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Multilabel classification through structured output learning

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March 24, 2015

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.
- ▶ 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.



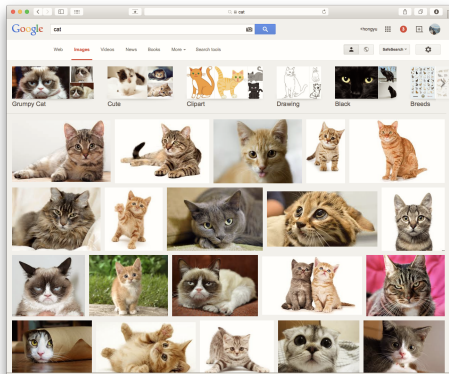
- ▶ ASIRRA system (Elson et al., 2007) uses images.



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

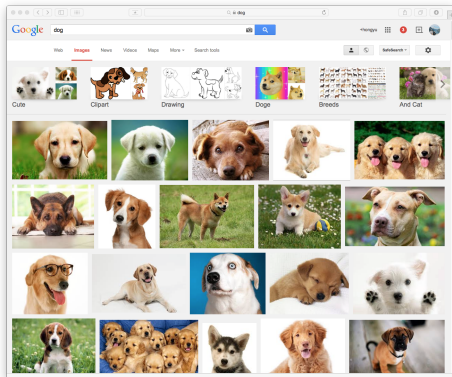
In search engine

- ▶ 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

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