

Learning how to Active Learn: A Deep Reinforcement Learning Approach

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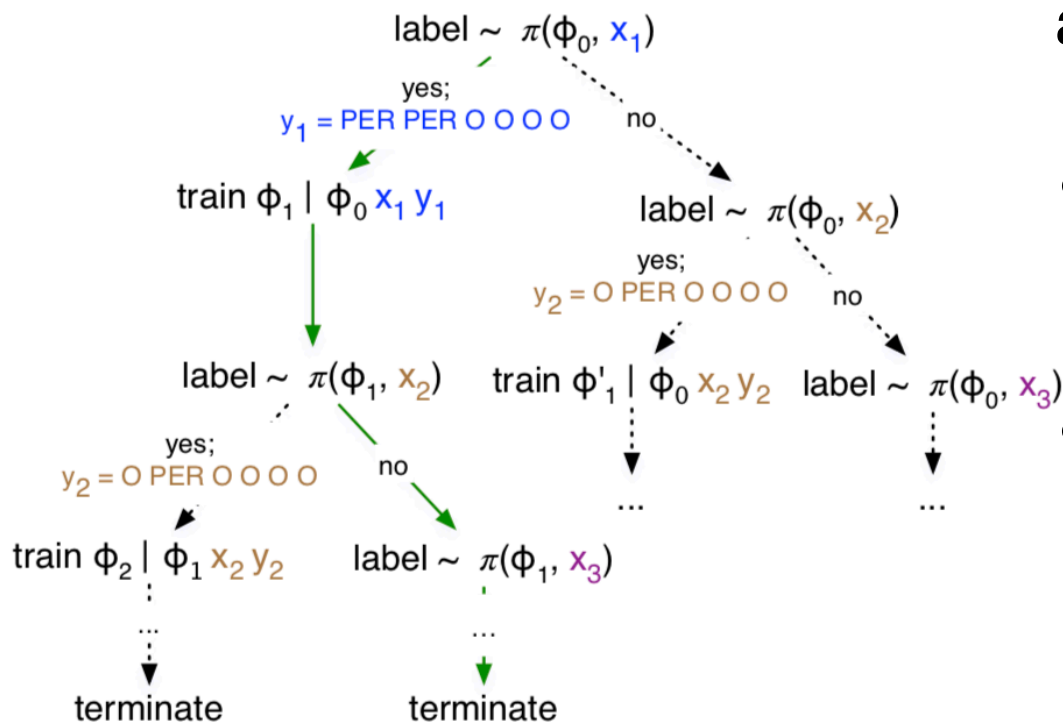
Motivation

- Low-resource languages
 - Little annotations - No deep learning
 - More annotation requires more budget
- Two problems to solve
 - What to annotate? (limited budget) -> Active learning
 - Active learning without a seed set for a basic classifier
-> Transfer learning

Active Learning Example

1: Pierre Vinken will join the board
2: Mr. Vinken is chairman of Elsevier
3: Ms. Haag plays Elianti
4: There is no asbestos in our products
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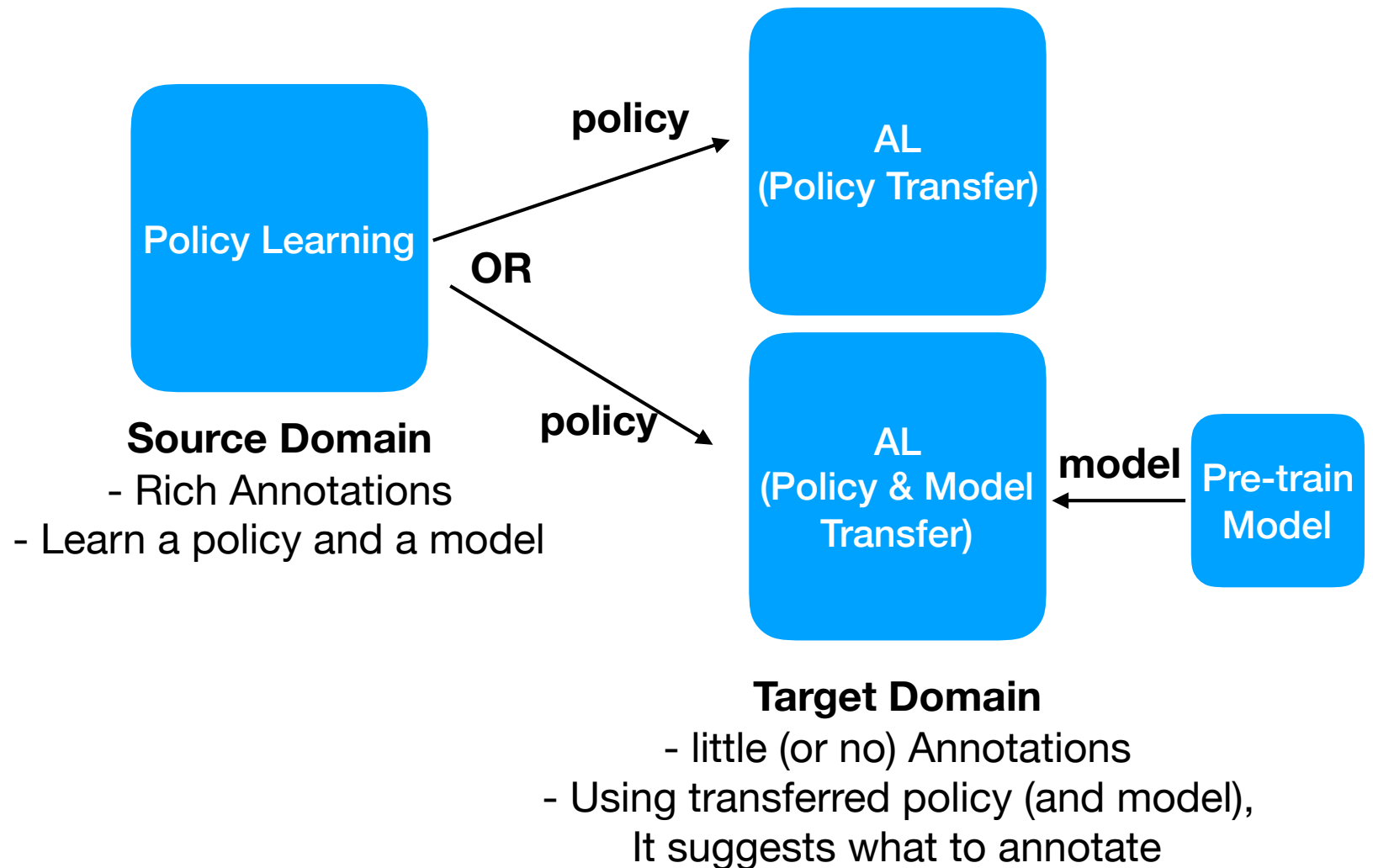
- Given a sentence, x_1 , AL decides if it asks the annotation for it
- If Yes: The classifier is updated
- If No: Ignore that sample



Problem Formulation

- **Input:** D , a random sequence of sentences, x_1, x_2, \dots, x_n
- **Output:** D_l , a subset of D , need to be annotated
- **S:** states
 - $g(s_t)$: input sentence representation
 - $\Phi(s_t)$: prediction for the target task
 - C : Confidence of sequential prediction (A measurement how good is it so far)
- **A:** binary action (select to annotate or ignore)
- **R:** reward $R(s_{i-1}, a) = \text{Acc}(\phi_i) - \text{Acc}(\phi_{i-1})$
- **Active learning (AL)**
 - Aims to select a small subset of data for annotation
- **Reward Estimation, Q**
- **Policy:** π , $\text{argmax_action}(Q)$
- **Model:** Φ , target task model

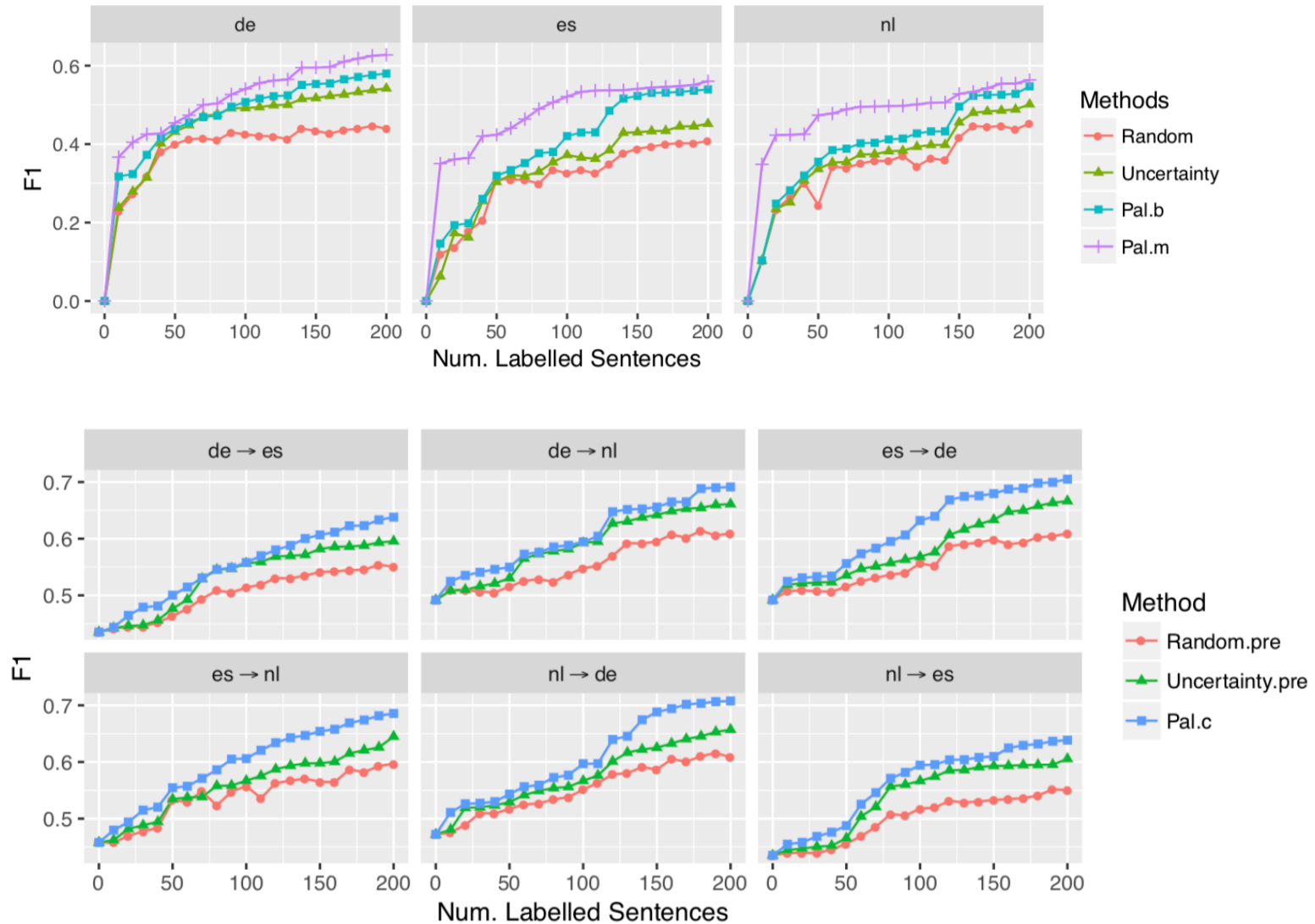
AL with Transferred models



Experimental Configuration

Bilingual		Multilingual		Cold-start		
tgt	src	tgt	src	tgt	src	pre
de	en	de	en,nl,es	de	nl	en
nl	en	nl	en,de,es	nl	de	en
es	en	es	en,de,nl	es	de	en
-	-	-	-	de	es	en
-	-	-	-	nl	es	en
-	-	-	-	es	nl	en

Experiment



Discussion

- Successful MDP formulation for a binary annotation decision problem
- Reduces the annotation burden to as low as 10%.
- Outperform the existing methods