TED4LAT

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RĪGAS TEHNISKĀ UNIVERSITĀTE

Study of Impact of Global Trends, Culture and Positive Practice Influences in Latvian Learning Materials

E-Learning Technologies and Management

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15.07.2025

TED4LAT, No. 101079206

The Problem: Tracing Linguistic Influence in Educational Texts

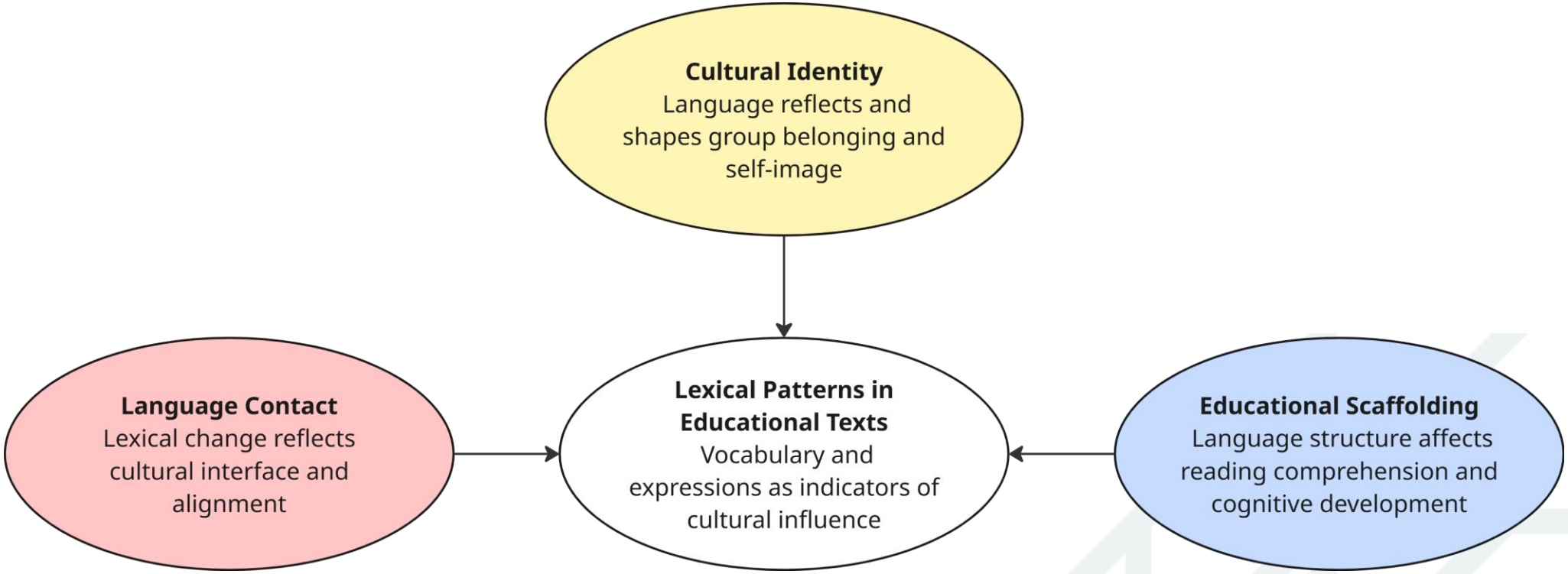
- **Research Focus**
  – Latvian educational materials (Wikipedia, textbooks)
  – Global trends, foreign elements, positive linguistic practices
  – Focus on lexical-level patterns: loanwords, calques, metaphors
- 70% of Latvian corpus is translated language
- Borrowed terms dominate key domains (AI, technology)
- Risk of identity weakening and cognitive overload in learners
- Lack of tools to trace linguistic influence in small-language education

Methodological Innovation & Societal Relevance

- Fine-tuned mBERT for Latvian loanword detection in a low-resource setting
- Developed a monolingual approach to loanword detection, avoiding reliance on bilingual or parallel corpora
- Integrated language-contact theory into a modular binary classification pipeline
- Extended detection beyond phonetic borrowings to include structural borrowing (calques) based on linguistic patterns
- Built an annotated dataset based on linguistic categories (loanwords, calques)
- Promotes awareness of language–culture alignment in material design
- Supports language preservation policy by visualizing lexical borrowing patterns
- Provides tools for scaffolded reading environments
- Builds open-access methods for monitoring linguistic change in under-resourced languages

Theoretical Foundations

- Three perspectives on how language forms carry culture and shape learning.



Theoretical sources: Matras (2009); Hammond et al. (2001); Kramsch (1998); Givón (2005); Carneiro et al. (2020).

Object and Subject of the Study

Object of the Study

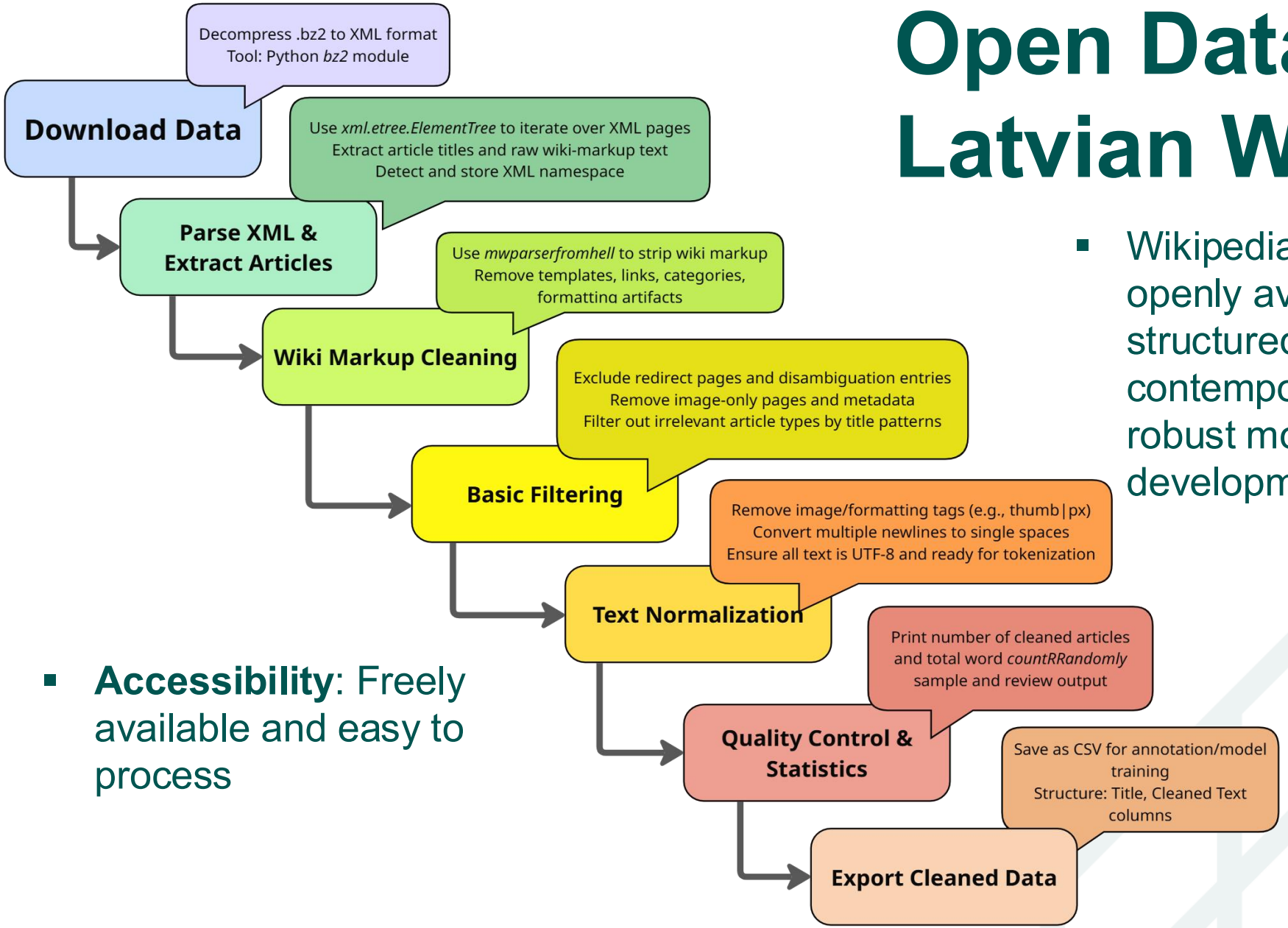
- Language use in Latvian educational materials
- Focus on how lexical borrowing reflects global cultural influence

Subject of the Study

- A machine learning–based framework for detecting borrowed lexical elements
- Focused on loanwords and calques in Latvian Wikipedia as a proxy for educational discourse

Open Data Corpus: Latvian Wikipedia

- Wikipedia provides a large, openly available, and well-structured corpus of contemporary Latvian, enabling robust model pre-training and development.

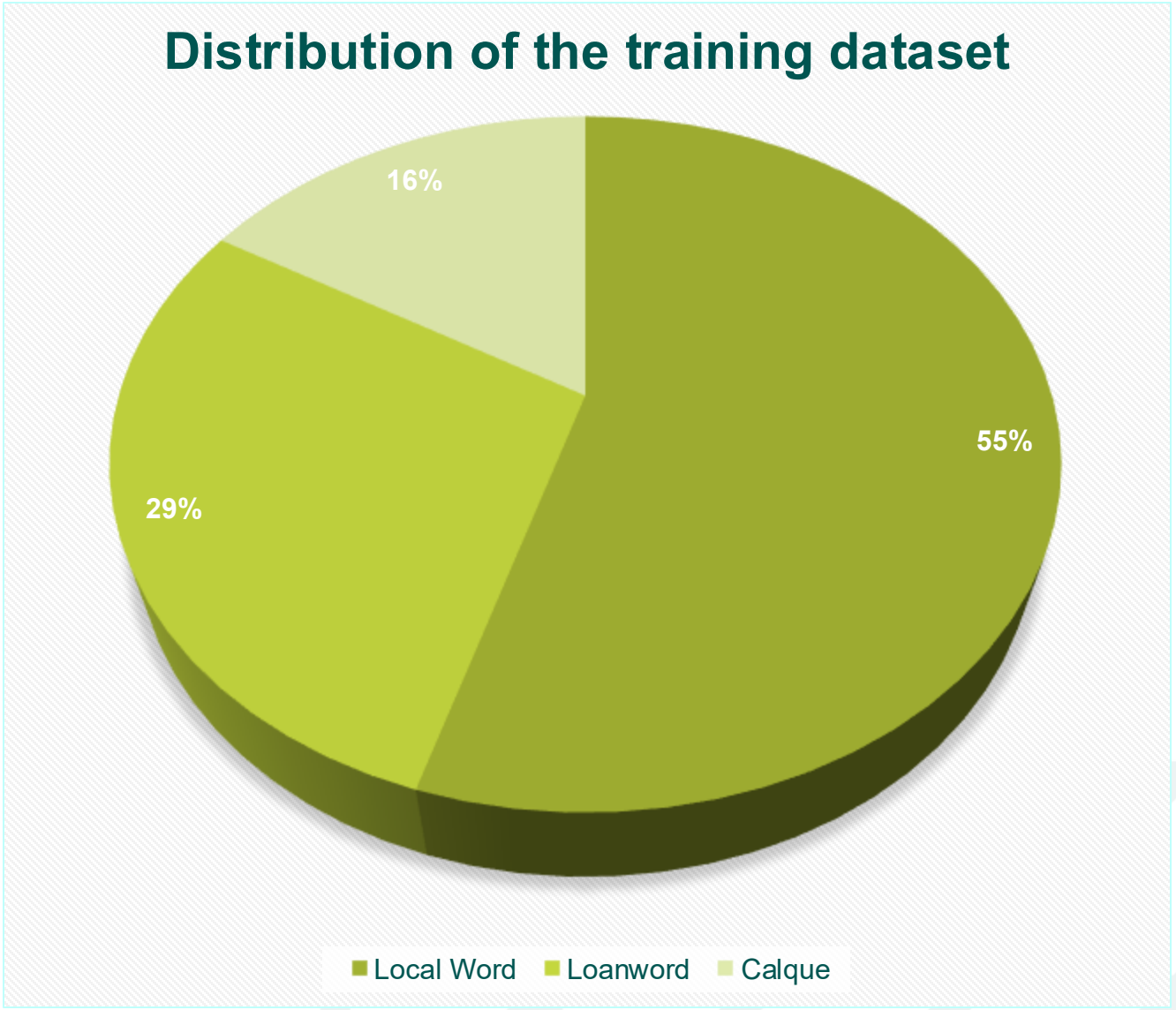


- **Accessibility**: Freely available and easy to process

Methods

Model: Multilingual BERT (mBERT), pre-trained on >100 languages, including Latvian

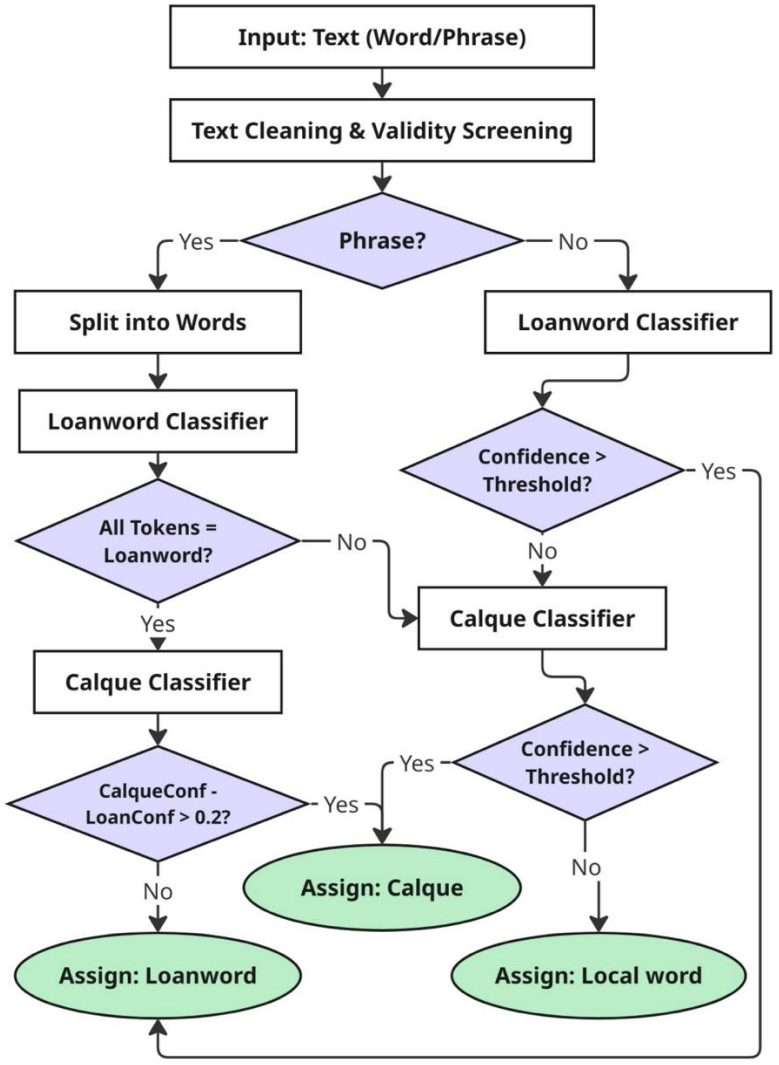
- **Task:** Detecting borrowing in Latvian texts
- **How**: Fine-tune using a smaller, manually labeled Latvian dataset
- **Weighted cross-entropy** assigns a higher penalty to mistakes on underrepresented classes, encouraging the model to pay more attention to them.



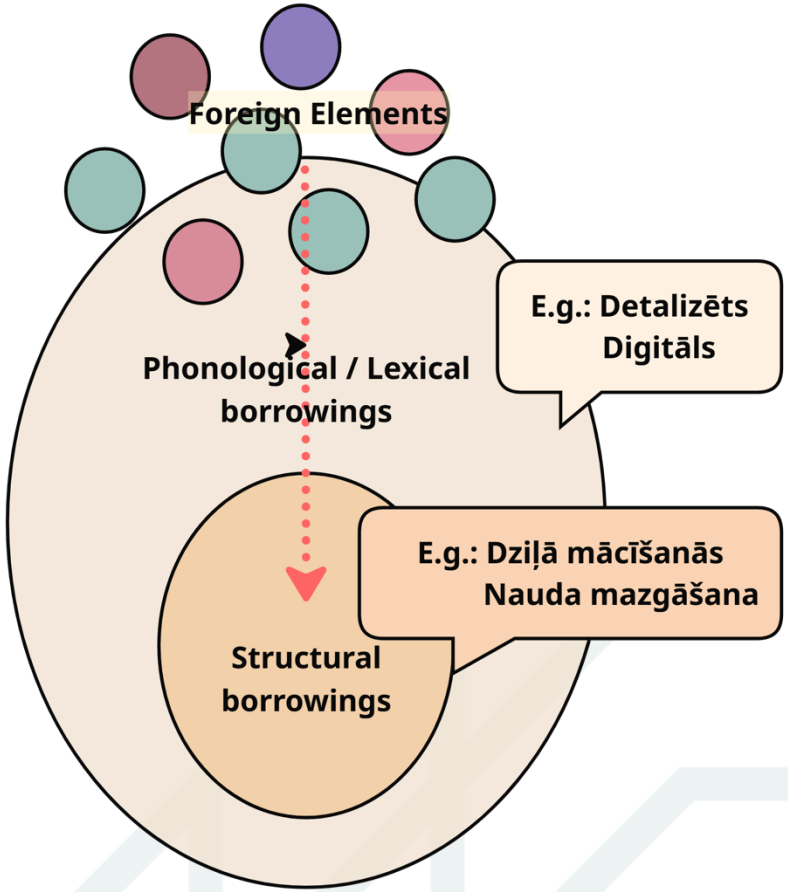
Method: Semi-supervised Learning with Pseudo-labels

- **Pseudo-labels:**
- Unlabeled examples are assigned predicted labels by a model trained on real data. These "pseudo-labeled" samples are then included in further rounds of training as if they were real.
- **Feasibility & Cautions**
- Expands effective training data:
  - Pseudo-labeling leverages a large pool of unannotated text, reducing reliance on expensive manual annotation.
- Improves generalization:
  - The model learns broader patterns, potentially boosting accuracy and recall on rare or complex cases.
- Risks:
  - If the model's initial accuracy is low, adding many pseudo-labeled examples may amplify noise and introduce systematic errors.

Method: Modular Binary Classification Pipeline



- Decompose the multi-class task into a sequence of binary classification steps.
- Breaking a challenging multi-class problem into two-stage binary decisions reduces confusion and error propagation—especially important when certain categories have overlapping features.
- The staged binary process mirrors the natural stratification

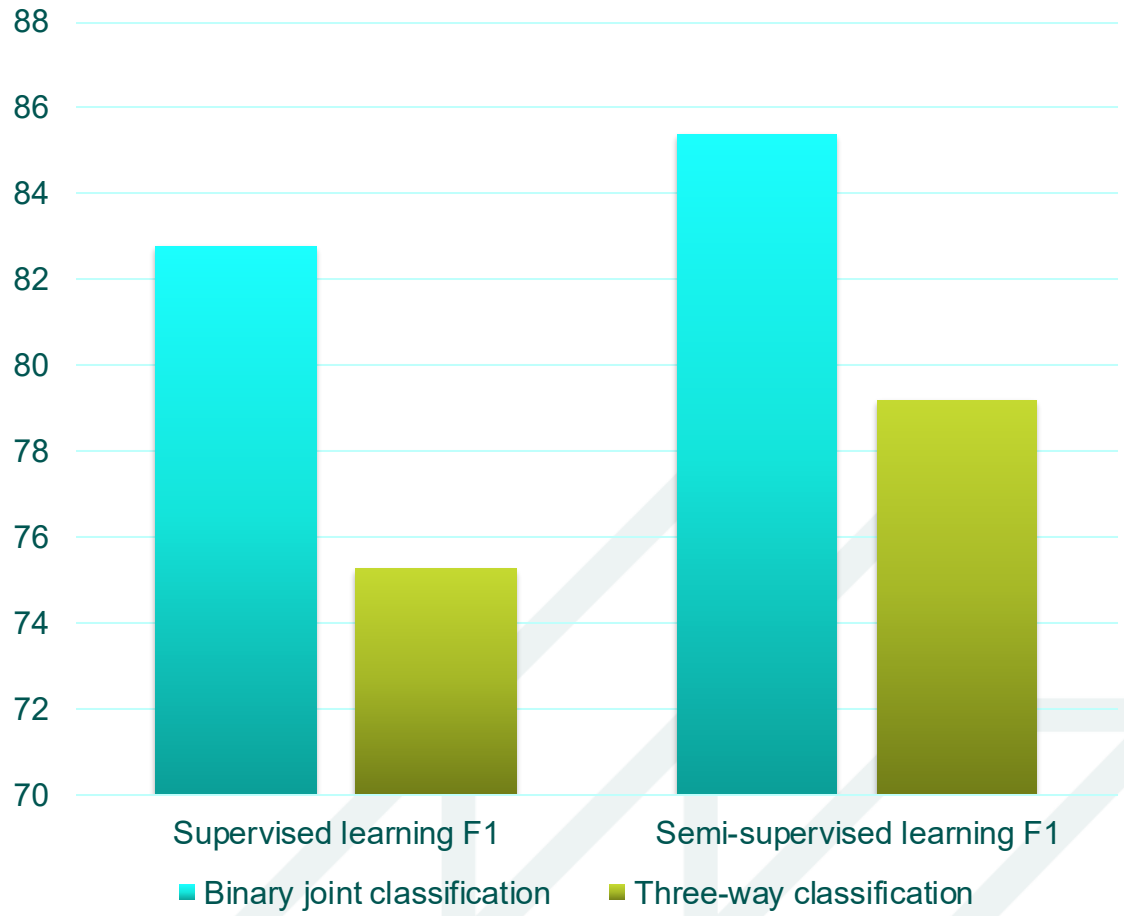


- Based on Matras, Y. (2009). Language contact. https://doi.org/10.1017/cbo9780511809873

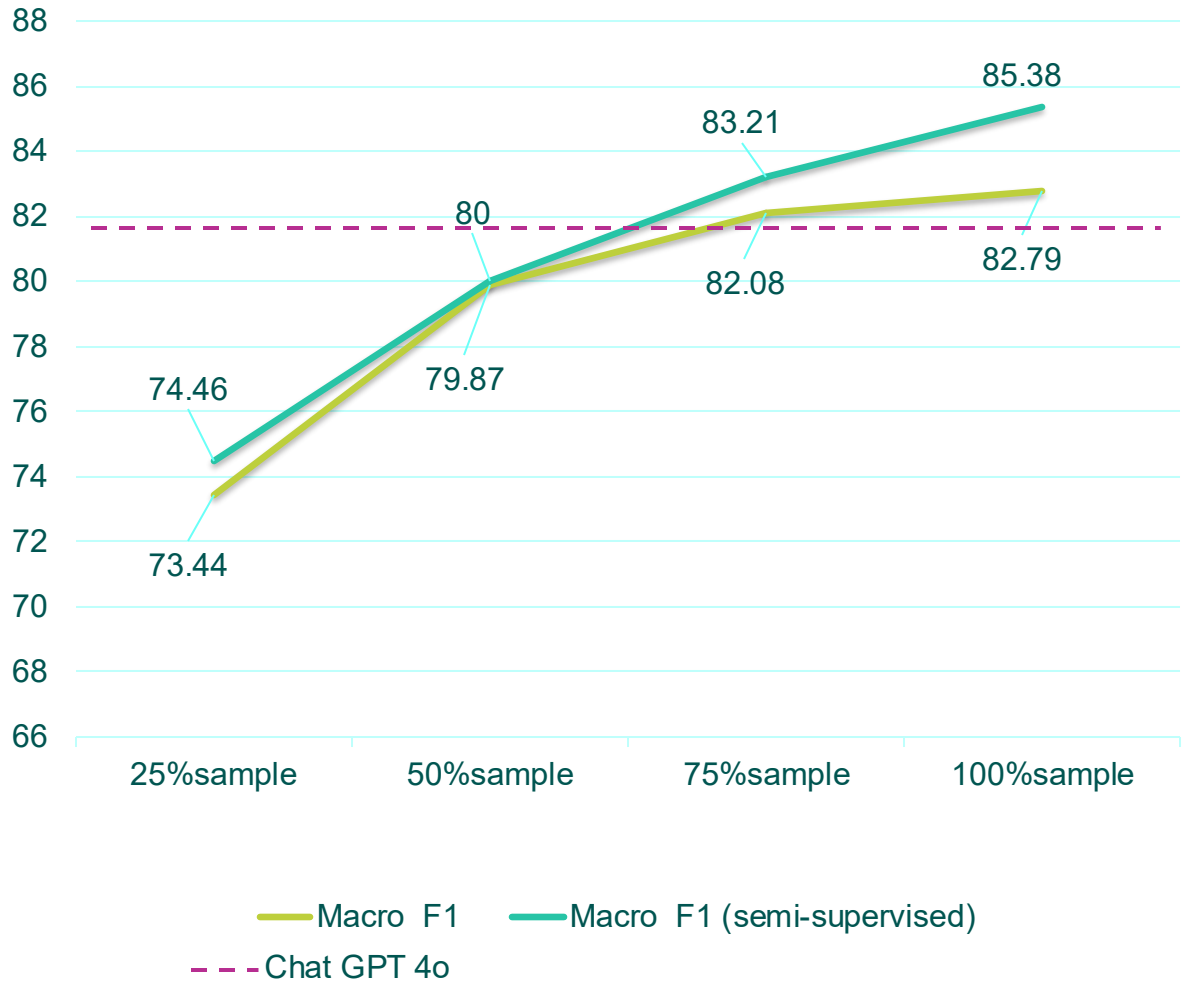
Ablation Study

Why Perform Ablation Studies?

- To identify the optimal balance between labeled and pseudo-labeled data for training;
- To determine how much model performance improves as more annotated data becomes available;
- To compare the effectiveness of different model architectures.
- Both architectures improve with semi-supervised training
- Joint binary pipeline consistently outperforms the three-way classifier



Main Findings



- Supervised model performance increases with data, but shows diminishing returns beyond 75% sample
- Semi-supervised training becomes increasingly effective as base model improves (pseudo-label quality rises)
- At 75% data scale, model performance surpasses GPT-4o benchmark on lexical borrowing detection
- Calque classification remains more challenging due to limited signals and fewer training examples
- Main classification errors occur in borderline cases such as place names, personal names, and media titles

Conclusions & Future Work

- Monolingual training showed strong performance, suggesting that native and borrowed patterns retain learnable structural differences
- The binary classification pipeline reflects not only computational efficiency but also cognitive stages of perception and category separation
- Structural borrowing has long been considered difficult to detect due to its localized surface form, but reliable identification is possible, even in low-resource settings.
- Open data enabled scalable, low-barrier model development and promotes future reproducibility in different language settings
- Next steps: extend domain coverage to real educational texts and analyze underlying pattern distinctions that support model decisions

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Acknowledgement

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101079206.

Thank you!