Interactive Machine Learning

Zitao Liu
ztliu@cs.pitt.edu

School of Arts of and Sciences
Department of Computer Science
Outline

- **What is Interactive Machine Learning (IML):**
  - Motivation & Goal
  - Classical Machine Learning V.S Interactive Machine Learning
  - Design Principle of IML

- **Applications of IML:**
  - IML Categories
  - Existing IML Applications (CHI, UIST, IUI, KDD)
Motivation & Goal

• “...We believe that trying to fully automate tasks is extremely difficult and even undesirable, but instead there exists a computational design methodology which allows us to gracefully combine automated services with direct user manipulation...”

—— from Microsoft Research
Motivation & Goal

- The complexity of machine learning has largely restricted its use to experts and skilled developers.
- Solving real world problems can benefit from end-user’s interaction.
- A better understanding/assessment of a model’s performance.
- ... ...
What is IML?

**Classical ML**

- One-pass process
- No users’ feedback
- Long time to train the model
- Numerical evaluation

**Interactive ML**

- Iterative process
- Users control the behavior
- Latency sensitive for training
- Friendly visualization evaluation
How to design effective end-user interaction with interactive ML system?

- **Questions:**
  - Which examples should a person provide to efficiently train the system?
  - How should the system illustrate its current understanding?
  - How can a person evaluate the quality of the system’s current understanding in order to better guide it towards the desired behavior?
Design Principle

Fast and Focused

• Fast:
  – Takes seconds or minutes rather than weeks or months to train an effective model.
  – User can quickly refine the classifier by adding more manual info.
  – User can get feedback as quickly as possible.

• Focused:
  – UI component needs to be simple so the user can remain focused on the ML problem at hand.
IML Research Groups

- dub Human-Computer Interaction and Design
  University of Washington

- Microsoft Research

- ICE Interactive Computing Everywhere
  Brigham Young University

- Stanford HCI Group

And so on...
IML Categories

- Interaction Perspective
- Data Perspective
- Learning Perspective
IML Categories

- Interaction Perspective

Training Data → Learning Algorithm → Results Evaluation
IML Categories

- Interaction Perspective

- Training Data
- Learning Algorithm
- Results Evaluation
IML Categories

- Interaction Perspective

- Training Data
- Learning Algorithm
- Results Evaluation
IML Categories

- **Interaction Perspective**

  ![Diagram showing the process of training data, learning algorithm, and results evaluation.]
IML Categories

- **Interaction Perspective:**
  - Supplying training data
  - Choosing a learning algorithm
  - Evaluating and comparing models

No matter what stage we interact with, our goal is the same:

**Put the full potential of machine learning in the hands of everyday people.**
IML Categories

• Date Perspective:
  – Stream-based IML
  – Pool-based IML

• Learning Perspective:
  – Concept Learning
  – Supervised Learning
  – Unsupervised Learning
IML Categories

• **Date Perspective:**
  – Stream-based IML
  – Pool-based IML

• **Learning Perspective:**
  – Concept Learning
  – Supervised Learning
  – Unsupervised Learning

**Focus on Interaction Perspective**
# IML Categories

- **Interaction Perspective:**
  - Supplying training data

<table>
<thead>
<tr>
<th>IML Sys Name</th>
<th>Description</th>
<th>Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>CueFlik</td>
<td>Allows users to create their own rules for re-ranking images based on their visual characteristics.</td>
<td>CHI2008</td>
</tr>
<tr>
<td>CueT</td>
<td>Learns from decisions of operators in a highly dynamic environment.</td>
<td>CHI2011</td>
</tr>
<tr>
<td>Content Creation with IE</td>
<td>A synergistic method for jointly amplifying community content creation and learning based information extraction.</td>
<td>CHI2009</td>
</tr>
<tr>
<td>Apolo</td>
<td>Help users make sense of large network data</td>
<td>CHI2011</td>
</tr>
<tr>
<td>ReGroup</td>
<td>Help people create custom groups on-demand</td>
<td>CHI2012</td>
</tr>
</tbody>
</table>
# IML Categories

- **Interaction Perspective:**
  - Choosing a learning algorithm

<table>
<thead>
<tr>
<th>IML Sys Name</th>
<th>Description</th>
<th>Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual-FSSEM</td>
<td>Guides the feature selection procedures.</td>
<td>KDD2000</td>
</tr>
<tr>
<td>CueFlik</td>
<td>Allows users to create their own rules for re-ranking images based on their visual characteristics.</td>
<td>CHI2008</td>
</tr>
<tr>
<td>EnsembleMatrix</td>
<td>Presents a graphical view of confusion matrices to help users understand relative merits of various classifiers.</td>
<td>CHI2009</td>
</tr>
</tbody>
</table>
IML Categories

- Interaction Perspective:
  - Evaluating and comparing models

<table>
<thead>
<tr>
<th>IML Sys Name</th>
<th>Description</th>
<th>Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnsembleMatrix</td>
<td>Presents a graphical view of confusion matrices to help users understand relative merits of various classifiers.</td>
<td>CHI2009</td>
</tr>
<tr>
<td>ManiMatrix</td>
<td>Provides controls and visualizations that enable system builders to refine the behavior of classification systems in an intuitive manner.</td>
<td>CHI2010</td>
</tr>
</tbody>
</table>
Examples: ReGroup\textsuperscript{(CHI2012)}

- **Goal:** helps people create custom, on-demand groups in online social networks.

- **Workflow:** ReGroup observes a person’s normal interaction of adding members to a group, it learns a probabilistic model of group membership in order to suggest both additional members and group characteristics for filtering a friend list. It continually update its membership model based on interactive user feedback.

- **ML Model:** Naïve Bayes(probability of each friend being a member of the group). Re-trained every time a person adds friends to a group.

- **Specialties:** obtain implicit negative examples; unlearnable groups; missing data

Examples: ReGroup\textsuperscript{(CHI2012)}

Top 5 relevant group characteristics

A static, hierarchical list of all feature value filters

Relevant friend suggestions
Reference

• **Html:**

• **Bib:**
Thank you!