Introduction

- We have ℓ labeled examples $(x^i, \tilde{y}^i) \quad i = 1, \dots, \ell$.
- We have u unlabeled examples $x^j \quad j = 1, \dots, u$.
- **Goal: Find y^j!**

In real-world projects:

- Easy to get data
- Hard to get labels $\to$ **Huge number of unlabeled data**

We consider problems with 2 classes, labels $\{-1, +1\}$.

Paradigm: Similar features = Similar labels

- Define weights w_{ij}: similarity between **labeled** example i and **unlabeled** example j.
- Define weights $\tilde{w}_{ij}$: similarity between **unlabeled** examples i and j.

Solve the problem:

$$\min_{y \in \mathbb{R}^u} \left(\sum_{i=1}^{\ell} \sum_{j=1}^{u} w_{ij} (y^j - \tilde{y}^i)^2 + \frac{1}{2} \sum_{i=1}^{u} \sum_{j=1}^{u} \tilde{w}_{ij} (y^i - y^j)^2 \right)$$

- **Term 1**: Unlabeled examples similar to close labeled ones.
- **Term 2**: Similar unlabeled examples get similar labels.

How to choose weights?

- Use some similarity measures based on features.

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1. Randomly generate a set of points in 2D and give labels to a small subset of those points.
2. Choose a proper similarity measure to define w_{ij}.
3. Consider the problem $*$.
4. Solve problem $*$ with:
   a) Gradient descent
   b) Block with GS rule
   c) Coordinate minimization

   For **(b)** use **blocks of dimension 1**.
5. Choose a publicly available dataset and test the methods on this.
6. Analyze accuracy vs. runtime (plots).
7. Describe what you did in a PDF file.
8. Upload files on Moodle (see tile "Homework").

Free Tips

Gradient with respect to y^i:

$$\nabla_{y^i} f(y) = 2 \sum_{i \neq j} w_{ij} (y^i - \tilde{y}^j) + 2 \sum_{i \neq j} \tilde{w}_{ij} (y^i - y^j)$$