Image classification

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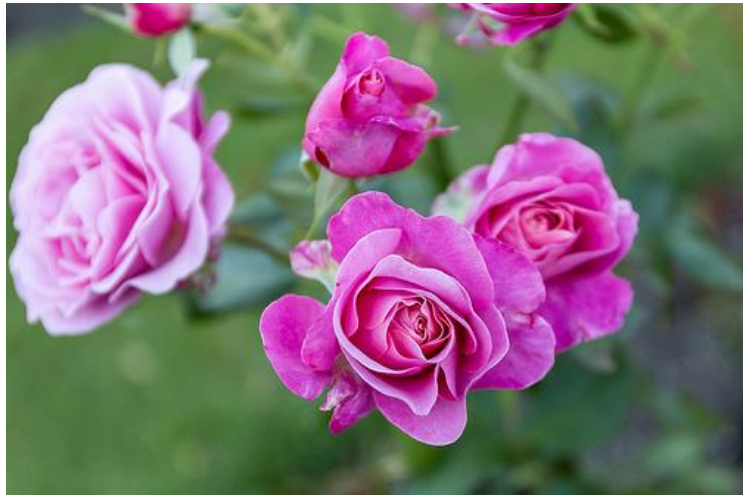
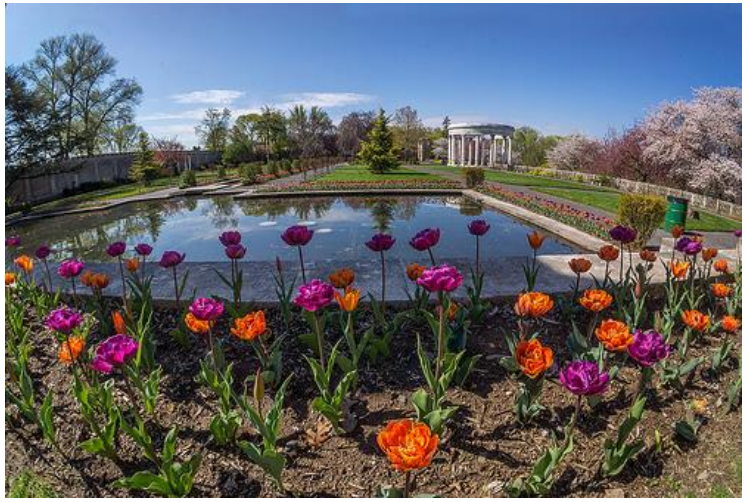
What is image classification?

- Categorizing images
- Tries to answer the question: „What is in the picture?”
- Based on pixels or vectors within an image
- Tries to recognize patterns within an image to make predictions
- We explore „single-label classification” which only assigns one value to an image

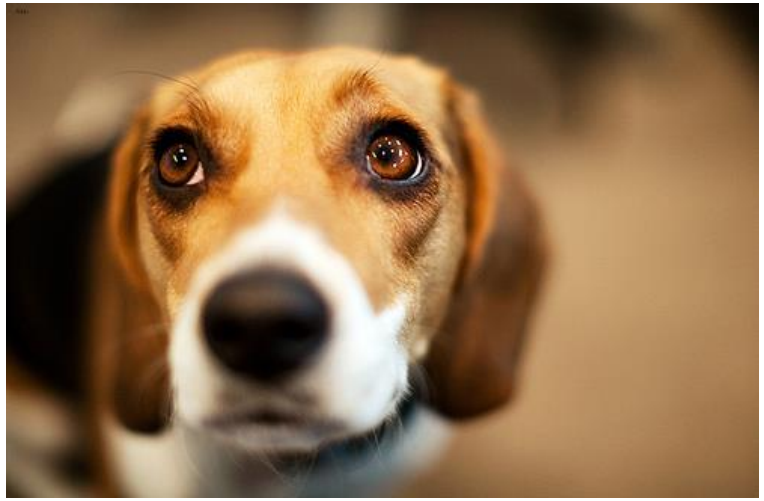
Roses



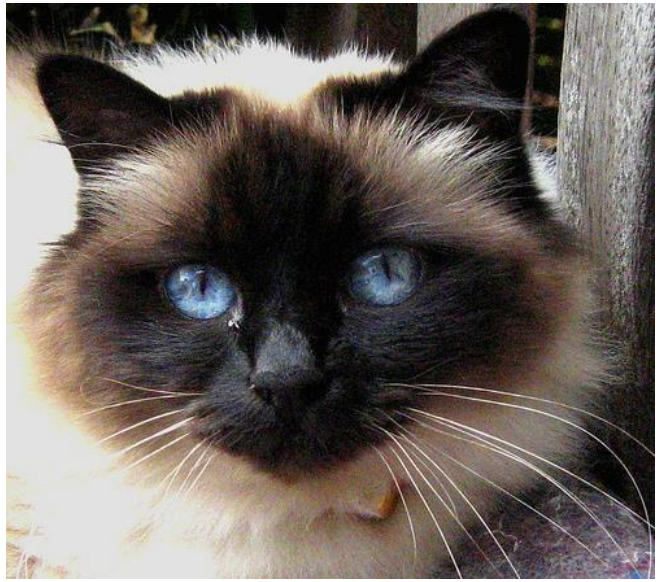
Tulips



Dog



Cat



Real life examples of image recognition

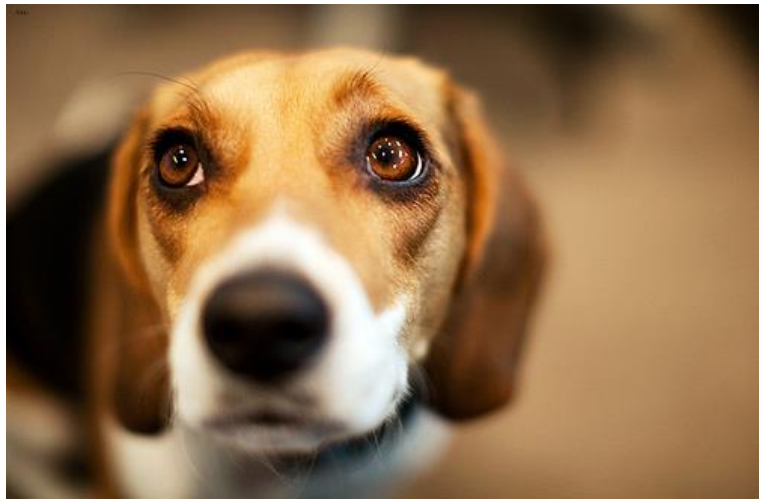
- Medicine – eg. to help doctors detect abnormalities such as cancer
- Self-driving cars
- Face ID and other facial recognition systems
- Retail – eg. the ability to try on a piece of clothing online

Our project

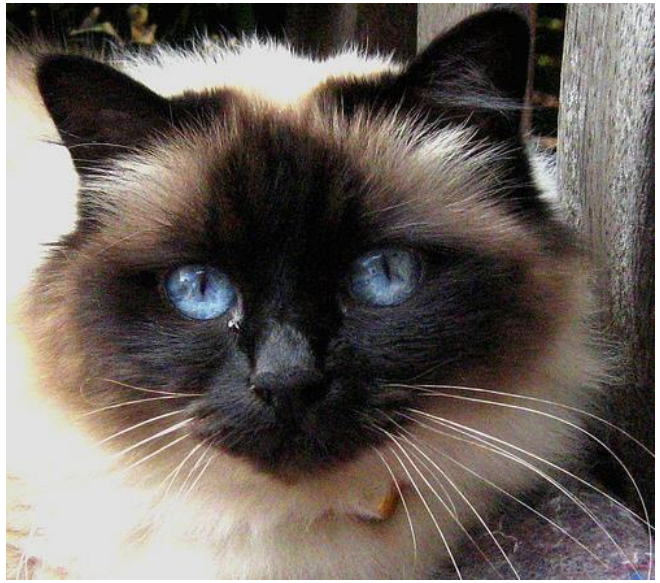
Distinction between cat and dog breeds

- One step further than just saying „dog or cat”
- Input: an image
- Output: name of dog or cat breed as well as certainty (in %)

98% Beagle



84% Birman



Dataset used for training

- Courtesy of The University of Oxford
- JPG image files
- 37 cat or dog races
- About 200 images for each breed
- Over 7390 images in total
- Various sizes (have to be standardized before training)

Description of technology

- Programming language: Python
- TensorFlow – used to create, train, save and load model
- Keras – used to simplify data loading and dividing into different categories
- MatPlotLib – used to generate plots describing model performance, accuracy
- Algorithm:
  - Divide images into groups based on race
  - Calculate minimum, maximum and average image size (used when creating model)
  - Load data, split into two groups: training, validation
  - Create, compile, train and evaluate model
  - Save model as a group of files

```
model = Sequential([
        # ..
])

model.compile(
        # ..
)

model.build()

model.fit()
```

What is a model?

- Program, consists of code, metrics, pre-calculated values, etc. – often hundreds of thousands of lines
- Often split into multiple files when saved
- Trained to a set of data
- Can be „fed” data it hasn’t seen before to make predictions
- Ideally should perfectly distinguish images that were used for training
- Most often evaluated using:
  - Accuracy (overall percentage of correct predictions)
  - Loss (value of cost function for validation data)
  - Confusion Matrix (tracks correct and incorrect predictions divided into classes)

Example model file

```
NumNormalizationFeatures=9040
0   0   6,324555
1   0   8,774964
2   0   8,774964
3   0   4,387482
4   0   2,924988
5   0   8,774964
6   0   7,416198
7   0   3,162278
8   0   8,774964
9   0   8,717798
10  0   8,774964
11  0   8,774964
12  0   6,633249
13  0   5,937171
14  0   2,915476
15  0   2,915476
16  0   3,513821
17  0   6,363961
18  0   4,821826
19  0   4,821826
20  0   4,176123
```

Example model tree

```
+---TrainingInfo
|       Version.txt
|
\---TransformerChain
    |   Model.key
    |
    +---Transform_000
    |   |   Model.key
    |   |
    |   +---Transform_000
    |   |   |   Model.key
    |   |   |
    |   |   +---Transform_000
    |   |   |   |   Model.key
    |   |   |   |
    |   |   |   \---Vocabulary
    |   |   |           Model.key
    |   |   |           Terms.txt
    |   |   |
    |   |   +---Transform_001
    |   |   |   |   Model.key
    |   |   |   |
    |   |   |   \---Chain
    |   |   |       |   Model.key
    |   |   |       |
    |   |   |       +---Transform_000
    |   |   |       |       Model.key
    |   |   |       |
    |   |   |       +---Transform_001
    |   |   |       |       Model.key
    |   |   |       |
    |   |   |       +---Transform_002
    |   |   |       |   |   Model.key
    |   |   |       |   |
    |   |   |       |   +---Transform_000
    |   |   |       |   |   |   Model.key
    |   |   |       |   |   |
    |   |   |       |   |   \---Vocabulary
    |   |   |       |   |           Model.key
    |   |   |       |   |           Terms.txt
    |   |   |       |   |
    |   |   |       |   \---Transform_001
    |   |   |       |           Model.key
    |   |   |       |
    |   |   |       +---Transform_003
    |   |   |       |       Model.key
    |   |   |       |
```

Sources

- https://www.kaggle.com/datasets/zippyz/cats-and-dogs-breeds-classification-oxford-dataset
- https://www.tensorflow.org/
- https://docs.python.org/3/reference/

The end