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# Multilabel classification through structured output learning

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# content

- ▶ machine learning
- ▶ single label classification
- ▶ multilabel classification
- ▶ structured output learning
- ▶ future work
- ▶ what can we do



# Example: dog vs. cat?

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



- ▶ Computer digitalize each picture into  $100 \times 100$  pixels.
- ▶ Given a new picture, we want to answer: is it a dog or a cat?
- ▶ Simple task for human, dog, or cat.
- ▶ Golle (2008) 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>).

# Human verification system

- ▶ Is the human verification system safe from machine learning attack.
  - ▶ CAPTCHA vs. ASSIRA



Assira

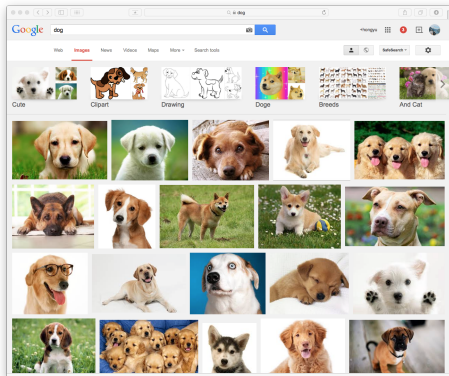
Assira is a human interactive proof that asks users to identify photos of cats and dogs. It's powered by over **two million photos** from our unique partnership with [Flickr](#). Protect your web site with Assira — [free!](#)



- ▶ If machine can assign correct attribute to all pictures, we can search pictures by attributes.

# Search engine

- Search all cat pictures.



# Search engine

- Search all dog pictures.



# Single label classification





# Future work



# To get benefit?

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

# To contribute?

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

# Bibliography

Golle, P. (2008). Machine learning attacks against the asirra captcha. In *Proceedings of the 15th ACM Conference on Computer and Communications Security, CCS '08*, pages 535–542, New York, NY, USA. ACM.