Information Retrieval
(Preference Learning)

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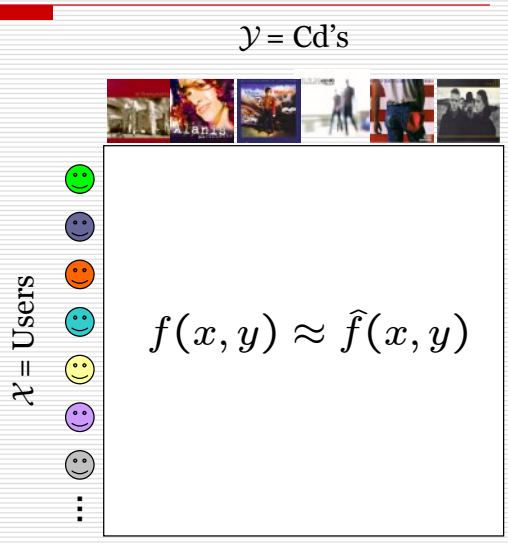
The structure of prediction

- **(Label) Ranking Tasks : FO($\mathcal{Y}$)**
  - Category Ranking
  - (Bipartite) Category Ranking
  - Q-label Classification
  - Single-label classification
- **(Instance) Ranking Tasks : FO($\mathcal{X}$)**
  - (Binary) Instance Ranking
- **Quantitative Tasks : {0,...,R-1}^{m}**
  - (Multivariate) Ordinal Regression
  - (Univariate) Ordinal Regression
  - Multi-label Classification
  - Binary Classification
  - One-class Classification



Types of predictions [Aiolli05]

- Ordering Predictions
  - Ordering of classes (or documents) on a relevance basis in such a way to be consistent with the supervision given as partial orders over the classes (or documents)
  - Single-label classification, ranking
- Rating Predictions
  - Giving ranks from an ordinal scale to examples
  - Binary classification, ordinal regression, and their multivariate extensions

Supervision

- Supervision can be described as conjunctive sets of preferences of two types
  - Qualitative Preferences
    - $(u(d_i,y_r), u(d_j,y_s))$
  - Quantitative Preferences ($\tau \in \mathcal{R}$)
    - $(u(d,y), \tau)$
    - $(\tau, u(d,y))$

Linear Preferences

- Now, consider linear expansion of the relevance function
  - $u(d,y) = w \cdot \phi(d,y)$
  - where $\phi(d,y) \in \mathcal{R}^d$ is a joint representation of document-class pairs and w a weight vector
- Qualitative preferences can be written as

  $w \cdot (\phi(d_i,y_r) - \phi(d_j,y_s)) > 0$
- Quantitative preferences $\delta(u(d,y)-\tau)$ can be written as

  $(w,\tau) \cdot (\delta\, \phi(d,y),-\delta) > 0$

Summarizing

- All the problem setting above can be seen as homogeneous linear problems in an opportune augmented space
- Any algorithm for linear optimization (e.g. perceptron, SVMs, or a linear programming package) can be used to solve them