Sparse Filtering
Jiquan Ngiam, Pang Wei Koh, Zhenghao Chen, Sonia Bhaskar & Andrew Y. Ng

Labeled Training Examples

Extract Features

Classifier

Unlabeled Examples

Learned Features
Why Sparse Filtering?

- **Easy, fast** approach to feature learning
- No hyper-parameters that need tuning
- Easy to evaluate objective function
- Minimal data preprocessing required
- Trains well with off-the-shelf optimization toolboxes (e.g., L-BFGS).
### Sparse Filtering

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#### Examples

<table>
<thead>
<tr>
<th>Feature Values</th>
<th>( x_1 )</th>
<th>( x_2 )</th>
<th>( x_3 )</th>
<th>( x_4 )</th>
<th>( \ldots )</th>
<th>( x_m )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f_1 )</td>
<td>0.5</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
<td>( \ldots )</td>
<td>4</td>
</tr>
<tr>
<td>( f_2 )</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
<td>0</td>
<td>( \ldots )</td>
<td>0</td>
</tr>
<tr>
<td>( f_{99} )</td>
<td>3.2</td>
<td>0</td>
<td>1.6</td>
<td>0.3</td>
<td>( \ldots )</td>
<td>1</td>
</tr>
<tr>
<td>( f_n )</td>
<td>4</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
<td>( \ldots )</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Sparse Filtering

**Objective Function**

1. Normalize across rows
2. Normalize across columns
3. Cost Function = Sum of the normalized entries

\[
M_{ij} = |w_i^T x_j|
\]
Evaluating sparse filtering features on natural images, image classification (STL Dataset), audio classification (TIMIT).

*Results comparable to state-of-the-art and fast!*

code available at http://cs.stanford.edu/~jngiam/