PNN分享

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京东

动机

网络结构

Product Layer

知乎推荐框架

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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。

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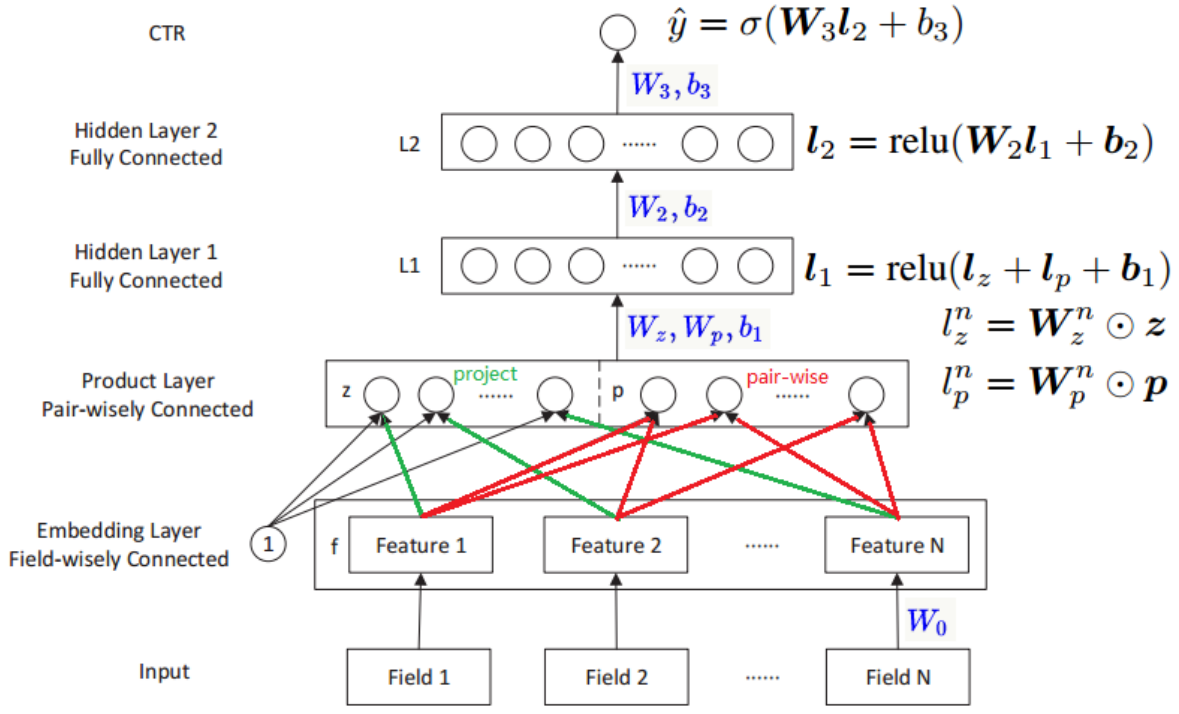
网络结构



Product-based Neural Network Architecture

Product Layer

- Product Layer

$$\boldsymbol{l}_1 = \text{relu}(\boldsymbol{l}_z + \boldsymbol{l}_p + \boldsymbol{b}_1)$$

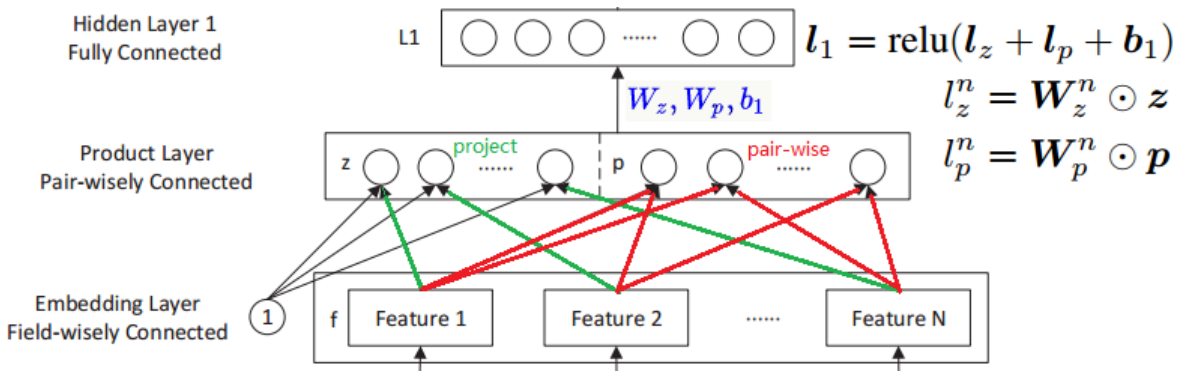
$$l_z = (l_z^1, l_z^2 \ldots l_z^n \ldots l_z^{D1}) \qquad l_z^n = W_z^n \odot z$$

$$l_p = (l_p^1, l_p^2 \ldots l_p^n \ldots l_p^{D1}) \qquad l_p^i = W_p^n \odot p$$

$$\boldsymbol{z} = (\boldsymbol{z}_1, \boldsymbol{z}_2, \ldots, \boldsymbol{z}_N) \triangleq (\boldsymbol{f}_1, \boldsymbol{f}_2, \ldots, \boldsymbol{f}_N)$$

$$\boldsymbol{p} = \{\boldsymbol{p}_{i,j}\}, i = 1 \ldots N, j = 1 \ldots N$$

$$\boldsymbol{p}_{i,j} = g(\boldsymbol{f}_i, \boldsymbol{f}_j)$$



Product Layer

- IPNN

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

计算复杂：N*N(D1+M)

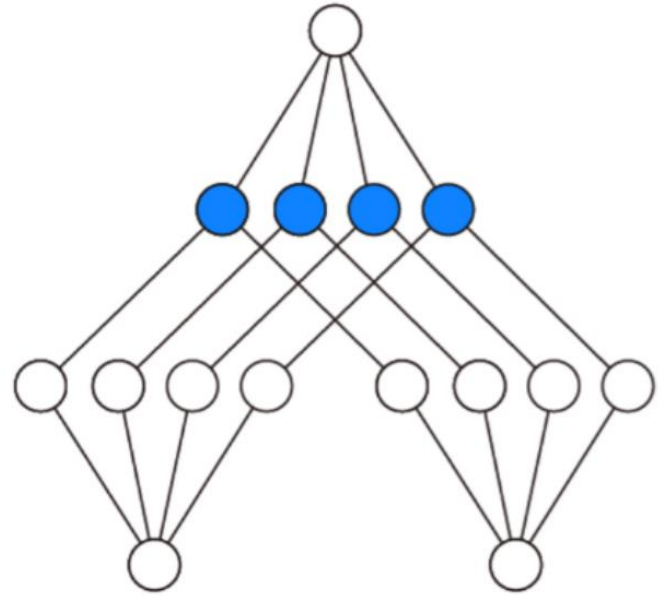
计算简化：

$$W_p^n = \theta^n \theta^{nT}$$

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

$$\boldsymbol{l}_p = \left(\| \sum_i \boldsymbol{\delta}_i^1 \|, \ldots, \| \sum_i \boldsymbol{\delta}_i^n \|, \ldots, \| \sum_i \boldsymbol{\delta}_i^{D_1} \| \right).$$

复杂度变为：D1*M*N



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Product Layer

- OPNN

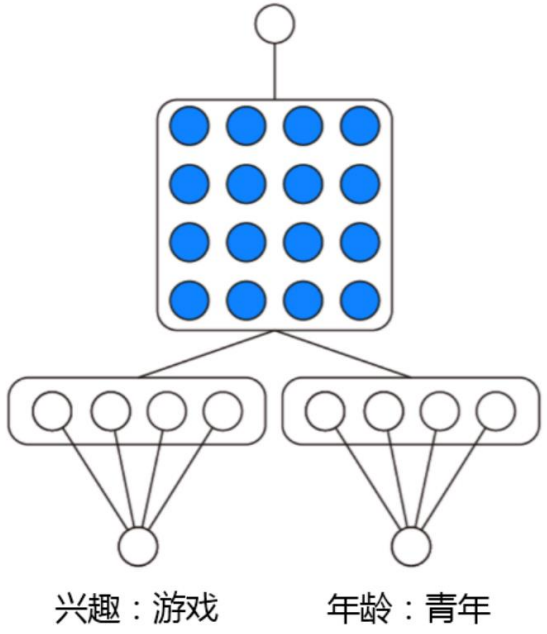
$$p_{i,j} = g(f_i, f_j) = f_i f_j^T$$

计算复杂：D1 * N*N*M*M

计算简化：

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

复杂度变为：D1*M*(M+N)



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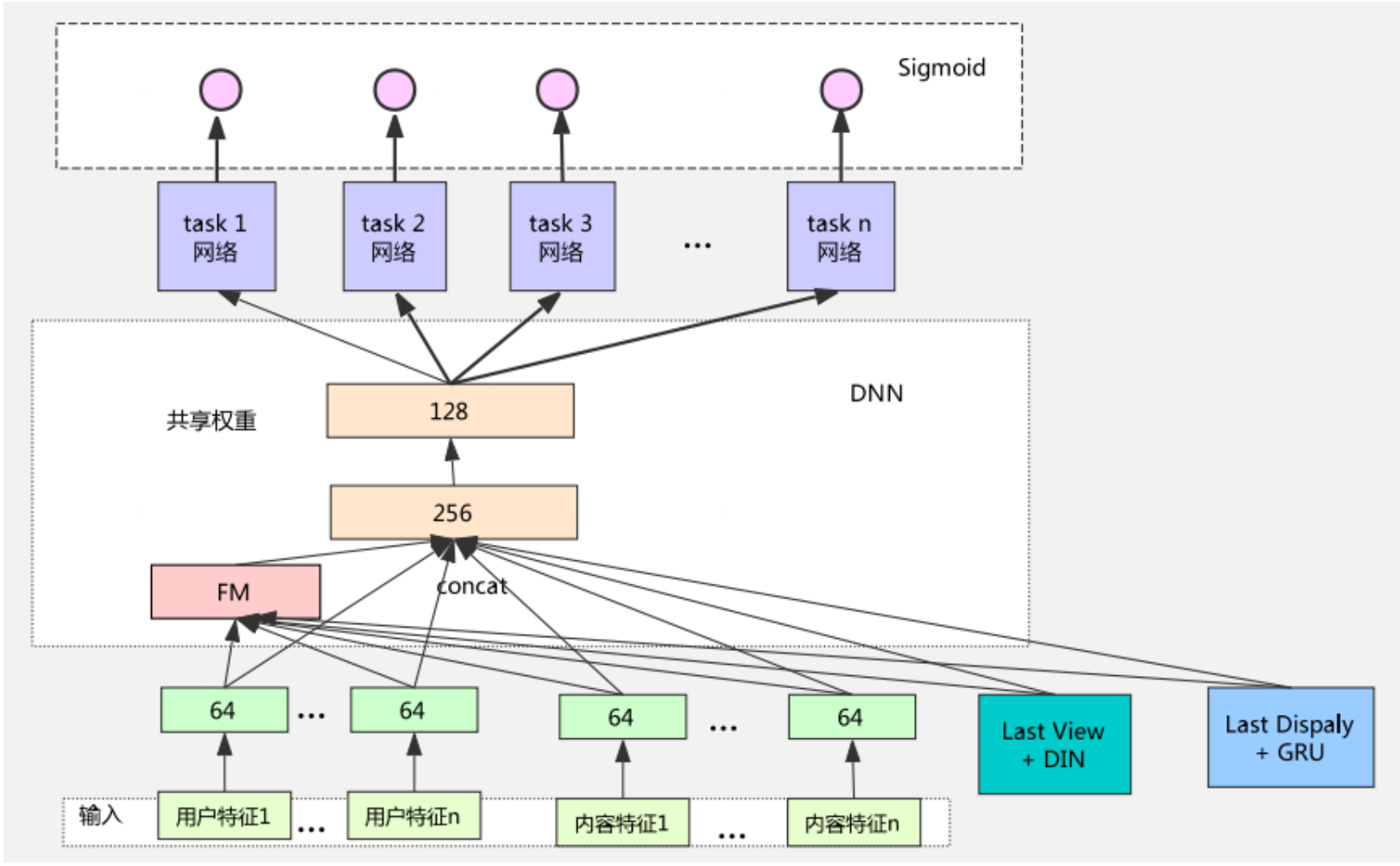
Sigmoid
task 1
网络
task 2
网络
task 3
网络
...
task n
网络
共享权重
128
DNN
256
FM
concat
64
...
64
64
...
64
Last View
+ DIN
Last Dispaly
+ GRU
输入
用户特征1
...
用户特征n
内容特征1
...
内容特征n

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