

Advanced Social Media Analysis

– *PhD thesis* –

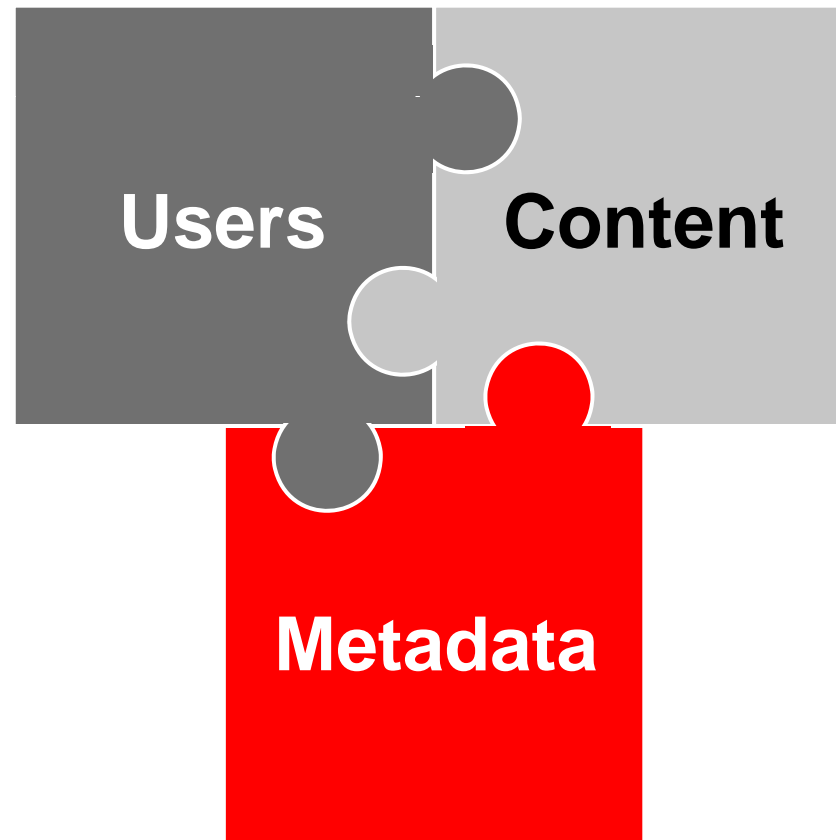
Author:
Ivan Ivanov, PhD



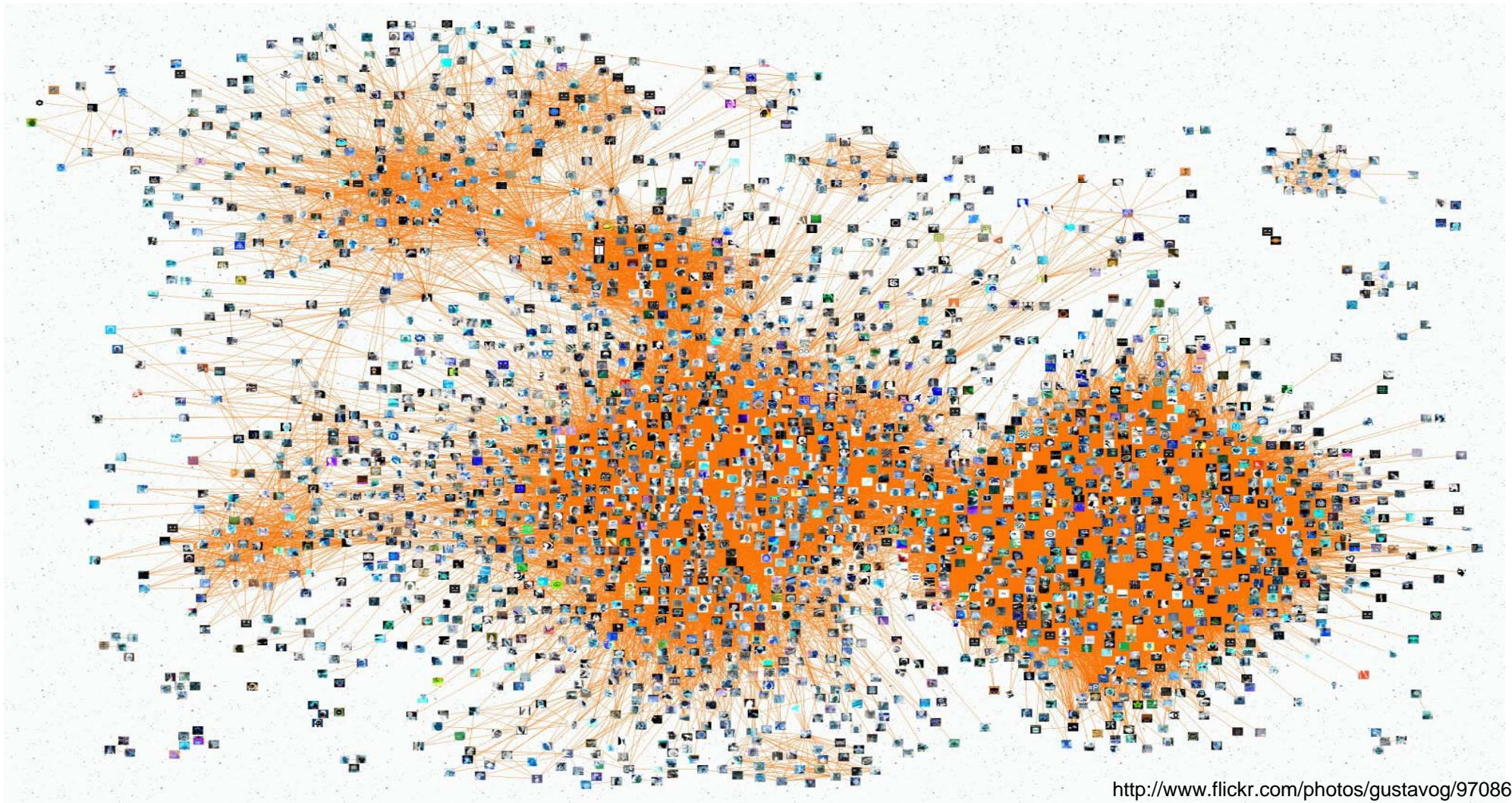
Multimedia Signal Processing Group
Swiss Federal Institute of Technology



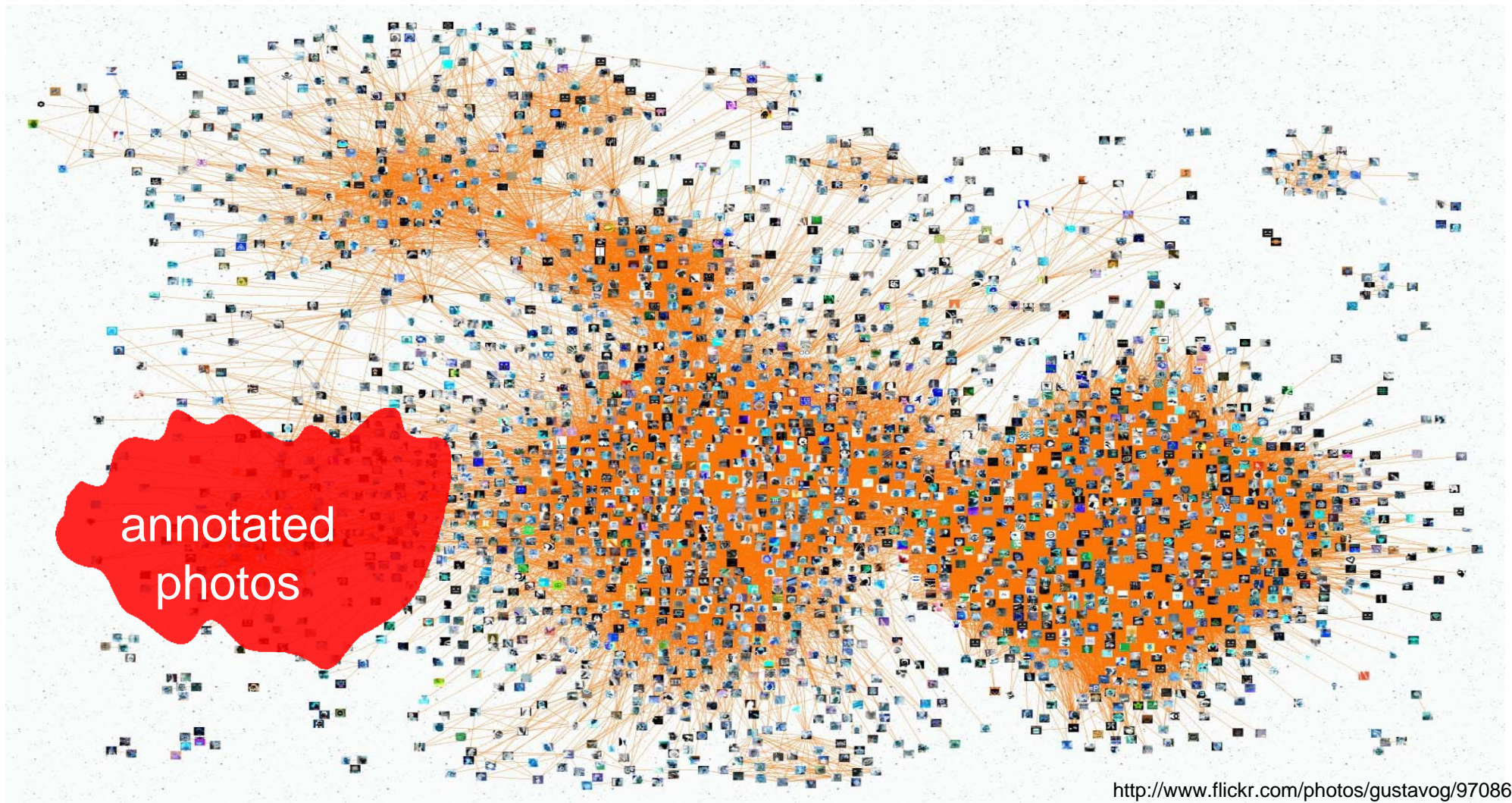
Object-based Tag Propagation for Semi-Automatic Annotation of Images



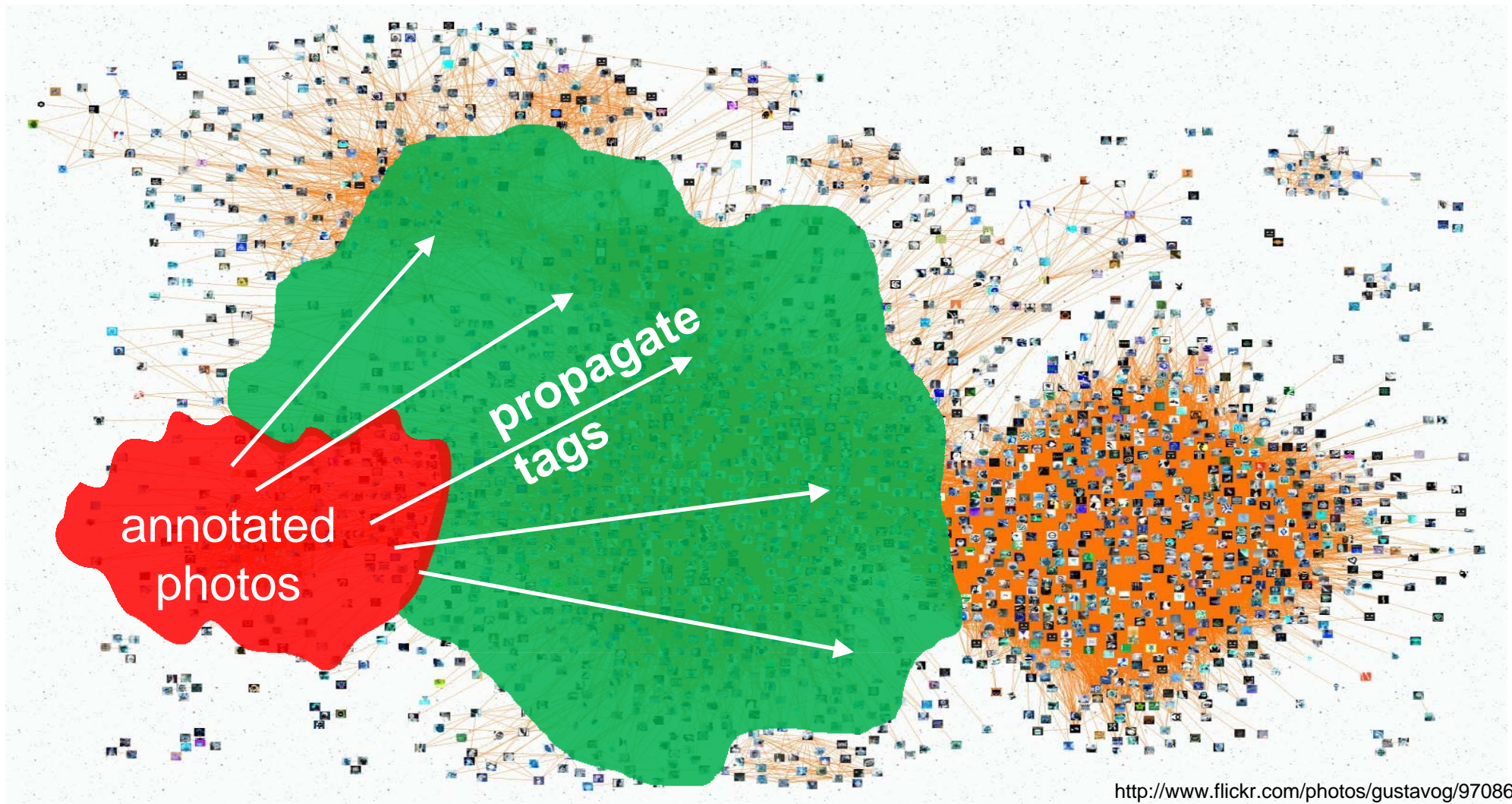
- Ease the process of annotating large photo collections
 - Content-based similarity to propose tags



- Ease the process of annotating large photo collections
 - Content-based similarity to propose tags



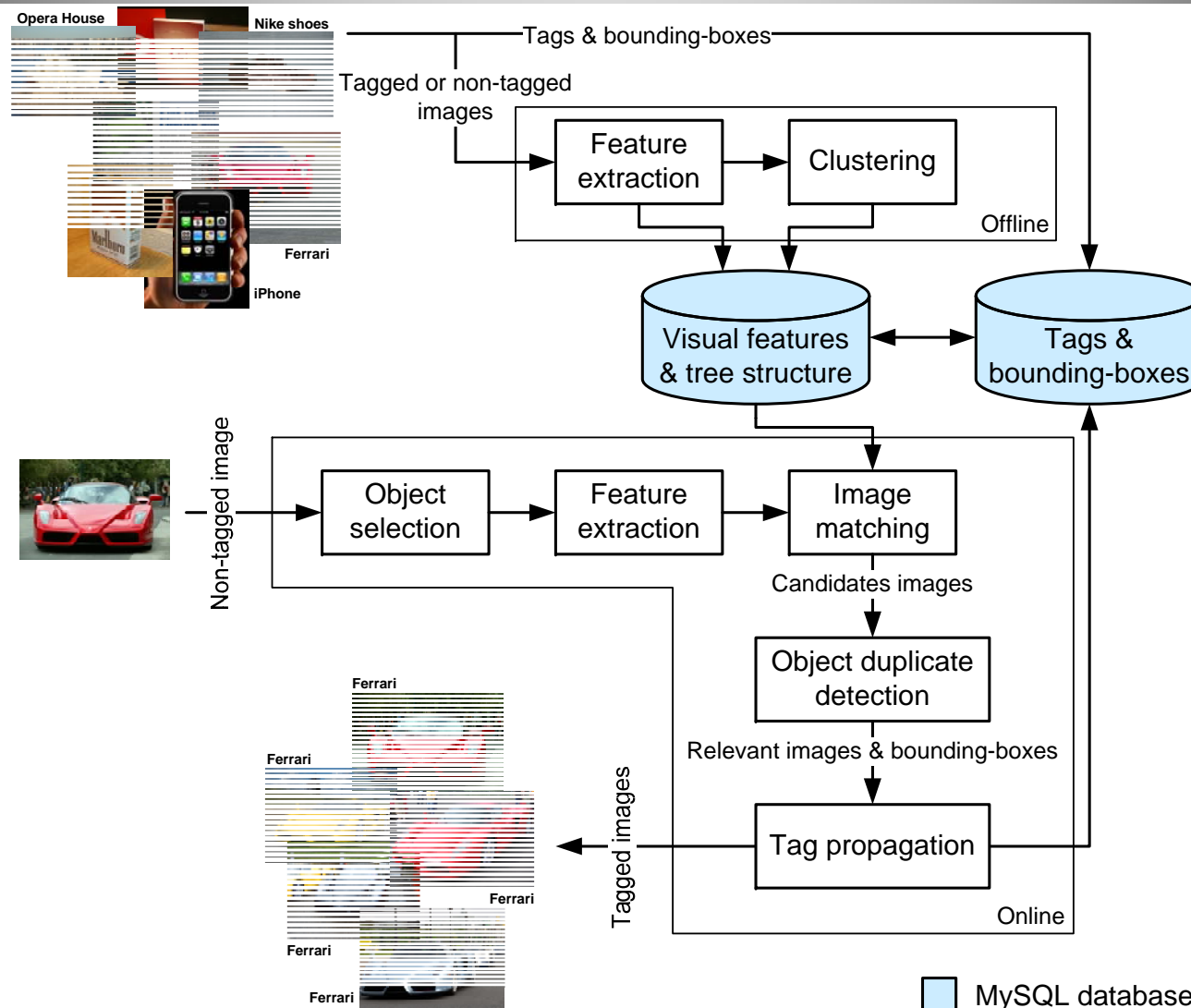
- Ease the process of annotating large photo collections
 - Content-based similarity to propose tags



- Games with a purpose
 - ESP game, TagCaptcha
- Specific applications:
 - People, Locations, Objects, Events
- Features
 - Textual: tags
 - Visual: color, texture, shape, edges, SIFT, SURF, HOG
 - Visual & textual features
- Commercial applications
 - Google Goggles, Kooaba, TinEye
- Our approach
 - Generality
 - Scalability
 - Object-based tagging
 - Interactivity

System overview

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- Feature extraction



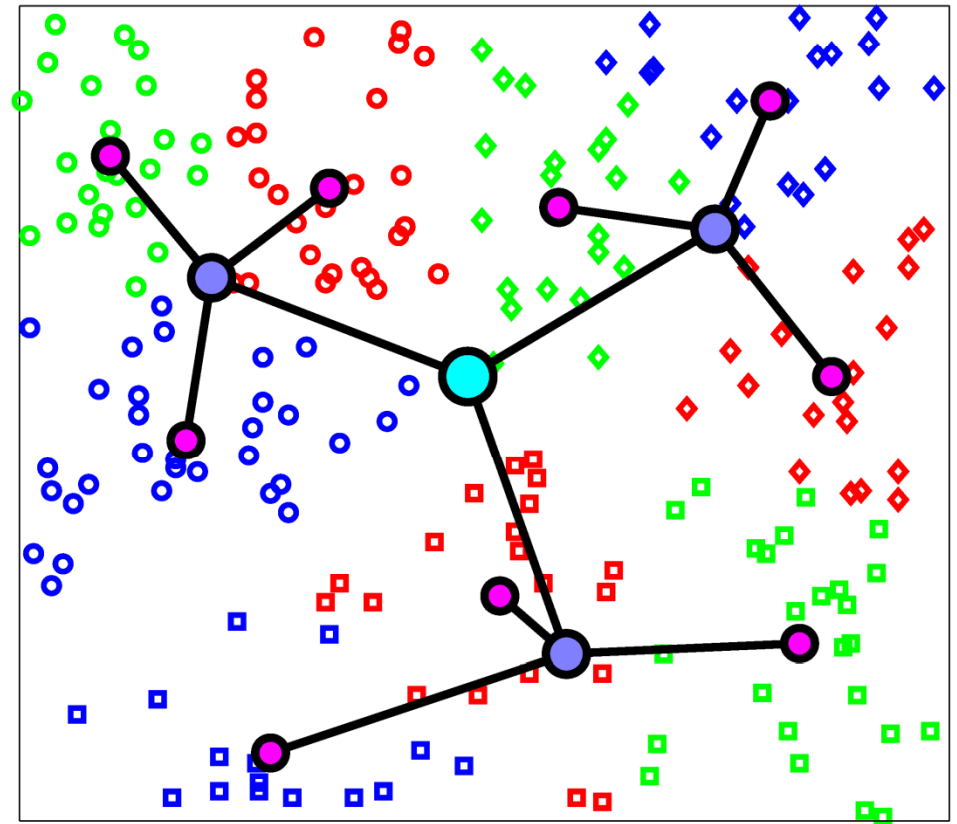
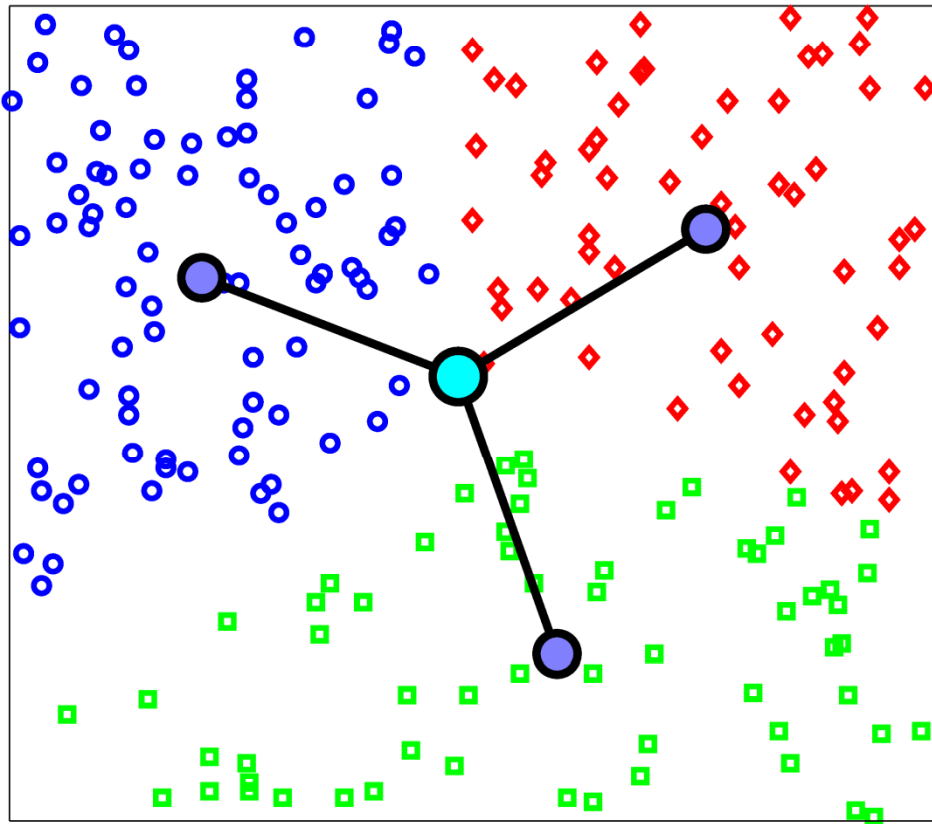
- Feature extraction
 - Fast-Hessian detector



- Feature extraction
 - SURF descriptor

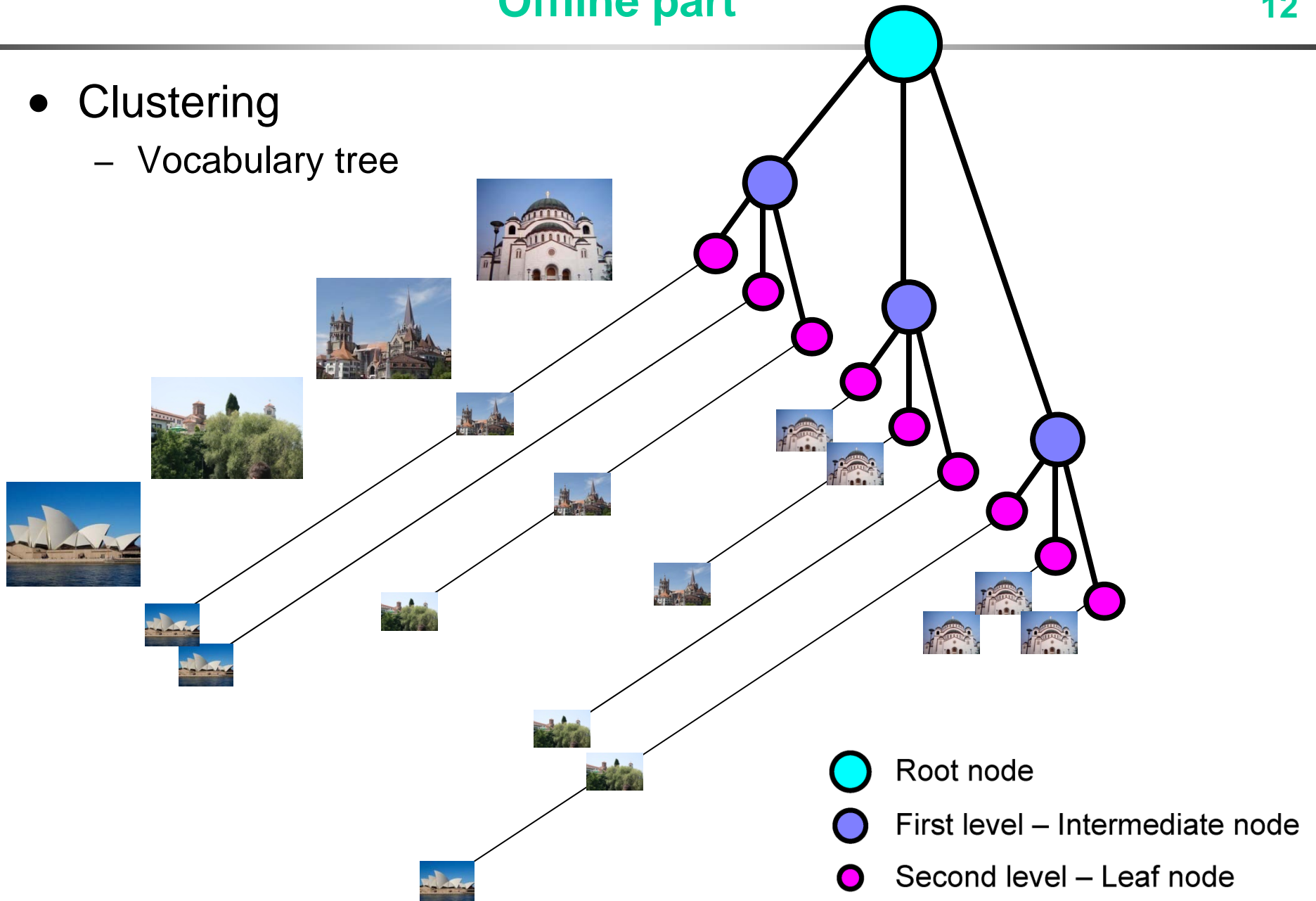


- Clustering
 - Hierarchical k-means



■◆● Image descriptors

- Clustering
 - Vocabulary tree



- Clustering
 - TF-IDF weighting scheme

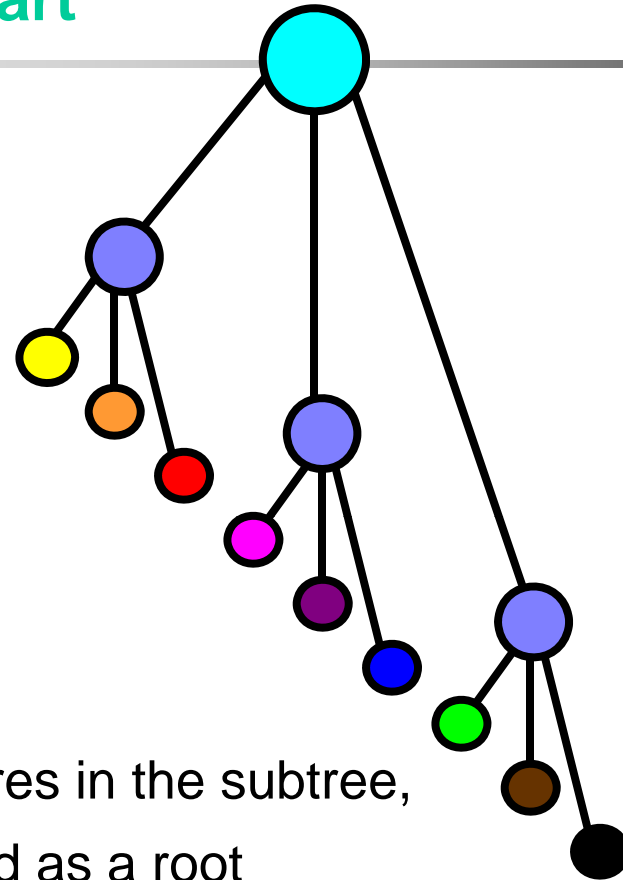
$$d_{ij} = m_{ij} \cdot w_i = \frac{N_{ij}}{\sum_k N_{kj}} \cdot \log \left(\frac{N}{N_i} \right)$$

N : # images

N_i : # images which have features in the subtree,
if the i -th node is considered as a root

N_{ij} : # occurrences of a visual word i within an image j

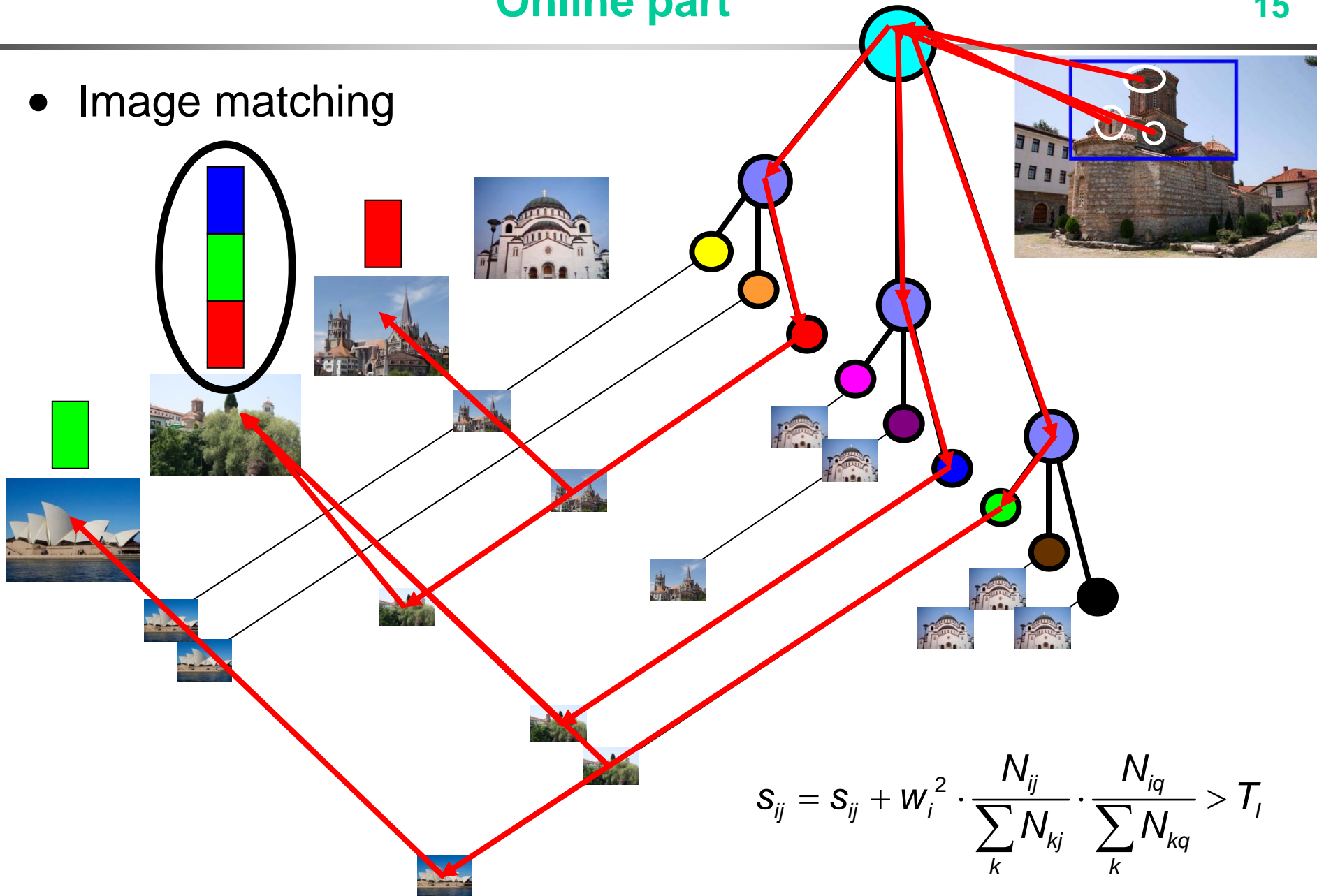
$\sum_k N_{kj}$: # occurrences of all features within an image j



- Object selection
 - Bounding-box & tags



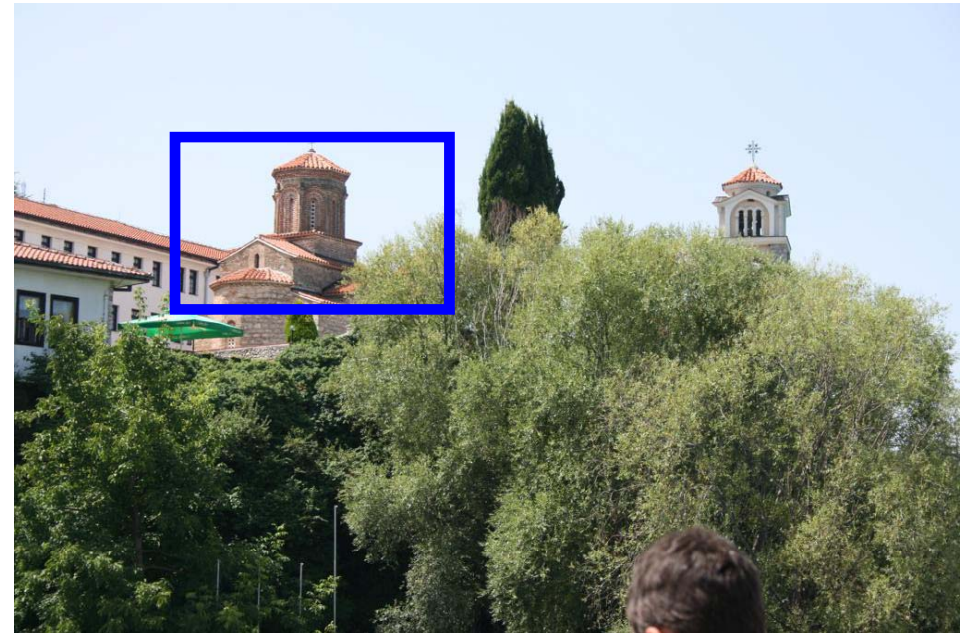
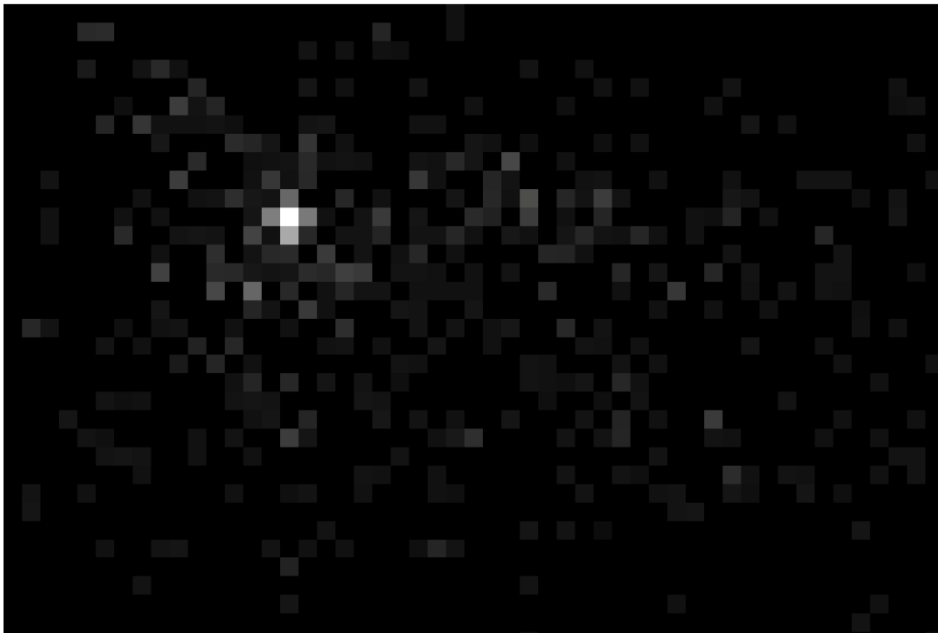
- Image matching



- Object duplicate detection
 - Feature matching $< T_F$



- Object duplicate detection
 - Generalized Hough transform



- Tag propagation



Cheese

Visual Search and Tag Propagation Demonstrator

GALLERIES MY ACCOUNT LOG OUT

Home » Image Galleries » World » IMG 8313 sjk

NAVIGATION

- My images
- Image locations
- User locations
- Create content
 - Add Image
 - Import Facebook Album
- About

Tag propagation

- < Comparing images to query image: time = 1521.27ms
- < Load features...Query 229
- > time = 47.7814ms



"Monastery of Saint Naum, Lake Ohrid, Macedonia" by *Ivanov*
[Propagate tag](#)
[View comment](#)

Submit






☒ propagate
 ☒ propagate
 ☒ propagate
 ☒ propagate




☐ propagate
 ☐ propagate




ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



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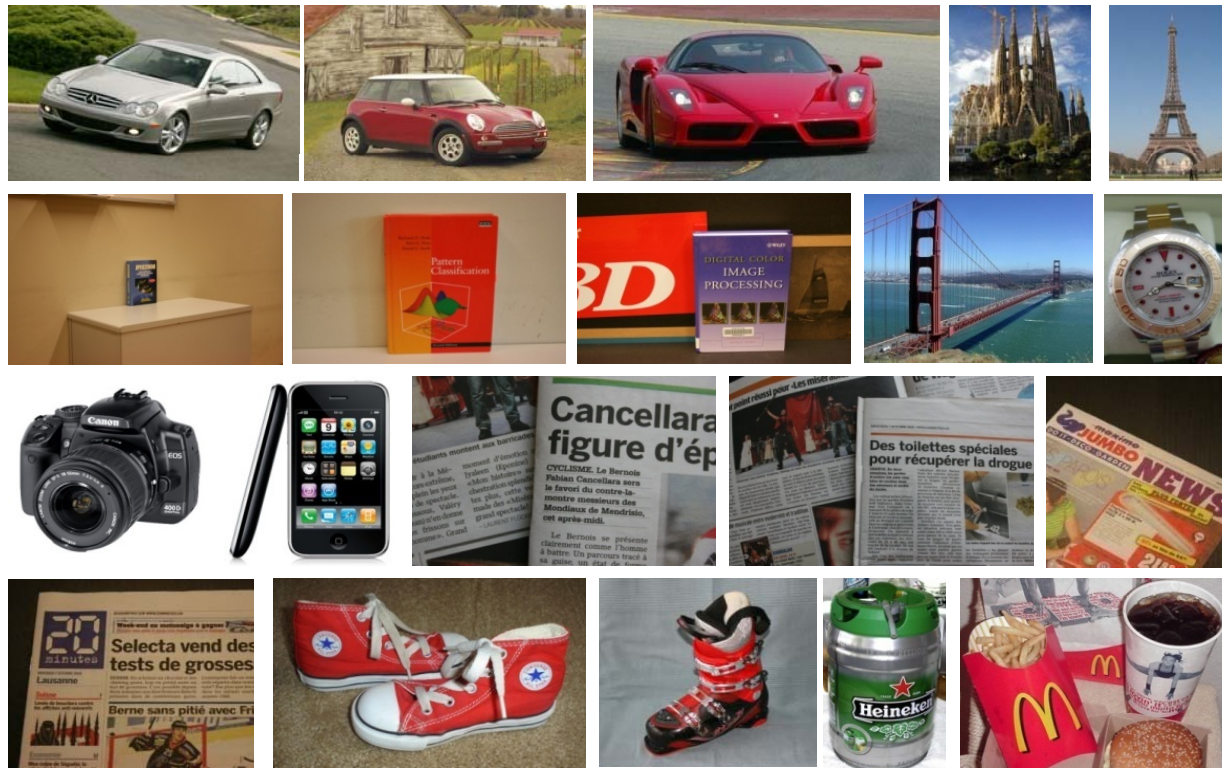


INTERACTIVE
MULTIMODAL
INFORMATION
MANAGEMENT

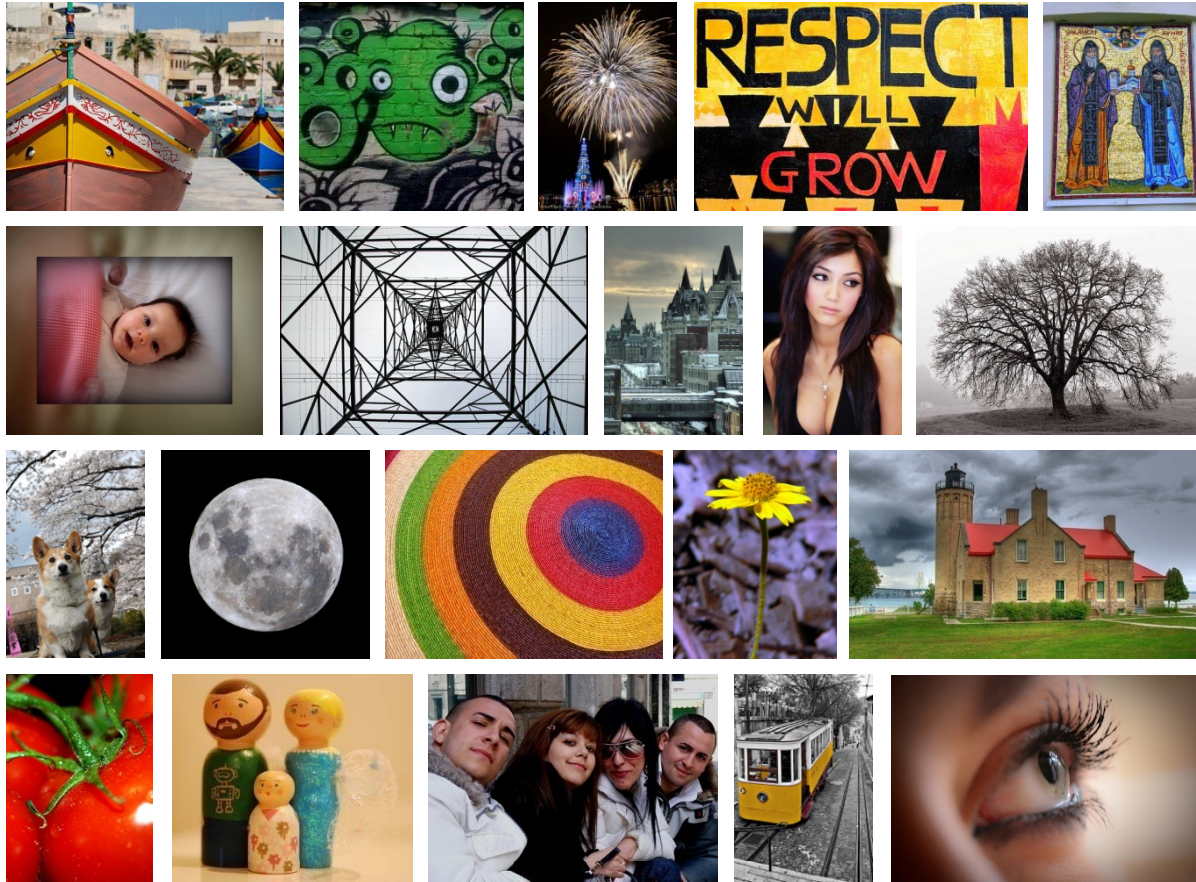




- Database
 - Controlled database: 3200 images + ground truth
 - 8 classes of objects, 20 objects, 20 sample images



- Database
 - Distractor database: MIRFLICKR-1M = 1+ million images



- Evaluation

- First scenario: only controlled database
Detection problem

$$P = \frac{TP}{TP + FP}$$

$$R = \frac{TP}{TP + FN}$$

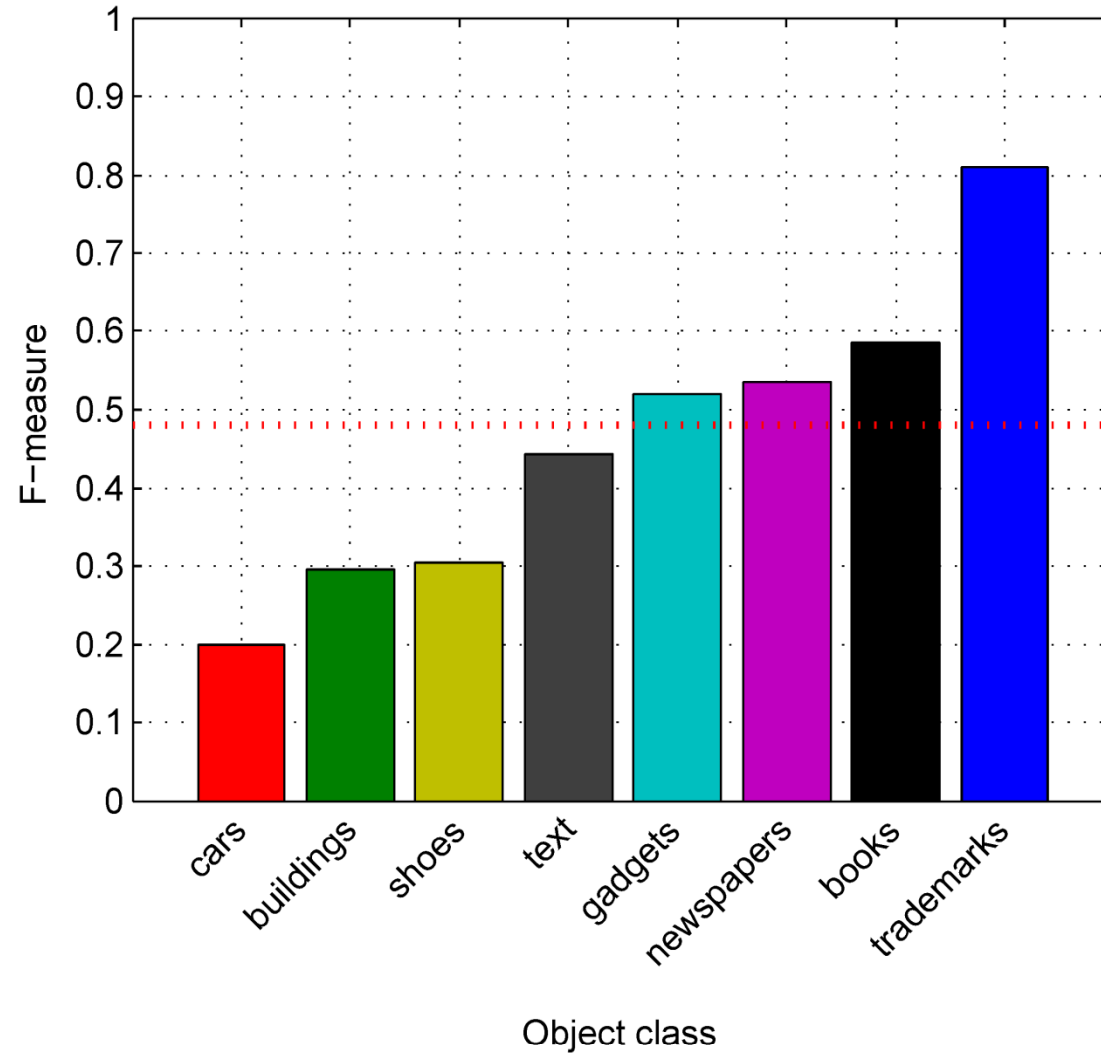
$$F = \frac{2 \cdot P \cdot R}{P + R}$$

- Second scenario: controlled + distractor databases
Ranking problem

$$\text{RankFactor}(N, q) = \frac{\sum_{i=1}^N \omega(o_i, q) \cdot \frac{1}{i}}{\sum_{i=1}^N \frac{1}{i}}$$

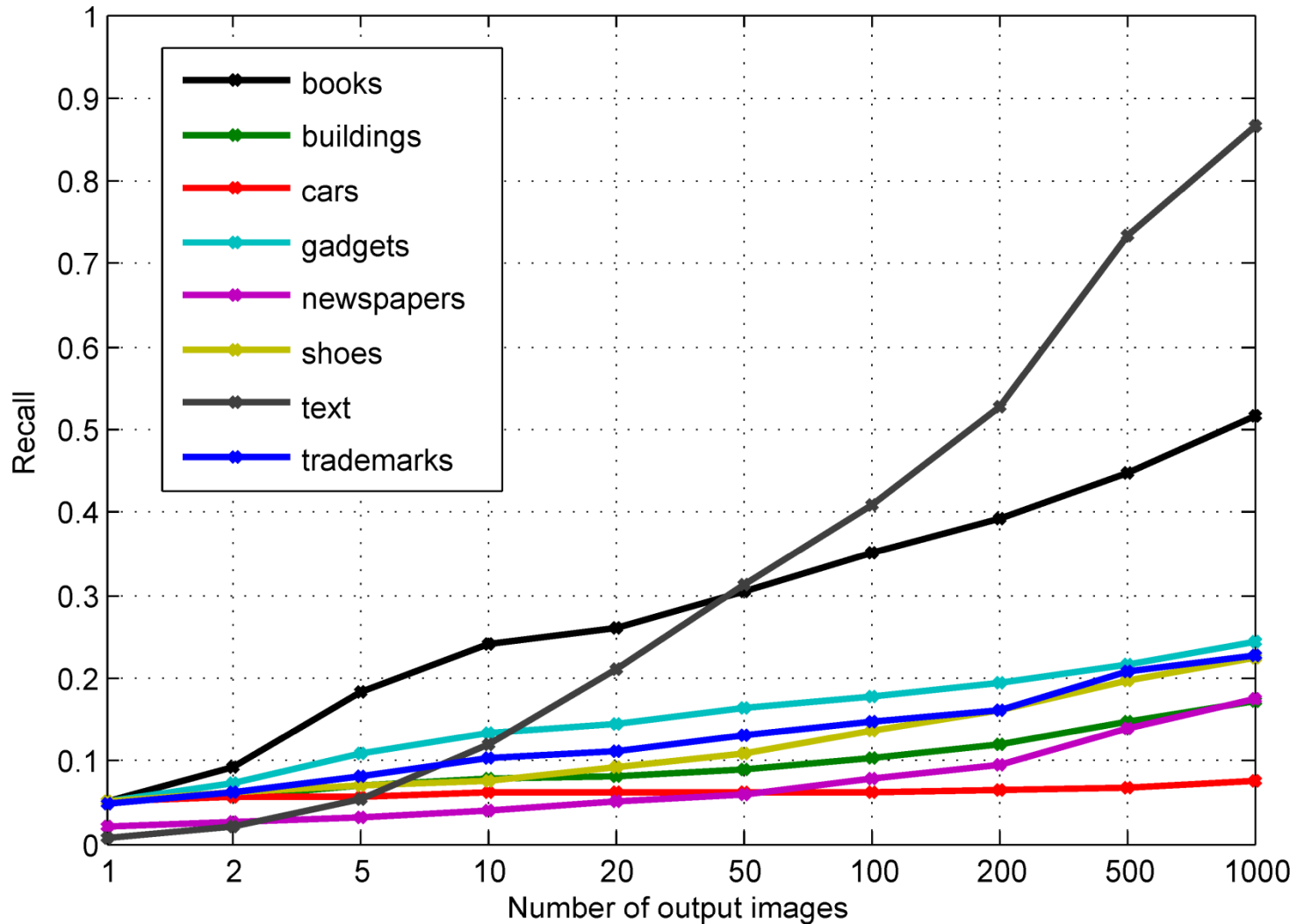
Results – Controlled database

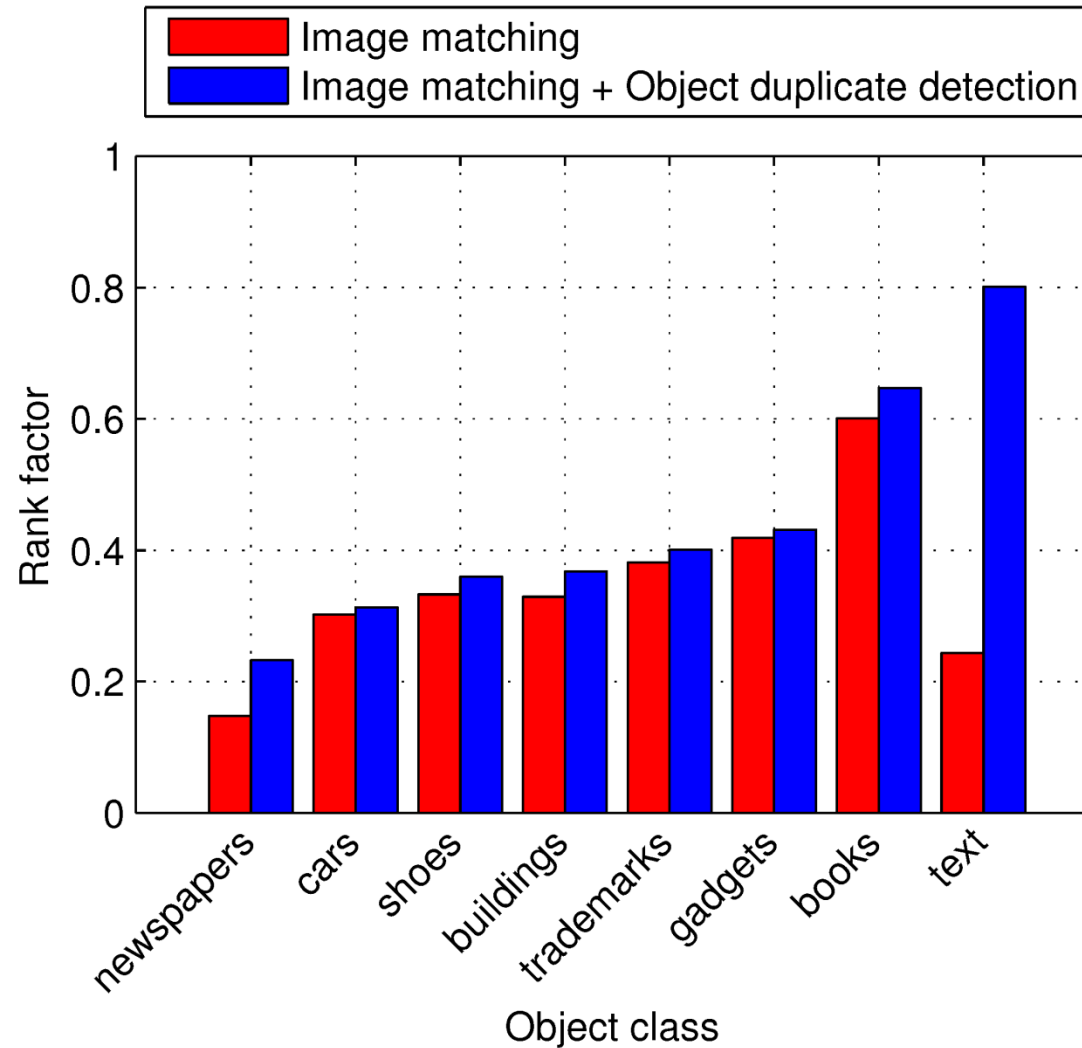
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Results – Controlled + Distractor databases

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- **Interactive**
- **User-friendly**
- **Collecting and annotating** image database
- **1+ million images**
- Applications:
Visual search
Tag propagation

http://cheese.epfl.ch

The screenshot displays the Cheese website interface. At the top, the logo features a yellow wedge of cheese with a small mouse face, followed by the text "Cheese" and "Visual Search and Tag Propagation Demonstrator". A search bar is located in the top right corner. Below the header, a navigation menu includes "GALLERIES" and a breadcrumb trail: "Home » Image Galleries » MMSPG » IMG_0109". On the left side, there is a "NAVIGATION" section with links: "My images", "My account", "Create content" (with a sub-link "Add image"), and "About". Below this is a "USER LOGIN" section with a "Connect" button, fields for "Username" and "Password", a "Log in" button, and links for "Create new account" and "Request new password". The main content area shows the image "IMG_0109" with a "View" button and a "JPSearch export" button. The image is dated "Mon, 09/20/2010 - 23:49" and is attributed to "mmspg". Below the image, there is a caption "MATTERHORN" and a comment "mmspg - 10/12/2011 - 01:13 Matterhorn". On the right side, there are logos for "mmSPG", "EPFL", "FN-SNF", "IM", and "peta media".

- An efficient system for **semi-automatic object tagging** in images
- The system performs **image matching and object duplicate detection** in the whole database and returns the search results with images containing similar objects
- The detection **works reliably for salient objects** such as trademarks, books, newspapers, and gadgets
- Future work
 - Support for other classes of objects
 - Tag recommendation