Abstract

- Motivation: Obtaining labels is expensive and time consuming.
- Problem Statement: Developing a task-agnostic algorithm to query the most representative unlabeled samples for labeling.
- Strategy: Using adversarial learning to measure representativeness of samples without training for the main-stream task.
- Performance: State-of-the-art on image classification - semantic segmentation

Active Learning

Approaches in active learning have been all task-dependent.

• Explicit uncertainty measurement
  - Task Learner
  - Human expert / Oracle
  - Query-By-Committee
  - Human expert / Oracle
  - Coreset
  - Human expert / Oracle

• Representation-based / Bayesian uncertainty
  - Human expert / Oracle

Variational Adversarial Learning (VAAL)

VAE’s Objective Function

\[ L_{VAE} = \lambda_1 L_{VAE}^{CE} + \lambda_2 L_{VAE}^{Adv} \]

where:

\[ L_{VAE}^{CE} \rightarrow \text{VAE's transductive loss} \]

\[ L_{VAE}^{Adv} \rightarrow \text{VAE's adversarial loss} \]

\[ \lambda_1, \lambda_2 \rightarrow \text{Weighting factors} \]

Discriminator’s Objective Function

\[ L_D = -\mathbb{E}[\log(D(y_1|x_1))] - \mathbb{E}[\log(1 - D(y_0|x_0))] \]

Variational Adversarial Active Learning (VAAL)

Input: Labeled pool \((X_L, Y_L)\), Unlabeled pool \((X_U)\), Initialized \(\phi^0\), \(\lambda^0\), \(\zeta^0\)

Oracle

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Algorithm & Sampling Strategy

Algorithm 1: Variational Adversarial Active Learning

Input: Labeled pool \((X_L, Y_L)\), Unlabeled pool \((X_U)\), Initialized \(\phi^0\), \(\lambda^0\), \(\zeta^0\)

Oracle

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Algorithm & Sampling Strategy

Results on Image Classification and Semantic Segmentation Benchmarks

Ablation

Key roles in VAAL in the order of importance:
1. VAE + Discriminator
2. VAE (no Discriminator)
3. Fixed VAE + Discriminator (no adversarial learning) < random
4. Discriminator (no VAE) < random

Robustness & Time Analysis

Source Code

References