Browsing-Pattern Mining from e-Book Logs with Non-negative Matrix Factorization

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Abstract: An e-Book system can collect various kinds of operation logs when a page is opened, when the next page is browsed and so on. The analysis of e-Book logs enables teachers to understand how a student browses a given material. We report our work-in-progress study about browsing-pattern mining from e-Book logs based on non-negative matrix factorization (NMF). We applied NMF to an observation matrix with 21-page browsing logs of 110 students, and discovered five kinds of browsing patterns. We found out that NMF could provide reasonable decomposed matrices to explain the browsing patterns.

Proposed Approach

e-Book system

e-Book operation logs

User	Material	Operation	PageNo	Date	Time
X	00000000NLAT	OPEN	0	2014/10/15	9:01:09
X	00000000NLAT	CLOSE	1	2014/10/15	9:01:13
Y	00000000P82P	OPEN	26	2014/10/29	10:05:30
Y	00000000P82P	PREV	25	2014/10/29	10:05:35
Y	00000000P855	NEXT	2	2014/11/19	8:52:47
Z	00000000P84Z	CLOSE	28	2014/11/12	10:00:27
Z	00000000P82P	NEXT	19	2014/11/12	8:50:28
Z	00000000P84Z	NEXT	9	2014/11/12	9:31:30
...	...				

How students browse material?

Browsing pattern vs. Quiz score?

Browsing time t

$t > 10$ sec.

otherwise

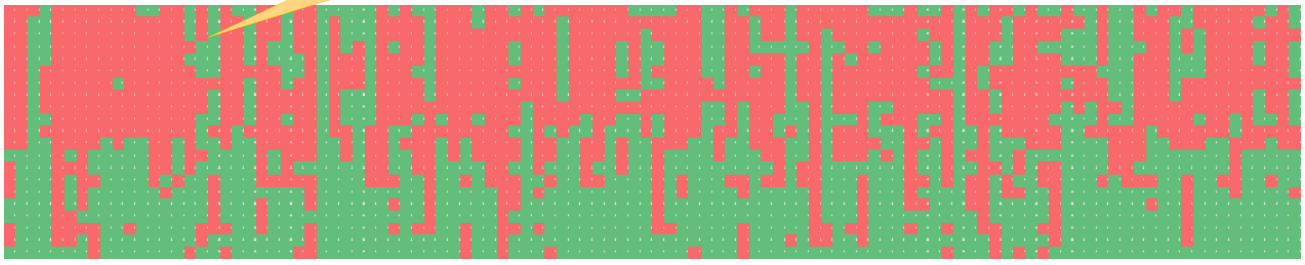
110 students

Browsing Matrix $\mathbf{V}$

page 1

page i

page 21



Non-negative Matrix Factorization(NMF) $\mathbf{V} = \mathbf{W} \times \mathbf{H}$

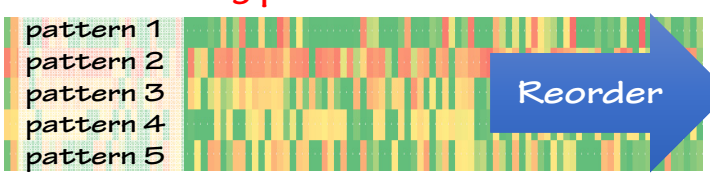
Experimental Results

$\mathbf{W}^T$ Browsing pattern vs. page

page 1 ••• page i ••• page 21

pattern 1: browse the latter part
pattern 2: browse the former part
pattern 3: browse the middle part
pattern 4: browse the beginning and end part
pattern 5: browse pages between page #12 and #15

$\mathbf{H}$ Browsing pattern vs. student

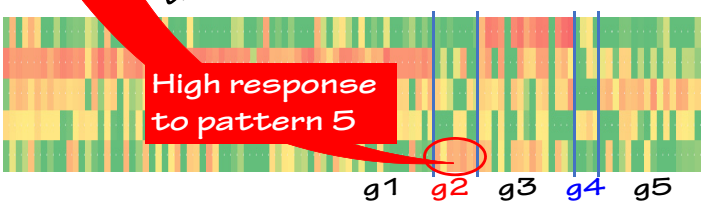


Reorder

110 students

G2 had understood the contents?

practice exercise



g1 g2 g3 g4 g5

Ave. Quiz Score (6.95) (5.49)

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