A Character-level Convolutional Neural Network for Distinguishing Similar Languages and Dialects

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1. Overview

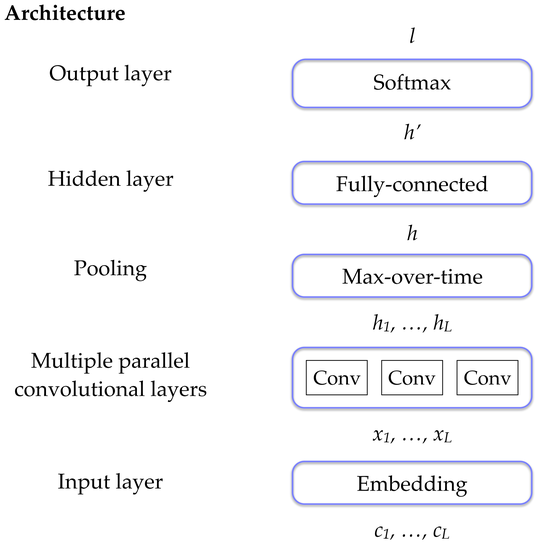
- Discriminating closely-related language varieties
- DSL shared-task with two sub-tasks:
  1. Similar languages, journalistic texts
  2. Arabic dialects, speech transcriptions
- Previous work mostly used sequences of characters and words, with simple machine learning algorithms (SVM, MaxEnt)
- We use a fully character-level convolutional neural network

2. Approach

Multi-class classification

- Given pairs of texts and labels, $\{t^{(i)}, l^{(i)}\}$, learn predictor $f : t \longrightarrow l$
- Implement predictor as a neural network
- Represent text as sequence of characters: $t := c_1, \ldots, c_L$

Architecture



3. Implementation Details

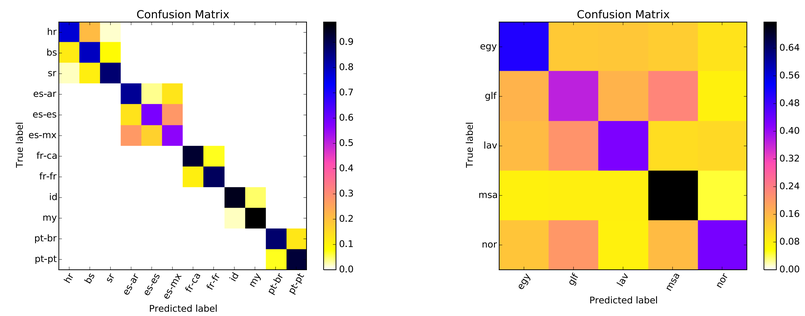
- Cross-entropy loss with mini-batches, Adam optimizer
- Early stopping on dev set with a 10 epoch patience
- Implemented in Keras with the TensorFlow backend
- Hyper-parameters tuned on 10% of the Arabic train set
  - ρ_{emb}=0.2, ρ_{fc}=0.5, L=400, d_{emb}=50, d_{fc}=250
  - Conv filters: *{1*50, 2*50, 3*100, 4*100, 5*100, 6*100, 7*100}*

4. Submitted Runs

- Sub-task 2 (Arabic dialects)
  - Run 1: 90% of train for training, 10% for development
  - Run 2: 100% of train for training, stop based on Run 1
  - Run 3: 10 models trained on different 90%/10% splits
- Sub-task 1 (languages): Run 1 similar; Run 2 more filters; Run 3 more hidden units and dropout in FC layer

5. Results and Discussion

Test Set	Track	Run	Accuracy	F1 (micro)	F1 (macro)	F1 (weighted)
A	closed	Baseline	0.083			
A	closed	run1	0.8042	0.8042	0.8017	0.8017
A	closed	run2	0.825	0.825	0.8249	0.8249
A	closed	run3	**0.8307**	**0.8307**	**0.8299**	**0.8299**
A	closed	Best	*0.8938*			*0.8938*
C	closed	Baseline	0.2279			
C	closed	run1	0.4487	0.4487	0.4442	0.4449
C	closed	run2	0.4357	0.4357	0.4178	0.4181
C	closed	run3	**0.4851**	**0.4851**	**0.4807**	**0.4834**
C	closed	Best	*0.5117*			*0.5132*



(a) Sub-task 1, test set A, Run 3

(b) Sub-task 2, test set C, Run 3

Results

- 6/18 in sub-task 2; 2nd to last in sub-task 1
- Spanish most difficult, Malay/Indonesian easiest
- Gulf most confusing Arabic dialect, MSA easiest

Discussion of the Arabic task

- Transcribed texts, Buckwalter transliteration
- MSA confusion, news broadcasts
- Linguistic vs geographic proximity

6. Error Analysis

1. Competing features: *AllbnAnyp*, *hmA*, *-An*; verb-subject word order: *AndlEt AlHrb*
2. Mixing: *>h HDrp*, *bdy* vs *hl syHdv*
3. Morphology: *Alm$kwk fyh*
4. Word vs char: *AlmAlky*, *AlhA$my*
5. ASR mistakes: *byt>vr* vs *byt>tr*
6. Rare features: *<HnA wyAhm*. But: *bqyt* common in NA

	True	Predicted	Text
1	MSA	Levantine	AndlEt AlHrb AllbnAnyp EAm 1975 >Syb bxybp >ml whmA yrwyAn kyf ynhArwn wqthA
2	MSA	Egyptian	>h HDrp AlEmyd AlAHtkAk bdy dm$q AlEASmp AlsyAdyp AlEASmp AlsyAsyp fy fy >kvr mn mrp wbEmlyp nwEyp kbyrp jdA hl syHdv AlmnErj fy h*h AlmwAjhp
3	MSA	Gulf	>mA xrjt ElY tlfzywn Aldwlp fy Alywm AltAly lvwrp wqlt lh HAfZ ElY tAryx >ql AlwzArp Alywm Thr AlbrlmAn mn AlEDwyAt Alm$kwk fyh <dY msyrp Al<SlAH wbdA h*A qbl SlAp AljmEp
4	MSA	North African	>wlA Al Al Alsyd AlmAlky ytmnY mn TArq AlhA$my Alxrwj wlA yEwd
5	Egyptian	Gulf	>nA bEmrnA ftrp mn HyAty snp Al>xyrp mtEwd ElY wqf Altfrd AHtlAly tEtbr llmsjd gryb mn mjls AlwzrA' wmjls Al$Eb wAl$wrY wnqAbp AlmHAmyn wxlAfh fkAn >y wAlAHtjAjyp byt>vr bhA Almsjd b$>n Al>wDAE
6	North African	Gulf	$Ahd tglb wAjb \|xr mr Ebr EddA mn brnAmjh <HnA wyAhm lA ymnE xrwj bAlb$r ftzydh whlA Em lxrwqAt AlHq Al$yx xAld Hqq mEy lA yglq fyjb hdf AlnAtw bAlAxtyAr mn Altwqf lA tqAs bqyt Endk nsmH lkl $y' HtY tqrr trHb

Table 1: Example errors made by our system on the Arabic data set.

7. Future Work

- Combine word and char features
- Add word white-lists
- Combine acoustic and phonetic features

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