A Framework for Optimizing Paper Matching

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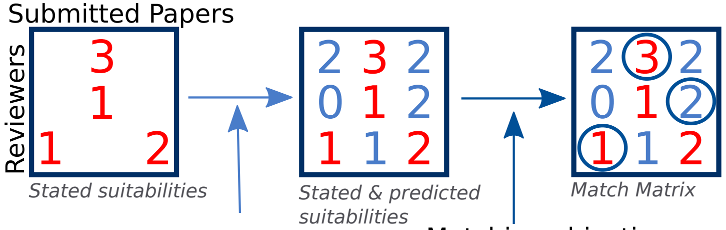
Problem: Assign submitted papers to reviewers

Standard solutions have limitations:
- Completely centralized or de-centralized
- Bidding

Some recent work using CF + matching

We propose a flexible framework for matching reviewers to papers:
- **Predict** missing suitabilities (ratings)
- Find optimal **matchings**



Our contributions:
- Compare learning methods
- Incorporate objectives and constraints
- Interaction between learning & matching
- *Aim: make learning sensitive to final objective*

Learning Methods

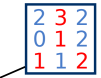
LR - Linear regression using words from submitted papers

BPMF -Bayesian probabilistic matrix factorization
- Factorizes the suitability matrix
- Collaborative filtering

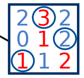
LM - Language model
- Model reviewers using a word-level model

Matching

Possible desiderata:
- **o** Match papers to best reviewers
- **o** Load constraints



$$\max.\ J^{basic}(x) = \sum_r \sum_p s_{rp} x_{rp}$$



$$\text{s.t. } x_{rp} \in \{0,1\}, \quad \forall r, p$$

$$\sum_r x_{rp} = R_{targ}, \quad \forall p$$

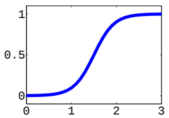
$$\sum_p x_{rp} \geq P_{\min}, \ \sum_p x_{rp} \leq P_{\max}, \ \forall r.$$

- **o** Load equity

$$J^{balance}(x) = J^{basic} + \sum_r \lambda f\Big(\big(\sum_p x_{rp}\big) - \bar{x}\Big)$$

- **o** Conflicts of interest
- **o** Non-linear relationship between utilities

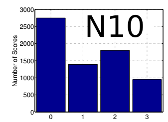
Sigmoid transformation of the suitabilities

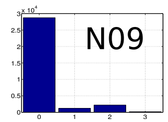


Experiments

- Data from NIPS'09 and NIPS'10
  - Use top 1,000 words
  - Suitabilities: 0--3
  - N10: 1250 papers, 48 revs
    - avg. 143 suitabilities per reviewer
    - mean suitability 1.14
  - N09: 1079 papers, 30 revs
    - mean suitability 0.19

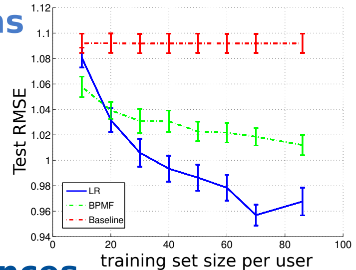
Histogram of suitabilities



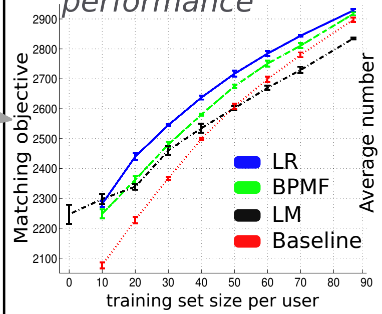


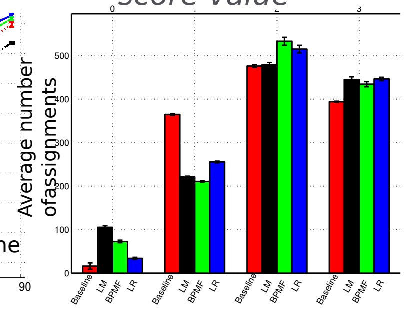
Learning Predictions

- RMSE objective
- LR does the best
  - Information contained in papers is useful



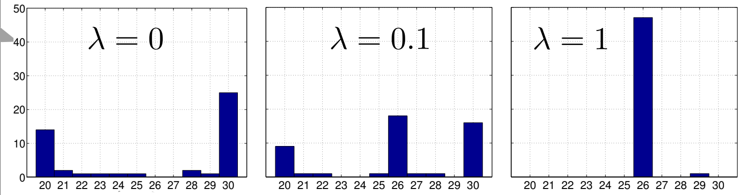
Matching Performances



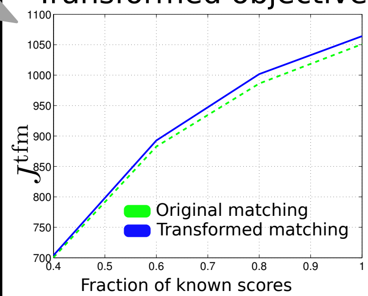


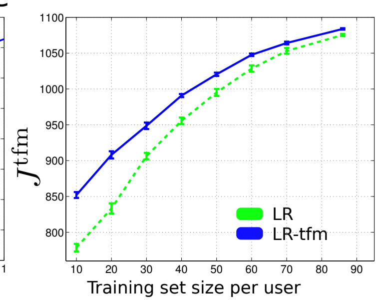
- LR outperforms other methods - LM does well at the beg.

Load equity



Transformed objective





- Better performance when learning with transformed objective

Conclusion: Effective for determining high-quality matches using few suitabilities

Current work: Active learning approaches