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Evolutionary Strategy to perform Batch-Mode Active Learning on Multi-Label Data

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Introduction

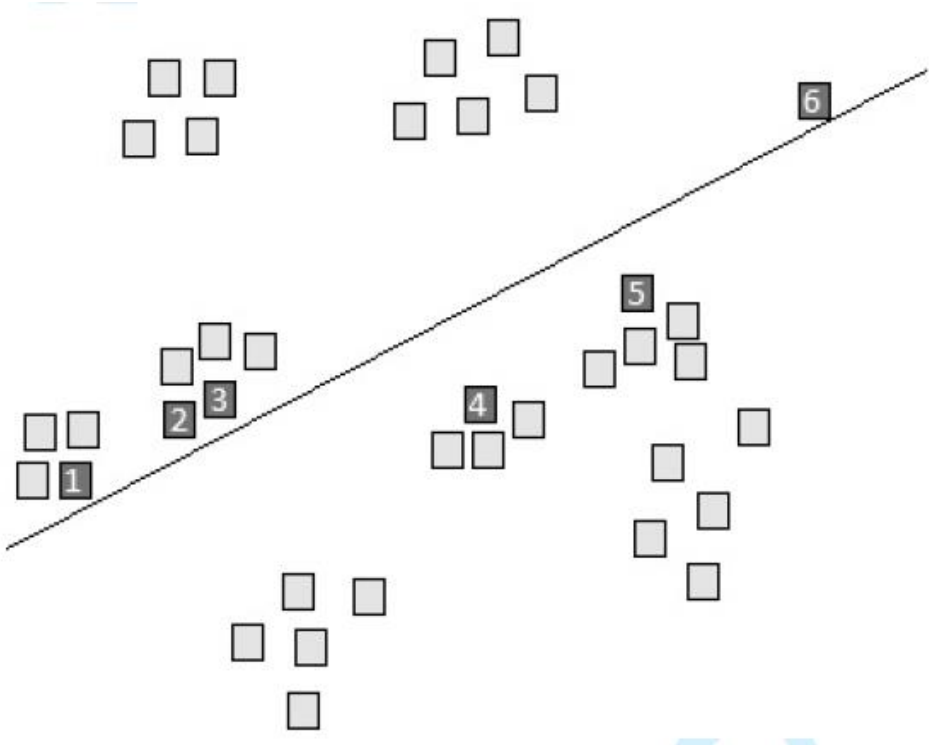
Batch-mode

- fast training procedure
- a parallel annotation environment is available

maximum information and minimal overlapping parts

AL

informativeness, representativeness and diversity



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Informativeness

$$u_i = -\frac{1}{q}\sum_{\forall \ell \in \mathcal{Y}} [p_{i,\ell} \times \log p_{i,\ell} + (1 - p_{i,\ell}) \times \log(1 - p_{i,\ell})] \qquad u_S = \frac{1}{b}\sum_{\forall i \in \mathcal{S}} u_i$$

Diversity

$$d_i = \frac{1}{q \times |L|}\sum_{\forall l \in Y}\sum_{\forall j \in L}(p_{i,l} - p_{j,l})\ln\frac{p_{i,l}}{p_{j,l}} \qquad d_s = \frac{1}{b}\sum_{\forall i \in S} d_i + \frac{1}{q \times b^2}\sum_{\forall l \in Y}\sum_{\forall i,j \in S}(p_{i,l} - p_{j,l})\ln\frac{p_{i,l}}{p_{j,l}}$$

Representativeness

$$r_i = \frac{\sum_{\forall j \in \mathcal{L}} dx(i,j)}{\sum_{\forall j \neq i \in \mathcal{U}} dx(i,j)} \qquad r_S = \frac{1}{b}\sum_{\forall i \in S} r_i$$

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Multi-objective problem

Multi-objective problem

$$\underset{S\in\Omega}{maximize}\, M(S)=(u_S,d_S,r_S)$$

Solution:

NSGA2 (Non-dominating Sorting Genetic Algorithm)

AL strategy :

$$S=\underset{S\in P_\Omega}{\mathbf{argmax}}\ \frac{\sum_{\forall m\in\{u,d,r\}} pos(R_m,S)}{3\times|P_\Omega|}$$

P_Ω : Pareto front

$pos(R_m,S)$: position of batch S in the ranking R_m

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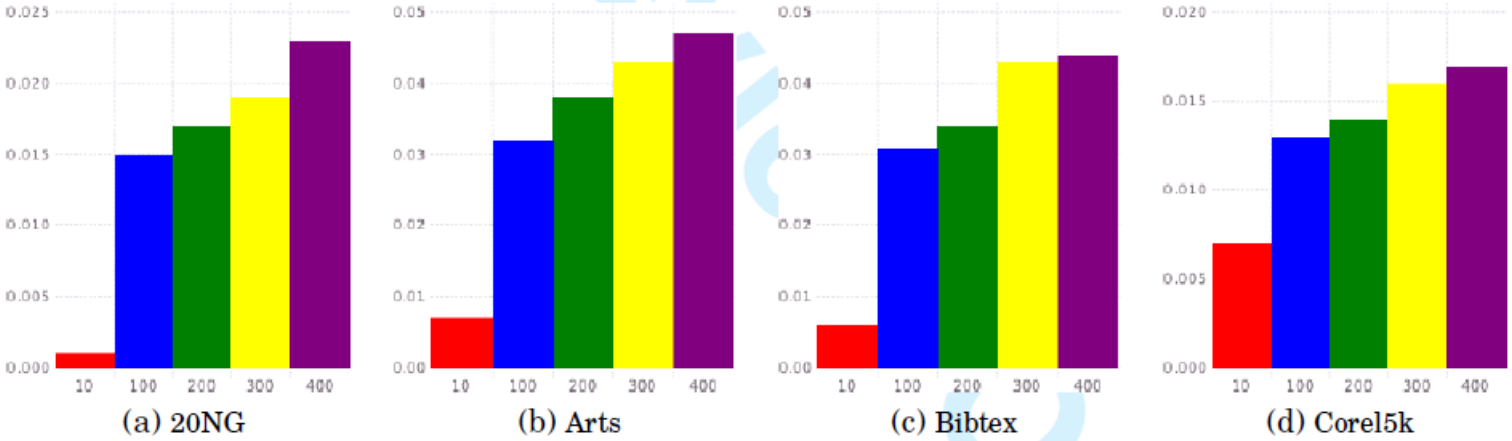
Batch size influence

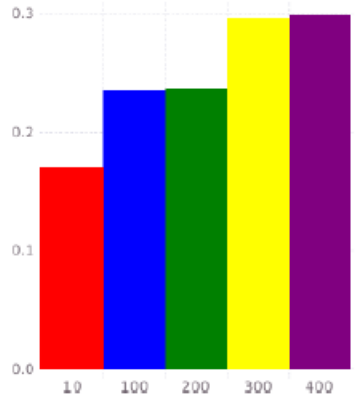


(a) 20NG

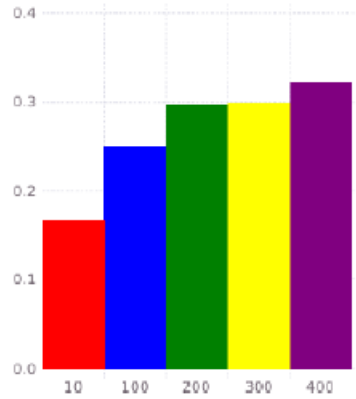
(b) Arts

(c) Bibtex

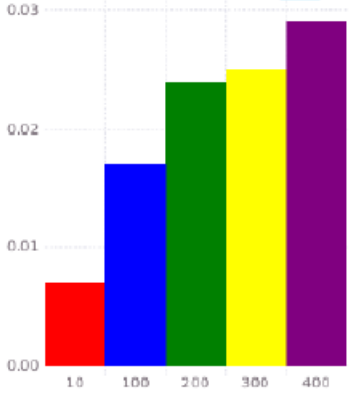
(d) Corel5k



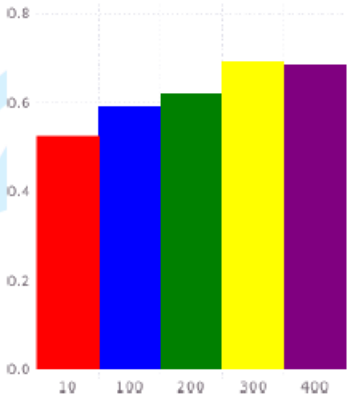
(e) Enron



(f) Health

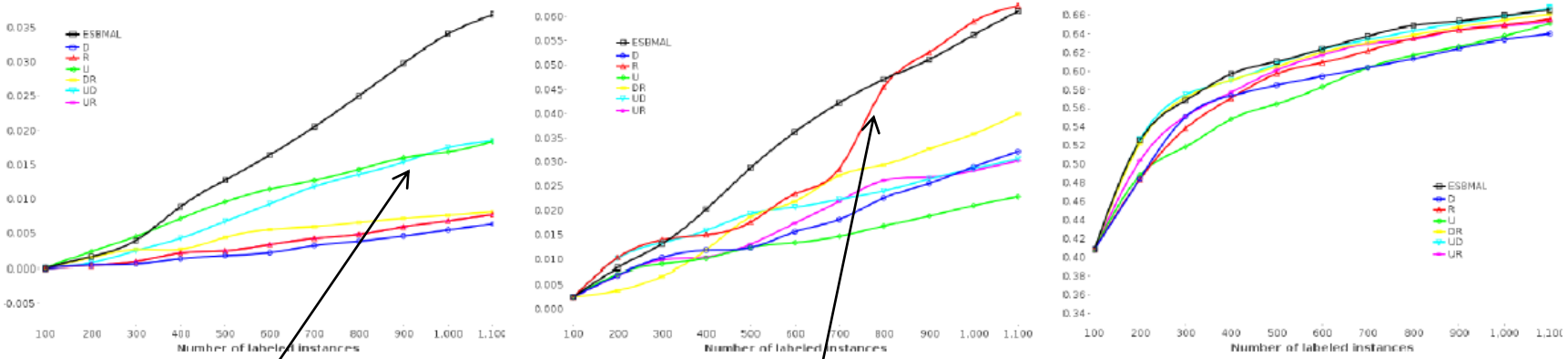


(g) Recreation



(h) Scene

Benefit of combining informativeness (U), diversity (D) and representativeness (R) criteria



(a) 20NG (b) Bibtex (c) Scene

U,UD

R

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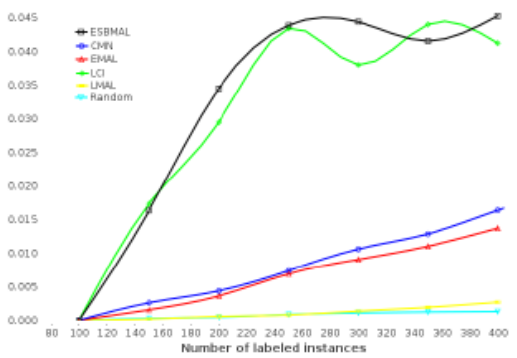
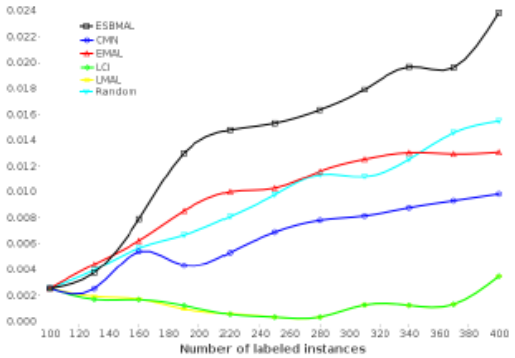
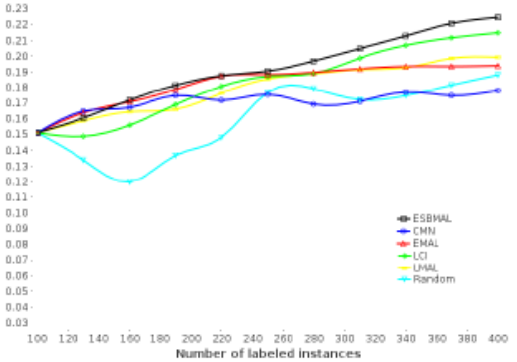
Comparison with myopic AL strategies



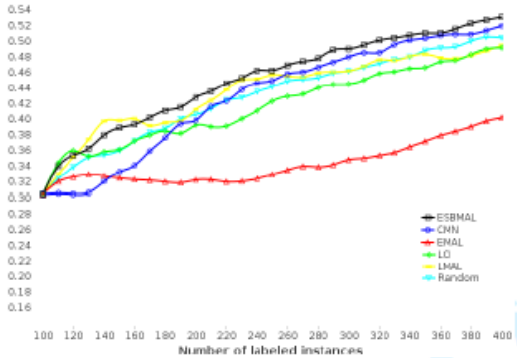
(a) 20NG



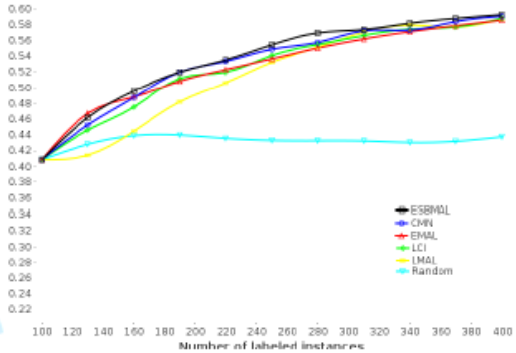
(b) Bibtex



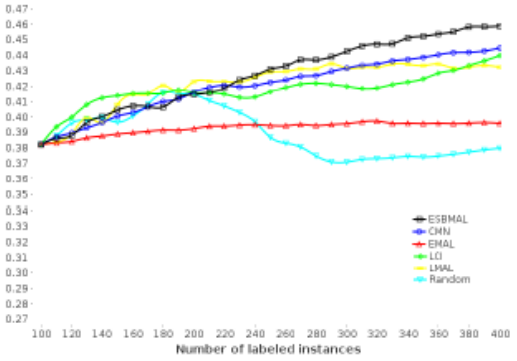
(c) Enron



(d) Medical



(e) Scene



(f) TMC2007-500

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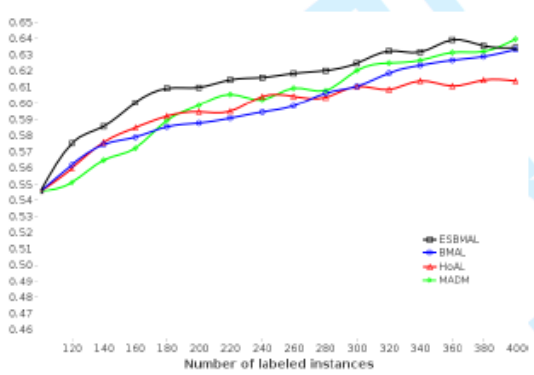
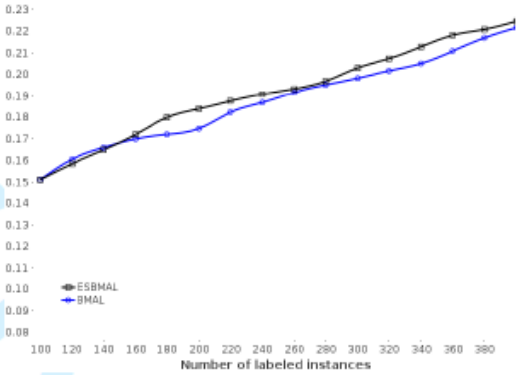
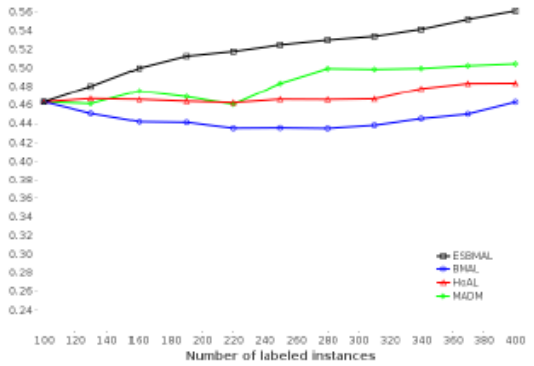
Comparison with batch-mode AL strategies



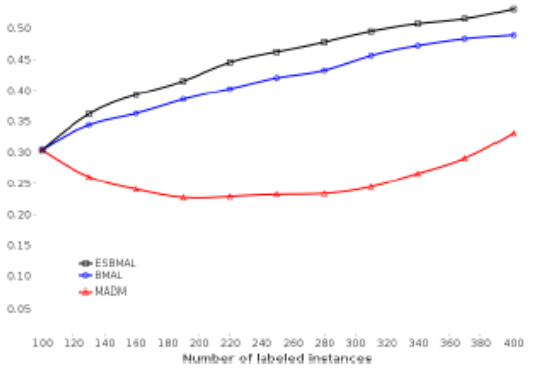
(a) Emotions



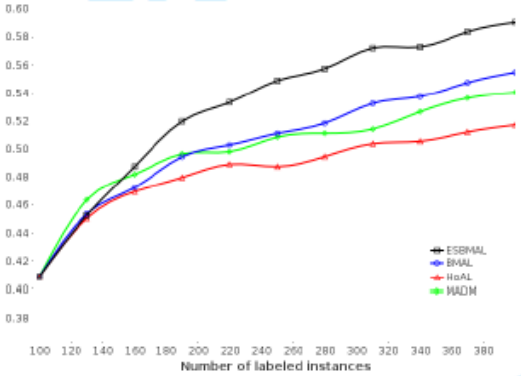
(b) Enron



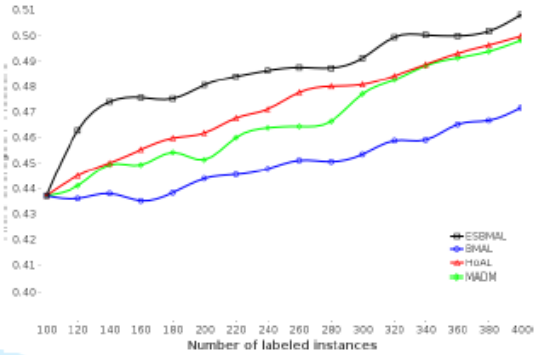
(c) GnegativePseAAC



(d) Medical



(e) Scene



(f) Water-quality

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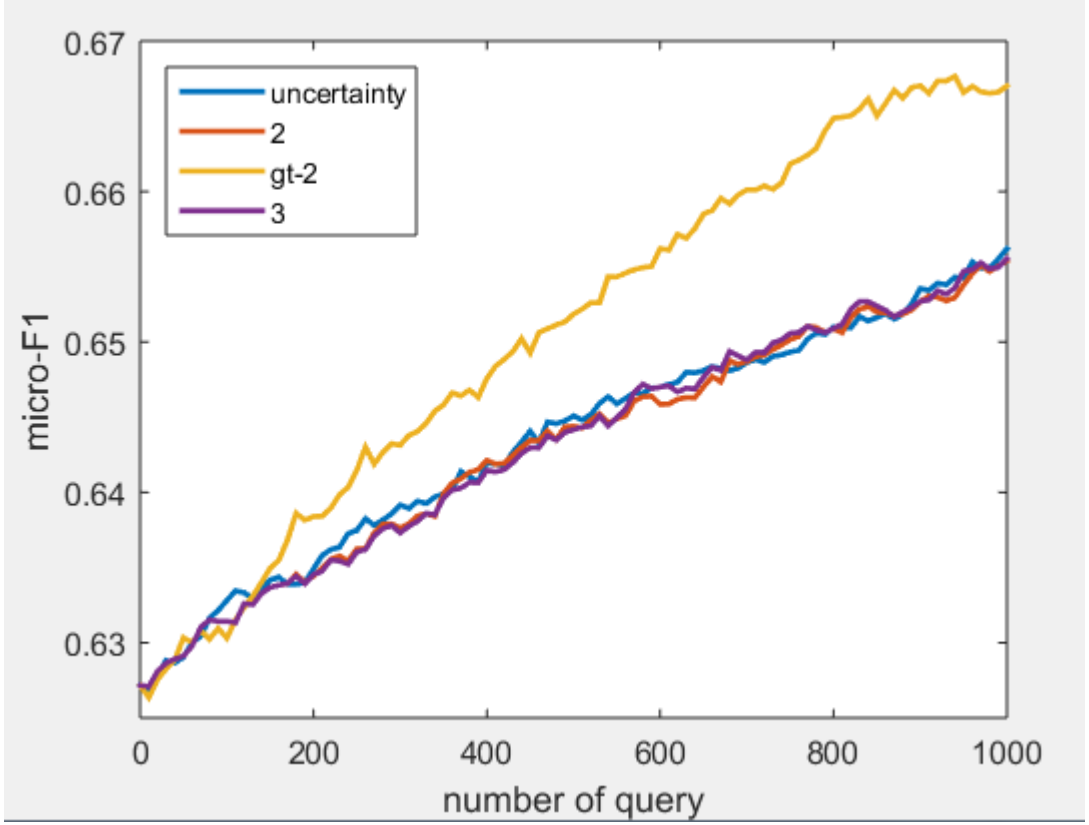
Hierarchical Active Learning Classification



Thank you