Towards Inclusive Automatic Assessments of Children's Oral Language Development

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Children's Oral Language Assessments

Tests of children's speaking, language, and comprehension skills designed to:

- Identify children who may be falling behind their appropriate grade level
- Monitor for speech difficulties that need intervention through speech -language pathology

Focus of the study is on automatic assessments for African American English   -speaking children
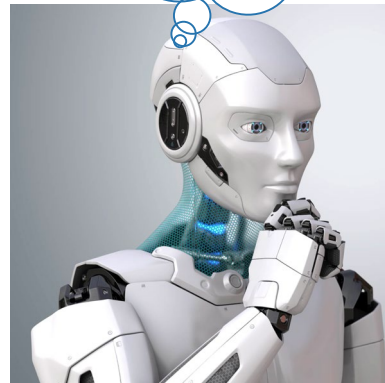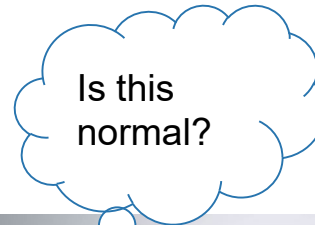
Children's Oral Language Assessments

Example Assessment Prompt:

- Please describe the picture as completely as possible

Children's Oral Language Assessments

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- Please describe the picture as completely as possible

Sample responses:

1. That boy, he ain't got no umbrella
2. Dhose kids takin' dhey time walkin' cross da street
3. She had aksed her mom take her home

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Children's Oral Language Assessments

- Assessments need to account for dialectal differences to indicate if an intervention is needed
- Can machines also be trained to do this?

Is this normal?

Unstressed syllable deletion

Inconsistent use of verb tense

Overregularization in conjugation of irregular verb

Metathesis of final /s/+stop (eg. "ask" as "aks")

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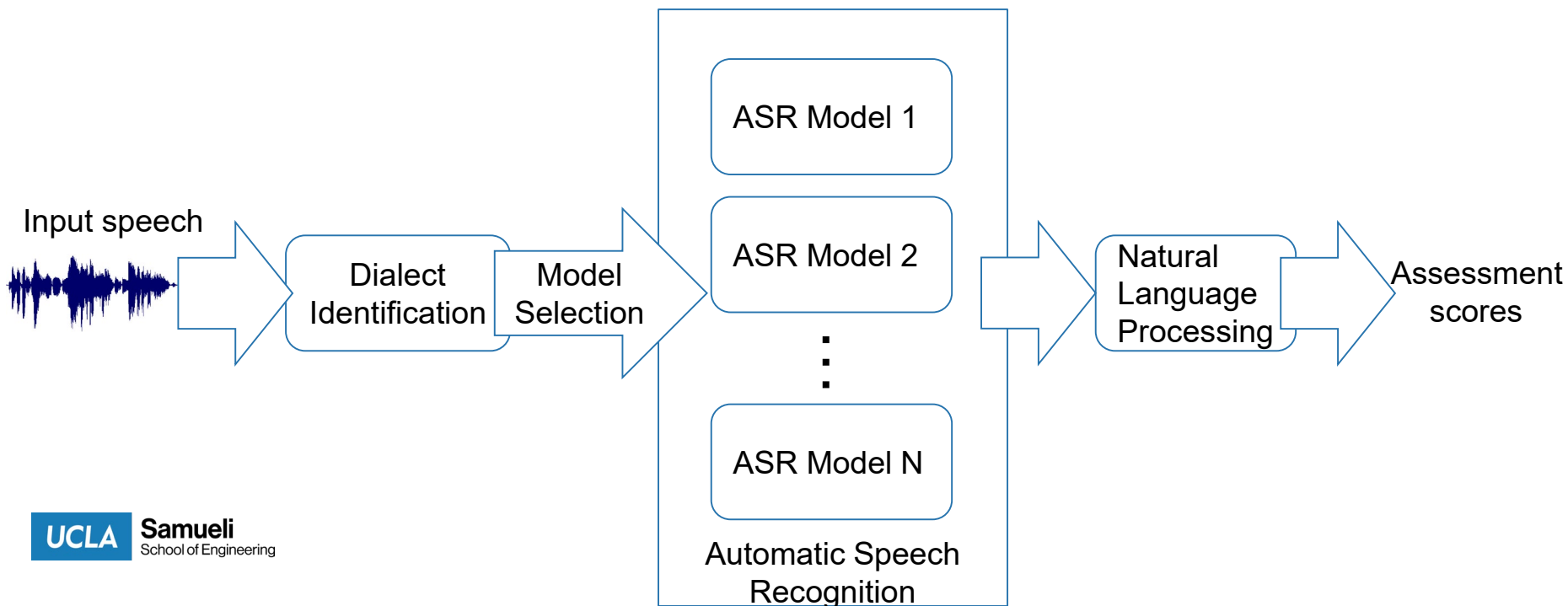
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Challenges for a machine

- Lack of training in -domain training data
- Variability in children's speech
- Variability across and within dialects (eg. code - switching)

Our Framework

A possible pipeline for oral language assessment scoring for African American English and Southern American English Speaking kids from Georgia, USA
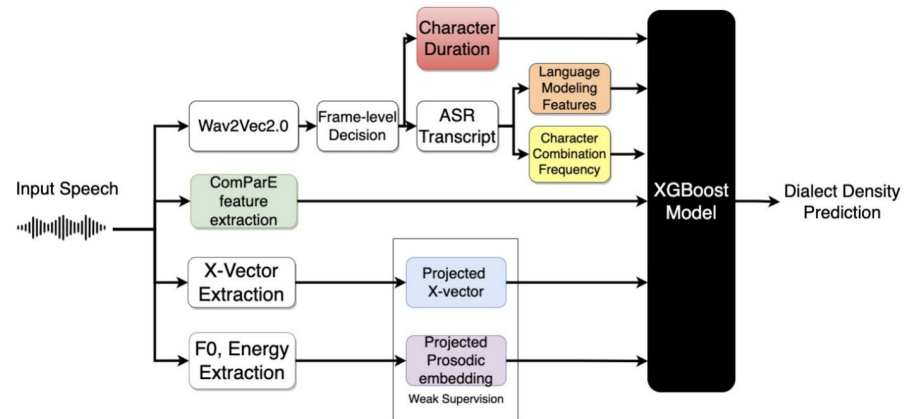

Input speech → Dialect Identification → Model Selection → Automatic Speech Recognition (ASR Model 1, ASR Model 2, ... ASR Model N) → Natural Language Processing → Assessment scores

Dialect Identification and Dialect Density Scoring

1. ## Extract known linguistic features of dialect

   - Phonetic Modeling (ASR features)
   - Language Modeling (Perplexity and surprisal)
   - Speaker Identification (X-vectors)
   - Paralinguistics (ComParE16 feature set)
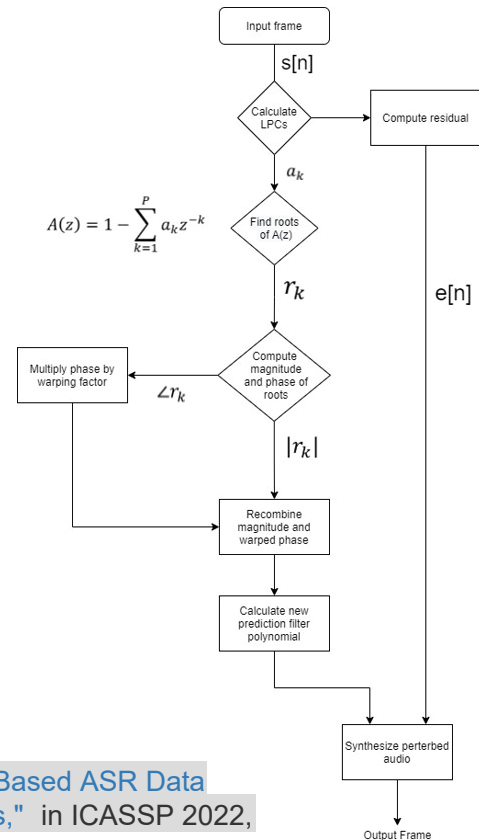   - Prosodic Modeling (Energy, Duration, Pitch)

1. ## Train a classifier to predict dialect and strength of dialect from the input features

A. Johnson, K. Everson, V. Ravi, A. Gladney, M. Ostendorf, and A. Alwan, "Automatic Dialect Density Estimation for African American English," in Interspeech 2022, 1283-1287, doi: 10.21437/Interspeech.2022796

Improved Dialect and Age -specific ASR

We fine-tune child-specific ASR models and apply data augmentation for low-resource dialects

Schematic of LPCAugment - a data augmentation method created to shift vowel formant frequencies in a manner characteristic of southern dialectal shifts

$$A(z) = 1 - \sum_{k=1}^{P} a_k z^{-k}$$

A. Johnson, R. Fan, R. Morris, and A. Alwan, "LPC AUGMENT: An LPC-Based ASR Data Augmentation Algorithm for Low and Zero -Resource Children's Dialects," in ICASSP 2022, doi:https://doi.org/10.1109/ICASSP43922.2022.9746281, page 8577-8581
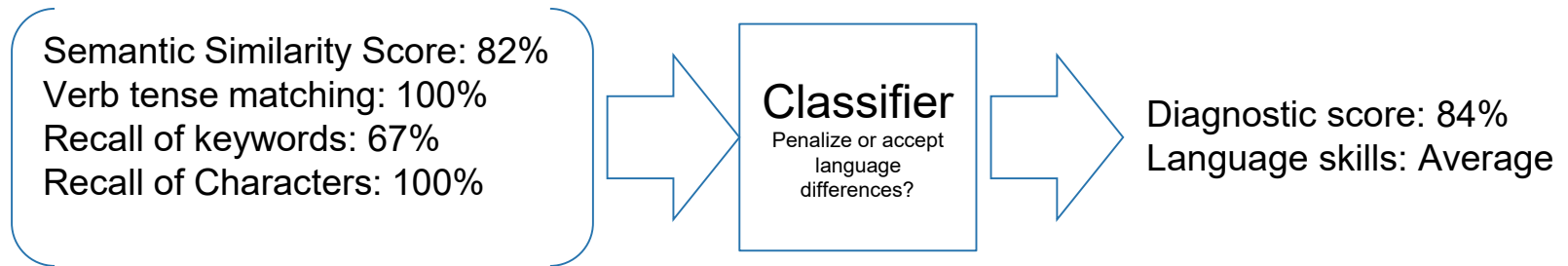
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NLP for Oral Assessments Scoring

Given the best transcripts, we then extract NLP features and train a classifier to give a score for the assessment

Groundtruth Test item: Jake and Todd asked their mom for **pizza**, **hamburgers**, and **ice cream**

ASR Transcript: Jake and Todd aksed they mom for **pizza** and **ice cream**

Semantic Similarity Score: 82%
Verb tense matching: 100%
Recall of keywords: 67%
Recall of Characters: 100%

Classifier
Penalize or accept language differences?

Diagnostic score: 84%
Language skills: Average

Thank you for listening

Questions welcome