Visually grounded cross-lingual keyword spotting in speech

SLTU, August 2018

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http://www.kamperh.com/

Advances in speech recognition

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- **Addiction to labels**: 2000 hours transcribed speech audio; ∼350M/560M words text [Xiong et al., TASLP'17]

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- Very different from the "supervision" infants use to learn language
- Sometimes not possible, e.g., for unwritten languages

Images as weak labels for speech

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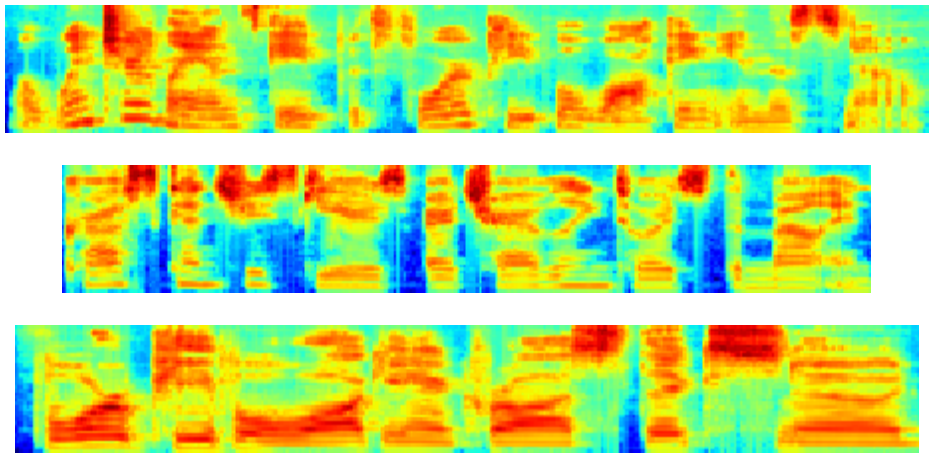
Can we use images as weak labels in low-resource settings?

Play



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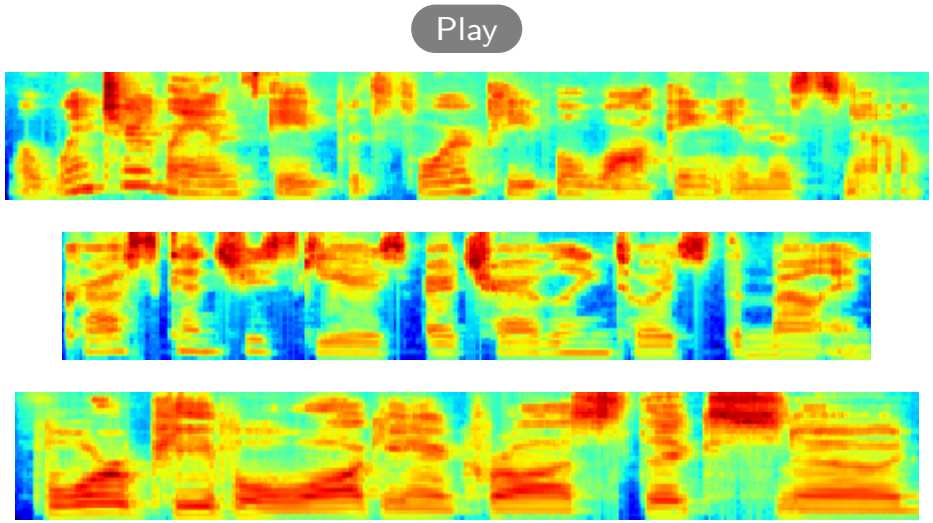

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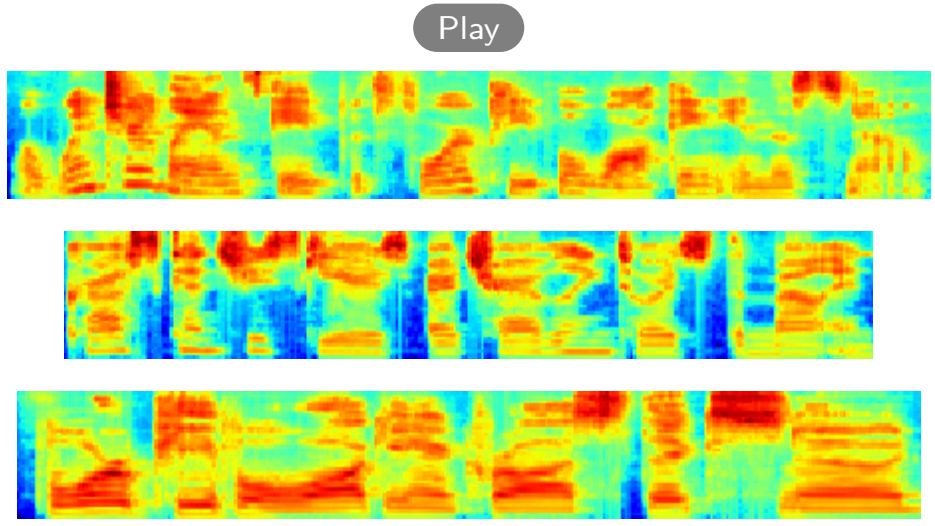


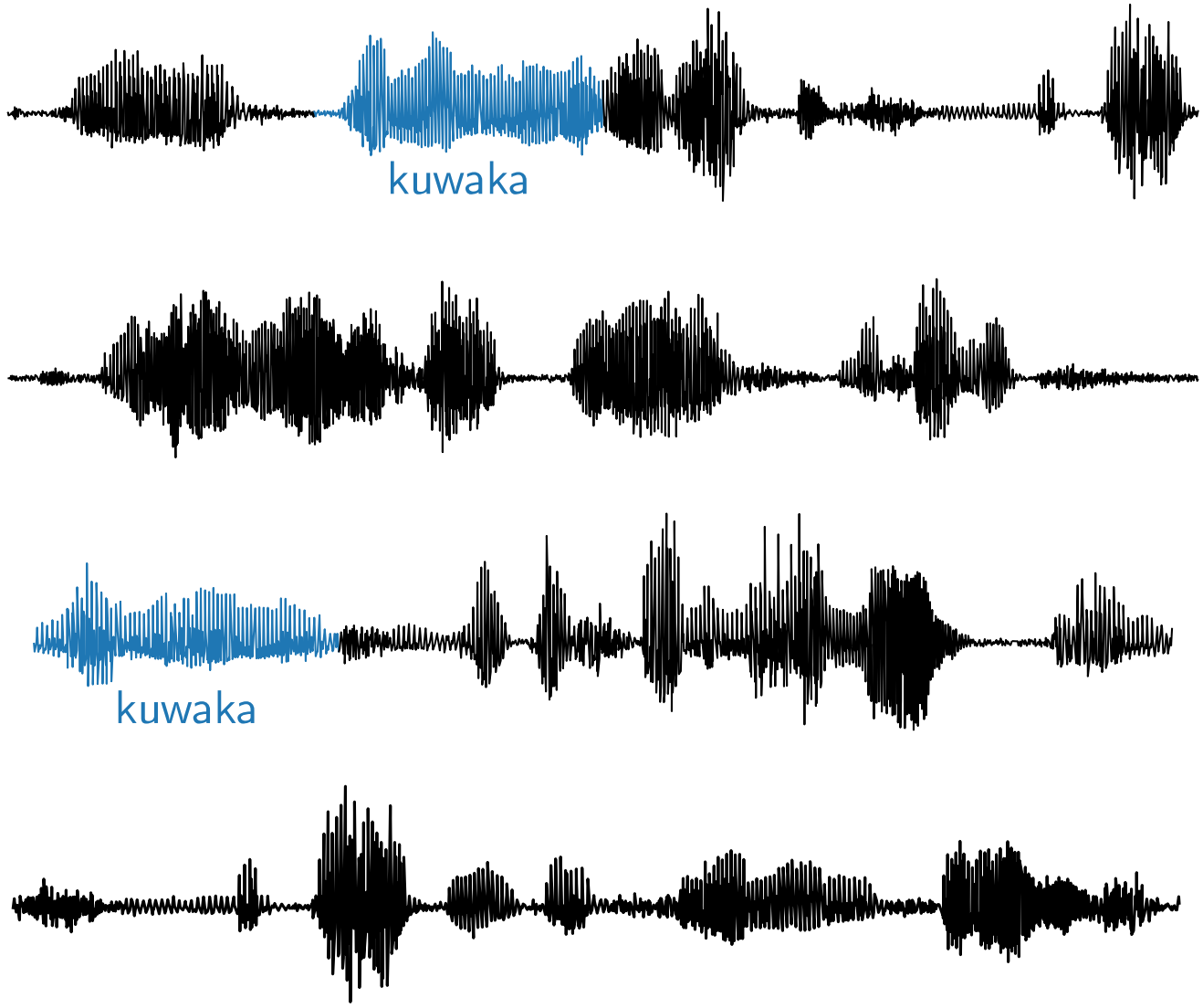
- Maybe we cannot use this type of data for full ASR, but maybe it can be used for other tasks?
- **Goal:** Use this type of data for cross-lingual keyword spotting

Cross-lingual keyword spotting

Written query:

burning

(English)



Swahili speech corpus

Cross-lingual word prediction from images

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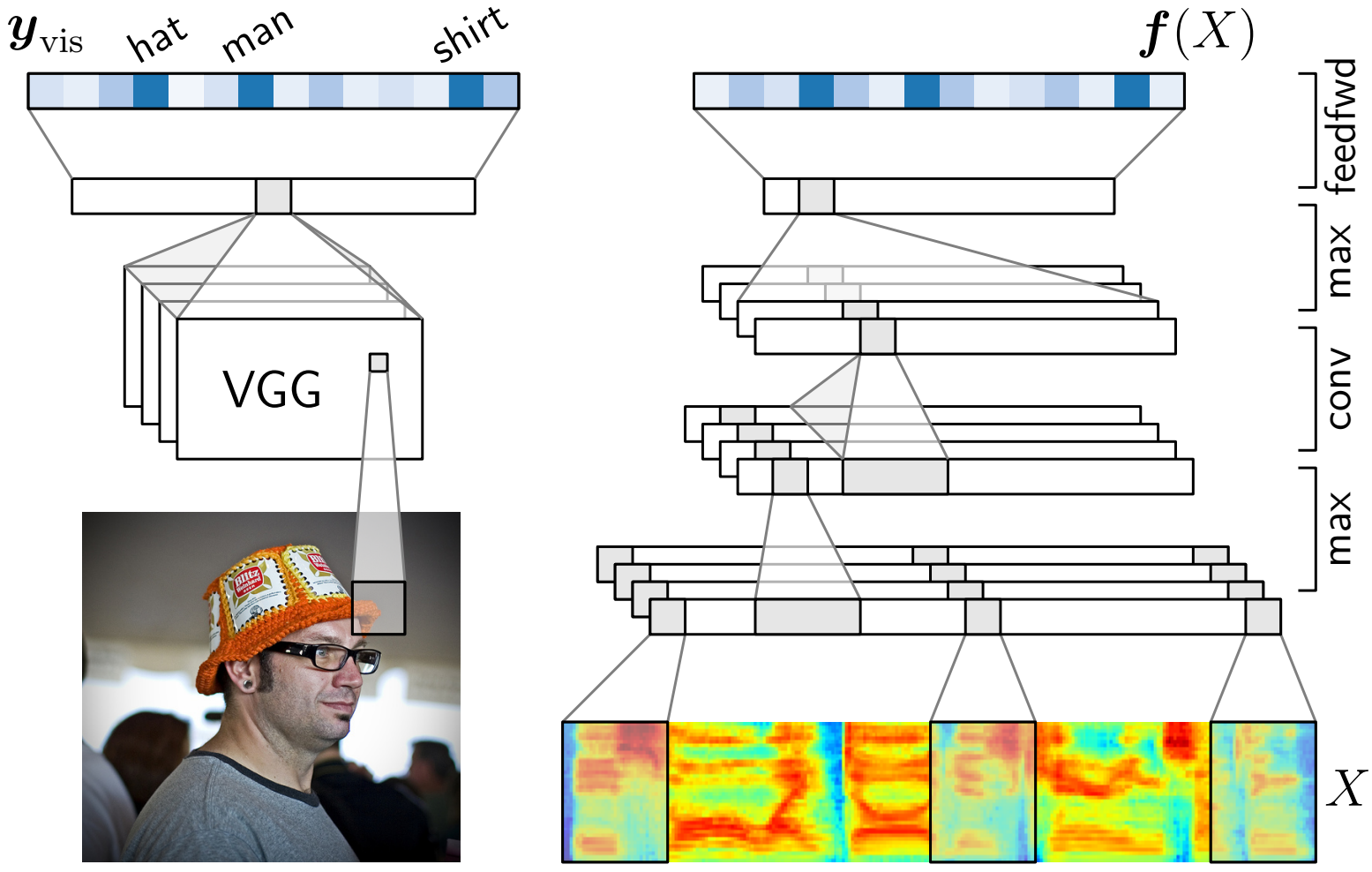

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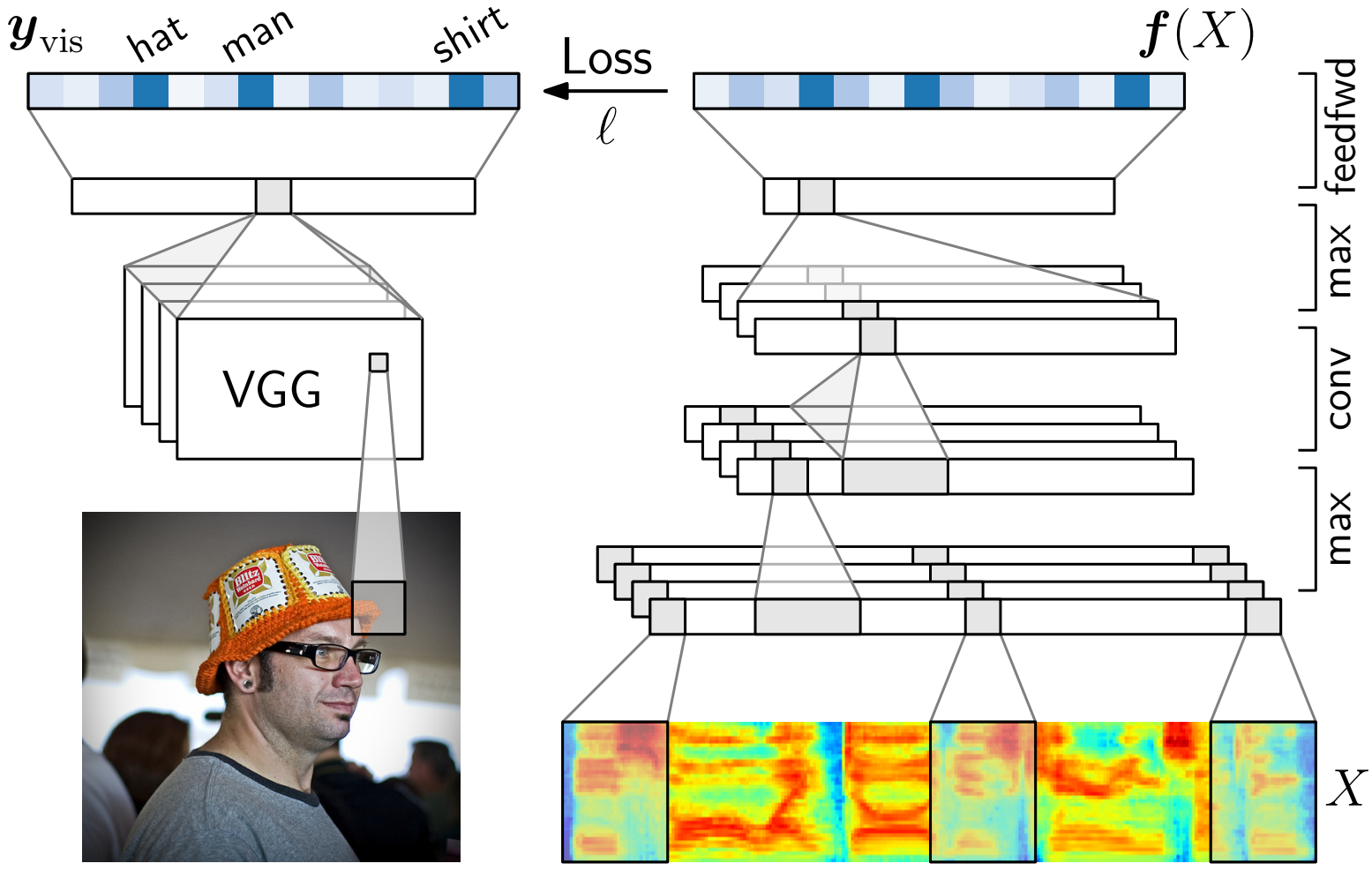

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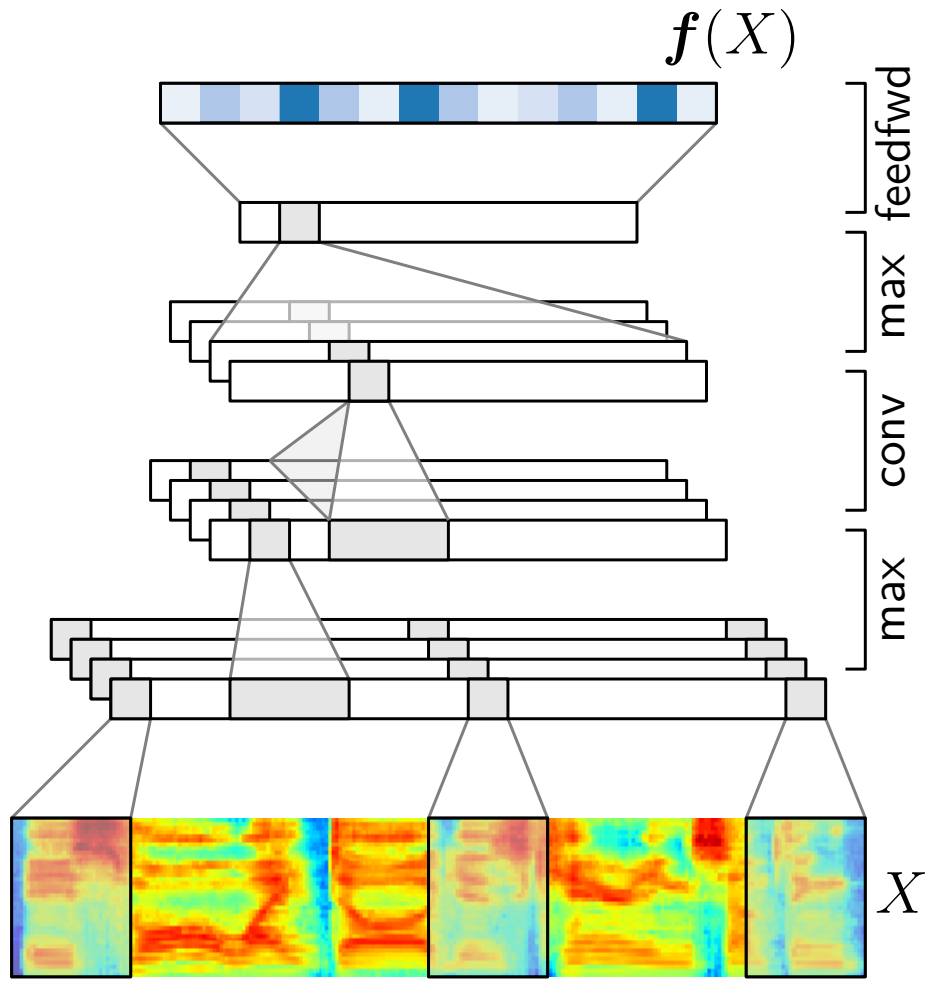

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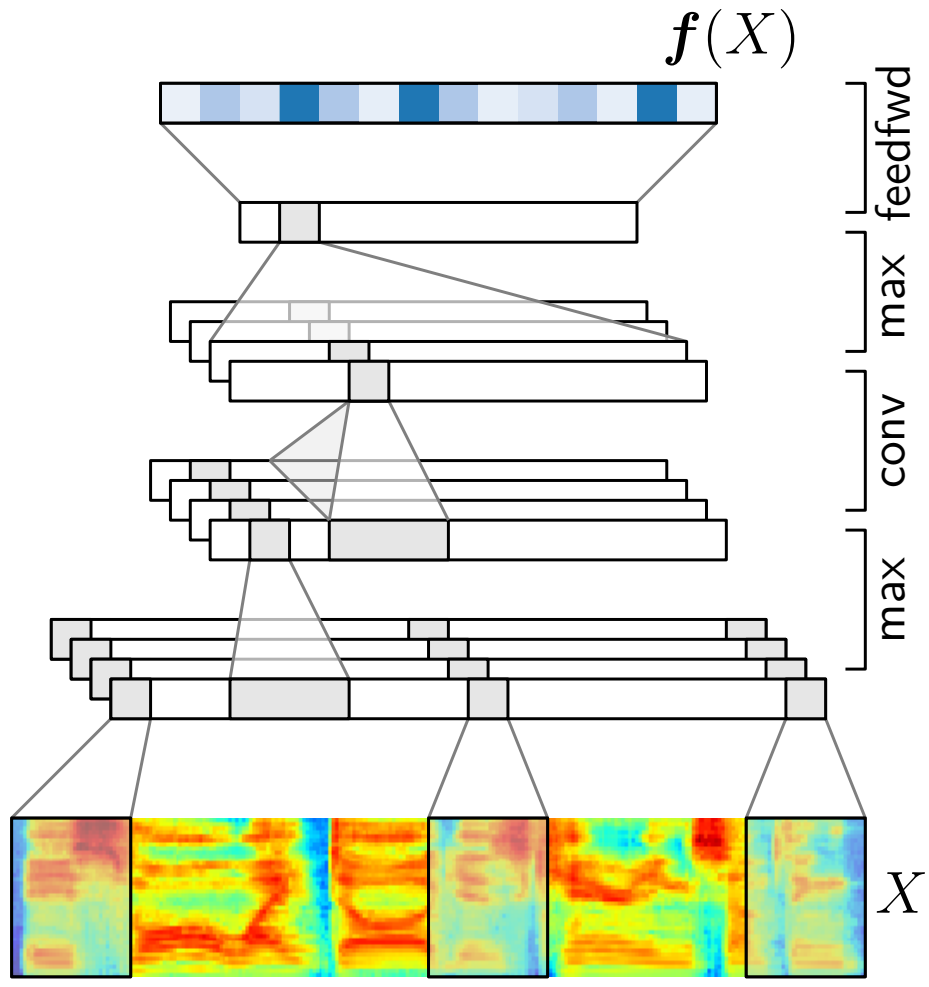

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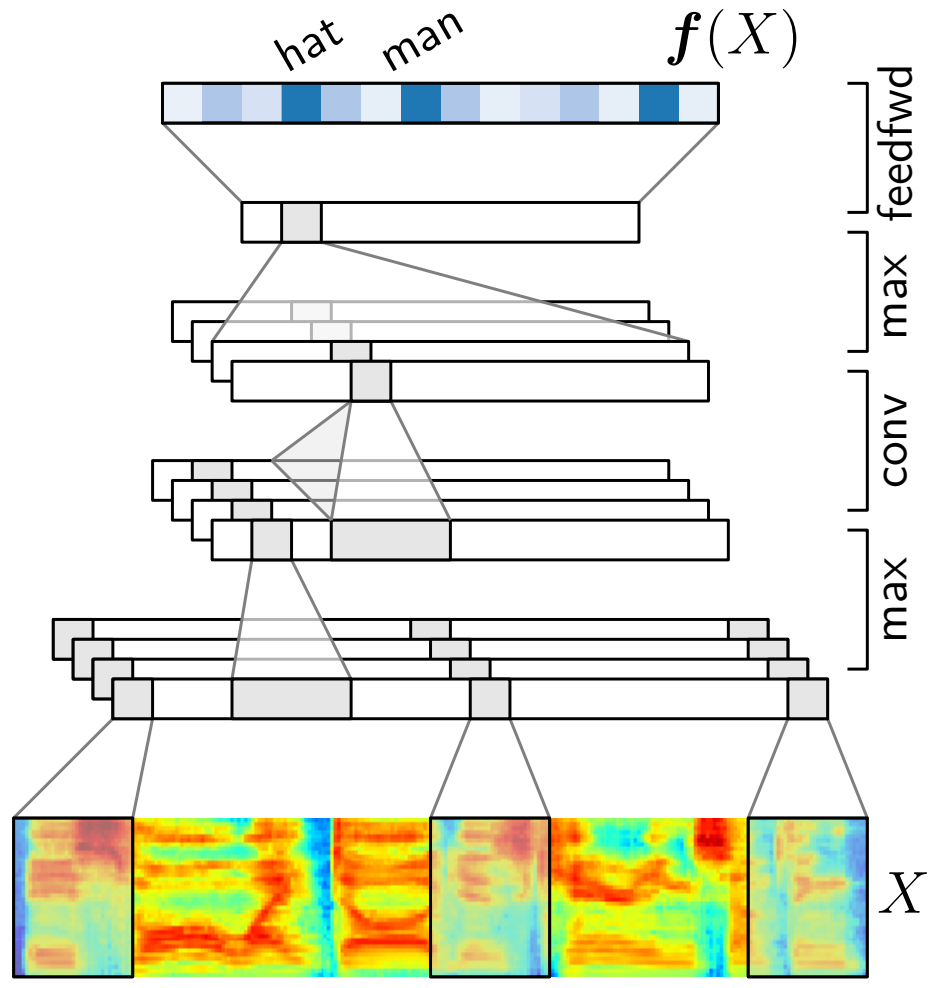

Cross-lingual word prediction from images

$\boldsymbol{f}(X) \in \mathbb{R}^W$ is vector of word probabilities

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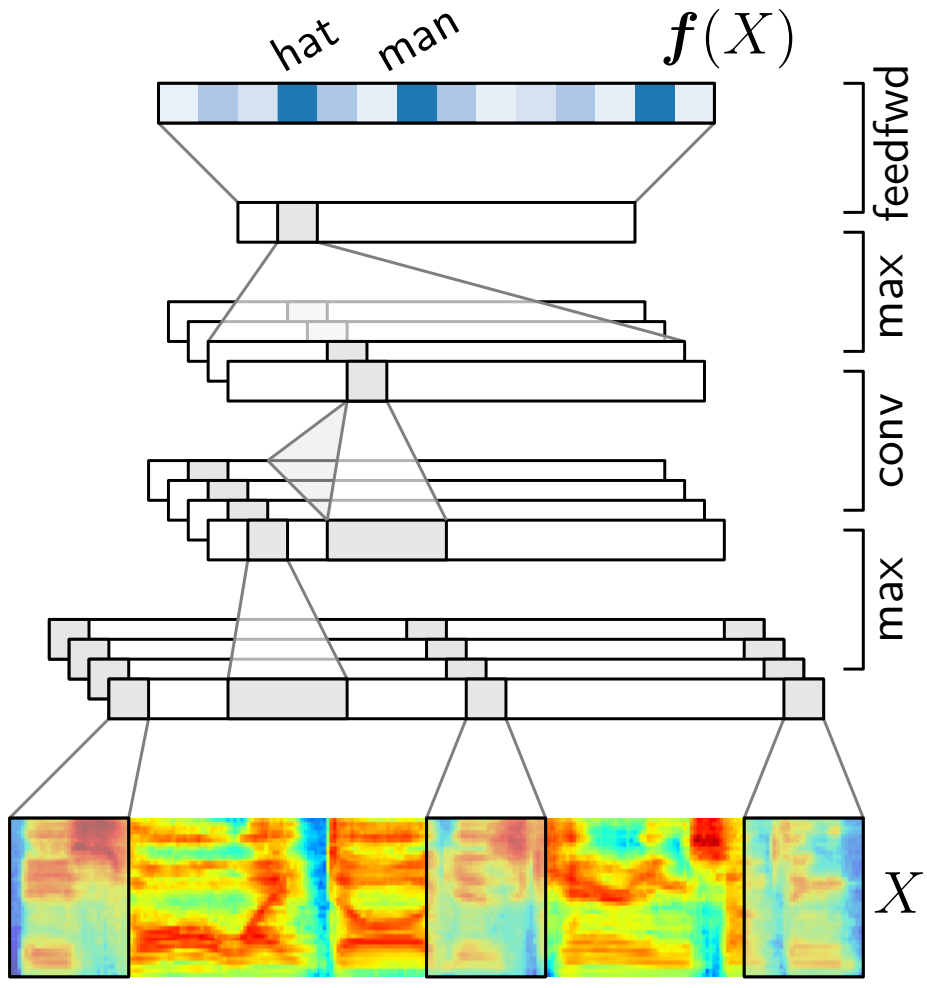

Cross-lingual word prediction from images

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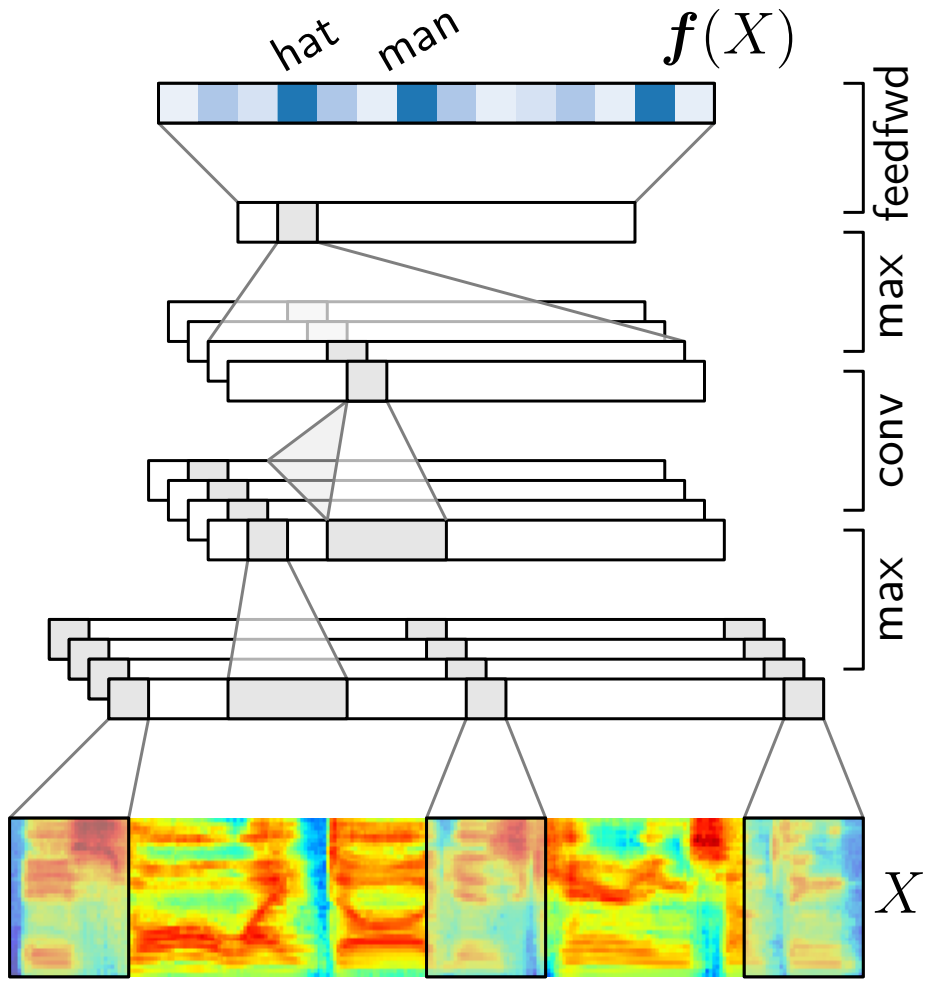
I.e., a cross-lingual spoken bag-of-words (BoW) classifier

Swahili speech



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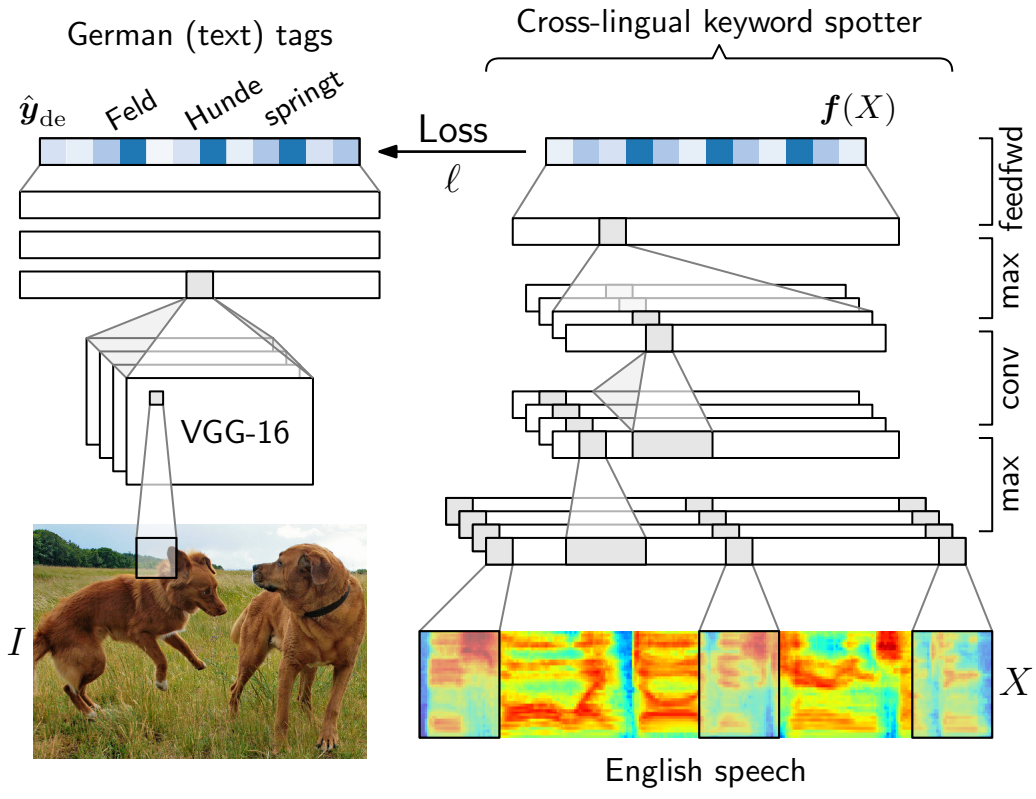

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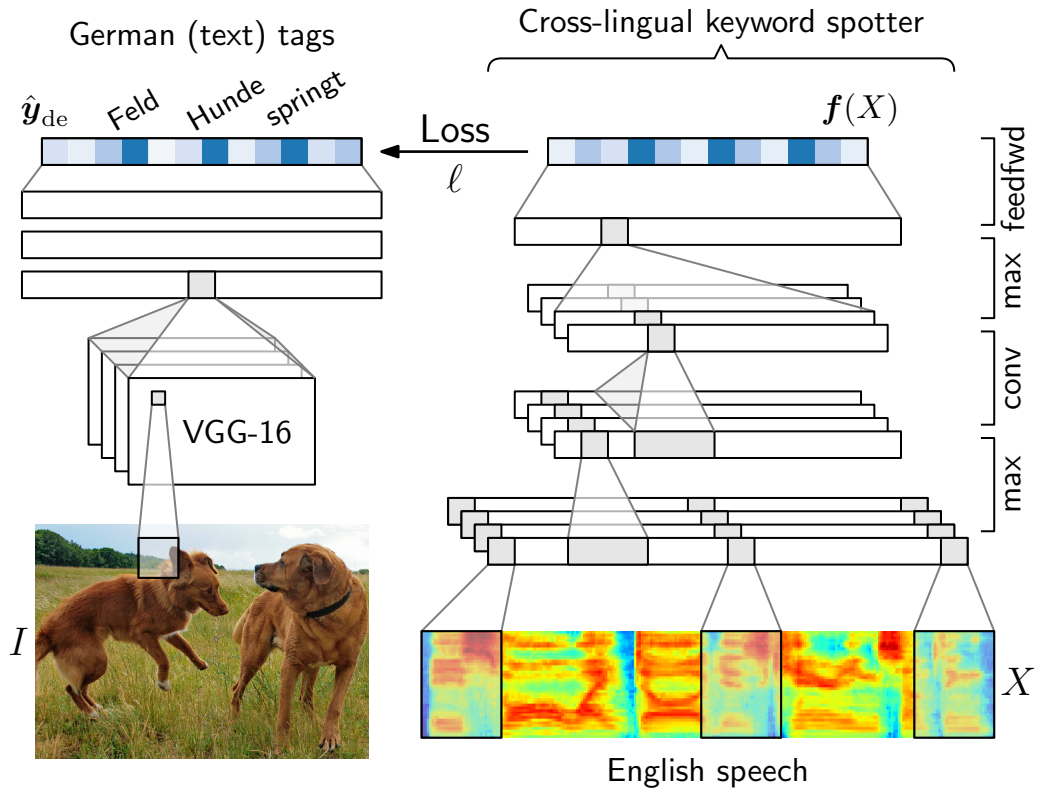
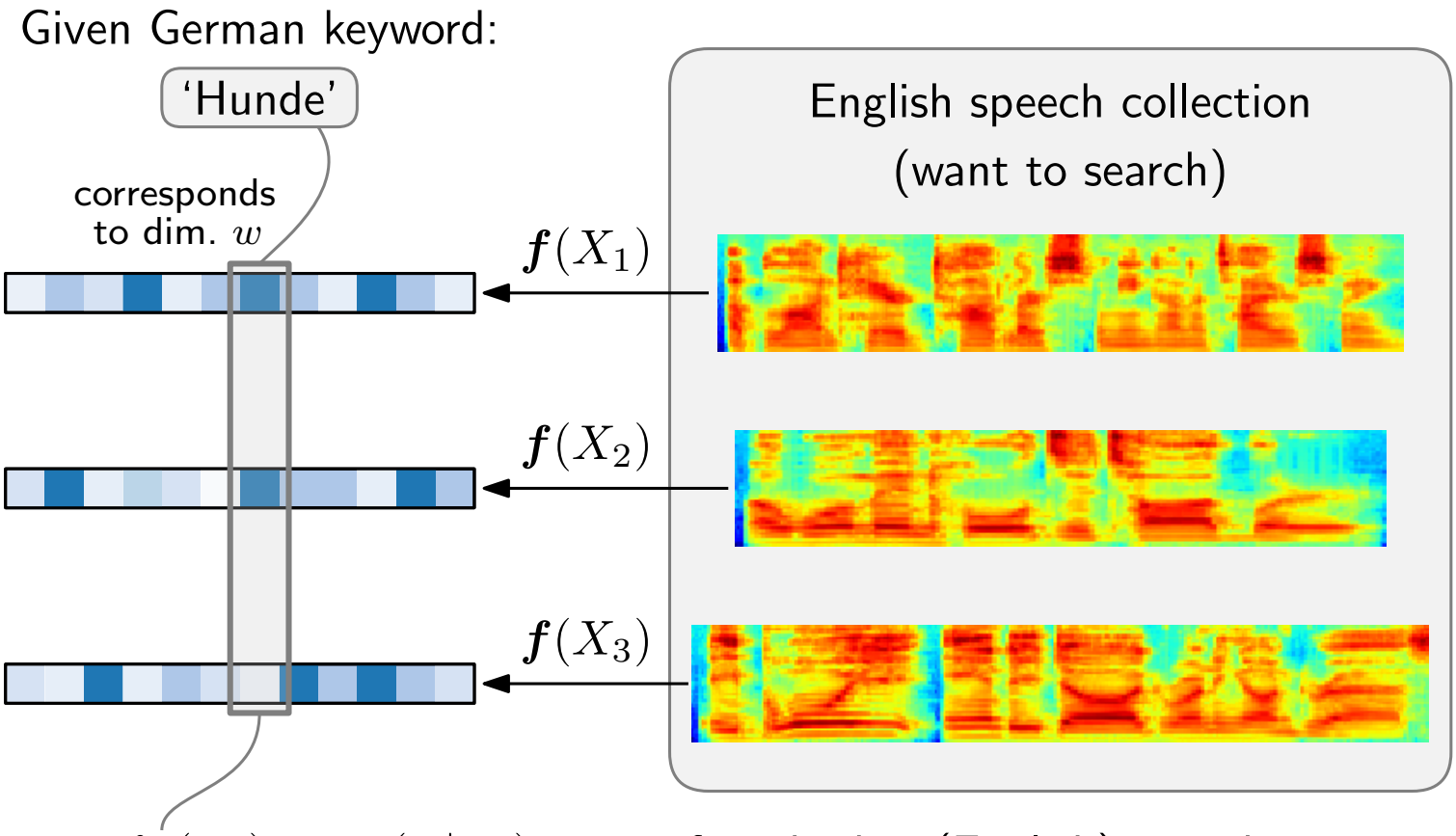


- **Data:** 8000 images with 5 English spoken captions (∼37 hours)
- **Weak labels:** German visual tagger trained on German Multi30k

Predictions on test data



$f_w(X_i) = P_{\boldsymbol{\theta}}(w|X_i)$: score for whether (English) speech X_i contains translation of given (German) keyword w

Evaluation: Does predicted keyword occur in reference translation?

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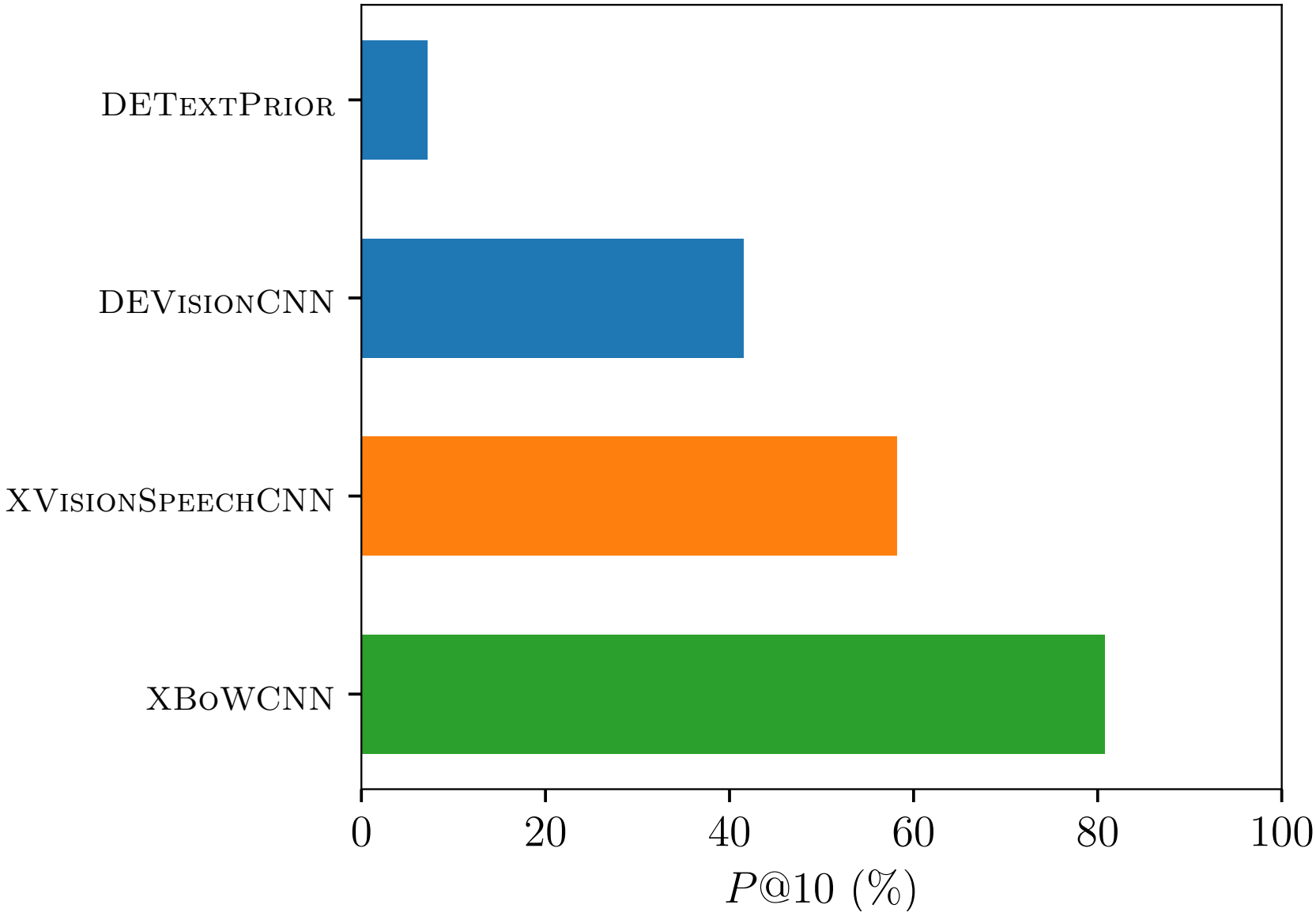
- a woman in black and red listens to an ipod walks down the street
- people on the city street walk past a puppet theater
- an asian woman rides a bicycle in front of two cars

Cross-lingual keyword spotting performance



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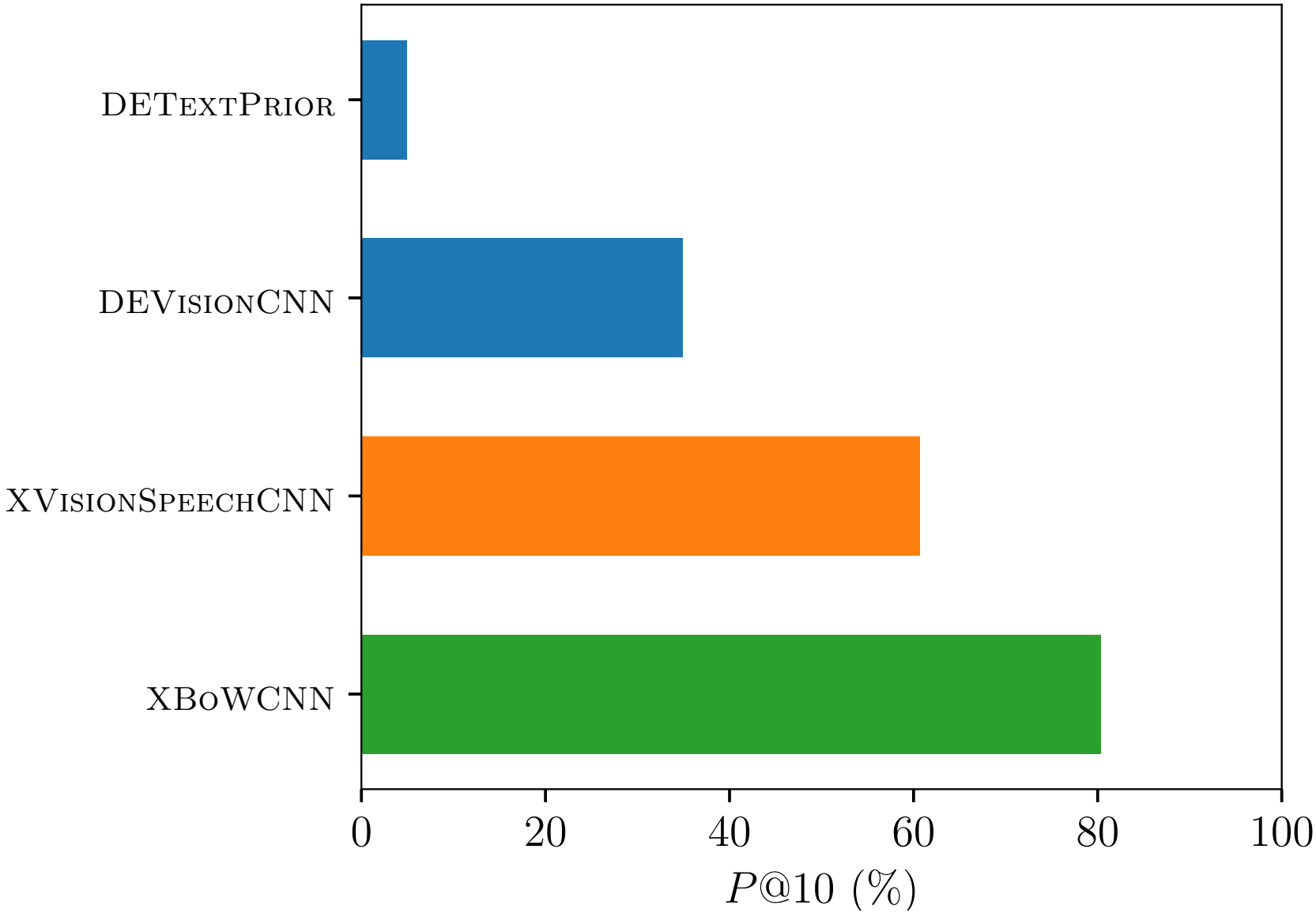
Error analysis by annotator



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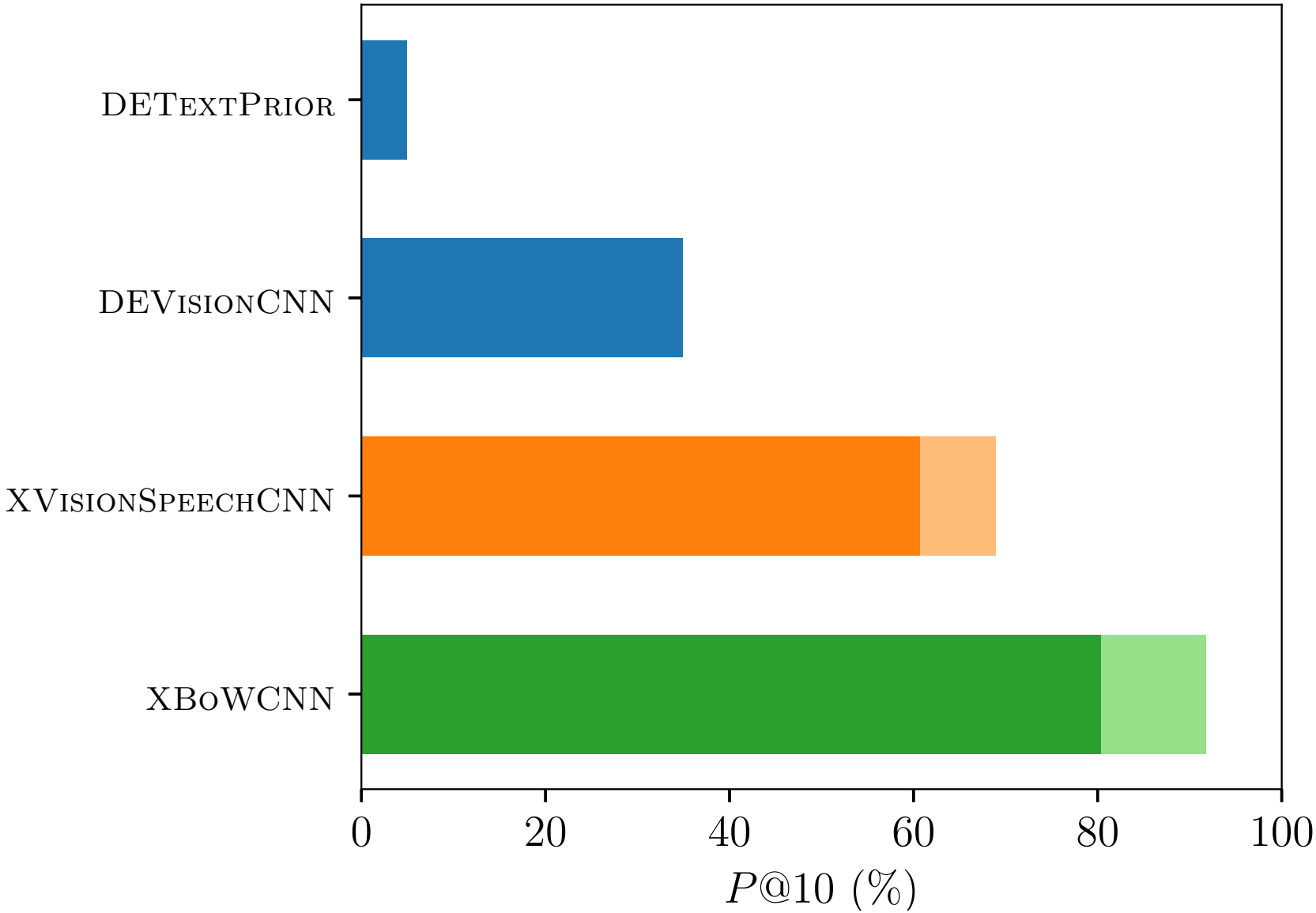

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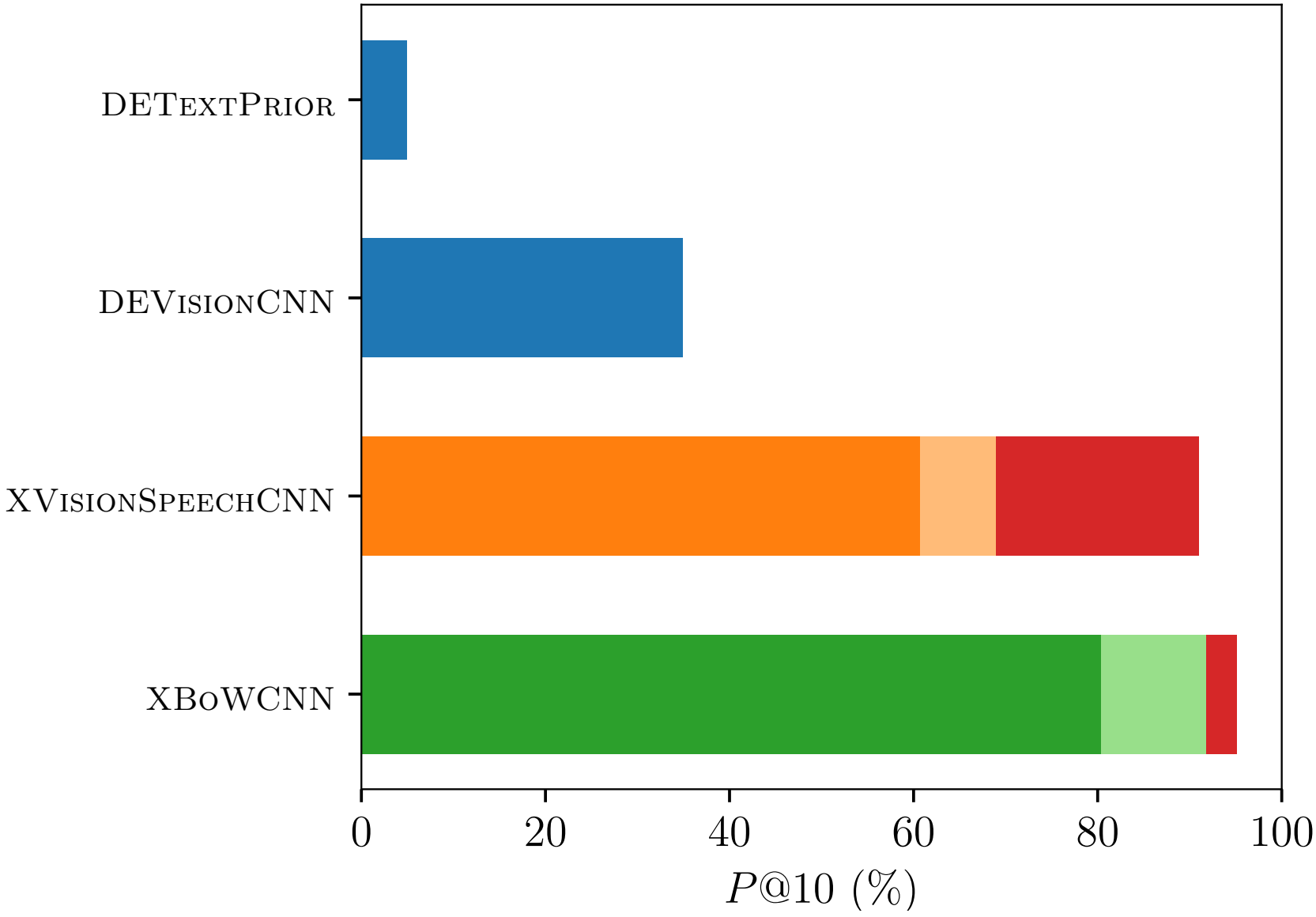

Cross-lingual keyword spotting

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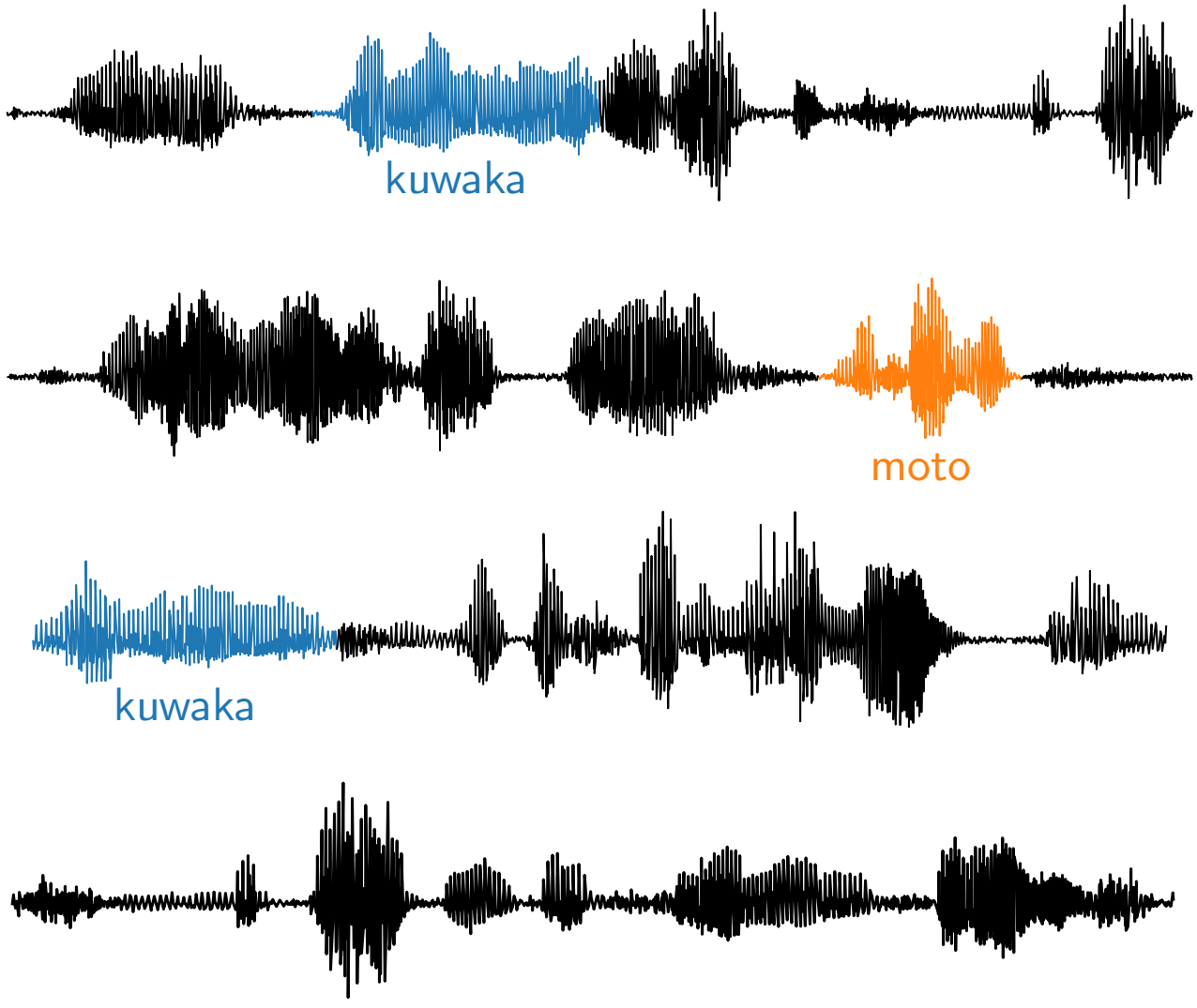
(English)



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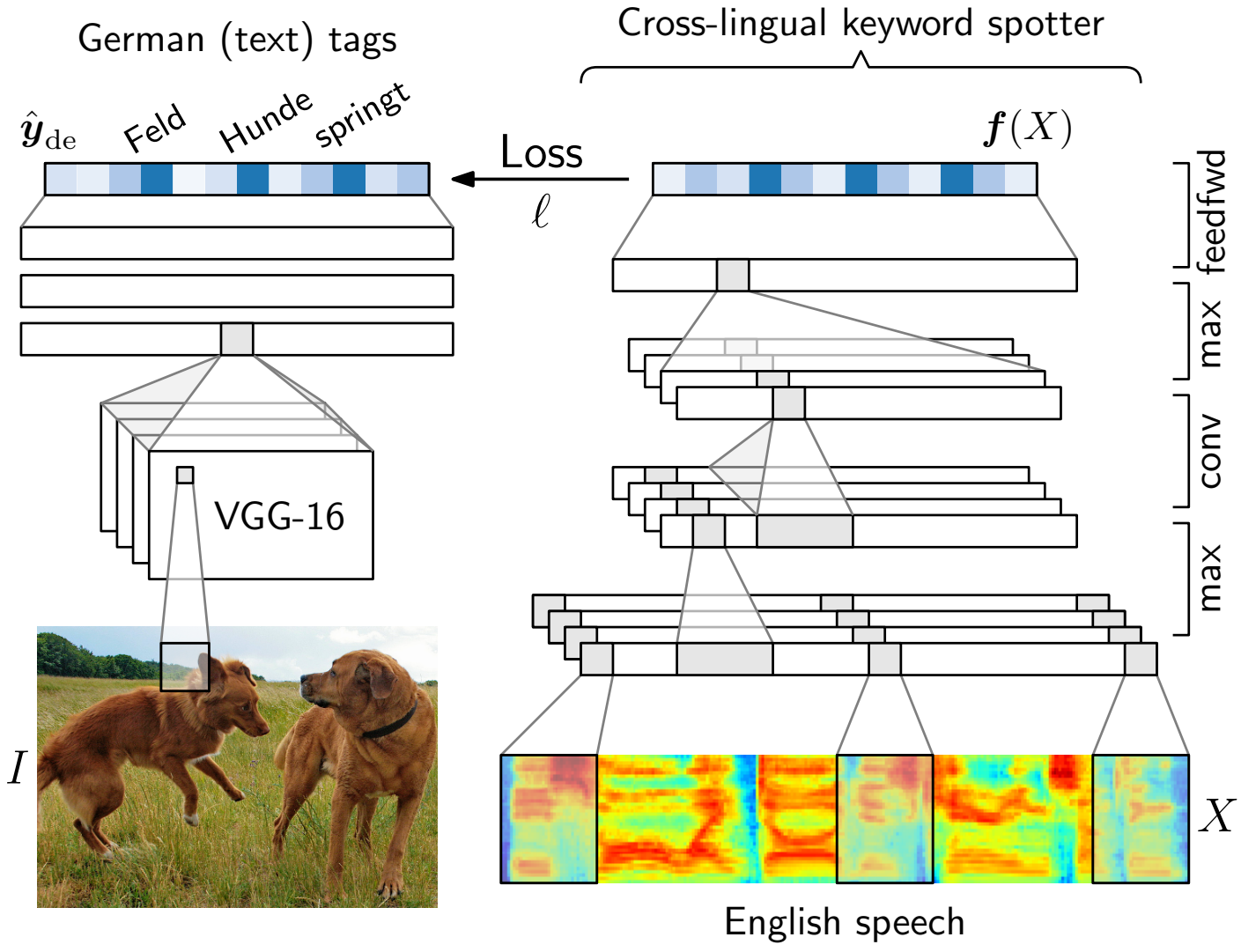
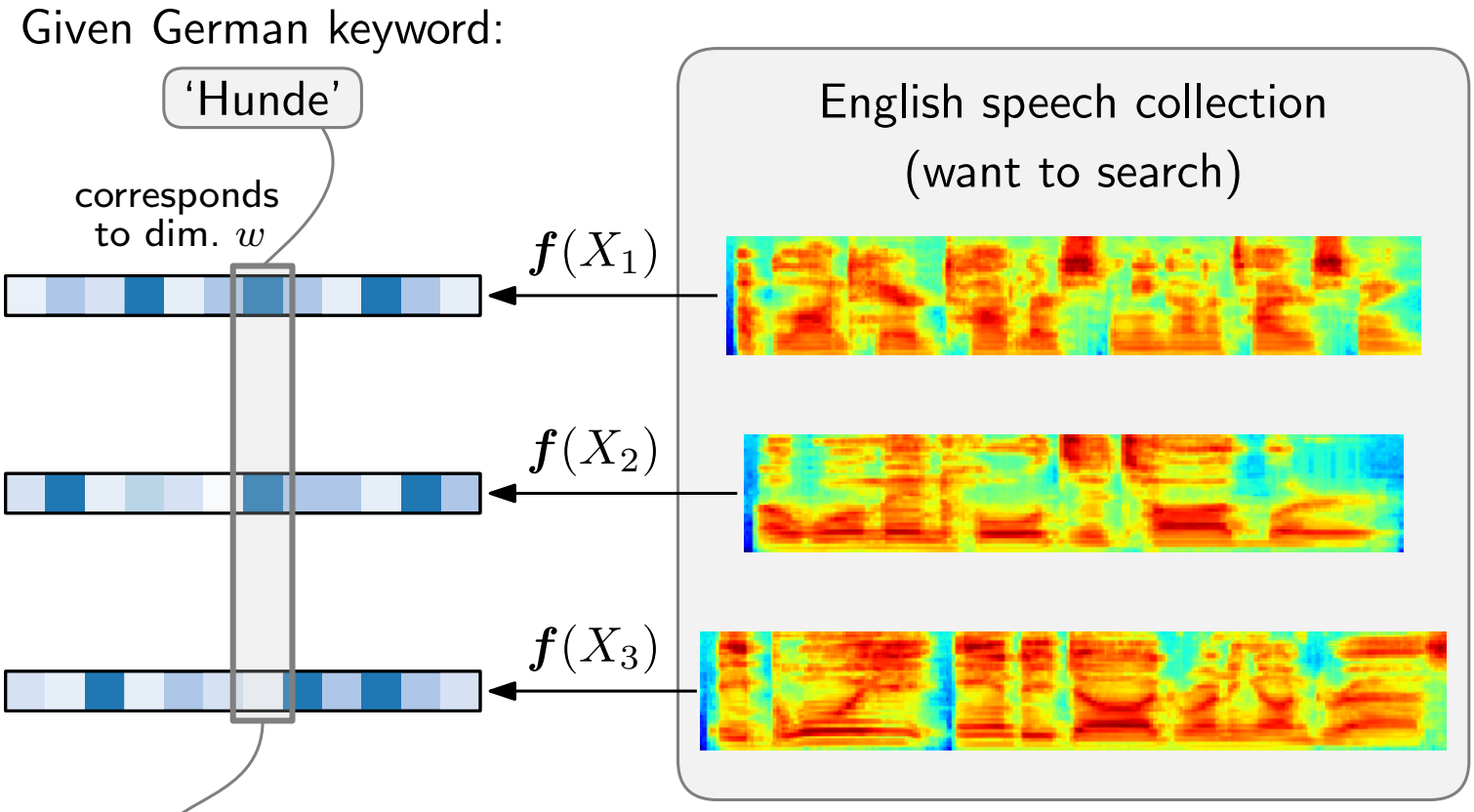
- Future: Apply approach to a truly low-resource language
- Perform error analysis on larger scale
- Visual tagger improvements: language-agnostic visual recognition

https://github.com/kamperh/

Training: Visually grounded model



Testing: Cross-lingual keyword spotting



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