

# Factorized Machine

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6:08 PM

## Feature Cross:

linear model: 
$$y = b + \sum_{i=1}^d w_i x_i + \underbrace{\sum_{i=1}^d \sum_{j=i+1}^d u_{ij} x_i x_j}_{\text{feature cross } O(d^2)}$$

$$\begin{bmatrix} u_{11} & u_{12} & \dots & u_{1d} \\ \vdots & & & \\ u_{d1} & u_{d2} & \dots & u_{dd} \end{bmatrix}_{d \times d} = V_i^T \begin{bmatrix} \text{---} \\ \text{---} \\ \text{---} \end{bmatrix}_{d \times k} \begin{bmatrix} \text{---} \\ \text{---} \\ \text{---} \end{bmatrix}_{k \times d}$$

matrix  $U$ : matrix  $V$  matrix  $V^T$

*(Note: The diagram shows the  $i^{th}$  row of  $V$  and the  $j^{th}$  column of  $V^T$ )*

## Factored Machine:

$$y = b + \sum_{i=1}^d w_i x_i + \underbrace{\sum_{i=1}^d \sum_{j=i+1}^d (v_i^T \cdot v_j) x_i x_j}_{\text{feature cross } O(k \cdot d)}$$

reduce # of parameters from  $O(d^2)$  to  $O(k \cdot d)$