# Am I Stressed? Detecting Stress in Bengali

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## Objectives

- Train a model to detect stress in Bengali, using data from a Bengali speech corpus
- Compare my results against existing accounts of Bengali stress

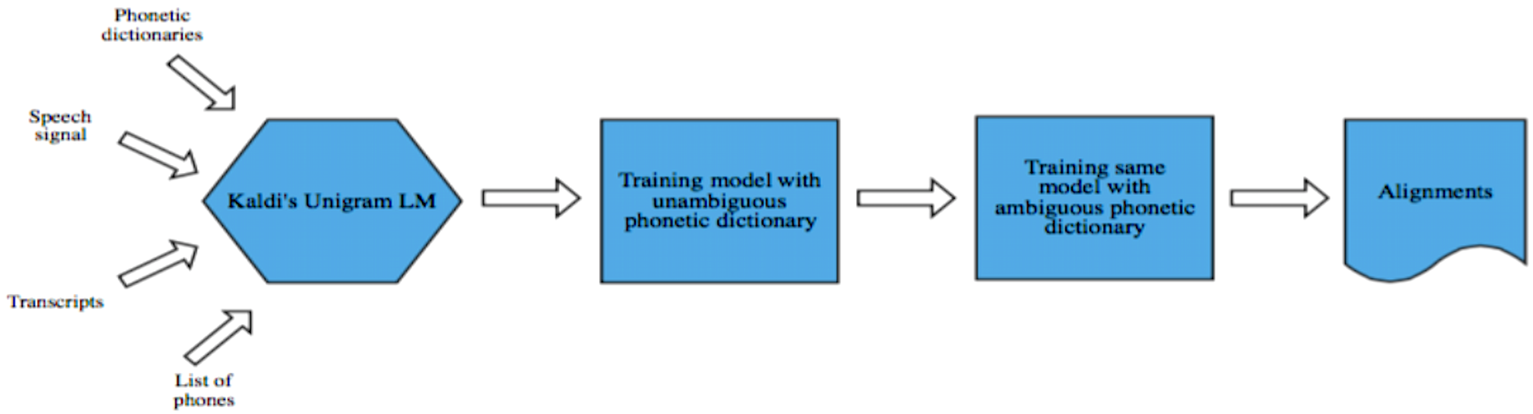
## Existing accounts

- Proposal 1 states that stress falls on the initial syllable (Hayes & Lahiri 1991, Chatterji 1921, Ferguson & Chowdhury 1960).
  - (1) ˈbari
    'house'
  - (2) ˈd̪ʰukeçʰilo
    'entered'
  - (3) ˈmakʰieçʰilen
    'you had mashed'
- Proposal 2 states that stress falls on the initial syllable only if it is heavy (CVC), otherwise on the second syllable (Shaw 1984).
  - (4) ˈsɔŋʃar
    'family'
  - (5) aˈkaʃ
    'sky'
  - (6) koˈbiṭa
    'poem'

- Both proposals agree that stress may fall on the first syllable but only Proposal 2 predicts that stress may fall on the second syllable.
  - (7) ˈbaṭaʃa
    'type of candy'
  - (8) baˈṭaʃa
    'type of candy'

## Proposal

Test the two existing formal accounts of stress by training an ASR (Automatic Speech Recognition) system to detect stress cues in a Bengali speech corpus, Shruti (Mandal et al. 2011).




Overview of training process

## Experiment

- Using Kaldi (an ASR toolkit created by Povey et al. 2011), the sound waves from the corpus were converted to their corresponding vector representations.
- Through OpenFST (a weighted finite-state toolkit created by Allauzen et al. 2007), two finite state models were trained on a phonetic dictionary to map these vector representations to the transcript of an utterance.

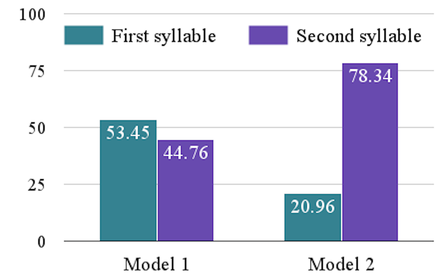
- Model 1:
  - Stage one: Trained on a phonetic dictionary with stress marking on the first syllable
  - Stage two: Trained on a phonetic dictionary which had three variants for each word: no stress marking, stress marking on the first syllable, and stress marking on the second syllable.
- Model 2:
  - Stage one: Trained on a phonetic dictionary with stress marking on the second syllable
  - Stage two: Trained on the phonetic dictionary which had three variants for each word: no stress marking, stress marking on the first syllable, and stress marking on the second syllable.

## Selected References

Chatterji, S. K. (1921). Bengali phonetics. *Bulletin of the School of Oriental and African Studies, 2*(01), 1–25.
Ferguson, C. A., & Chowdhury, M. (1960). The phonemes of Bengali. *Language, 36*(1), 22-59.
Hayes, B., & Lahiri, A. (1991). Bengali intonational phonology. *Natural Language & Linguistic Theory, 9*(1), 47-96.
Shaw, R. (1984). Stress-patterns in Bengali and Hindi: A comparative study. *Papers in phonetics and phonology: proceedings of an institute.* Mysore: Central Institute of Indian Languages.
Mandal, S., Das, B., Mitra, P., & Basu, A. (2011). Developing Bengali speech corpus for phone recognizer using optimum text selection technique. In *International Asian Language Processing Conference(IALP 2011).* 268–271. IEEE.

## Results

- Although initially trained on different phonetic dictionaries, in stage two both models detected stress on both the first and second syllables.
- The percentages are given in the bar graph:




Comparison of stress placement between two models

- These results cannot be explained by the training probabilities. Since the models detected stress in positions they were not trained on, it illustrates that the models learned to detect stress cues in this study.

## Conclusion

- Model 1 & Model 2 detect stress cues on both the first and second syllable and thus, this suggests word-level stress is not strictly word-initial (supports Proposal 2).
- Finite-state models can be trained to detect prosodic and suprasegmental phonological features in natural language.

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