test

Linear Classifier (2)

Image



Array of **32x32x3** numbers
(3072 numbers total)

$$\boxed{f(x, W)} = \boxed{W} \boxed{x} + \boxed{b}$$

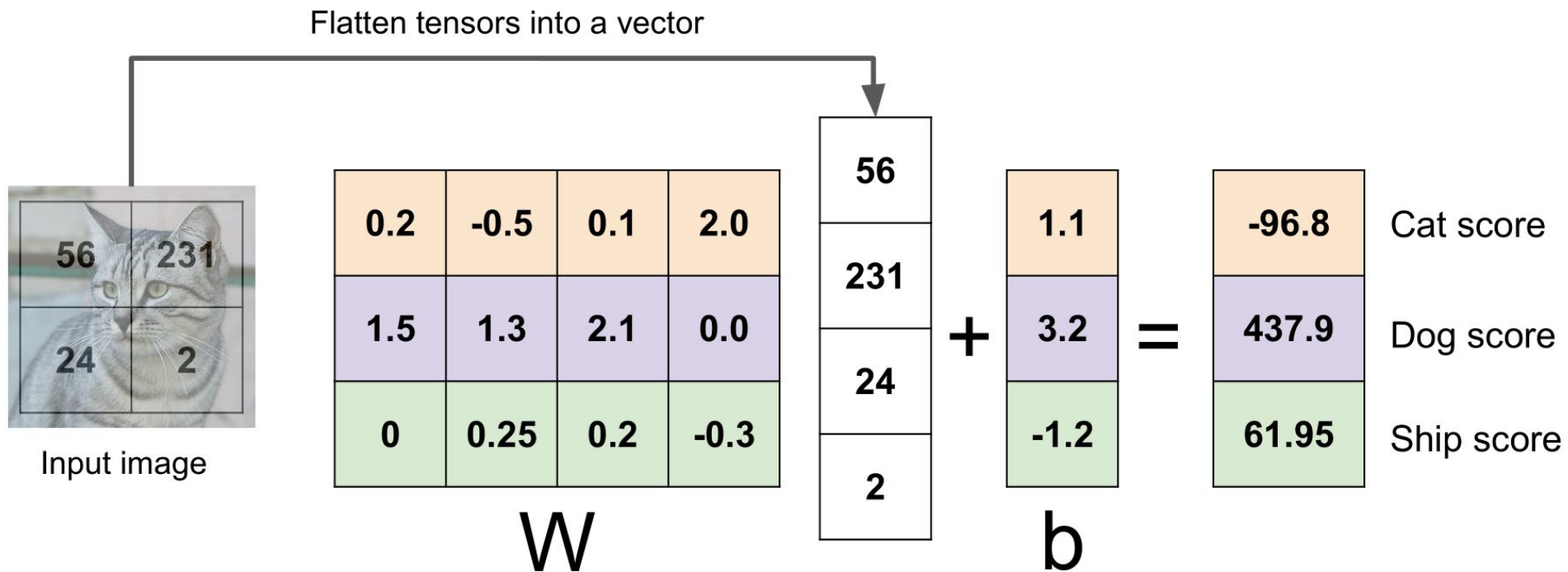
10×1 10×3072 3072×1 10×1

→ $f(\mathbf{x}, \mathbf{W})$ → 10 numbers giving class scores



W
parameters
or weights

Linear Classifier: Example



Interpreting a Linear Classifier

airplane

automobile

bird

cat

deer

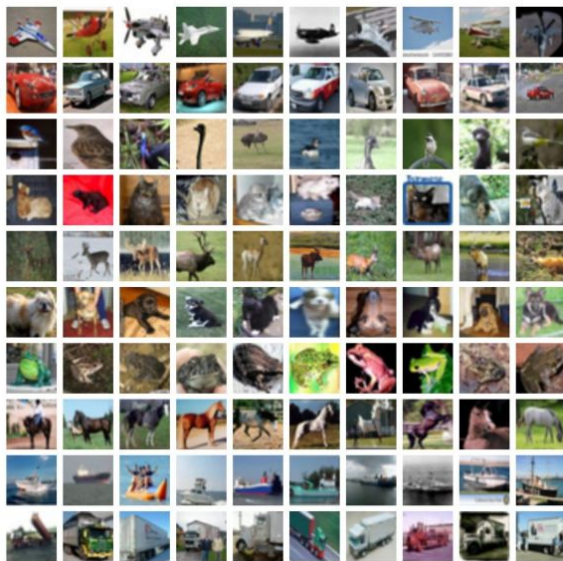
dog

frog

horse

ship

truck



plane

car

bird

cat

deer

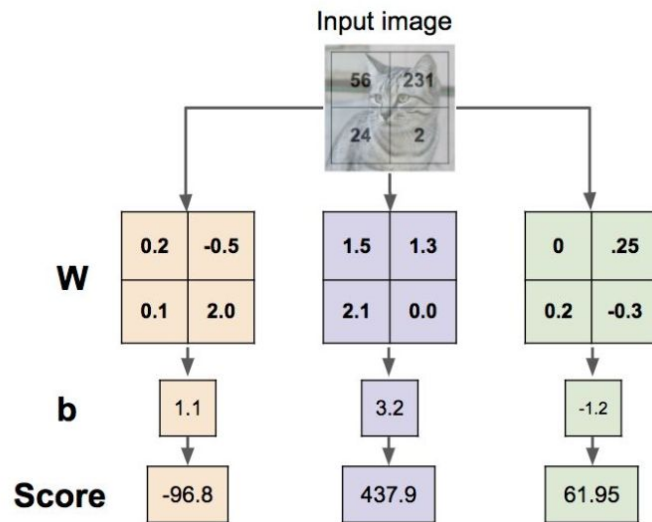
dog

frog

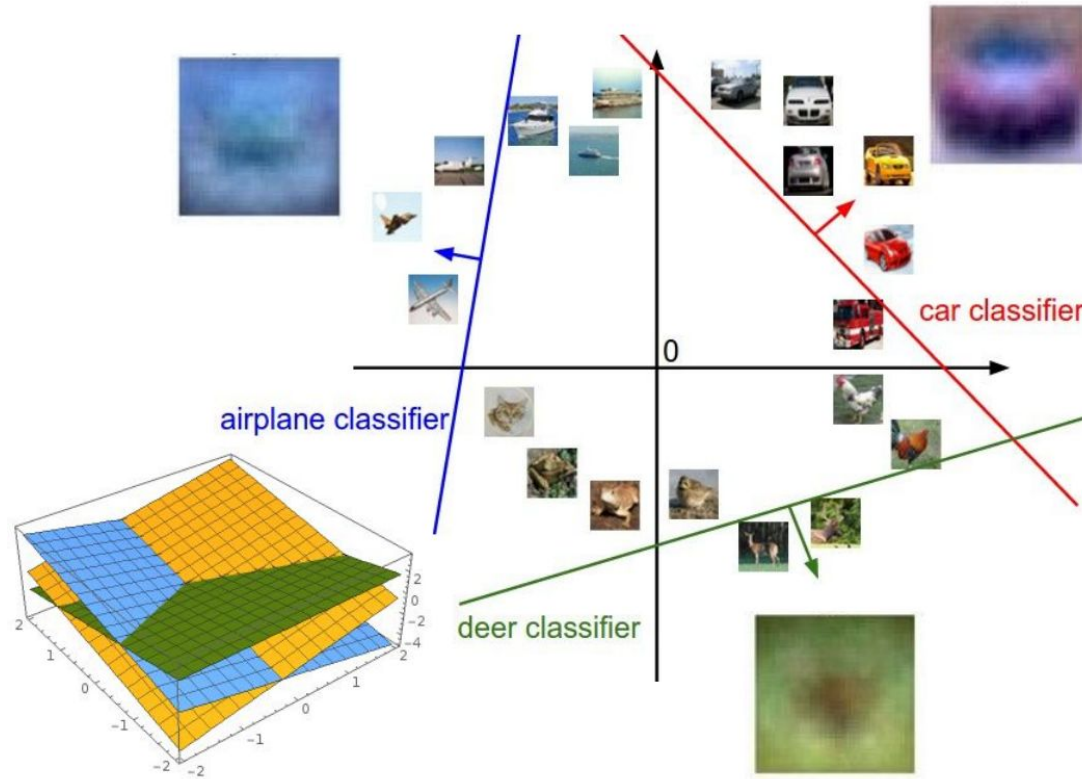
horse

ship

truck



Interpreting a Linear Classifier: Geometric Viewpoint



$$f(x, W) = Wx + b$$



Array of **32x32x3** numbers
(3072 numbers total)