Supplementary Material

A Derivation from feature interaction component in NFM to Aggregated pairwise analysis component in FCCF

This appendix is going to show the details of the derivation in FCCF paper.

$$MLP(f_{BI})$$

$$=MLP(\sum_{i=1}^{N}\sum_{j=i+1}^{N}(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j))$$

$$=\mathbf{W}_L(\dots(\mathbf{W}_1(\sum_{i=1}^{N}\sum_{j=i+1}^{N}(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j)) + b_1)\dots) + b_L$$

$$=\mathbf{W}_L\dots\mathbf{W}_1\sum_{i=1}^{N}\sum_{j=i+1}^{N}(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j) + (\mathbf{W}_L\dots\mathbf{W}_2 b_1) + \dots + b_L$$

$$=\sum_{i=1}^{N}\sum_{j=i+1}^{N}(\mathbf{W}_L\dots\mathbf{W}_1(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j)) + (\mathbf{W}_L\dots\mathbf{W}_2 b_1) + \dots + b_L$$

$$=\sum_{i=1}^{N}\sum_{j=i+1}^{N}(\mathbf{W}_L\dots\mathbf{W}_1(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j) + (\mathbf{W}_L\dots\mathbf{W}_2 b_1) + \dots + b_L) - C$$

$$=\sum_{i=1}^{N}\sum_{j=i+1}^{N}(\mathbf{W}_L(\dots(\mathbf{W}_1(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j) + b_1)\dots) + b_L) - C$$

$$\equiv\sum_{i=1}^{N}\sum_{j=i+1}^{N}(MLP_{pairwise}(\mathbf{v}_i \odot \mathbf{v}_j)x_i x_j) - C$$

$$=\sum_{i,j\in R_k, j>i}(\phi_p(e_{ij}, \mathbf{v}_i, \mathbf{v}_j)) - C,$$

where $C = (\frac{N(N-1)}{2} - 1)((\mathbf{W}_L\dots\mathbf{W}_2 b_1) + \dots + b_L)$.