Teaching Old Models New Tricks

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Machine Learning Algorithms and Platforms
LinkedIn Has a Diverse Range of Products

- **500,000,000+**
  - World’s largest professional network

- **Core Product**
  - Members build their network and knowledge

- **Hire**
  - Recruiters connect talent with opportunity

- **Market**
  - Build brand, raise awareness, generate leads

- **Sell**
  - LinkedIn Sales Navigator empowers social selling
Machine Learning
Key to LinkedIn Member and Customer Experience

- Ranking – feed, search
- Response prediction – advertising, marketing
- **Classification** – spam, quality, topics
- **Recommendations** – jobs, topics, connections
Old model at larger scale

How we personalized recommendations

Where we use human labels

FOR THE JOB SEEKER

Recommendations
Three Sources of Features

Member Profile
- Skills
- Education
- Keywords from positions
- Standardized position
- Location

Job Description
- Keywords from job description
- Job title
- Extracted skills
- Location

Similarity Features
- Cosine similarity of job description and member positions
- Geo proximity
- Title overlap
Features
Labeled Examples
Training Data
Logistic Regression
Global Weights
Members Applied To Job

Job Specific Weights
Generalized Linear Mixed-Effect Model

http://github.com/linkedin/photon-ml
Crowd human evaluation has most impact on global weights and global training data.

Not practical to gather enough data for significant impact on personalized or job specific weights.

Also useful for:
- Validation of models, no matter technique.
- Training complementary models, such as quality filters.
<table>
<thead>
<tr>
<th>Don’t</th>
<th>Do</th>
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<tbody>
<tr>
<td>• Don’t ask “Is this job recommendation relevant to this member”</td>
<td>• Break down the task into simpler tasks</td>
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<td>• Requires worker to put themselves in the mind of the member</td>
<td>• Does this member have the required skills?</td>
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<td>• Creates a complex task with long instructions that are hard to</td>
<td>• Does the amount of experience match the job requirements?</td>
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<td>consistently apply</td>
<td>• Does the job function match?</td>
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<td>• Workers regularly fail qualification tests</td>
<td>• Do these as separate jobs to reduce context switching</td>
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Key Takeaways

- Personalized – very wide – models can provide significant lifts
- Crowd human evaluation applies most directly to training global model components
- Human evaluation also important for choosing and tuning models
- Simplify tasks, breaking down complex work into separate jobs