The curious case of Logistic Regression for Italian Dialects Identification

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Introduction

Automatic Language Identification represents an important task for improving many real-world applications. We propose an extensive evaluation of different approaches for the identification of **Italian dialects and languages**, spanning from classical machine learning models to more complex neural architectures.
This work was developed in the context of the Identification of Languages and Dialects of Italy task organized at **VarDial 2022** .

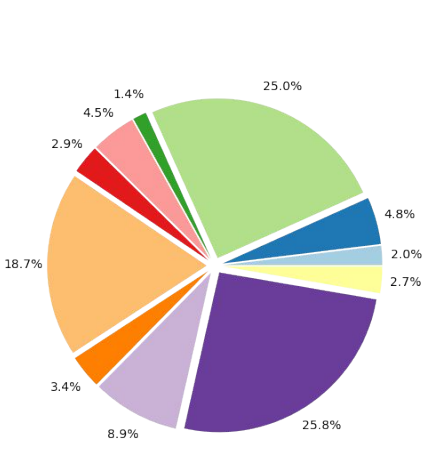
Method Overview

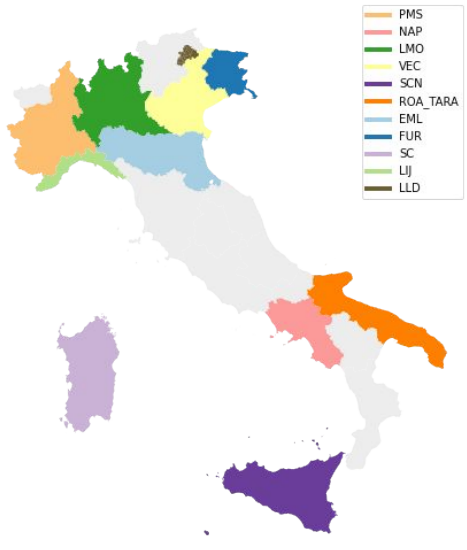
We tackled the identification problem exploiting three different architecture:

- **Linear models**: We experimented with three different models, namely Linear Support Vector Machines, Naïve Bayes classifiers and Logistic Regression. The models are trained on scaled word-level TF-IDF feature vectors.
- **CNN**: We implemented both word-based and character-based networks. All networks are 3 layers deep, with 2 convolutional layers and 1 fully- connected layer.
- **Transformers**: We fine-tuned 6 different HuggingFace BERT models pre-trained on Italian corpora for two epochs.

Data Exploration

- The dataset was provided by the organizers and consists of Wikipedia dumps including samples for all the eleven dialects.
- **Challenges** emerged with the given dataset:
  - Imbalanced classes.
  - Missing dialects in the validation set, difficult to fine-tune the models for those.
  - Validation and test sources different from Wikipedia, possible poor out-domain model performances.





Results and Discussion

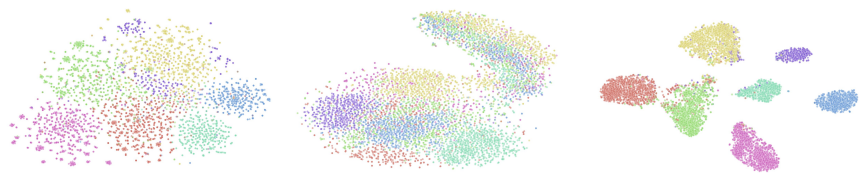
The evaluation results on the validation set for the best-scoring models of each categories are shown in the table.

Model	f1-micro
Logistic Regression	**0.9445**
Character-level CNN	0.7987
$BERT_{LARGE}$	0.8907

- Logistic Regression results the best performance.
- Key speculations on the model
  - ↑ Leverage the consistent linguistic variety between the evaluated Italian dialects and languages.
  - ↑ This model is simple and explainable. The number of parameters learned by the model is relatively small (~5 million), compared to other investigated models (BERT has 110 million parameters).
  - ↓ Impossibility of handling OOV problem and possibility of model overfitting to the validation set.

Analysis

- **Error analysis**: confusion matrix and explained logistic regression predictions
- Training and inference **time comparison** between models
- Feature space **visualization**



TF-IDF embeddings. CNN embeddings. BERT embeddings.

Conclusions

- Logistic Regression model achieved the best results, outperforming the other two models and ranking within the top 5 submissions the Vardial 2022 ITDI shared tasks.
- No notable difference in the performance of character-based and word- based CNN, of which the vast vocabulary size is more costly in terms of training time.
- BERT models performed weakly in this cross-domain language identification task, generalising less than linear models.

Github Demo