



Transfer Learning

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Motivation

What to transfer

- In some domains, labeled data are in short supply.
- In some domains, the calibration effort is very expensive.
- In some domains, the learning process is time consuming.

$$\begin{aligned} \mathcal{D}_S &\neq \mathcal{D}_T \\ \mathcal{X}_S &\neq \mathcal{X}_T \\ P_S(X) &\neq P_T(X) \\ \mathcal{T}_S &\neq \mathcal{T}_T \\ \mathcal{Y}_S &\neq \mathcal{Y}_T \\ P(Y_S | X_S) &\neq P(Y_T | X_T) \end{aligned}$$

How to transfer

- How to extract knowledge learnt from related domains to help learning in a target domain with a few labeled data?
- How to extract knowledge learnt from related domains to speed up learning in a target domain?

1. Inductive Transfer Learning
2. Transductive Transfer Learning
3. Unsupervised Transfer Learning

Instance-transfer

To re-weight some labeled data in a source domain for use in the target domain

Relational-knowledge-transfer

Build mapping of relational knowledge between a source domain and a target domain.

Methods

Feature-representation-transfer

Find a “good” feature representation that reduces difference between a source and a target domain or minimizes error of models

Model-transfer

Discover shared parameters or priors of models between a source domain and a target domain

Negative Transfer

- Most approaches to transfer learning assume transferring knowledge across domains be always positive.
- However, in some cases, when two tasks are too dissimilar, brute-force transfer may even hurt the performance of the target task, which is called negative transfer
- Some researchers have studied how to measure relatedness among tasks
- How to design a mechanism to avoid negative transfer needs to be studied theoretically

Flow Chart

Source domain Dataset

Target domain Dataset

Measure the similarity between domains and tasks and their transferability

Train the transfer classifier in source domain

Get the target predictive function $f_T(\cdot)$ in target domain

Results

TL algorithms compared with traditional algorithms on prediction accuracy

