



Aalto University
School of Science
and Technology

Multilabel classification through structured output learning

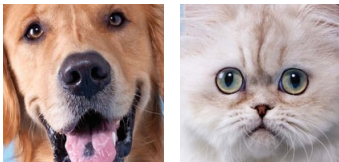
Hongyu Su

Department of Computer Science
School of Science, Aalto University
hongyu.su@aalto.fi

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Example: dog vs. cat?

- ▶ We have 5000 pictures of dog and 5000 pictures of cat.



- ▶ Computer digitalize each picture into 100×100 pixels.
- ▶ Given a new picture, we want to answer: is it a dog or a cat?
- ▶ Simple task for human, dog, or cat.
- ▶ ? claimed this is a difficult task for machines with only 82.7% accuracy.
- ▶ In 2013, 98.5% accuracy was reported in a Kaggle competition (<https://www.kaggle.com/c/dogs-vs-cats>).

In human verification system

- ▶ Human verification system is a program that protects website from robots by generating and grading test that human can pass but machine cannot.
- ▶ CAPTCHA system (?) uses distorted text.



- ▶ ASIRRA system (?) uses images.

Asirra

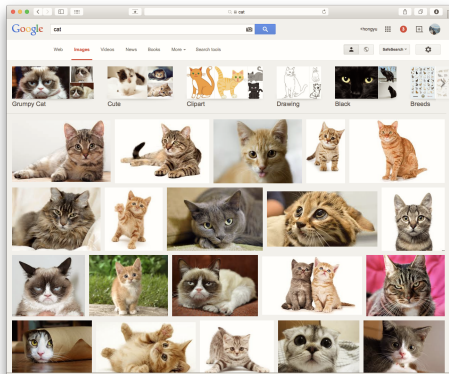
Asirra is a human interactive proof that asks users to identify photos of cats and dogs. It's powered by over two million photos from our unique partnership with [PawBoost.com](#). Protect your web site with Asirra -- free!



- ▶ To test if the ASIRRA system is safe from machine learning attack.
 - ▶ One should get all 12 pictures right!
 - ▶ Accuracy for machine is $(98.5\%)^{12} \approx 83.4\%$.

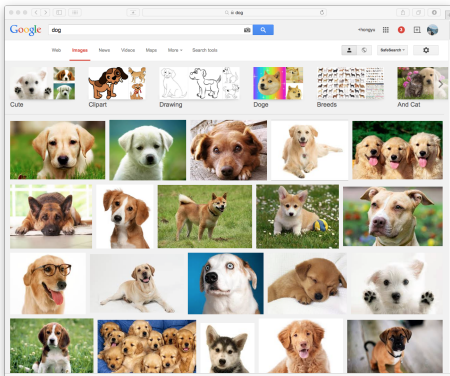
In search engine

- ▶ If machine can assign cat/dog to all pictures correctly, we can search pictures with keywords.
- ▶ Search all cat pictures.



In search engine

- ▶ If machine can assign cat/dog to all pictures correctly, we can search pictures with keywords.
- ▶ Search all dog pictures.



Single label classification

- ▶ The mathematical problem behind is known as *single label classification*.
 - ▶ *Input* is an object, e.g., an image, a video, a sound clip.
 - ▶ *Output* is an attribute of the object called *label*, e.g., dog or cat?
 - ▶ Explore a set of object and label pairs {(image #1, dog)}.
 - ▶ Learn a *mapping function* that predict the label of a unknown object.



Future work



To get benefit?

- ▶ Fingerprint identification
- ▶ Voice recognition
- ▶ Information assistant

To contribute?

- ▶ SETI@home
- ▶ Rosetta@home
- ▶ Foldit

Bibliography