

Machine Learning: Introduction to Classification

by Elena Battini Sönmez
İstanbul Bilgi University

based on 'Stanford's notes'

Classification:

The task of image classification is to predict a single label for a given image.



What the computer sees

image classification

82% cat
15% dog
2% hat
1% mug

by Elena Battini Sönmez, İstanbul Bilgi University

Challenges:

Viewpoint variation



Scale variation



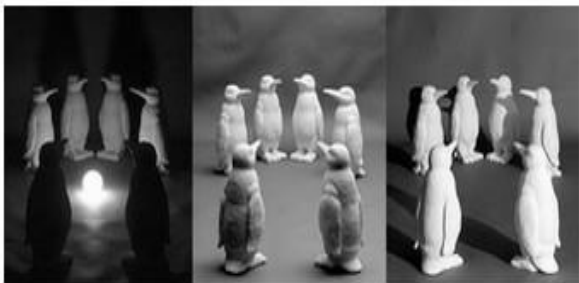
Deformation



Occlusion



Illumination conditions



Background clutter



Intra-class variation



Data Driven Approach:



by Elena Battini Sönmez, İstanbul Bilgi University

Classification steps:

- **Input:** Our input consists of a set of N images, each labeled with one of K different classes. We refer to this data as the **training set**.
- **Learning:** Our task is to use the training set to learn what every one of the classes looks like. We refer to this step as **training a classifier**, or **learning a model**.
- **Evaluation:** In the end, we evaluate the quality of the classifier by asking it to predict labels for a new set of images that it has never seen before. We will then compare the true labels of these images to the ones predicted by the classifier. Intuitively, we're hoping that a lot of the predictions match up with the true answers (which we call the **ground truth**).

Nearest Neighbor (NN) Classifier:

- The nearest neighbor classifier takes a test image, compares it to every single training image, and assigns to the test sample the label of the closest training image
- Having two 1D images, I_1 and I_2 , the L1 distance metric:

$$d_1(I_1, I_2) = \sum p |I_1 - I_2|$$

Example:

test image

56	32	10	18
90	23	128	133
24	26	178	200
2	0	255	220

-

training image

10	20	24	17
8	10	89	100
12	16	178	170
4	32	233	112

=

pixel-wise absolute value differences

46	12	14	1
82	13	39	33
12	10	0	30
2	32	22	108

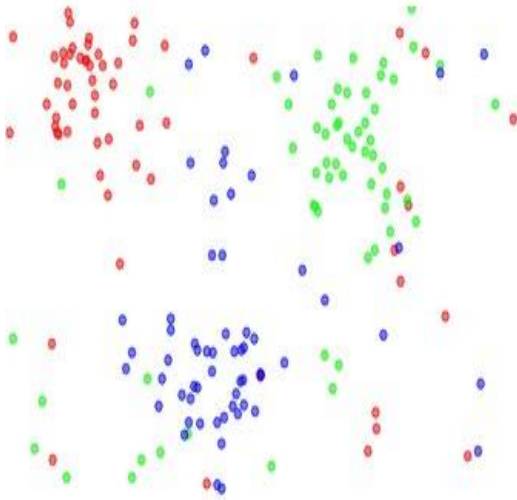
→ 456

K-Nearest Neighbor (K-NN) Classifier:

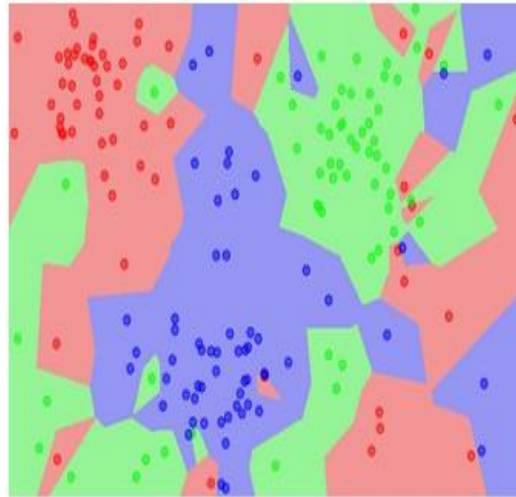
- The idea is very simple: instead of finding the single closest image in the training set, we will find the top **k** closest images, and have them vote on the label of the test image.
- In particular, when $k = 1$, we recover the Nearest Neighbor classifier.
- Intuitively, higher values of **k** have a smoothing effect that makes the classifier more resistant to outliers

Comparison NN vs K-NN:

the data



NN classifier



5-NN classifier

