Что осталось за кадром

Другие типы систем

- предсказания
    - понравится/не понравится (любым классификатором или регрессией)
- графовые модели (community detection)
- knowledge-based systems

Другие типы данных

- Графы
- Теги
- …

Гибридные системы

- Различные варианты использования нескольких систем вместе

Безопасность

- Виды угроз
- Борьба с нежелательным влиянием
- Защита пользовательских данных

Доверие

- Trust-based recommenders

Объяснение рекомендаций

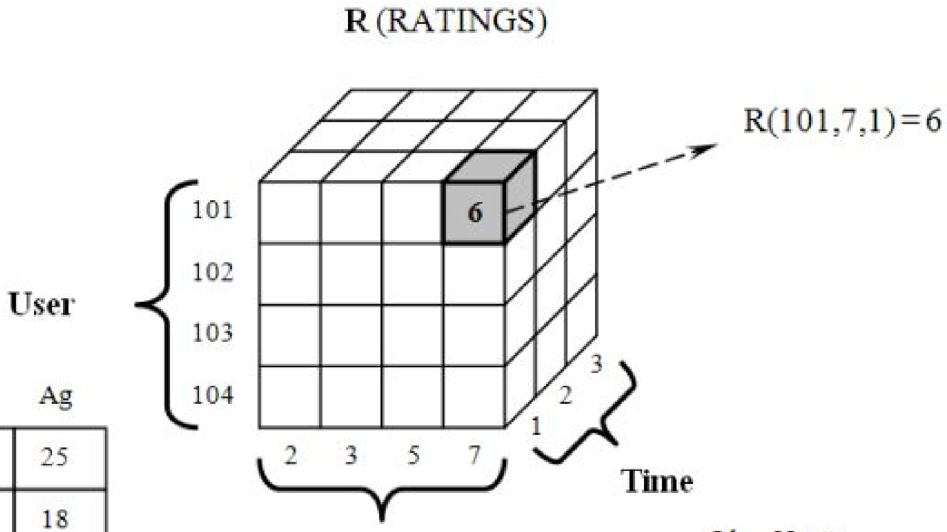
- Пользователю важно знать, почему система рекомендует тот или иной объект?

Холодный старт

- Новый пользователь
- Новый продукт
- Новая система

Учёт контекста

- Context-aware recommenders
- http://ids.csom.umn.edu/faculty/gedas/NSFCareer/CARS-chapter-2010.pdf
- http://www.recsyswiki.com/wiki/Context-aware_recommendation



Id	Name	Ag
10	John	25
10	Bob	18
10	Alice	27
10	Mary	21

Item

Id	Name	Cost
2	AB17	250.0
3	AB23	299.9
5	XY70	150.0
7	ZZ55	115.5

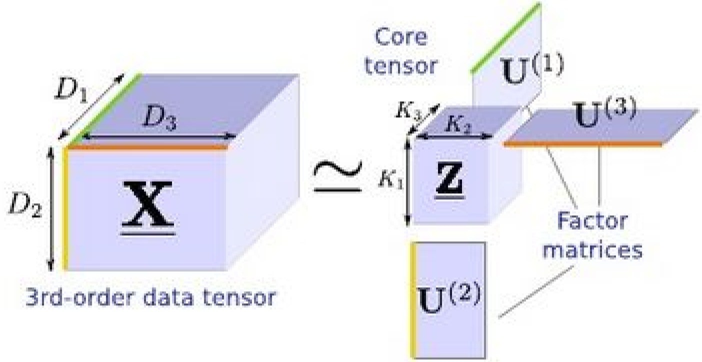
Id	Name
1	Weekday
2	Weekend
3	Holiday

Fig. 2 Multidimensional model for the *User* × *Item* × *Time* recommendation space.

Tensor factorizations

- http://www.slideshare.net/KoheiHayashi1/talk-in-jokyonokai-12989223

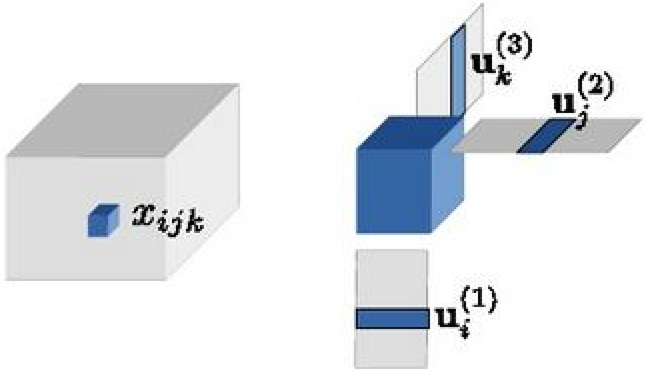
Tucker decomposition



$$x_{ijk} = \sum_{q=1}^{K_1} \sum_{r=1}^{K_2} \sum_{s=1}^{K_3} u_{iq}^{(1)} u_{jr}^{(2)} u_{ks}^{(3)} z_{qrs} + \varepsilon_{ijk} \tag{1}$$

- ε: i.i.d Gaussian noise

Tucker decomposition



$$x_{ijk} = \sum_{q=1}^{K_1} \sum_{r=1}^{K_2} \sum_{s=1}^{K_3} \underline{u_{iq}^{(1)} u_{jr}^{(2)} u_{ks}^{(3)}} \, \underline{z_{qrs}} + \varepsilon_{ijk} \qquad (1)$$

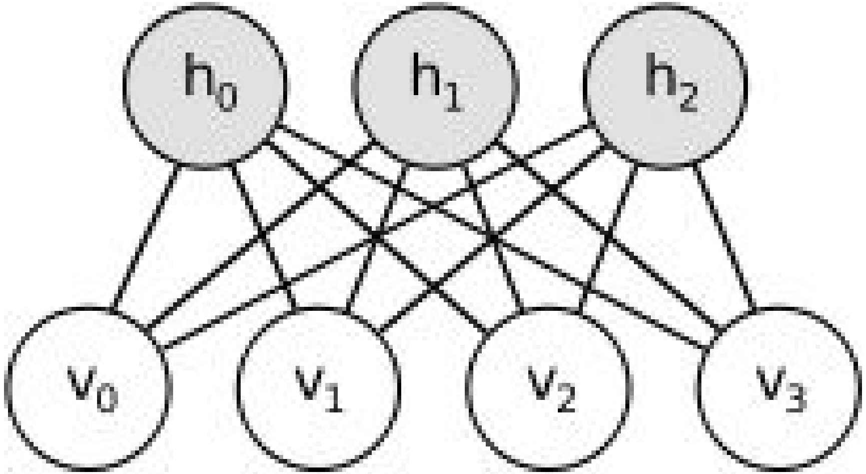
- ε: i.i.d Gaussian noise

Factorization Machines

- http://libfm.org/
- http://www.slideshare.net/hongliangjie1/libfm

Factorization machines (FM) are a generic approach that allows to mimic most factorization models by feature engineering. This way, factorization machines combine the generality of feature engineering with the superiority of factorization models in estimating interactions between categorical variables of large domain.

Restricted Boltzmann machine (RBM)



Restricted Boltzmann machine (RBM)

- Restricted Boltzmann Machines for Collaborative Filtering http://www.machinelearning.org/proceedings/icml2007/papers/407.pdf
- “We also show that RBM’s slightly outperform carefully-tuned SVD models. When the predictions of multiple RBM models and multiple SVF models are linearly combined, we achieve an error rate that is well over 6% better than the score of Netflix’s own system”

Restricted Boltzmann machine (RBM)

- Netflix Recommendations: Beyond the 5 stars http://techblog.netflix.com/2012/04/netflix-recommendations-beyond-5-stars.html
- “SVD by itself provided a 0.8914 RMSE, while RBM alone provided a competitive but slightly worse 0.8990 RMSE. A linear blend of these two reduced the error to 0.88.”

Deep Learning for Recommendations

- Deep learning for audio-based music recommendation http://www.russia.ai/single-post/2016/12/01/Deep-learning-for-audio-based-music-recommendation
- Spotify:https://hackernoon.com/spotifys-discover-weekly-how-machine-learning-finds-your-new-music-19a41ab76efe
- Deep Neural Networks for YouTube Recommendations https://research.google.com/pubs/pub45530.html
- Deep learning: the future of recommendations http://www.slideshare.net/balazshidasi/deep-learning-the-future-of-recommendations
- Wide & Deep Learning for Recommender Systems https://arxiv.org/abs/1606.07792

Спасибо!