Štefan Pero

PREDICTING STUDENT PERFORMANCE UTILIZING MATRIX FACTORIZATION

WIKT 2012

November 22-23, 2012, Smolenice, Slovak republic

Institute of Computer Science, Faculty od Science Pavol Jozef Šafárik University in Košice, Slovak Republic



- Student Performance Prediction
- Recommender systems
- Educational RSs
- Factorization techniques
- Conclusion

Real problem and situation

- students of the course Programming Algorithms Computation
- dataset collected during last two years
- current score of any task



Real problem and situation

- students of the course Programming Algorithms Computation
- dataset collected during last two years
- current score of any task

How to?

- improve student performance
- predict the likely performance of a student (for some exercises, tasks, materials, ...)
- recommend tasks or tasks sequences for future learning (by performance)



Recommender systems





Predicting Student Performance Utilizing MF

RS aim:

• suggest new products to users based on their preferences

Recommendations can be computed from different types of inputs:

- explicit feedback (rating/scoring/ranking)
- implicit feedback (clicking, selecting, viewing, printing, etc...)
- user and item characteristics







Educational recommender systems

ERS aim:

• suggest tasks sequences to students for improving their performance

Recommendations can be computed:

- student score
- student and task characteristics (student behaviour, knowledges, skills)



Educational recommender systems

ERS aim:

• suggest tasks sequences to students for improving their performance

Recommendations can be computed:

- student score
- student and task characteristics (student behaviour, knowledges, skills)

Casting student/task/performance in PSP as user/item/rating in RS



Predicting Student Performance Utilizing MF

Educational recommender systems



Matrix factorization

• latent factor model

$$X = W \times H^T$$



Bob	0.64	0.75	
Alice	0.66	0.75	
Mary	0.70	0.69	
John	0.90	0.94	
Tutu	0.27	0.93	
Susan	0.75	0.64	
	W		

	y=3x-4	y=-2x	y=1/x	y=-x-1	y=x
•	0.71	0.51	1.02	0.36	0.72
	0.70	0.56	0.41	0.96	0.69
			ΗΤ		



(1)

Matrix factorization

• latent factor model

$$X = W \times H^T$$



Bob	0.64	0.75	
Alice	0.66	0.75	
Mary	0.70	0.69	
John	0.90	0.94	
Tutu	0.27	0.93	
Susan	0.75	0.64	
W			

	y=3x-4	y=-2x	y=1/x	y=-x-1	y=x
•	0.71	0.51	1.02	0.36	0.72
	0.70	0.56	0.41	0.96	0.69
			Η ^T		

$$\hat{p}_{i,j} = \sum_{k=1}^{K} w_{i,k} h_{j,k} = (WH^T)_{i,j}$$
(2)



(1)

Predicting Student Performance Utilizing MF

Matrix factorization techniques are useful:

- in case of sparse data
- recommendation without no background knowledge about the students and the tasks



Matrix factorization techniques are useful:

- in case of sparse data
- recommendation without no background knowledge about the students and the tasks

Problems?

- new students or tasks (cold start problem)
- slip (student knows the solution but making a mistake)
- guess (student does not know the right solution but guessing correctly)
- time (the knowledge of the students improves over the time)
- student preferences vs. student performance



Thank you for your attention!

stefan.pero@ics.upjs.sk
http://www.ics.upjs.sk/~pero

