KProp: Knowledge Propagation in Large Image Databases Using Neighborhood Information

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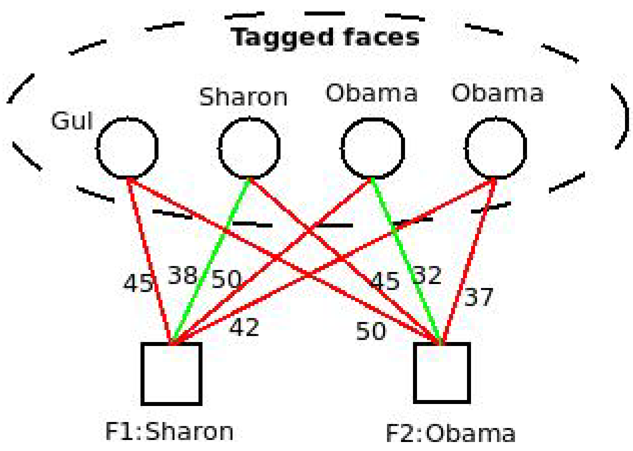
A query-based baseline -- Bestmatch

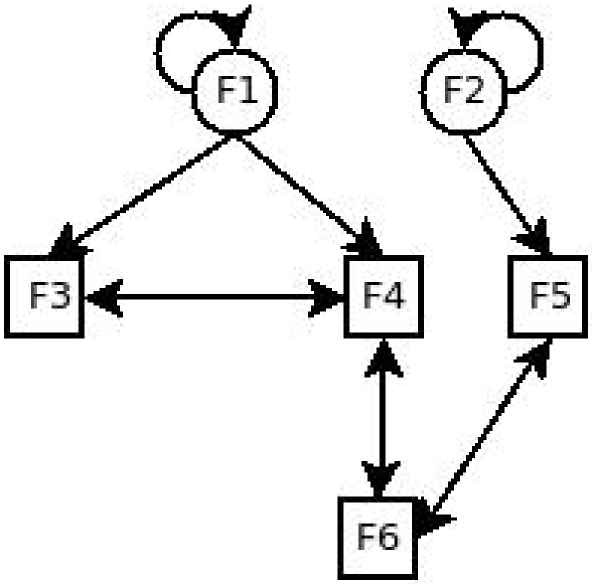
Bestmatch is a simple greedy algorithm which:

- Computes pairwise visual distances of detected objects;
- For each unlabeled object u, find its nearest labeled object v;
- Assign label t to u, where t is the label attached to v.



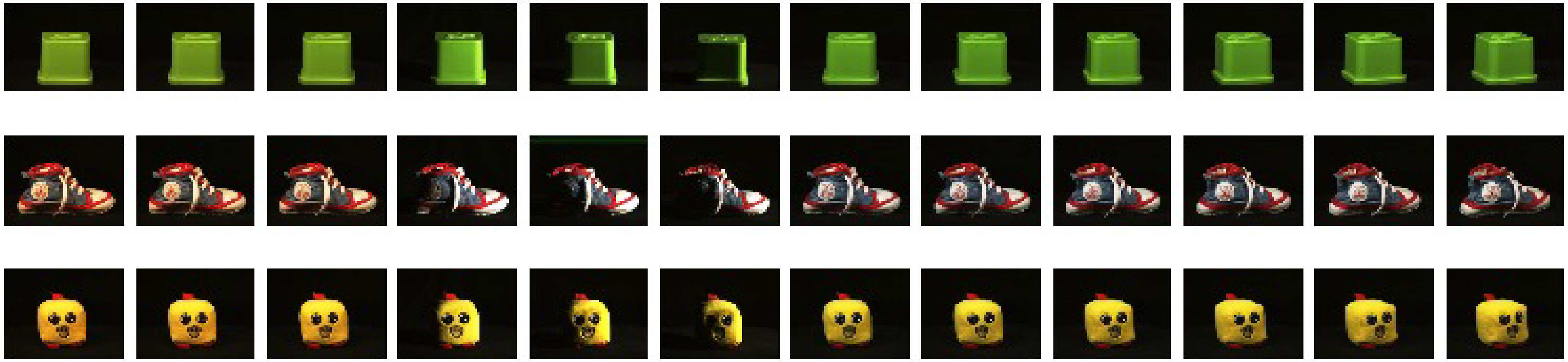
Building the influence graph

- Object relationships are modeled as a directed influence graph -- G(V, E), with the node set partitioned info $V=V_l \cup V_u$, where V_l and V_u represent the initially-labeled (source) object set and initially-unlabeled (non-source) object set, respectively. E is composed of 3 types of edges:
  - $\forall v \in V_l$, $\langle v,v \rangle \in E$;
  - $\langle v,u \rangle \in E$, whenever $v \in V_l$, $u \in V_u$ and v influences u; and;
  - $\langle u,u' \rangle$, $\langle u',u \rangle \in E$ whenever $u,u' \in V_u$, and either u influences u', or u' influences u (or both)
- Definition of regions of influence will be introduced shortly.



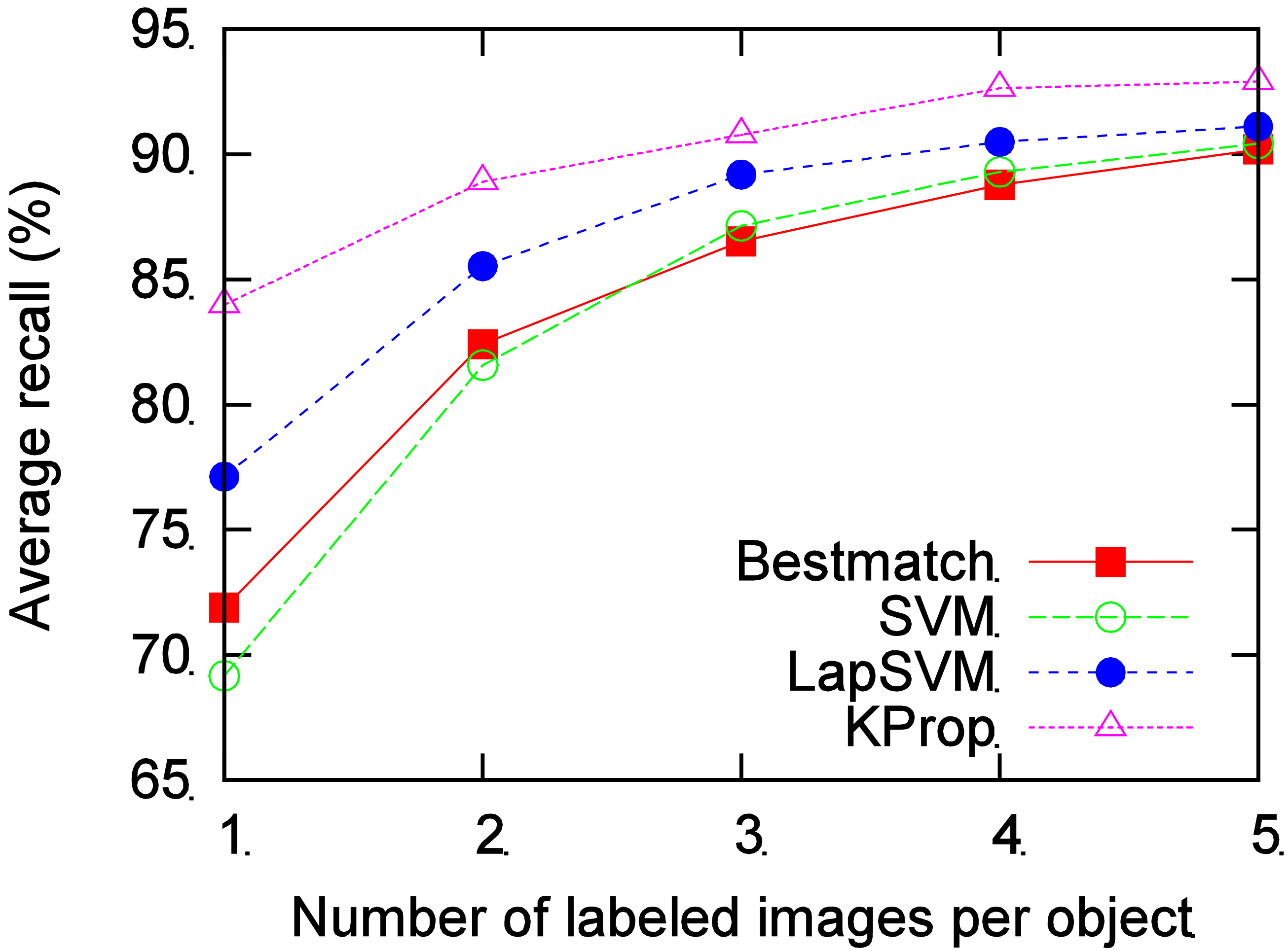
Sample images of the datasets

- ALOI-100

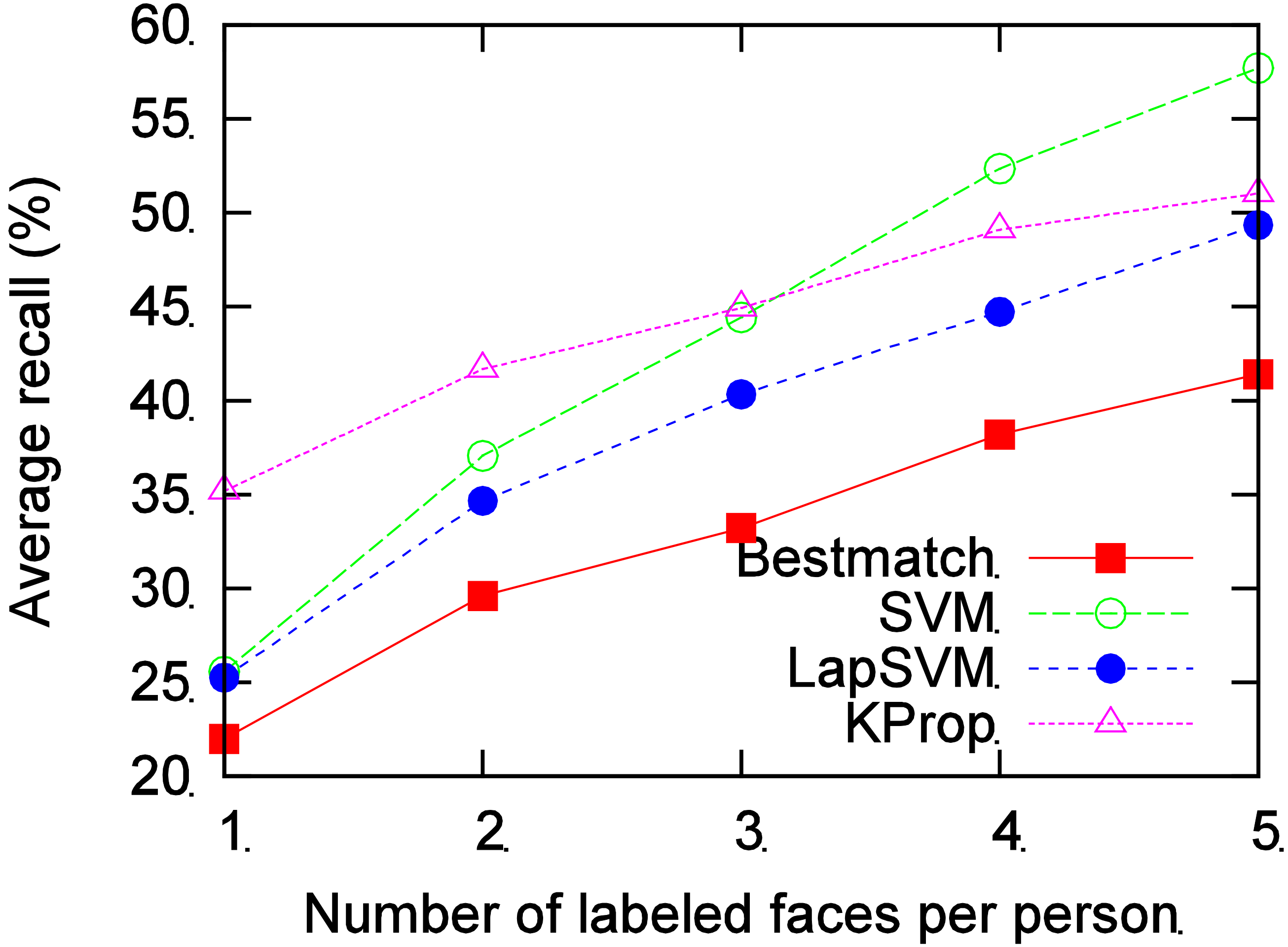


- Google-23

Experimental results – ALOI-100



Experimental results – Google-23

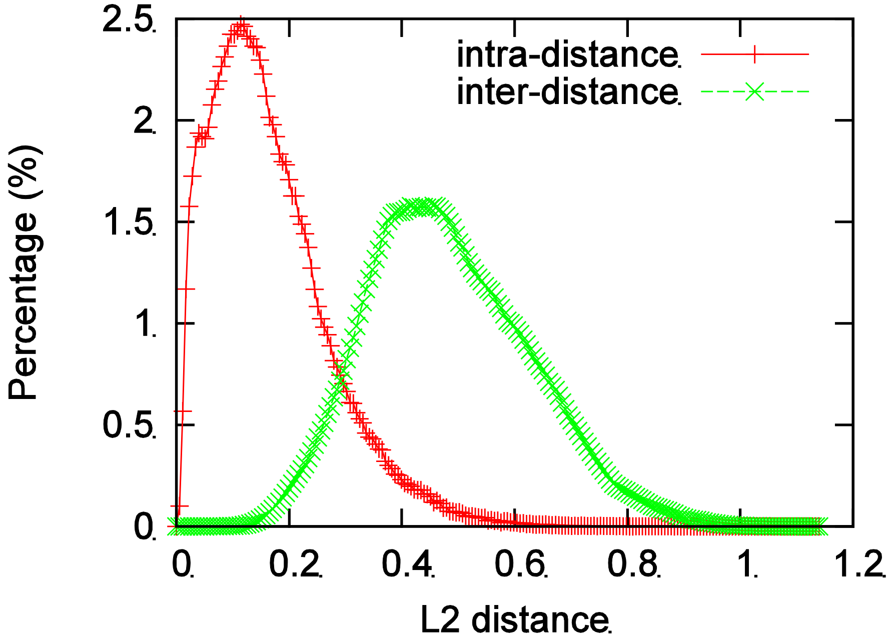


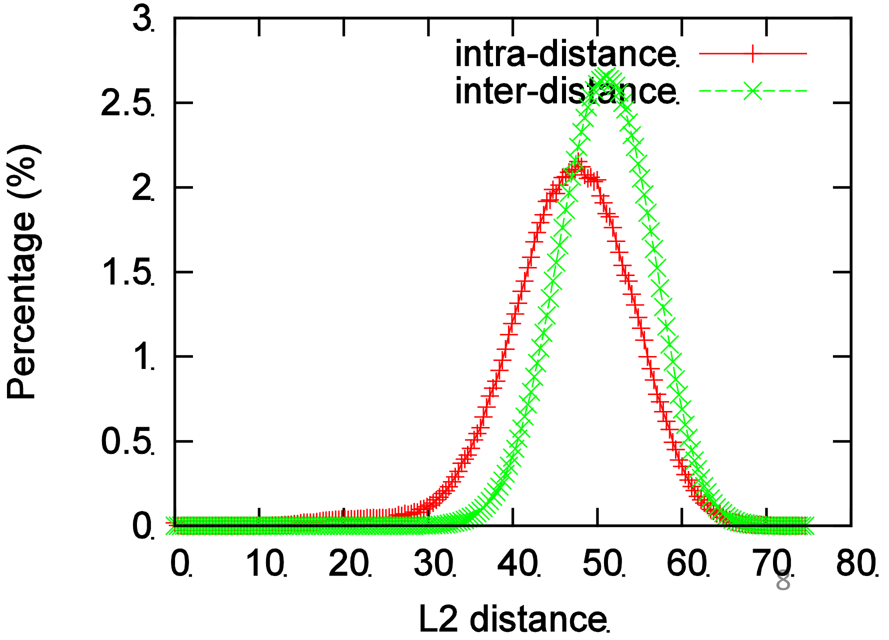
Discussion

- All four methods perform better on ALOI-100 than on Google-23.
- LapSVM is not consistently better than SVM --- it beats SVM on ALOI-100 but loses to SVM on Google-23 --- since it is sensible to labeled data and usually needs to be well tuned.
- KProp has much better performance than all other methods especially when the number of labeled sample is small (say 1, 2 or 3). It is always better than SVM on ALOI-100 but SVM overtakes KProp on Google-23 when more than 3 faces are labeled per person. This can be explained by the transitivity of object relationships.

Discussion (cont'd)

- Distance distributions of the two datasets (from left to right: ALOI-100 and Google-23).
- It can be seen from the figures that, it is much difficult to tell whether two faces belong to a same person by their distance.





Future works

- Using extra information (such as visual features of background or dressings) to build more reliable graph in the scenario where transitivity is not well applicable.
- Boost performance of global classifiers by pre-processing data objects using KProp. It is required to balance the numbers of correctly propagated objects in each class.
- Integrate KProp in our web service of photo album management for automatic face classification.