

# Visual Analysis on Relationships between Nouns and Adjectives Using a Large Number of Web Images

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# Research area : Image recognition

- We are working on
  - Automatic recognition of images



Dog



Car



Sky

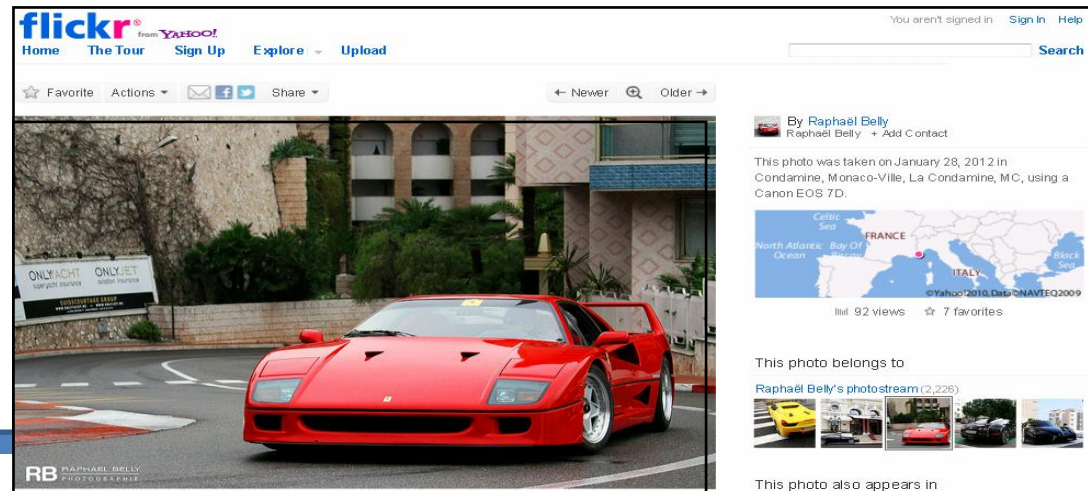
# Photo database on the Web

- Photo sharing Web sites (photo version of Youtube)

– e.g. **flickr**



- Everybody can upload photos with tags.



## Tags

Ferrari • F40 • Red • Rouge • Rosso •  
 Forty • 40 • Exotic • RB • Raphaël •  
 Monaco • Principality • Monte-Carlo • Hotel •  
 de • Paris • French • Riviera • Supercars •  
 Spotting • Passion • Car • Raphael • Belly •

Tags  
 Ferrari • F40 • Red • Rouge • Rosso •  
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 EOS • 7D • Photographie • Photography •  
 Casino • worldcars

# Background

Query word:  
**blue & car**

“red car”

“blue sky”

Irrelevant



Tags

North Vancouver • Canada • British Columbia •  
B.C. • Waterfront Park • 2012 •  
German Car Festival • German • car •  
Porsche • 911 • 993 • Porsche 911 •  
colourful • vibrant • vivid • red • sky • blue

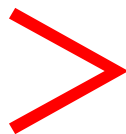
# Objective

- Analysis on visual relationships between nouns and adjectives

“red + flower”



visual  
relationships



“red + dog”



- Finding out the tag pair with high visual relationships

# Objective

- The class with high relationships contains similar images.

flower + red

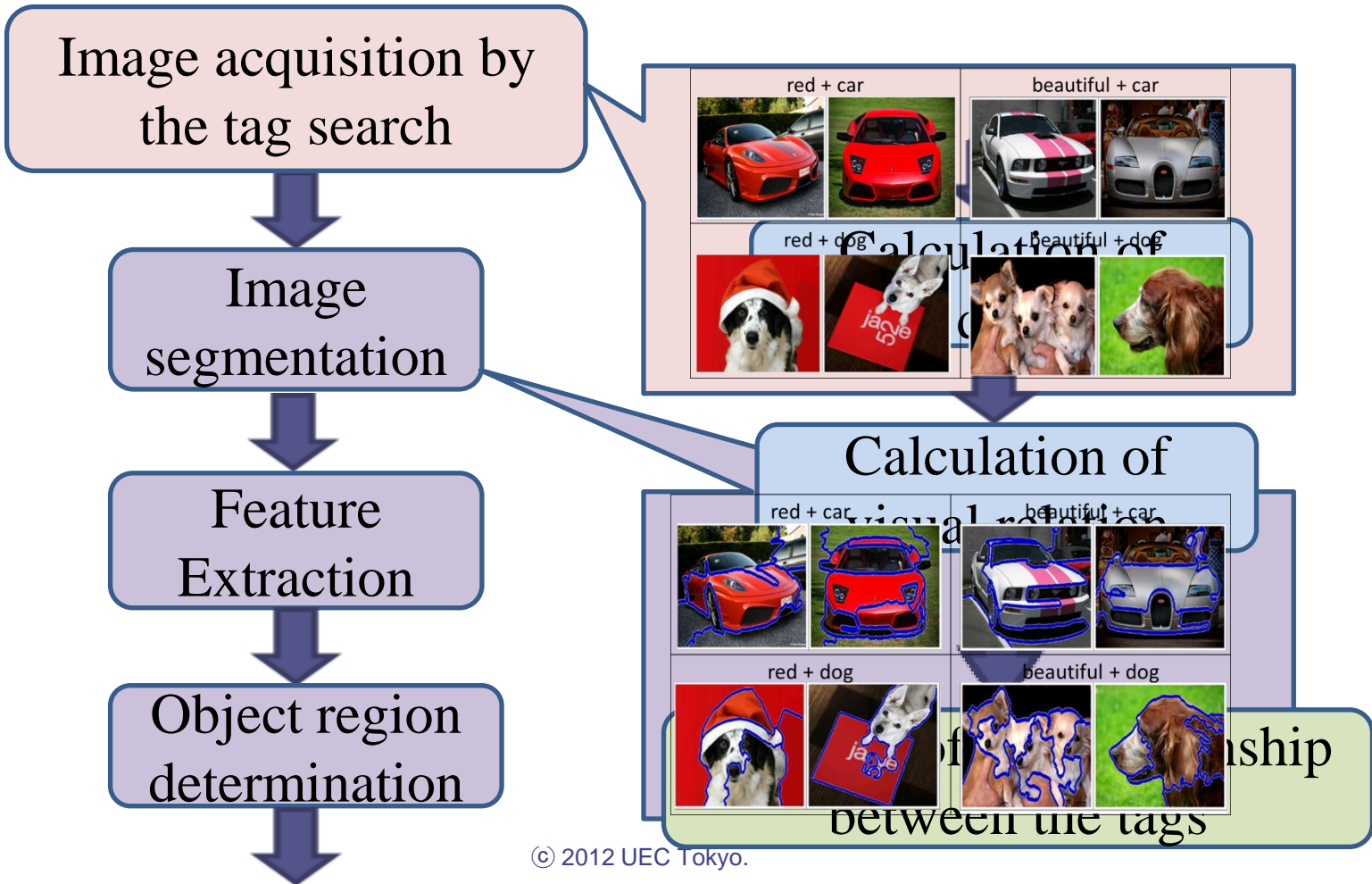


- Creating new dataset with less noise
- Improving accuracy of simultaneous recognition of nouns and adjectives
  - There is a flower and the color of the flower is red.

# Basic idea

- Prepare many tag pairs of nouns and adjectives
  - e.g. "red + car", "blue + sky", ...
- Search web image database for the images corresponding to each of the prepared tag pairs
- Detect regions of objects for all the images
  - Eliminating of background in the images
- Evaluate the distribution of the image set of each tag pair with entropy, and calculate mutual information

# Overview





# Example of gathered images

red + car



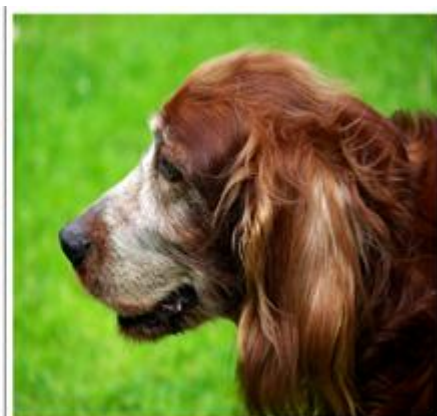
beautiful + car



red + dog



beautiful + dog



# Image acquisition

- Image acquisition from **flickr**
  - 20 nouns : car , dog , sky , ...
  - 16 adjectives : - , red , morning , old , ...
    - 20 nouns  $\times$  16 adjectives = 320 tag pairs
  - 200 positive images for each tag pair
  - 600 negative images (common to all tag pairs)
    - 64,600 images (=200  $\times$  320+60)

# Results of image segmentation

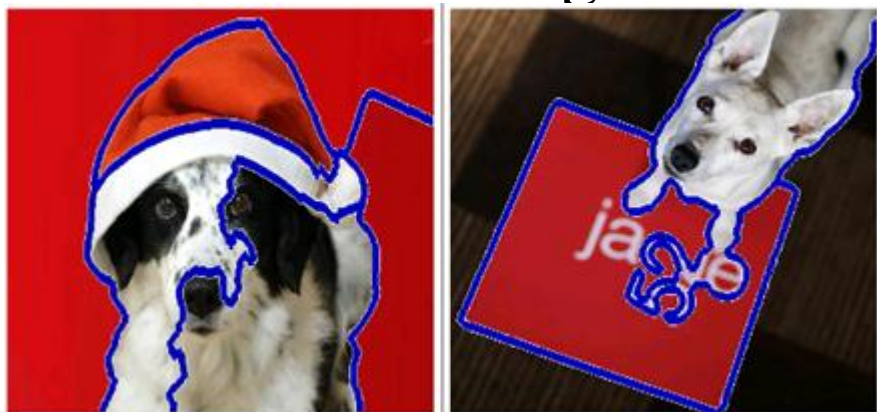
red + car



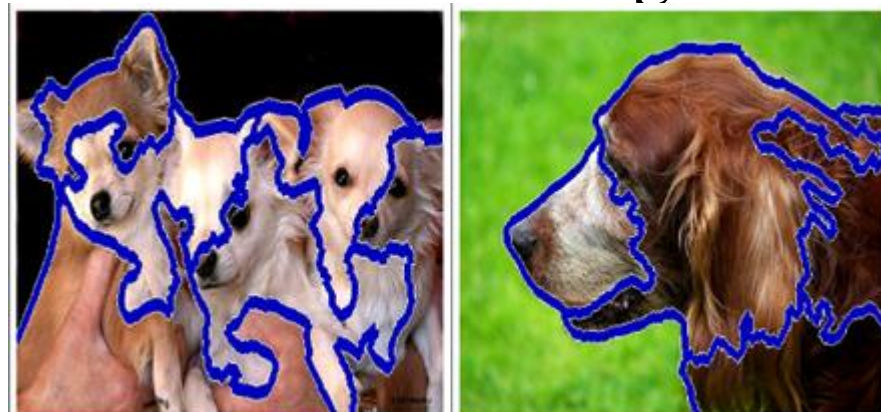
beautiful + car



red + dog



beautiful + dog

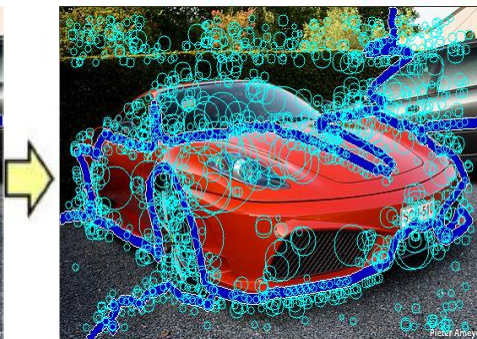


# Feature extraction and creating Bag of Feature

- Extract SIFT features from each region
- Create Bag of Feature vectors from a set of the SIFT features

Detection of Keypoints

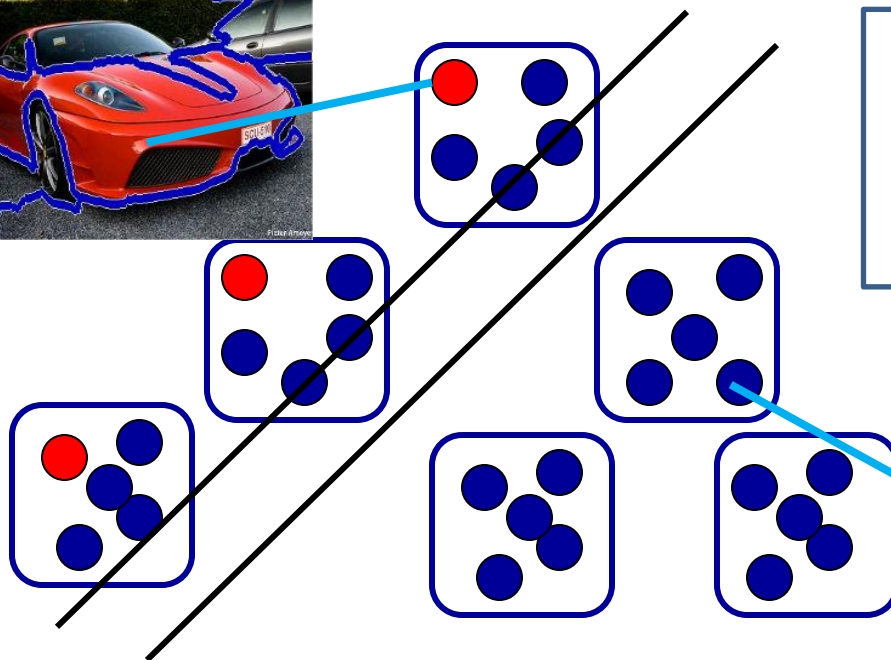
Frequency of representative pattern



# Assume good region corresponding keyword

- Multiple instance-SVM

– training → evaluation → changing dataset →  
training → ..... (5-loops)



High evaluated regions are positive data,  
and low evaluated regions are negative  
data in the next loop.



- **car & red regions**
- **Not (car & red) regions**

# Results of detected regions

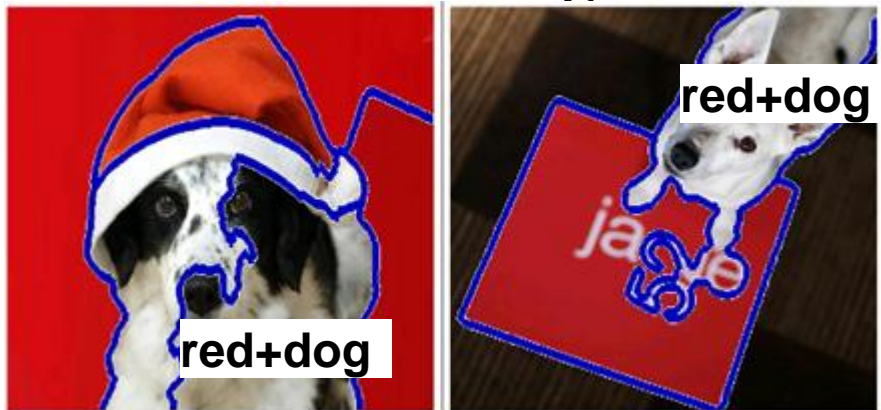
red + car



beautiful + car



red + dog



beautiful + dog



# Visual relation by mutual information

**Entropy** : Value of distribution of local features

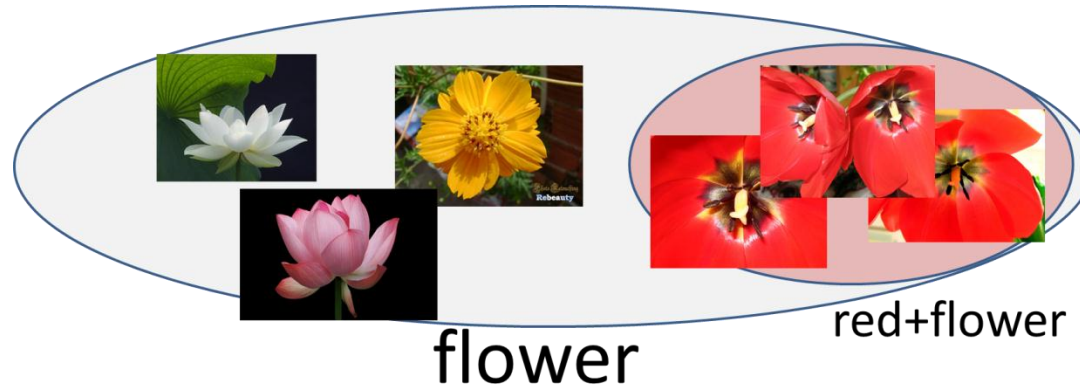
$$H(X) = -\sum P(x)\log(P(x))$$

High : Wide distribution ↔ Low : Narrow distribution

**Mutual information** : Difference of entropy

$$MI(X;Y) = H(X) - H(X|Y)$$

High : High relation ↔ Low : Low relation



# Experiments

Dataset: 64,600 images for 320 tagged pairs

1. Evaluate mutual information of tag pairs
2. Compare visual relation and tag co-occurrence



# Examples of results

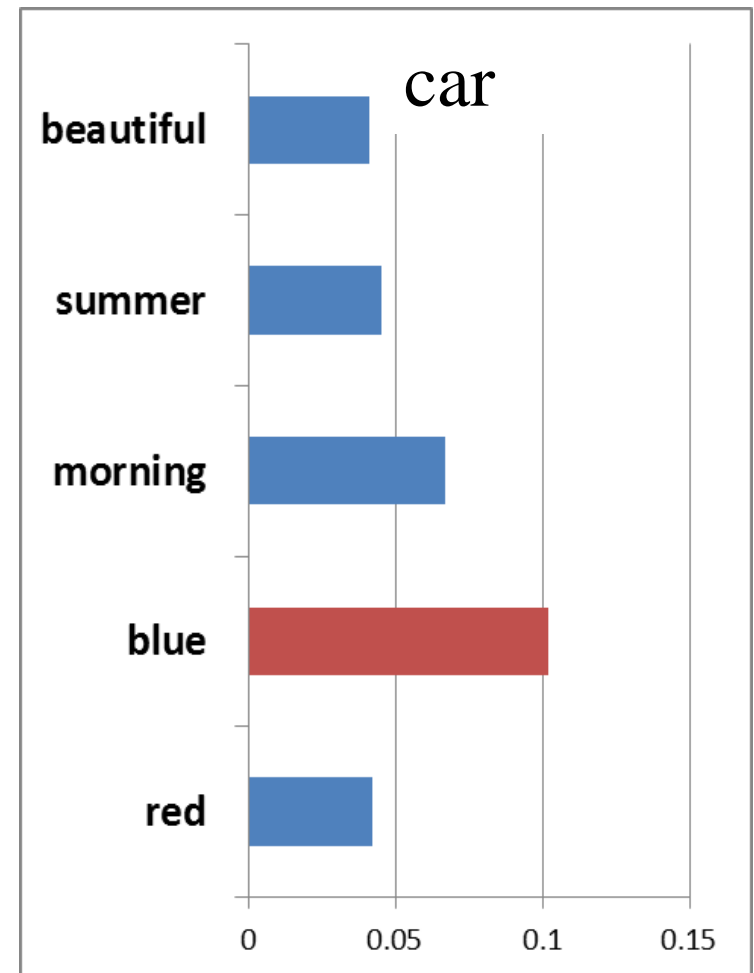
## 1. Evaluate mutual information of tag pairs

### High visual relationship between pair tags

- "red+sun" , "red+car"
  - Color adjective and object noun
- "morning+sun", "night+sun"
  - Time adjective and noun related sky

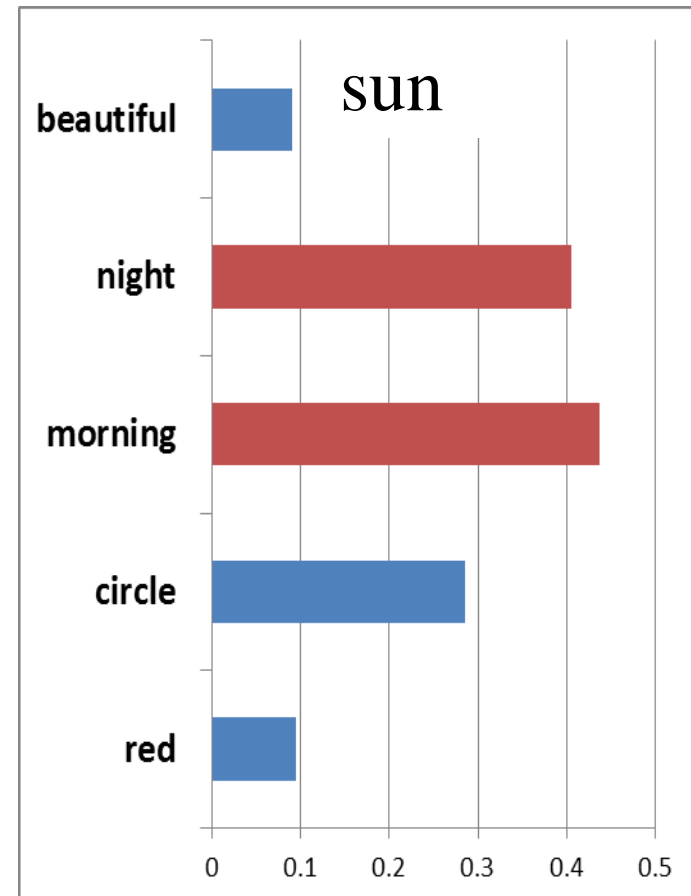
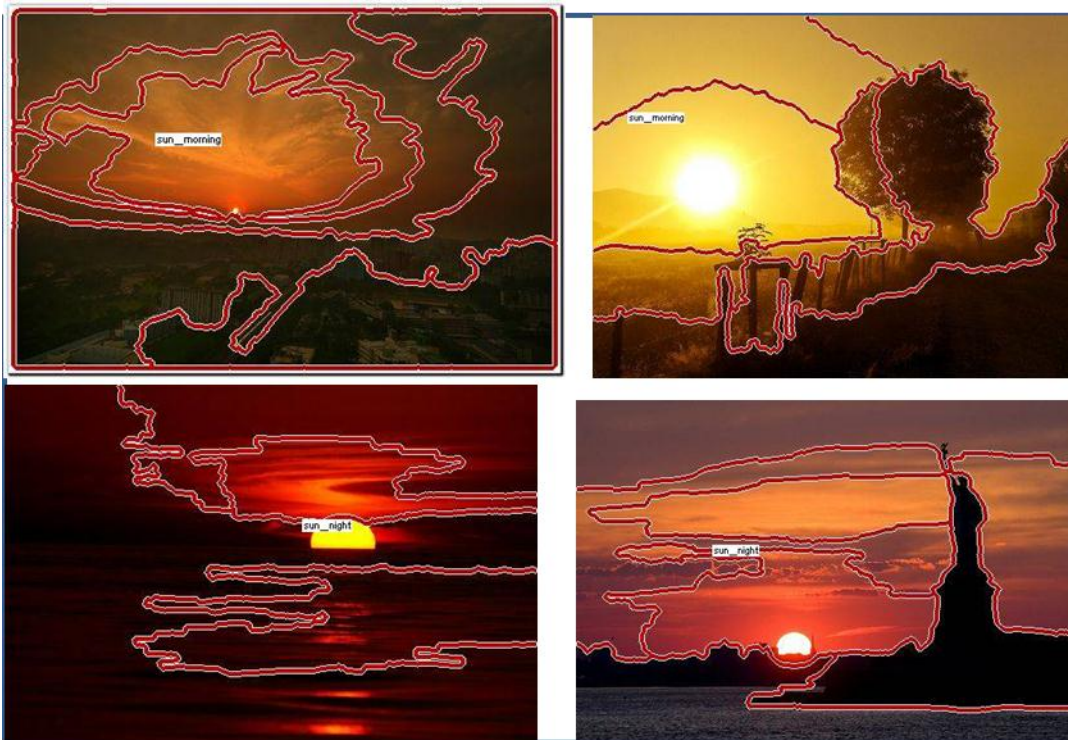
# 1. Evaluate mutual information of tag pairs

- Color adjective and object noun
  - “blue + car”



# 1. Evaluate mutual information of tag pairs

- Time adjective and noun related sky
  - “sun+morning” , “sun+night”



# Similarity by tag co-occurrence

Webpage Screenshot



Home The Tour Sign Up Explore Upload

You aren't signed in

2

Search

Photos Groups People

Everyone's Uploads

red

SEARCH

Full Text | Tags Only  
Advanced Search

ncy

T

Sort: Recent Interesting

View: Small Medium Detail Slideshow



From shannon...



From Lionya



From currentdr...



From akimcc



From pistol22



From AlexHSmith96



From Lens 92



From lokiloki



From lisan...



From helenogbourn



From Joybot



From KqYS



From Joybot



From LoBsTeRbig



From chausson bs



From hrd9xoay0...



From hrd9xoay0...



From hrd9xoay0...



← prev

1

2

3

4

5

6

7

...

next →

(6,397,362 results)

From 1 Fine...

From Les...

From 1 Fine...

From Ben\_in\_lo...

From rospix

From 1 Fine...

From 1 Fine...

X

← prev

1

2

3

4

5

6

7

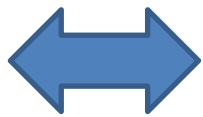
...

next →

(6,397,362 results)

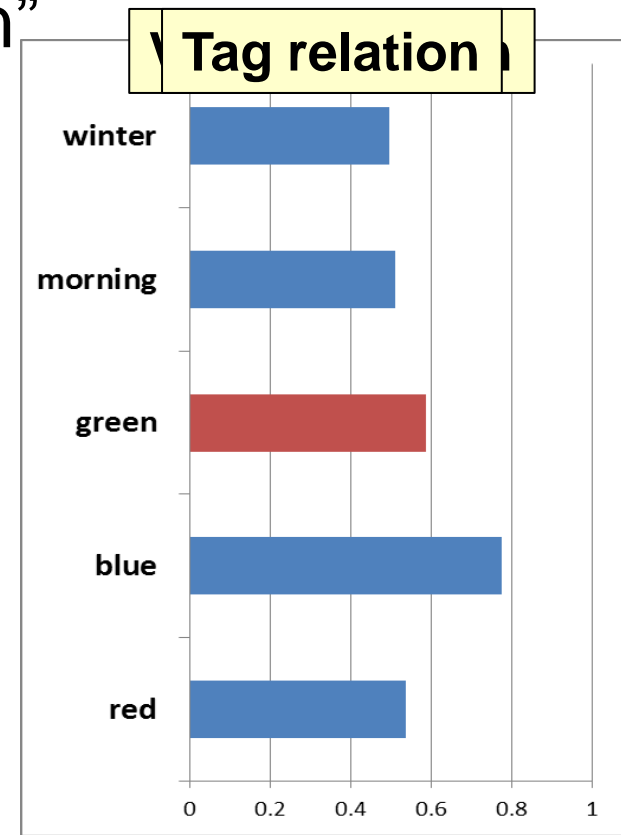
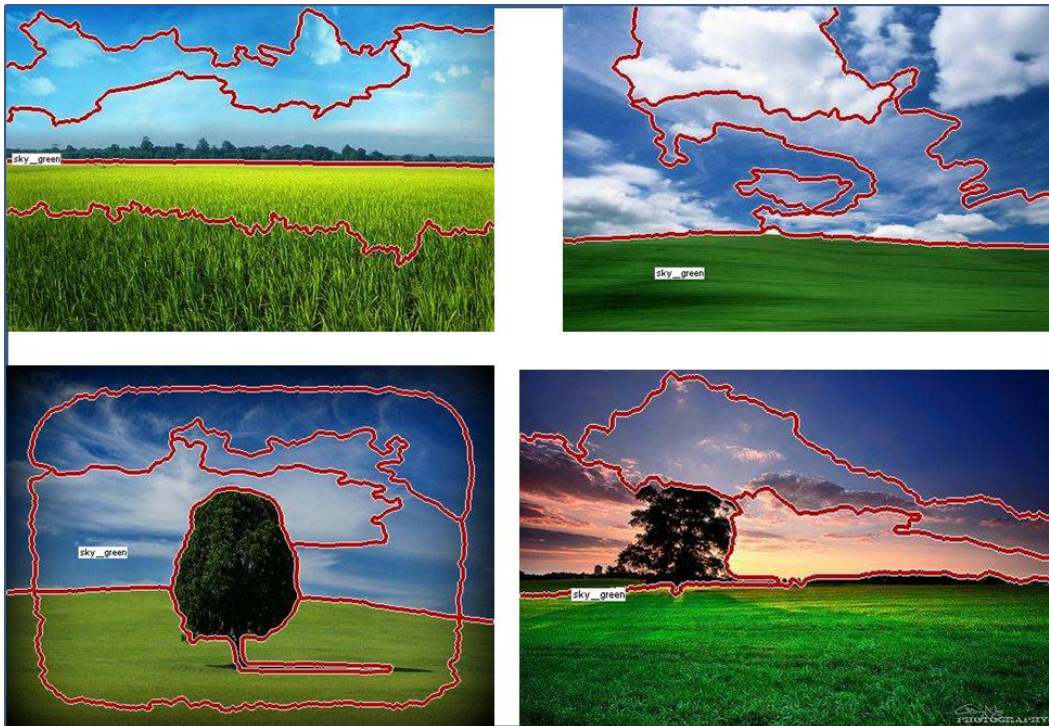
## 2. Compare visual relation and tag co-occurrence

- Low visual relationship



high similarity by tag co-occurrence

– “beach+summer “, “sky+green”



# Summary

- Analyze visual similarity between the tag pairs
- Calculate mutual information from the images of 360 tag pairs
  - High visual relationship
    - The pair of color adjectives and object nouns
    - The pair of time adjectives and related sky nouns
- Compare visual relation and tag co-occurrence
  - Exist the tag pair of Low visual relationship but High co-occurrence

# Future works

- Large scale experiments
  - e.g. 100 nouns × 100 adjectives
- Creating dataset considered visual relationship between the noun and the adjective
- Simultaneous recognition of the nouns and adjectives

# Future works



dog

bag

red

cute