OPTIMOL: automatic Online Picture collecTion via Incremental MOdel Learning

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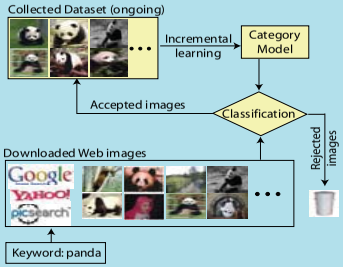
Motivation & Contributions

Desired State of the art

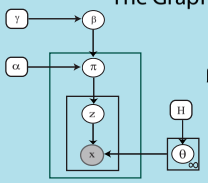
Contributions of OPTIMOL:

- Automatic object image dataset collection
- Simultaneous model learning for object category

Framework of OPTIMOL



The Graphical Model



HDP(Teh et al. 2004) as an example

$$\beta \mid \gamma \sim GEM(\gamma) \quad \pi_j \mid \alpha,\beta \sim DP(\alpha,\beta)$$

$$\theta_k \mid H \sim H \quad z_{ji} \mid \pi_j \sim \pi_j$$

$$x_{ji} \mid z_{ji},\theta_k \sim F(\theta_{z_{ji}})$$

Learning & Classification

Incremental learning $z_j \sim p(z \mid \Theta^{j-1}, I_j) \qquad \Theta^j \sim p(\Theta \mid z_j, \Theta^{j-1}, I_j)$

$$p(I \mid c) = \prod_i \sum_j P(x_i \mid z_j, c) P(z_j \mid c)$$

Likelihood

$$R_f(A \mid I) = \lambda_{Ac_f} P(c_f \mid I) + \lambda_{Ac_b} P(c_b \mid I)$$

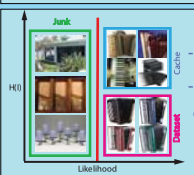
$$R_f(R \mid I) = \lambda_{Rc_f} P(c_f \mid I) + \lambda_{Rc_b} P(c_b \mid I)$$

Likelihood Ratio

$$\frac{P(I \mid c_f)}{P(I \mid c_b)} > \frac{\lambda_{Ac_b} - \lambda_{Rc_b}}{\lambda_{Rc_f} - \lambda_{Ac_f}} \frac{P(c_b)}{P(c_f)}$$

Automatically adjusted

Cache Set



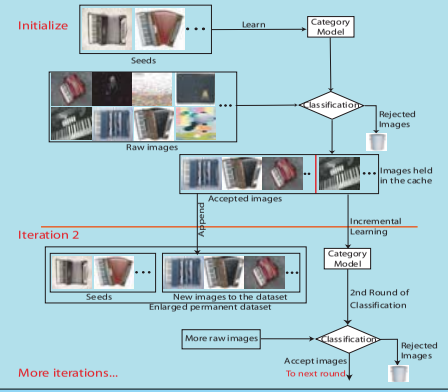
-prob: over specialization in the dataset

-solution: a cache set

Criteria

$$H(I) = -\sum_z p(z \mid I) \ln p(z \mid I)$$

System Illustration

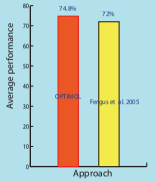


Dataset Collection Experiment

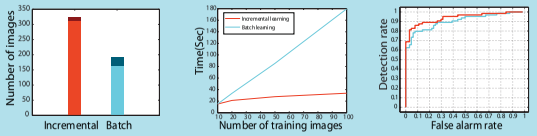
Classification Experiment

Classification Performance (Dataset Fergus et al. 2005)

airplane	**76.0**	14.0	0.3	5.3	0.3	0.3	4.8
car	1.0	**94.5**	0.3	4.5	0.3	0.3	0.3
face	0.5	1.4	**82.9**	3.7	0.5	0.5	11.5
guitar	2.2	4.9	5.6	**60.4**	13.3	0.2	13.3
leopard	1.0	2.0	1.0	5.0	**89.0**	1.0	2.0
motorbike	0.3	5.5	0.3	5.5	1.0	**67.3**	20.5
watch	1.7	5.5	17.7	11.0	5.5	5.0	**53.6**



Incremental vs batch learning comparison



Reference:

L.-J. Li, G. Wang and L. Fei-Fei. OPTIMOL: automatic Object Picture collecTion via Incremental MOdel Learning. IEEE Computer Vision and Pattern Recognition (CVPR), Minneapolis, 2007.