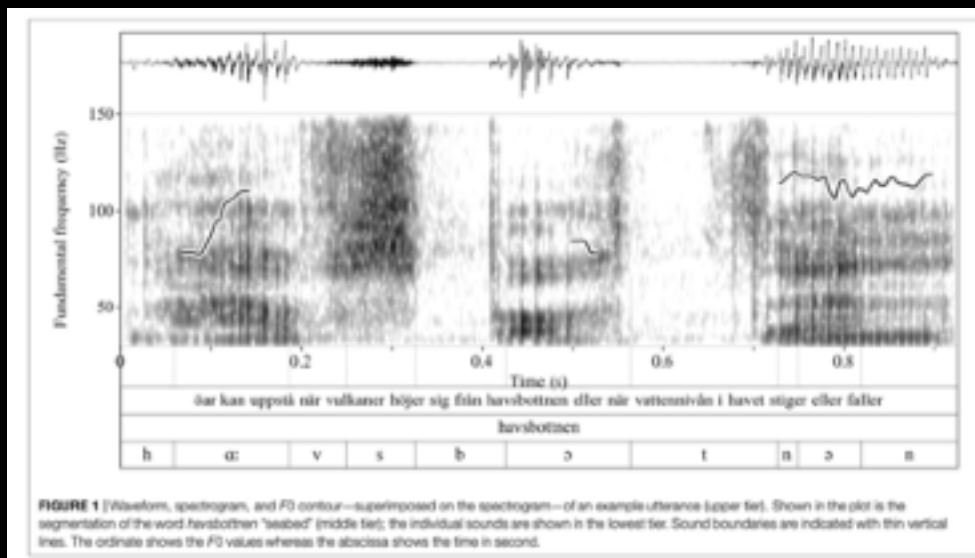# Patients with MCI

- Individuals with mild cognitive impairment (MCI) portray a noticeable memory difficulty in remembering events and situations along with problems in decision making, planning, interpreting instructions, and orientation.

- These cognitive problems become frequent and more severe compared to the cognitive decline in normal aging. As the MCI progresses, MCI individuals face a higher risk of developing Alzheimer's Disease (AD).

- The development of automated machine learning models that can learn the characteristics of MCI and provide an early and accurate identification of MCI is of utmost importance for two main reasons:
  - First, an early identification can enable multidomain lifestyle interventions and/or pharmacological treatments at the MCI stage, or even earlier, which can potentially delay or might even prevent the development of AD and other types of dementia.
  - Second, the early identification, will provide time to patients and their families to make decisions about their care, family issues, and legal concerns.

Identifying Patients with MCI from Healthy Controls

Patients with MCI and HC from Sweden

FIGURE 1 | Waveform, spectrogram, and F0 contour—superimposed on the spectrogram—of an example utterance (upper tier). Shown in the plot is the segmentation of the word *havsbotten* "seabed" (middle tier); the individual sounds are shown in the lowest tier. Sound boundaries are indicated with thin vertical lines. The ordinate shows the F0 values whereas the abscissa shows the time in second.

X input features where
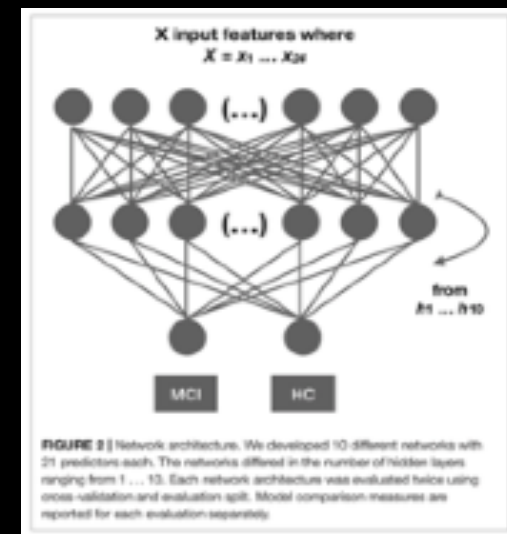$X = x_1 ... x_{21}$

FIGURE 2 | Network architecture. We developed 10 different networks with 21 predictors each. The networks differed in the number of hidden layers ranging from 1 ... 13. Each network architecture was evaluated twice using cross-validation and evaluation split. Model comparison measures are reported for each evaluation separately.
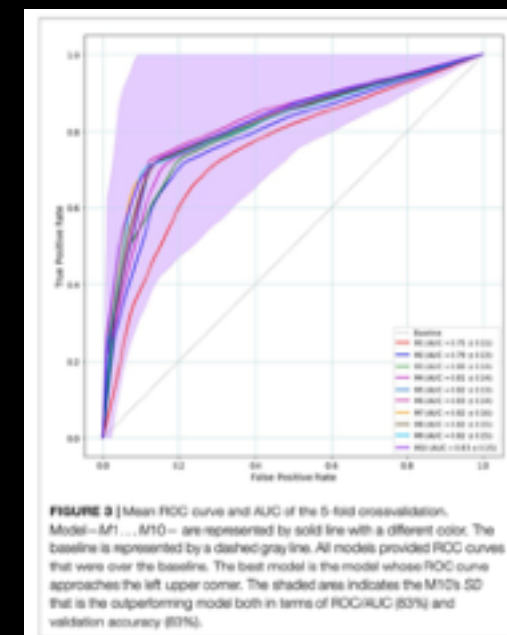
FIGURE 3 | Mean ROC curve and AUC of the 5-fold cross-validation. Model—M1 ... M10— are represented by solid line with a different color. The baseline is represented by a dashed gray line. All models provided ROC curves that were over the baseline. The best model is the model whose ROC curve approaches the left upper corner. The shaded area indicates the M10's SD that is the outperforming model both in terms of ROC/AUC (83%) and validation accuracy (83%).

Automatic Segmentation and Transcription

1. Vowel Formants (i.e., $F1$, $F2$, $F3$, $F4$, $F5$) at the 15%, 50%, and 75% of the vowels' total duration: i.e., $F1$ 15%, $F1$ 50%, $F1$ 75%...$F5$ 15%, $F5$ 50%, and $F5$ 75%.
2. Fundamental frequency ($F0$): *mean $F0$, min $F0$,* and *max $F0$.*
3. Vowel duration
4. Gender.
5. Age

Themistocleous Charalambos, Eckerström Marie, and Dimitrios Kokkinakis (2018). Identification of Mild Cognitive Impairment from Speech in Swedish using Deep Sequential Neural Networks. *Frontiers in Neurology*. doi: 10.3389/fneur.2018.00975.