



Aalto University  
School of Science  
and Technology

# Multilabel classification through structured output learning

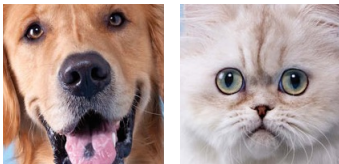
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# Example: dog vs. cat?

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



- ▶ Computer digitalize each picture into  $100 \times 100$  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>).

# 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 (Ahn et al., 2003) uses distorted text.



- ▶ ASIRRA system (Elson et al., 2007) uses images.

Asirra

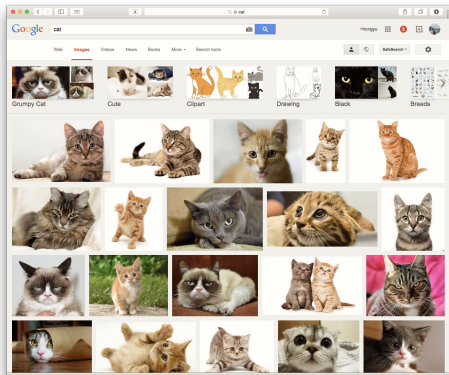
Asirra is a human interactive proof that asks users to identify photos of cats and dogs. It's powered by over two million photos from our unique partnership with PetaPixel.com. Protect your web site with Asirra - free!



- ▶ 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



# Future work



# To get benefit?

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



# To contribute?

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

# Bibliography

- Ahn, L. V., Blum, M., Hopper, N. J., and Langford, J. (2003). Captcha: Using hard ai problems for security. In *Proceedings of the 22Nd International Conference on Theory and Applications of Cryptographic Techniques, EUROCRYPT'03*, pages 294–311, Berlin, Heidelberg. Springer-Verlag.
- Elson, J., Douceur, J. R., Howell, J., and Saul, J. (2007). Asirra: A captcha that exploits interest-aligned manual image categorization. In *Proceedings of 14th ACM Conference on Computer and Communications Security (CCS)*. Association for Computing Machinery, Inc.
- 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.