Supplementary Material

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

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

$$MLP(f_{BI})$$

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

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

$$=\mathbf{W}_L\dots\mathbf{W}_1\sum_{i=1}^{N}\sum_{j=i+1}^{N}(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j)+(\mathbf{W}_L\dots\mathbf{W}_2b_1)+\dots+b_L$$

$$=\sum_{i=1}^{N}\sum_{j=i+1}^{N}(\mathbf{W}_L\dots\mathbf{W}_1(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j))+(\mathbf{W}_L\dots\mathbf{W}_2b_1)+\dots+b_L$$

$$=\sum_{i=1}^{N}\sum_{j=i+1}^{N}(\mathbf{W}_L\dots\mathbf{W}_1(x_i\mathbf{v}_i \odot x_j\mathbf{v}_j)+(\mathbf{W}_L\dots\mathbf{W}_2b_1)+\dots+b_L)-C$$

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

$$\equiv\sum_{i,j\in R_k,j>i}(MLP_{pairwise}(x_i\mathbf{v}_i \odot x_i\mathbf{v}_j))-C$$

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

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

where $C = (\frac{N(N-1)}{2}-1)((\mathbf{W}_L\dots\mathbf{W}_2b_1)+\dots+b_L)$.