

# Collaborative Filtering:

- low rank matrix factorization (ALS, WALS)

Loss Function as:

$$L = \sum_{m,n} (R_{mn} - U_m^T \cdot V_n)^2 + \lambda \sum_m ||U_m||^2 + \lambda \sum_n ||V_n||^2$$

ALS: Alternative least squares

Objective:  $R \approx U \cdot V^T$

alternative: update U, fixed V

: update V, fixed U

## Neural Network For Recommendation

Hybrid Recs: Content, Collaborative and Knowledge-based systems

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- Context Aware Recommendation Systems (CARS)

Traditional CF RS: Users x Items  $\Rightarrow$  Ratings

Contextual CF RS: Users x Items x Contexts  $\Rightarrow$  Ratings

: Ratings can differ based on contexts alone too! So, should be considered.

contexts can be: who, where, when

## CARS Algorithms

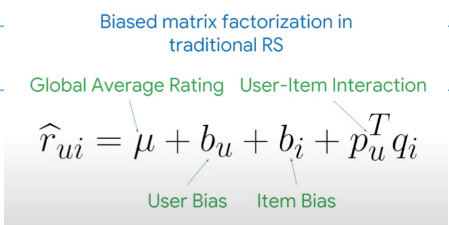
1. Contextual Prefiltering : Splitting, Pairing items

← 2. Contextual Postfiltering: heuristic or model based approaches - weight and filter

3. Contextual Modeling : m-dimensional model  
:  $U \times I \times C \rightarrow$  Recommendation  
: e.g Factorization machines

-can use standard or 'bias' matrix factorization

ignores context, gives normal recommendation first  
later, uses context to filter out that match the context



- without context, basic matrix factorization

### CAMF\_C approach

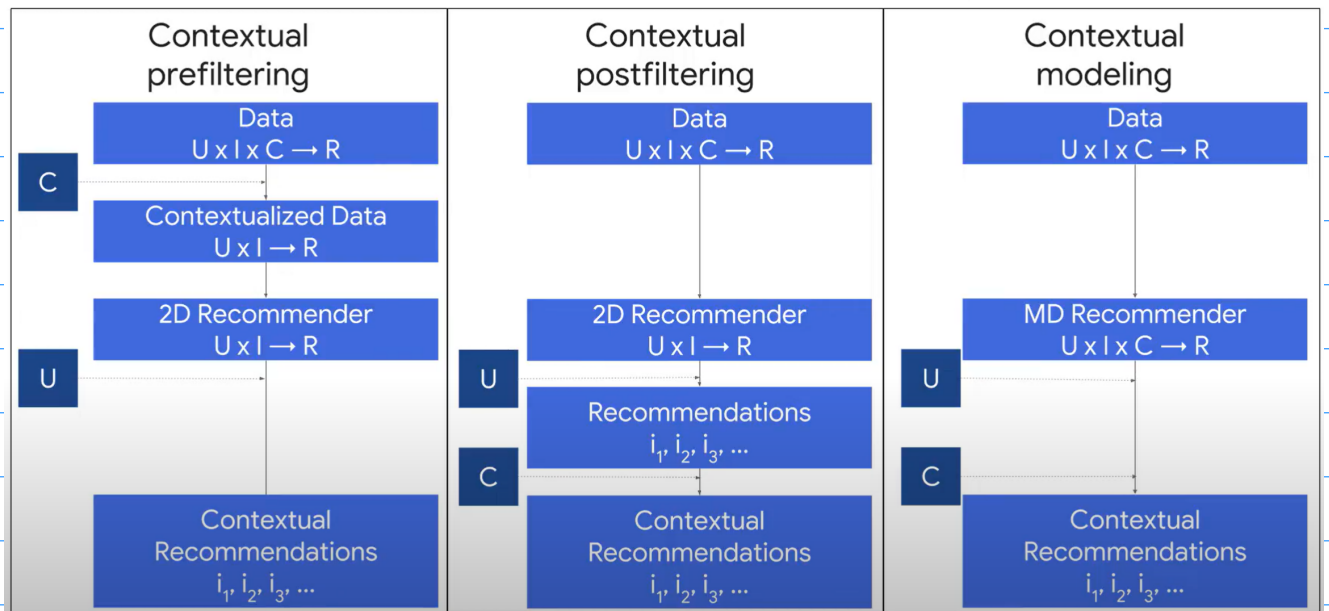
Global Average Rating User-Item Interaction

$$\hat{r}_{uic_1c_2...c_N} = \mu + b_u + b_i + p_u^T q_i + \sum_{j=1}^N CRD(c_j)$$

User Bias Item Bias  
Contextual Rating Contextual Rating Deviation

- context-aware Matrix Factorization

others are: context user and context item approaches!!



## Reinforcement learning for RecSys

- find the best sequence of actions that will generate the best result
- in the order of: observations, actions and rewards
- 2 methods:

1. Model based

2. Model Free: learn policy from environment directly

# Terminology in reinforcement learning

Term	Definition
State	Summary of events so far; the current situation
Action	One or more events that alter the state
Environment	The scenario the agent has to respond to
Agent	The learner entity that performs actions in an environment
Reward	Feedback on agent actions, also known as <i>reward signal</i>
Policy	Method to map the agent's state to actions
Episode	A termination point
Value	Long-term reward gained by the end of an episode
Value function	Measure of potential future rewards from being in a particular state, or $V(S)$
$Q(S,A)$	"Q-value" of an action in various state/action pairs
SARSA	State Action Reward State Action