Recommendation Systems

Deep learning part I

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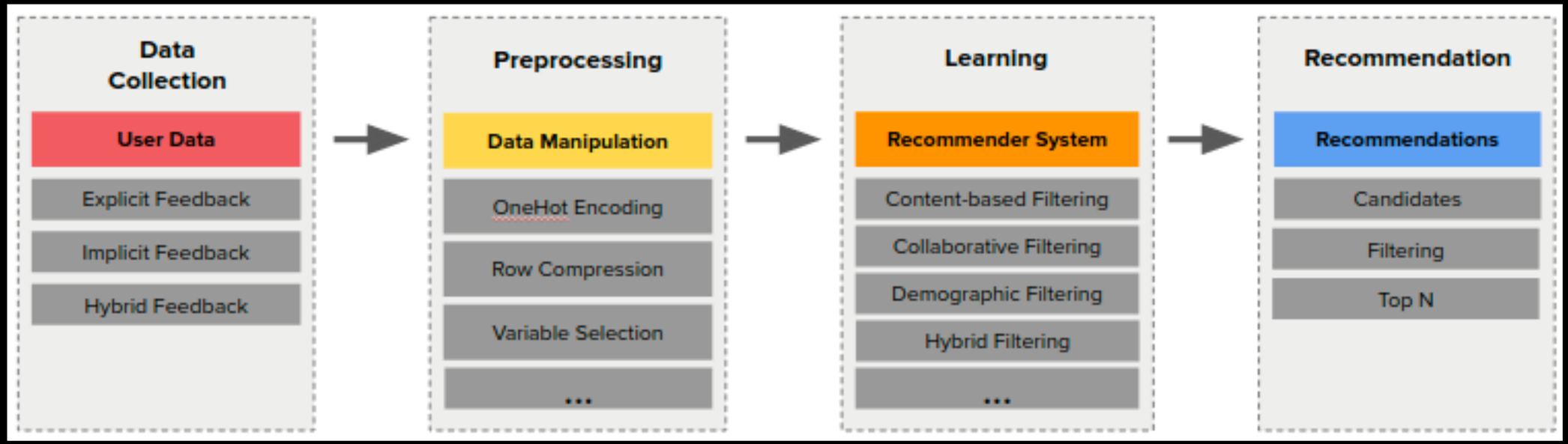
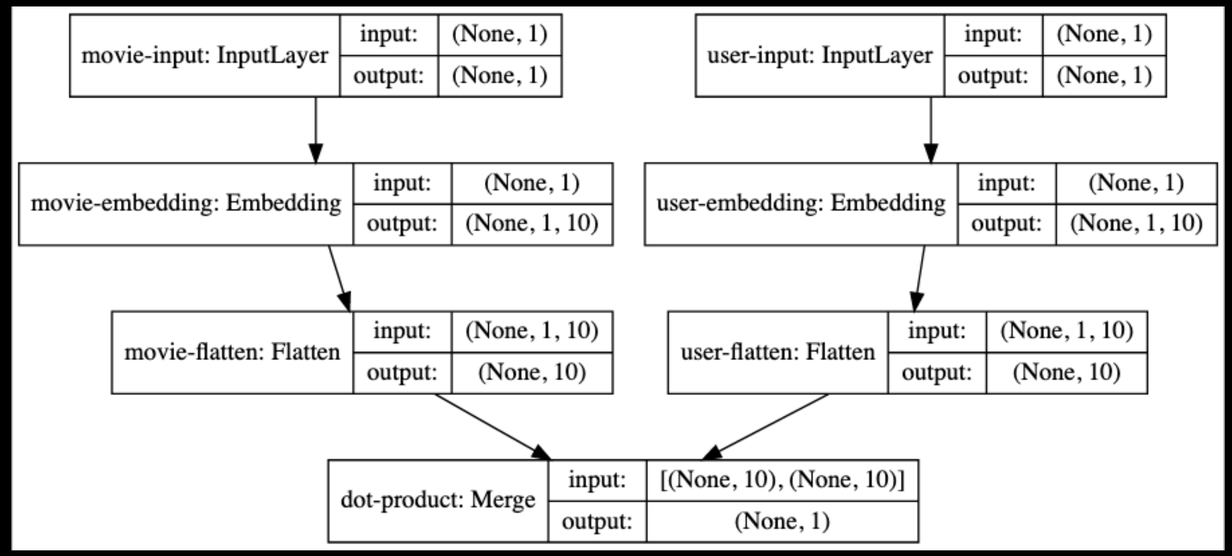
Recommendation pipeline



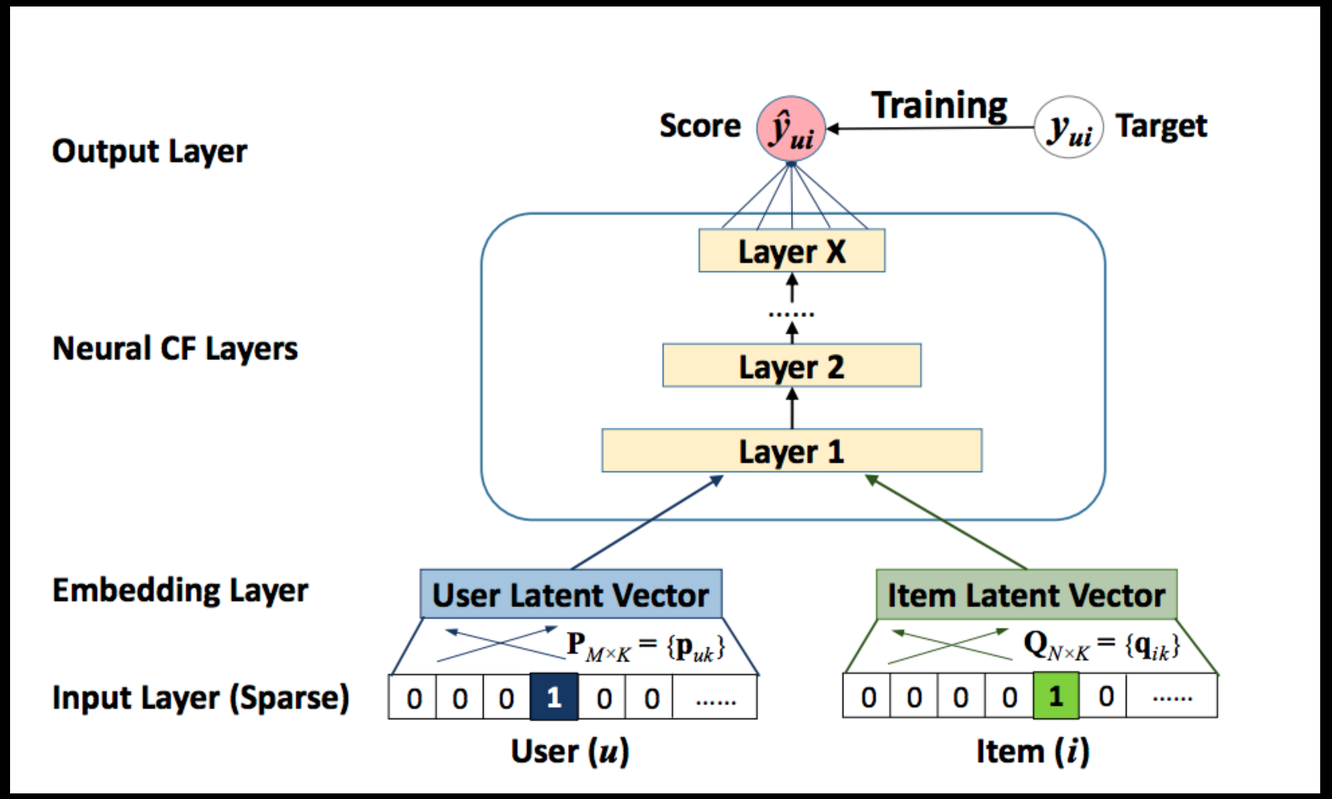
Deep learning Recommendations

- MLP
- Autoencoder
- CNNs
- RNNs
- RBM
- NADE
- Neural Attention
- Adversary Network
- DRL
- Hybrid Models

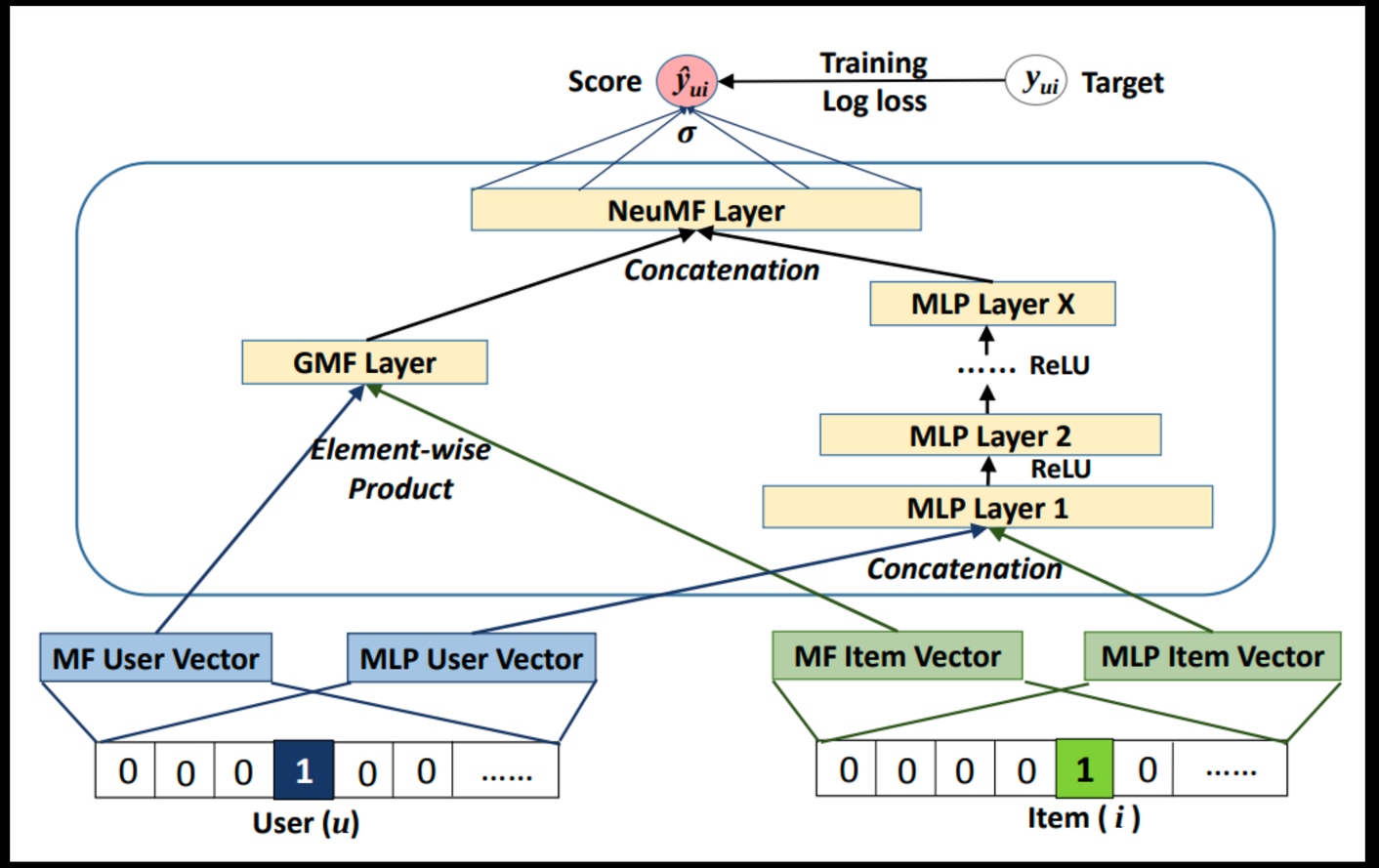
Neural Collaborative Filtering

- 

Neural Collaborative Filtering

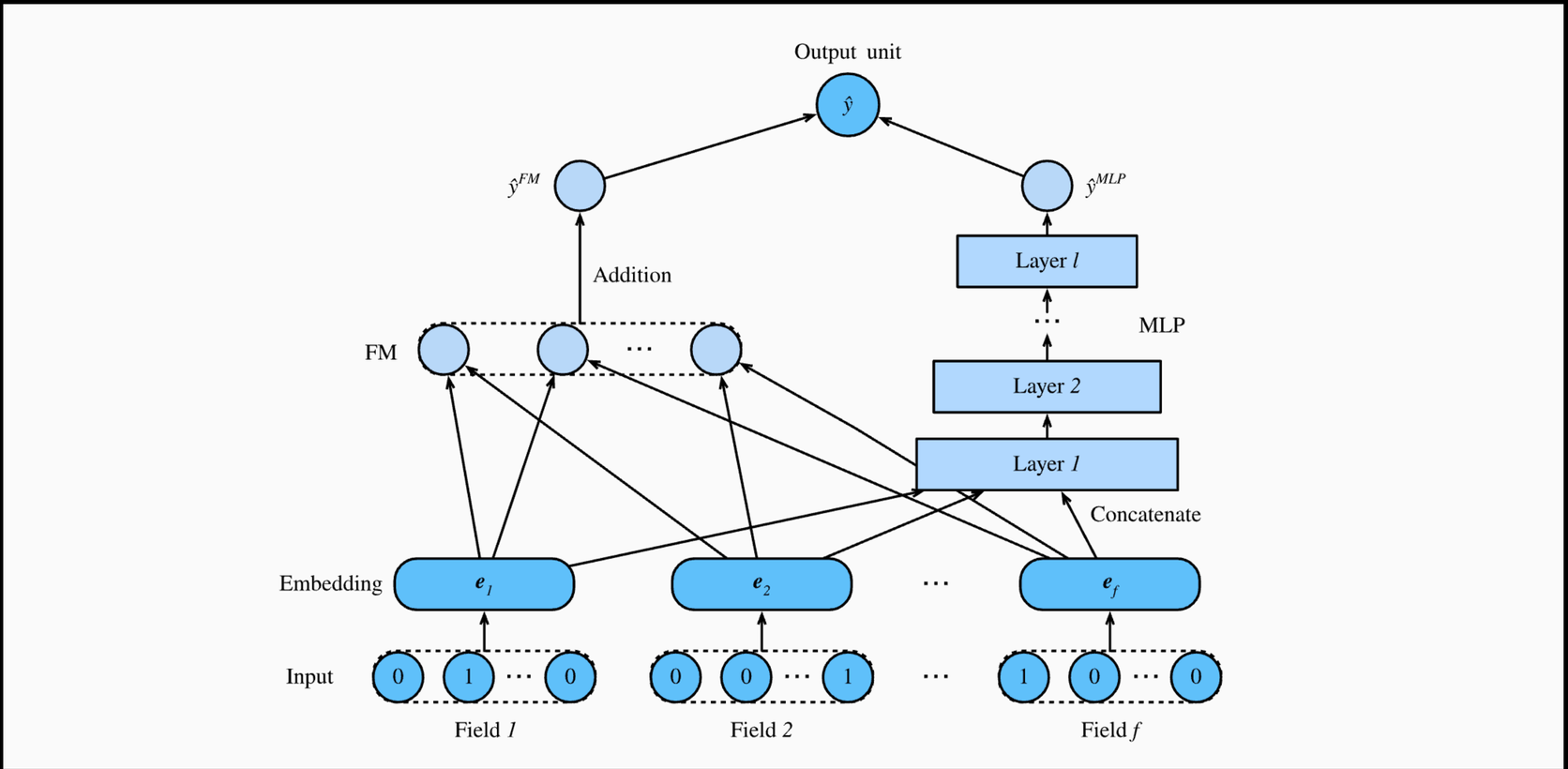
- 

Neural Collaborative Filtering

- 

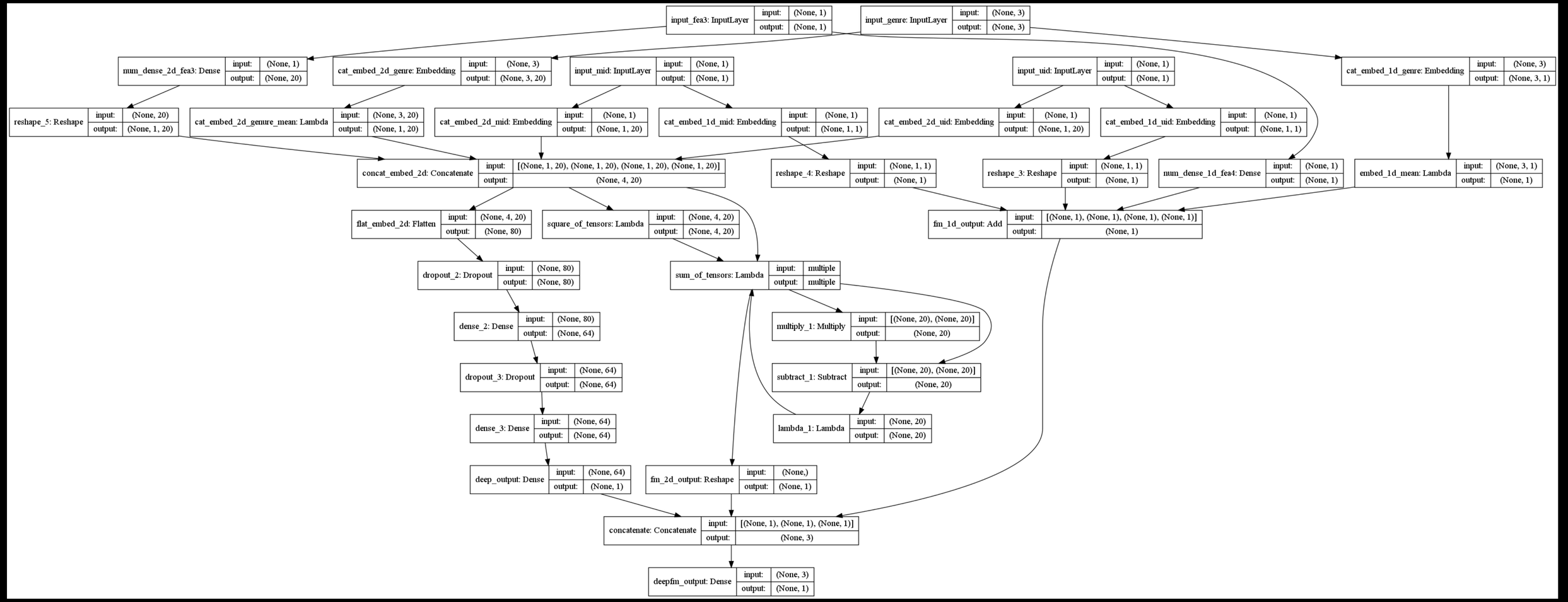
$$\mathscr{L} = -\sum_{(u,i)\in\mathcal{O}\cup\mathcal{O}^-} r_{ui}\log\hat{r}_{ui} + \left(1 - r_{ui}\right)\log\left(1 - \hat{r}_{ui}\right)$$

Deep Factorization Machine

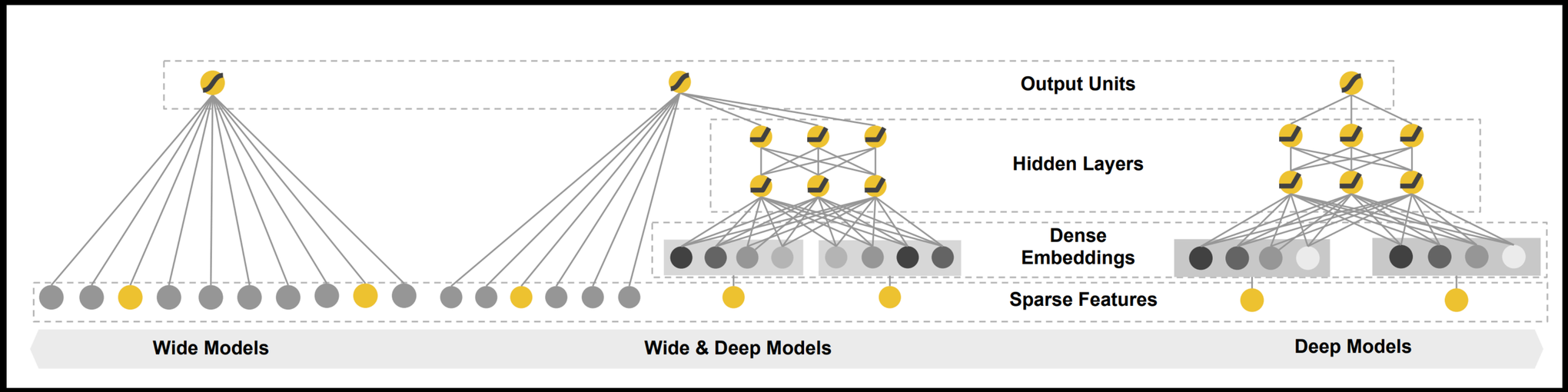
- 

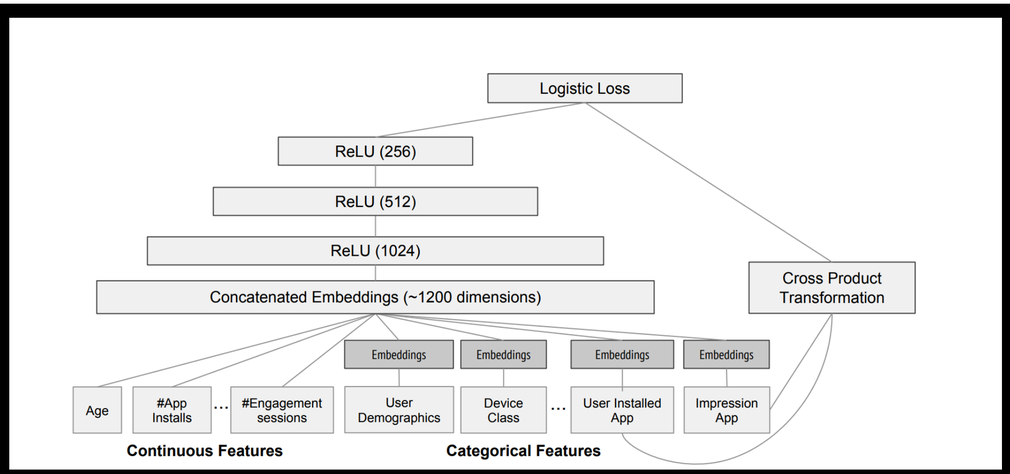
$$\hat{r}_{ui} = \sigma\left(y_{FM}(x) + y_{MLP}(x)\right)$$

Deep Factorization Machine

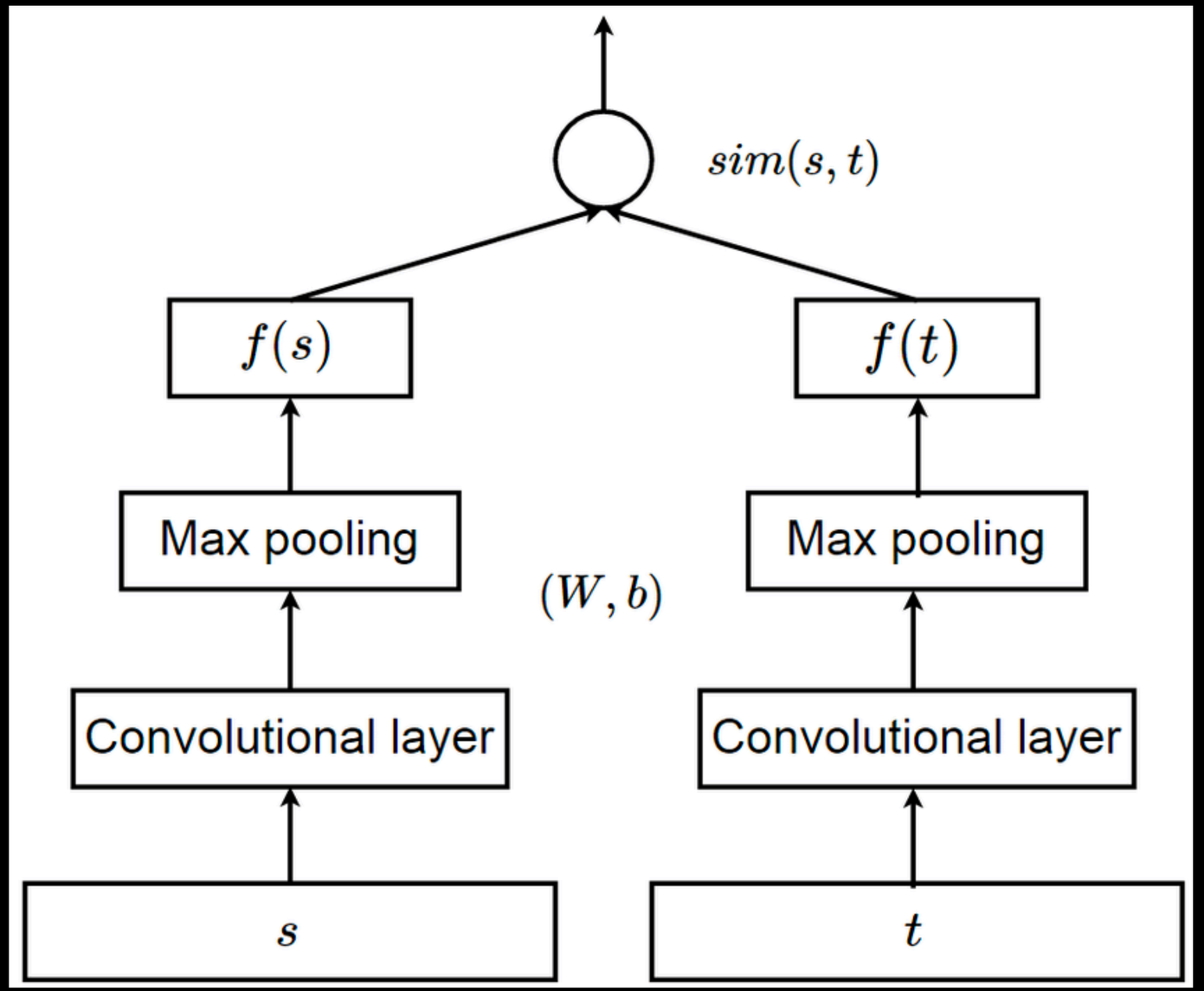


Wide & Deep Learning

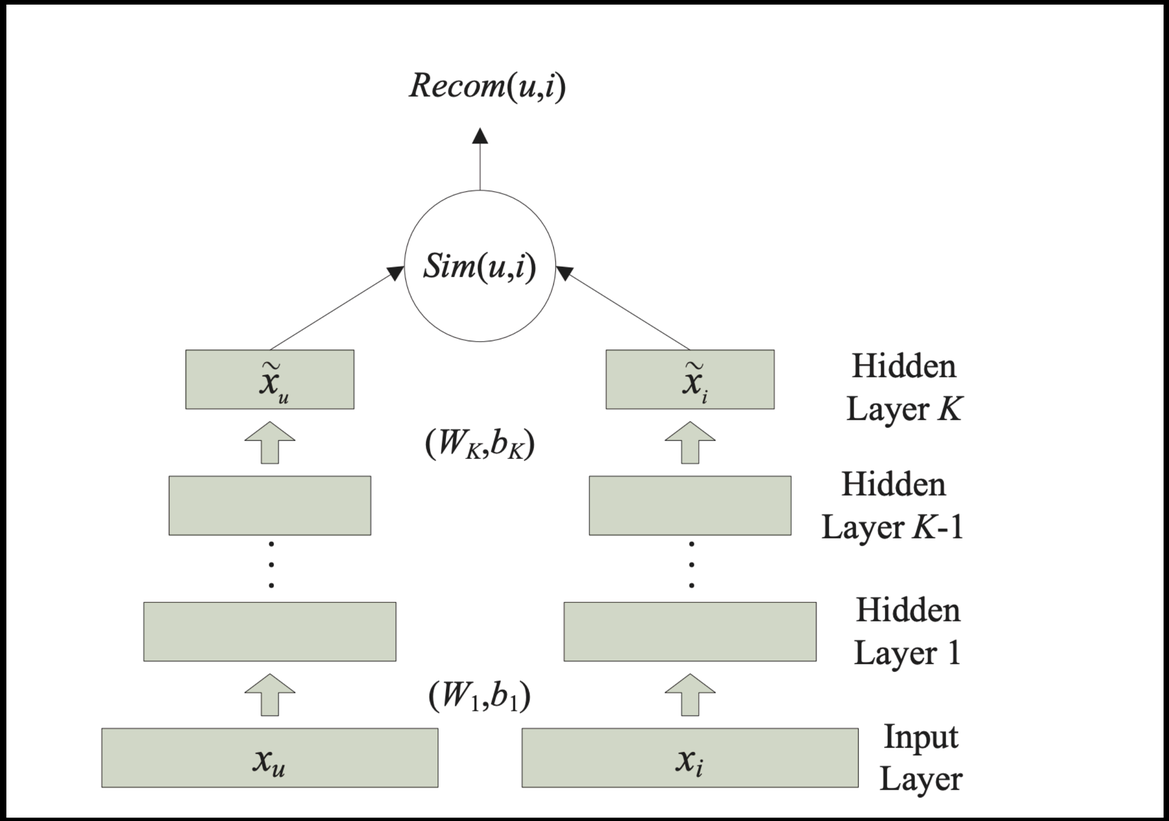




Deep Structured Semantic Model

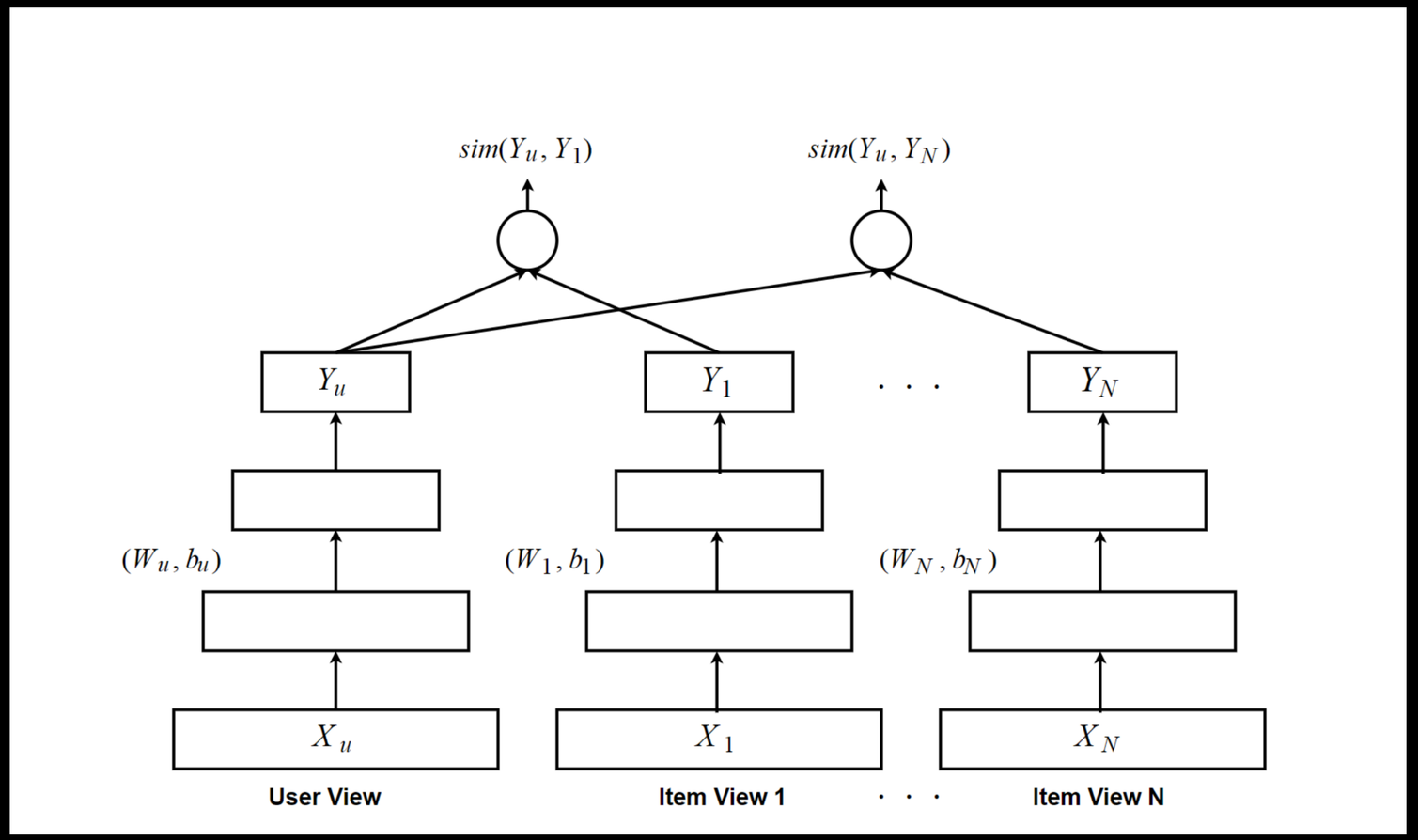


Deep Semantic Similarity based Personalized Recommendation

- 

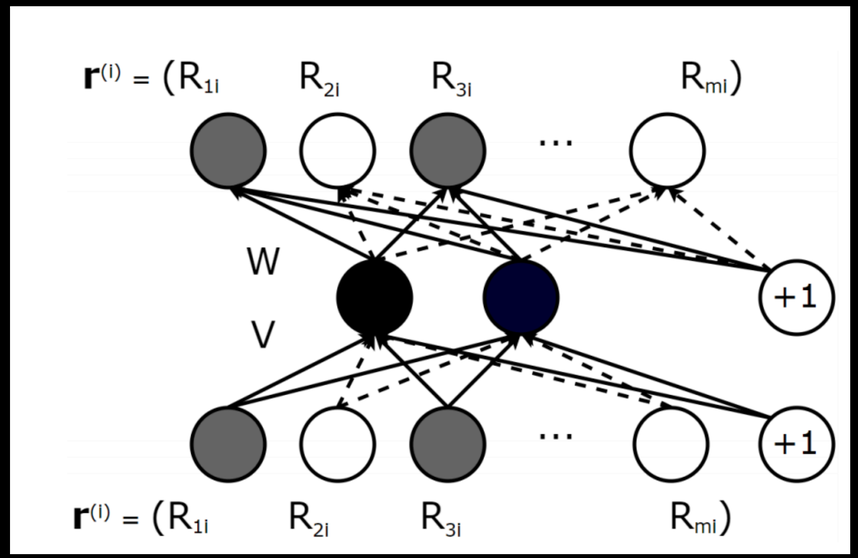
$$\mathscr{L} = -\sum_{(u,i^*)} \left[\log\left(e^{\mathrm{sim}(u,i^*)}\right) - \log\left(\sum_{(u,i^-)\in D^-} e^{\mathrm{sim}(u,i^-)} \right) \right]$$

Multi-View Deep Neural Network

- 

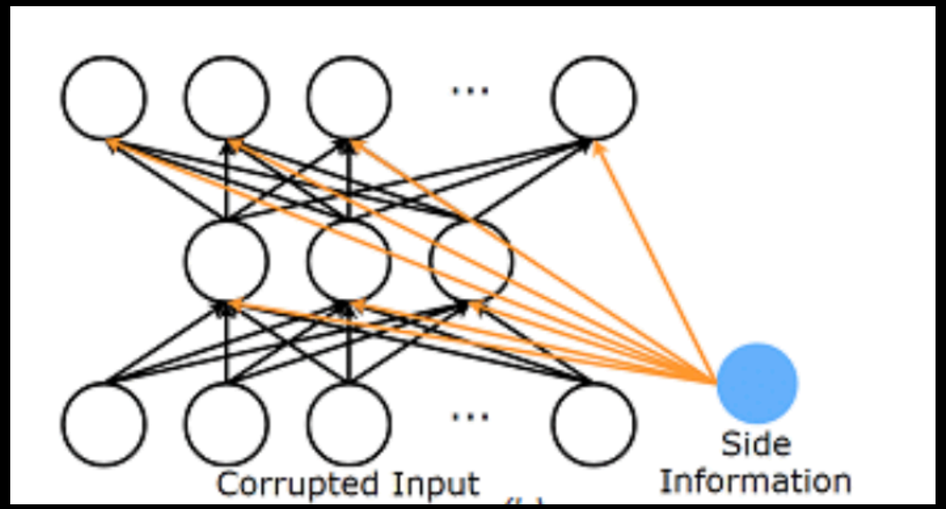
$$\mathscr{L} = \underset{\theta}{\operatorname{argmin}} \sum_{j=1}^{Z} \frac{\exp\left(\gamma \cdot \operatorname{cosine}\left(Y_u, Y_{a,j}\right)\right)}{\sum_{X' \in R^{da}} \exp\left(\gamma \cdot \operatorname{cosine}\left(Y_u, f_a(X')\right)\right)}$$

AutoRec

- 

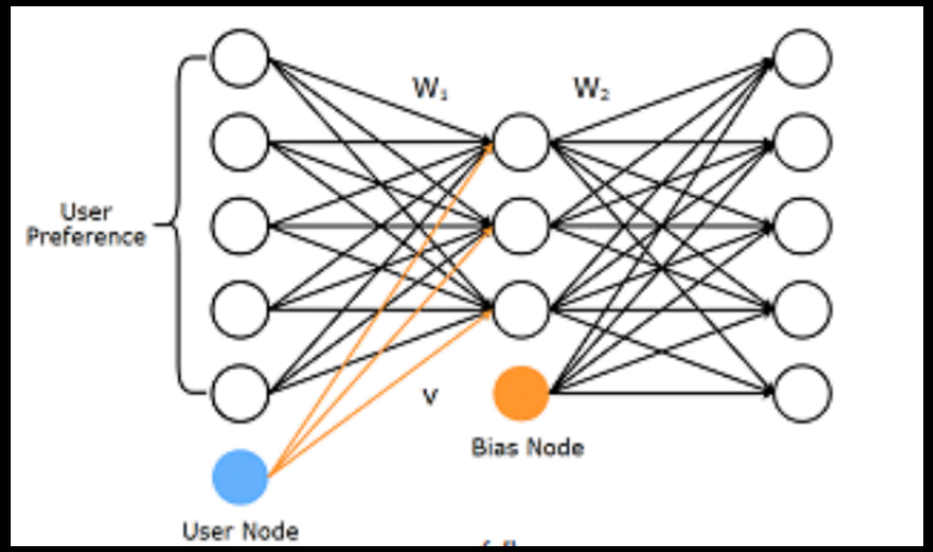
$$\underset{\theta}{\operatorname{argmin}} \sum_{i=1}^{N} \left\| \mathbf{r}^{(i)} - h\left(\mathbf{r}^{(i)}; \theta\right) \right\|_{\mathcal{O}}^{2} + \lambda \cdot \text{reg}$$

CFN



$$h\left(\left\{\tilde{\mathbf{r}}^{(i)}, \mathbf{s}_i\right\}\right) = f\left(W_2 \cdot \left\{g\left(W_1 \cdot \left\{\mathbf{r}^{(i)}, \mathbf{s}_i\right\} + \mu\right), \mathbf{s}_i\right\} + b\right)$$

Collaborative Denoising Auto-Encoder



$$h\left(\tilde{\mathbf{r}}_{pref}^{(u)}\right) = f\left(W_2 \cdot g\left(W_1 \cdot \tilde{\mathbf{r}}_{pref}^{(u)} + V_u + b_1\right) + b_2\right)$$

$$\underset{W_1,W_2,V,b_1,b_2}{\operatorname{argmin}} \frac{1}{M}\sum_{u=1}^{M} \mathbf{E}_{p\left(\tilde{\mathbf{r}}_{pref}^{(u)} \mid \mathbf{r}_{pref}^{(u)}\right)}\left[\ell\left(\tilde{\mathbf{r}}_{pref}^{(u)}, h\left(\tilde{\mathbf{r}}_{pref}^{(u)}\right)\right)\right] + \lambda \cdot reg$$

Convolutional Neural Networks

- Image Feature extraction
- Text Feature extraction
- Video & Audio feature extraction
- Pattern extraction ?

Sources

- https://arxiv.org/pdf/1708.05031.pdf
- https://arxiv.org/pdf/1703.04247.pdf
- https://arxiv.org/pdf/1606.07792.pdf
- https://static.aminer.org/pdf/fa/cikm2016/shp0489-xuA.pdf
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