PNN分享

汪冬冬



动机

网络结构

Product Layer

知乎推荐框架

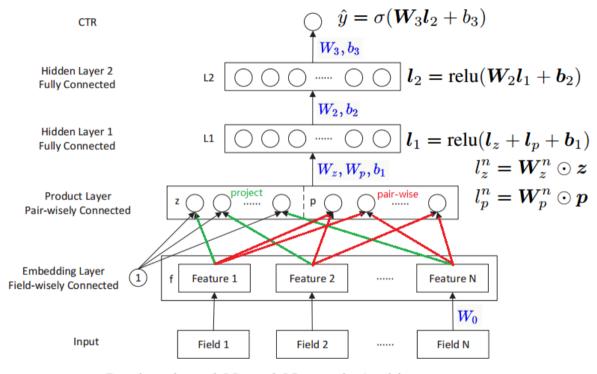


动机

在ctr预估中,认为特征之间的关系更多是一种and"且"的关系,而非add"加"的关系。例如,性别为男且喜欢游戏的人群,比起性别男和喜欢游戏的人群,前者的组合比后者更能体现特征交叉的意义。



网络结构



Product-based Neural Network Architecture



Product Layer

Hidden Layer 1

Fully Connected

Product Layer Pair-wisely Connected

Embedding Layer

Field-wisely Connected

Product Layer

$$egin{aligned} oldsymbol{l}_1 &= \operatorname{relu}(oldsymbol{l}_z + oldsymbol{l}_p + oldsymbol{b}_1) \ oldsymbol{l}_z &= (oldsymbol{l}_z^1, oldsymbol{l}_z^2 \dots oldsymbol{l}_z^n \dots oldsymbol{l}_z^{D1}) & oldsymbol{l}_z^n &= W_z^n \odot z \ oldsymbol{l}_p &= (oldsymbol{l}_p^1, oldsymbol{l}_p^2 \dots oldsymbol{l}_p^{D1}) & oldsymbol{l}_p^i &= W_p^n \odot p \ oldsymbol{z} &= (oldsymbol{z}_1, oldsymbol{z}_2, \dots, oldsymbol{z}_N) \ oldsymbol{p} &= \{oldsymbol{p}_{i,j}\}, i &= 1...N, j &= 1...N \ oldsymbol{p} &= \{oldsymbol{p}_{i,j}\}, i &= 1...N, j &= 1...N \ oldsymbol{p}_{i,j} &= g(oldsymbol{f}_i, oldsymbol{f}_j) \ oldsymbol{v}_{i,j} &= g(oldsymbol{f}_i, oldsymbol{f}_j) \ oldsymbol{v}_{i,j} &= W_z^n \odot z \ oldsymbol{v}_{i,j} &= W_p^n \odot p \ old$$



Product Layer

• IPNN

$$g(f_i,f_j)= < f_i,f_j>$$

计算复杂: N*N(D1+M)

计算简化:

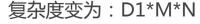
$$W_p^n = heta^n heta^{nT}$$

$$l_p^n = W_p^n \odot p = \sum_{i=1}^N \sum_{j=1}^N heta_i^n heta_j^n < f_i, f_j > = < \sum_{i=1}^N \delta_i^n, \sum_{i=1}^N \delta_i^n >$$

$$oldsymbol{l}_p = \Big(\| \sum_i oldsymbol{\delta}_i^1 \|, \dots, \| \sum_i oldsymbol{\delta}_i^n \|, \dots, \| \sum_i oldsymbol{\delta}_i^{D_1} \| \Big).$$

兴趣:游戏

年龄:青年





Product Layer

OPNN

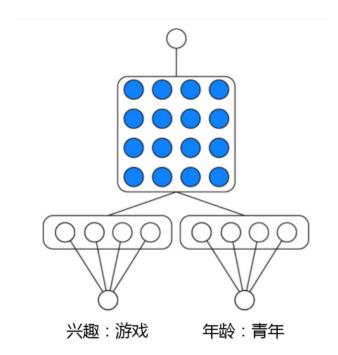
$$p_{i,j} = g(f_i,f_j) = f_i f_j^T$$

计算复杂: D1 * N*N*M*M

计算简化:

$$oldsymbol{p} = \sum_{i=1}^N \sum_{j=1}^N oldsymbol{f}_i oldsymbol{f}_j^T = oldsymbol{f}_\Sigma (oldsymbol{f}_\Sigma)^T, \quad oldsymbol{f}_\Sigma = \sum_{i=1}^N oldsymbol{f}_i,$$

复杂度变为: D1*M*(M+N)





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