DeepFM learns high-order **feature interactions** while preserving the ease of **interpretability** of a linear model.

Alzheimer's Disease Diagnosis via Deep Factorization Machine Models

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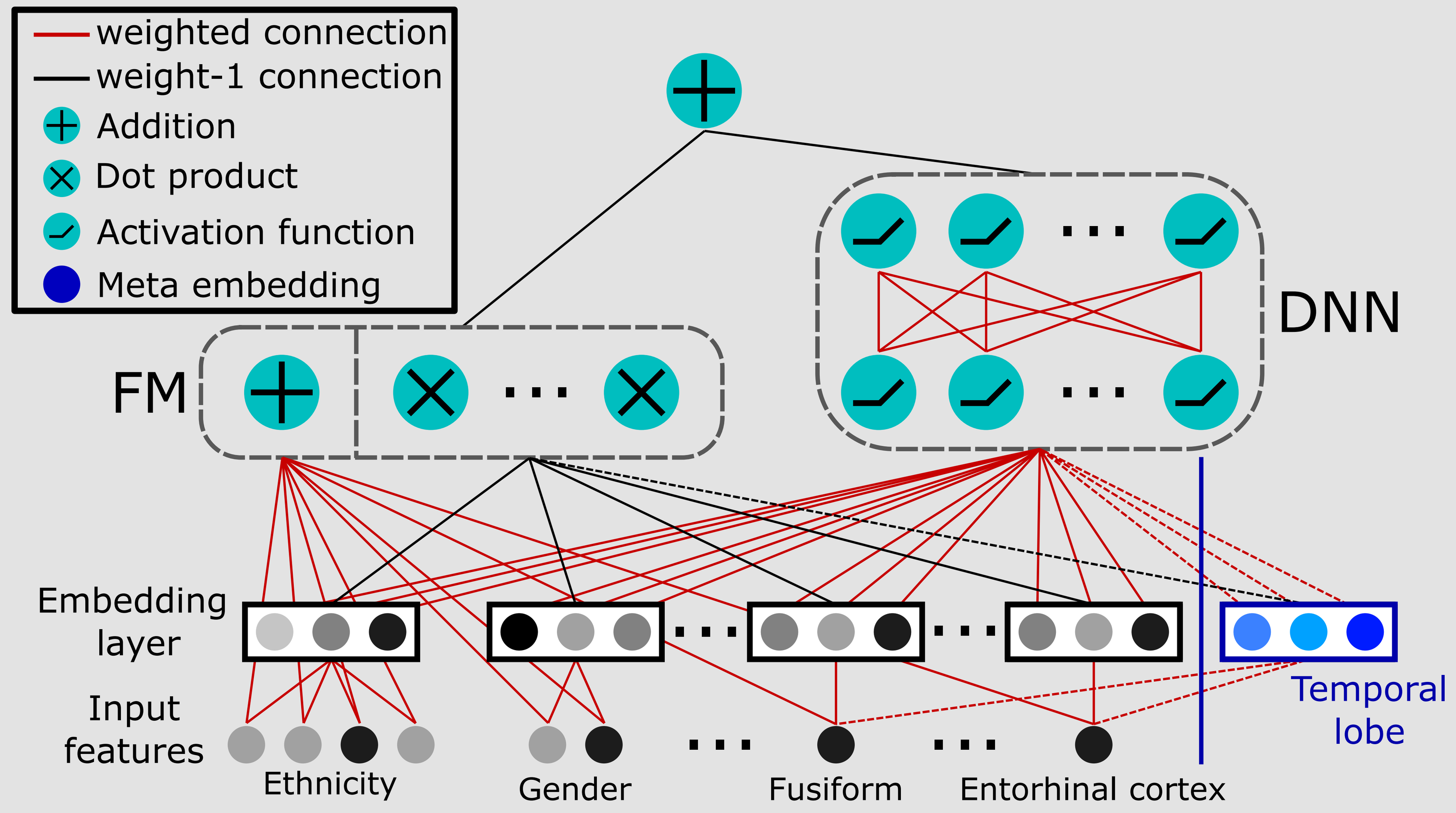
Background

- Alzheimer's Disease is a neurodegenerative disease whose progression is highly heterogeneous.
- Several important biomarkers exist:
  - Demographics
  - Volume and thickness of brain structures
  - Single nucleotide polymorphisms
  - Biomarkers in cerebrospinal fluid
- *Patient stratification*: Need to consider the **inter-relationships between biomarkers**.
- Neural networks learn all interactions *implicity* ⇒ not interpretable.
- Linear models require interactions to be defined *explicitly* ⇒ highly interpretable.

Methods

- *Goal*: Combine the interpretability of a linear model and the discriminatory power of a deep neural network.
- DeepFM has 3 components:
  1. Embedding layer to model *sparse and grouped data.*
  2. Factorization Machine (FM) to learn *pairwise interactions* explicitly (in linear time).
  3. Multi-layer perceptron (DNN) to implicitly learn *higher-order interactions.*
- *Meta-embedding*: Combine volume measurements of larger brain regions into a single embedding vector.

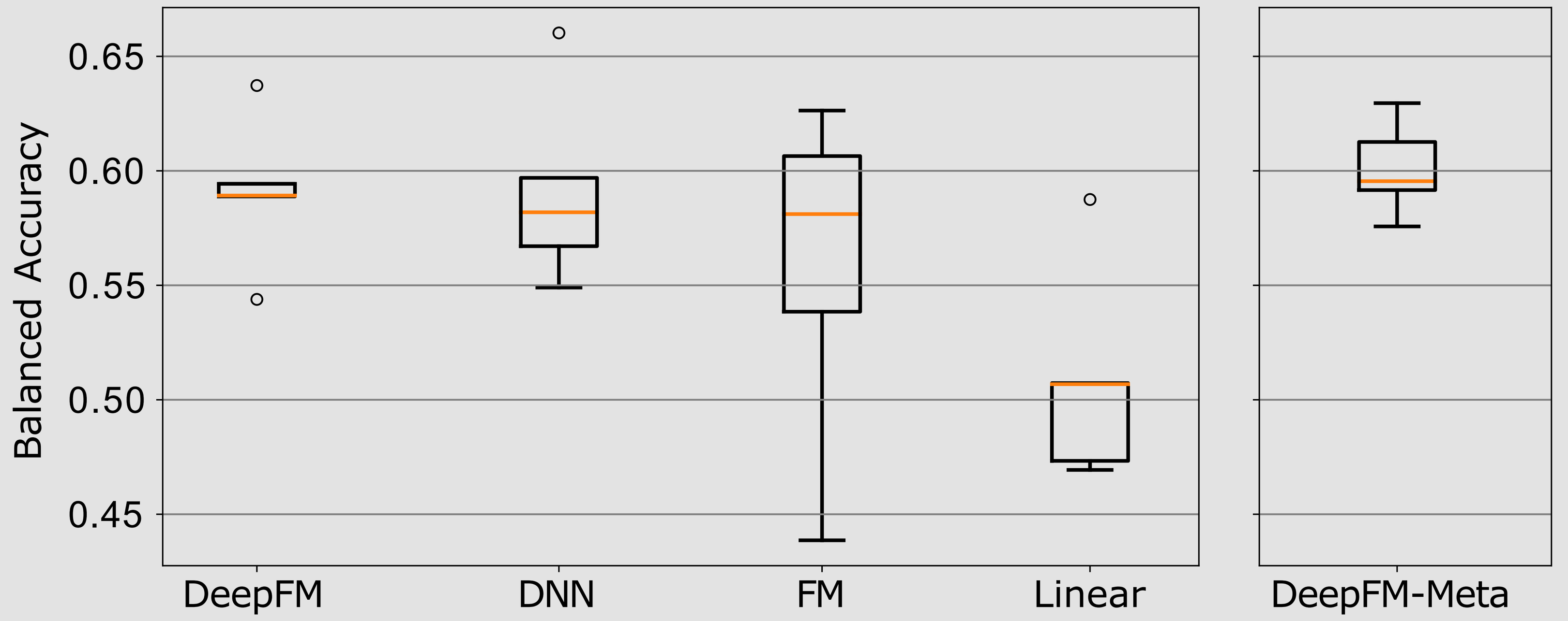


Experiments

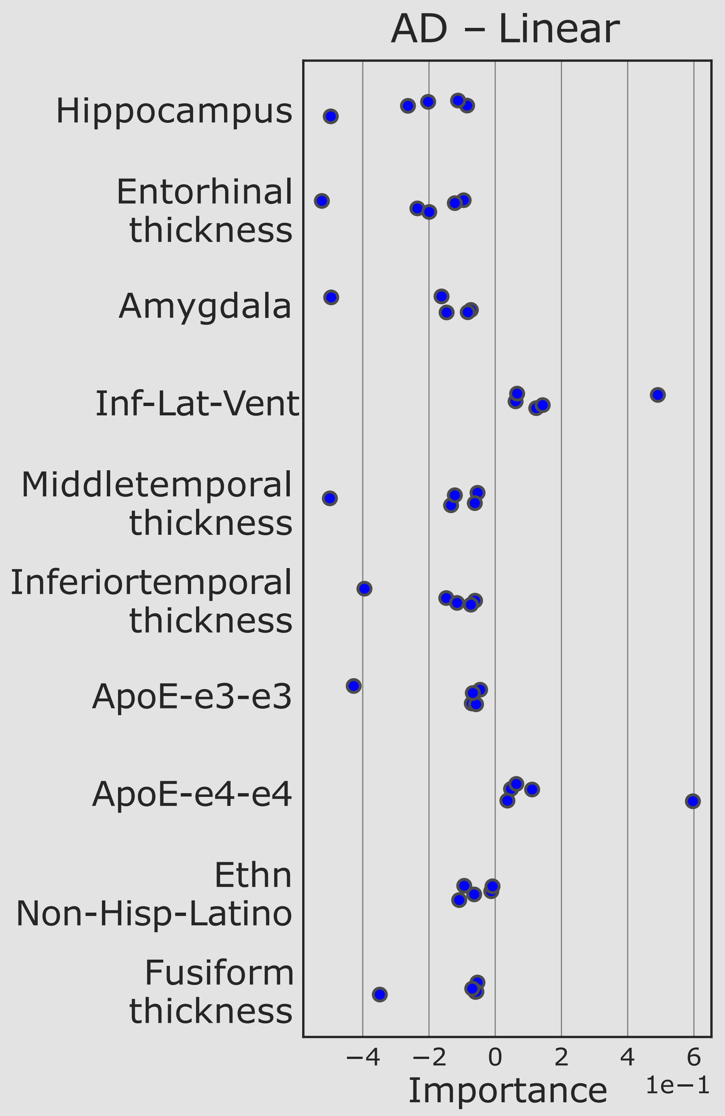
- 5-fold cross-validation.
- Data from the Alzheimer's Disease Neuroimaging Initiative:
  - 1492 patients with 6844 visits: Dementia (AD; 1536 visits), Mild Cognitive Impaired (MCI; 3131 visits), Cognitive Normal (CN; 2177 visits).
  - 20 volume and 34 thickness measurements.
  - CSF biomarkers: $A\beta_{42}$, Tau, p-Tau.
  - 41 genetic markers.

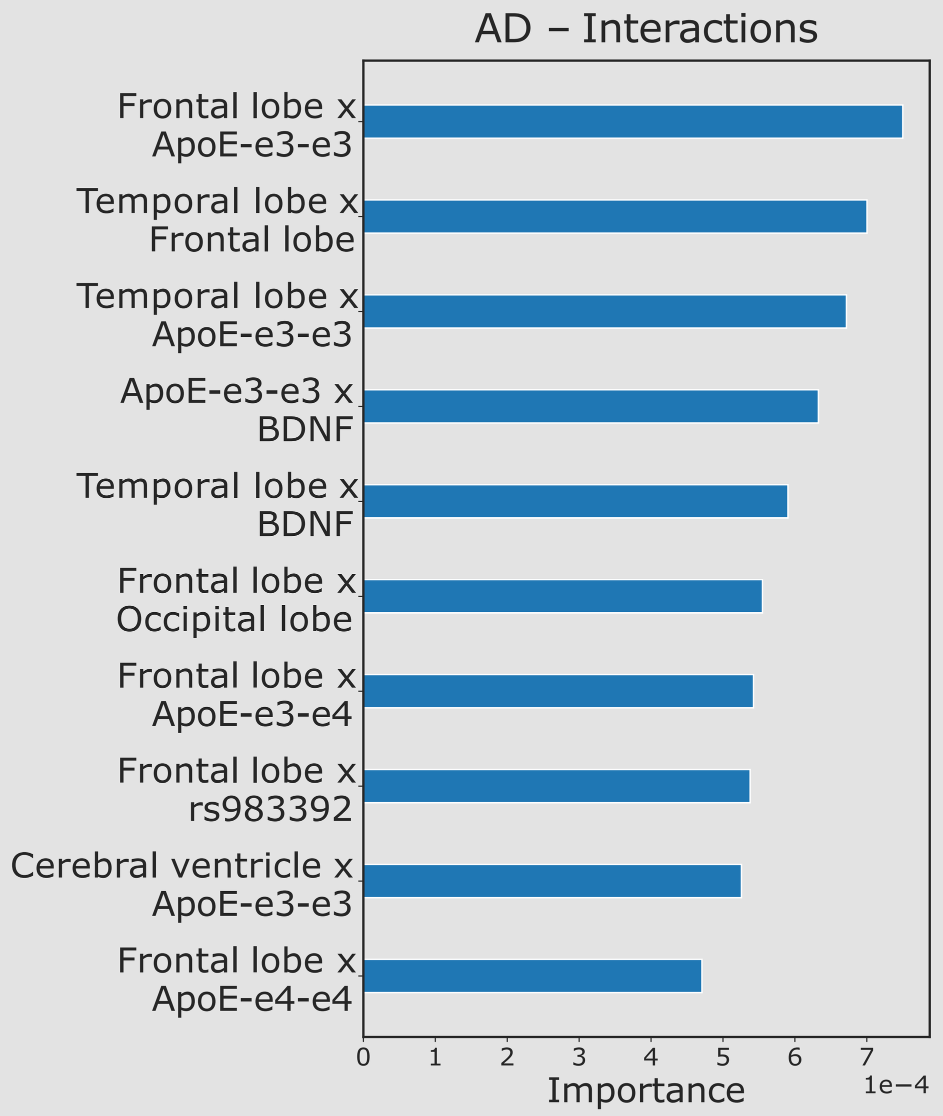
Results

- Predictive Performance:



- Interpretability:





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