Patent Partner Recommendation in Enterprise Social Networks

**Sen Wu**
Computer Science
Tsinghua University
Beijing, China
ronaldosen@gmail.com

**Jimeng Sun**
IBM TJ Watson Research Center
Hawthorne, NY, USA
jimeng@us.ibm.com

**Jie Tang**
Computer Science
Tsinghua University
Beijing, China
jietang@tsinghua.edu.cn

**Patent Partner Recommendation**

*Finding co-inventors in IBM (~300,000 employers)*

**Interactive ranking factor graph model**

**Step 1:** Candidate generation. Extract potential collaboration candidates through the similarity on several features.

**Step 2:** Candidate refinement.

**Step 3:** Interactive feedback.

**Objective Function**

\[
\log P(Y | X, \theta) = \sum_{y \in Y} a_t \phi(y_t, x_t, y_{-t}) + \sum_{y \in Y} \beta_t \phi(y_t, y_{-t}) - \log Z
\]

**Interactive Learning**

\[
E_{\text{new}}[\cdot] = \frac{N}{N+1} E_{\text{old}}[\cdot] + \frac{1}{N+1} \sum_t \phi(y_t, x_{-t}, y_{-t})
\]

**Observations**

(a) Interest similarity

\[
c_i(y_t, y_{-t}) = \frac{1}{d} \mathcal{U}_{y_t, y_{-t}}
\]

(b) Referral chaining length

\[
R_c(y_t, y_{-t}) = \text{dist}(y_t, y_{-t})
\]

(c) Recency

\[
S(y_t, y_{-t}) = \sum_{i} \frac{\text{time}_i - \text{time}_i(y_t, y_{-t})}{\text{time}_i}
\]

**All Features**

- **Feature**
  - Co-inventors
  - Number of existing co-inventors
  - Rate
  - Experience
  - OS-internet
  - Code similarity between persons
  - Count of published patents
  - Percentage of common inventors
  - Co-citation
  - Similarity between co-inventors
  - CF
  - Number of patent co-inventors
  - Referral
  - Referral chaining length
  - Number of existing co-inventors
  - Covariance

**Empirical Analysis**

**Datasets** (from USPTO):
- IBM: 45,972 inventors, 55,465 patents, and 269,330 co-invention relationships.
- Inventor: 18,224 inventors, 54,095 patents, and 54,095 co-invention relationships.

**Baseline:**
- Content
- Collaborative Filtering
- Hybrid
- Interactive Learning

**Observations**

Interactive learning with different numbers of feedbacks.

**Recommendation performance (%)**

*Sen Wu & Jie Tang @KEG, Tsinghua; Jimeng Sun @IBM TJ Watson*