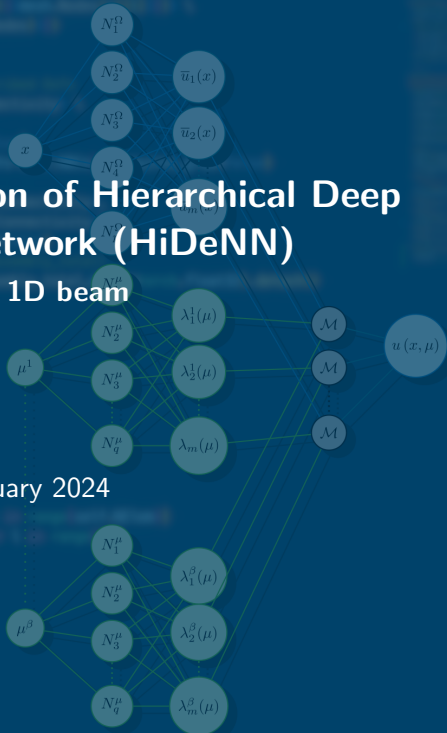


# Parametric implementation of Hierarchical Deep Learning Neural Network (HiDeNN)

1 parameter, 1D beam

29<sup>th</sup> of February 2024



- Tensor decomposition

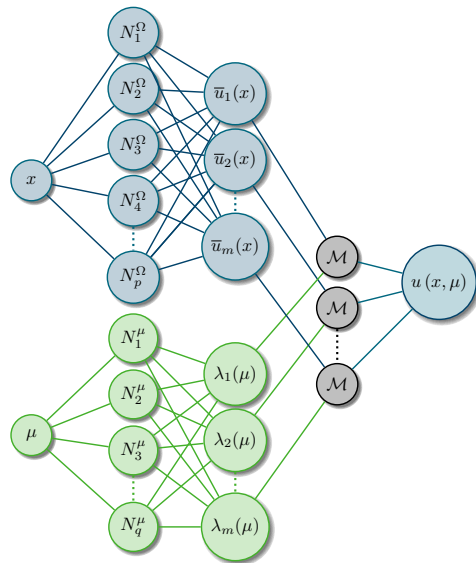
$$\blacktriangleright \mathbf{u}(\mathbf{x}, \boldsymbol{\mu}) = \sum_{i=1}^m \bar{\mathbf{u}}_i(\mathbf{x}) \lambda_i(\boldsymbol{\mu})$$

- Illustration with  $m = 2$

- We already have the computation of  $u_1(x)$

- $(p + q) \times m$  unknowns

- Achieve update by Freezing the  $\{u_i\}_{i \in \llbracket 1, m \rrbracket}$



- For a new patient, project  $\mu(x)$  onto a basis  $\{f^k(x)\}_{k \in \llbracket 1, \beta \rrbracket}$ 
  - ▶  $\mu(x) = \sum_{k=1}^{\beta} \mu^k f^k(x)$
  - ▶  $\{u^k\}_{k \in \llbracket 1, \beta \rrbracket}$  input parameters for the NN
- $u(x, \mu^1, \dots, \mu^\beta) = \sum_{i=1}^m \bar{u}_i(x) \prod_{j=1}^{\beta} \lambda_i^j(\mu^j)$
- Retrieve  $\mu(x)$  for computing the loss
  - ▶  $\mathcal{L} = g(u((x, \{u^k\}), x, \mu(x)))$

