How to build a recommender system based on Mahout and Java EE

Berlin Expert Days 29. – 30. March 2012 Manuel Blechschmidt CTO Apaxo GmbH

„All the web content will be personalized in three to five years.“

Sheryl Sandberg COO Facebook – 09.2010

Agenda

- What is personalization?
- What algorithms can be used?
- Architecture of a recommender system
- How to bundle Mahout into an Java EE application
- Interface with the recommender
- Conclusion

What is personalization?

Personalization involves using technology to accommodate the differences between individuals. Once confined mainly to the Web, it is increasingly becoming a factor in education, health care (i.e. personalized medicine), television, and in both "business to business" and "business to consumer" settings.

Source:
https://en.wikipedia.org/wiki/Personalization

Amazon.com

Manuel, Welcome to Your Amazon.com (If you're not Manuel Blechschmidt, click here.)

Today's Recommendations For You

Here's a daily sample of items recommended for you. Click here to **see all recommendations**.

Page 1 of 35

DVI Gear HDMI Cable 2M (6 Feet)
(5,789) $2.83
Fix this recommendation

Leather Case for Kindle 3
(48) $4.74
Fix this recommendation

The Little Black Book of Big R... (Paperback) by Natasha Burton
(58) $10.17
Fix this recommendation

The Little Black Book of Big Red Flags: Relationship Warning Signs You Totally Spotted... But Chose to Ignore

Kindle Fire, Full Color 7" Multi-touch Display,...
(15,390) $199.00
Fix this recommendation

The Lion King (Two-Dis... Blu-ray ~ Matthew Brod...
(1,009) $26.99
Fix this recommendation

TripAdvisor.com

Visiting Berlin, Germany

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All traveler photos and videos

Top-rated hotels

All 662 hotels

1 The Circus Hotel 736 reviews
2 Schlosshotel Im Grunewald 105 reviews
3 Casa Camper Berlin 203 reviews
4 The Regent Berlin 233 reviews
5 Adina Apartment Hotel Berlin Hacke... 151 reviews

Top-rated B&Bs

All 127 B&Bs

1 mittendrin 57 reviews
2 Pension Elefant 111 reviews
3 Pension Galerie 54 reviews

Top-rated vacation rentals

All 877 vacation rentals

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Friends' advice

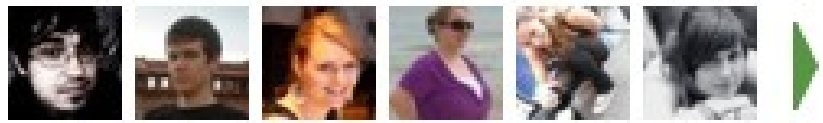
Markus Fiedler
Recommends Museumsinsel (Museum Island)
Berlin, Germany

Markus Fiedler
Recommends Deutsches Historisches Museum
Berlin, Germany

Markus Fiedler
Recommends Gendarmenmarkt
Berlin, Germany

Markus Fiedler

Friends who have been near Munich



Need travel advice? Ask your friends about Munich

Manuel Blechschmidt, das passt zu Ihnen — Inbox

Delete Junk Reply Reply All Forward Print To Do

eBay

TOLLE ANGEBOTE
GANZ NACH IHREM GESCHMACK

Das passt zu dem, was Sie sich angesehen haben.

Apple Cinema Display in OVP

EUR 779,00

Apple Cinema Display 23-defekt für Bastler

EUR 22,50

Seagate Cheetah 10K.7 ST3300007LW 300 GB U320...

EUR 149,99

Apple Cinema HD Display 23 inch *defekt* für bastler, OVP

EUR 1,50

Kingston Speicher KTT800D2/2G 2GB 800MHz...

EUR 45,19

Kostenloser Versand

Apple Cinema 23 HD Display Alu 23" NEUWERTIG Mod...

EUR 499,00

Andere Käufer beobachten diese Artikel

USB HDMI Konverter Adapter für Apple iPad 2 iPhone 4

EUR 25,29

Kostenloser Versand

auvisio HDMI-Video-Adapter 1080p für iPhone, iPad & iP...

EUR 31,99

Kostenloser Versand

Apple DVI to ADC Adapter

EUR 63,20

Apple Mini DisplayPort to VGA Adapter Neu und Orig....

EUR 6,50

FullHD HDMI-Video-ADAPTER

3 in 1 Adapter Kabel + Audio

criteo.com - Retargeting

Zalando

Wird oft zusammen gekauft mit

SALE -30%

ASICS
GEL 1160 W - Laufschuh - white / lipstick red / silver
~~99,95 €~~ 69,95 €

ASICS
GEL-TRAIL SENSOR 5 - Laufschuh - red/black/lightning
139,95 €

Zalando Essentials
Kleid - red

Plista

www.welt.de/wissenschaft/article13492851/Raumsonde-Dawn-erreicht-Urplaneten-Vesta.html#plista_widget_belowArticle

RSS

Trackback-URL http://disqus.com/forums

Das könnte Sie auch interessieren

FÜR ITALIEN

Ex-Rennfahrer Zanardi startet bei den Paralympics

Sieben Mal wurde Zanardi nach dem Unfall auf dem Lausitzring wiederbelebt und verlor beide Beine oberhalb der Knie. **mehr**

ANZEIGE

Panasonic LUMIX G3 Wechselobjektivkamera!

Kreative Freiheit auch bei wenig Licht! LUMIX G3: schneller Autofokus & hohe Bildqualität. **mehr**

HIGH HEELS, KRIEG, FONDUE

Was die E-Mails über das Ehepaar Assad verraten

Eine Gruppe von Aktivisten soll monatelang heimlich Mails von Syriens Präsident Assad und seiner Frau mitgelesen... **mehr**

VIDEO-EMPFEHLUNG

Neue Mercedes A-Klasse greift an

Auf dem Autosalon Genf 2012 stellt Mercedes seine neue A-Klasse vor. Die dritte Generation des Kompaktwagens ist sportlich... **mehr**

FLUGHAFEN-ABZOCKE

3-Sekunden-Anruf in Leipzig kostet US-Soldat 41 Dollar

Viele US-Soldaten müssen am Leipziger Flughafen umsteigen, bevor es weiter in die Kriegsgebiete geht. Sie nutzen die... **mehr**

ANZEIGE

Tipp für perfekten Bauch

Sie hat 19 kg Körperfett in 2 Monaten mit diesem einfachen Diät-Trick verloren. Die Ergebnisse werden sie schockieren. **mehr**

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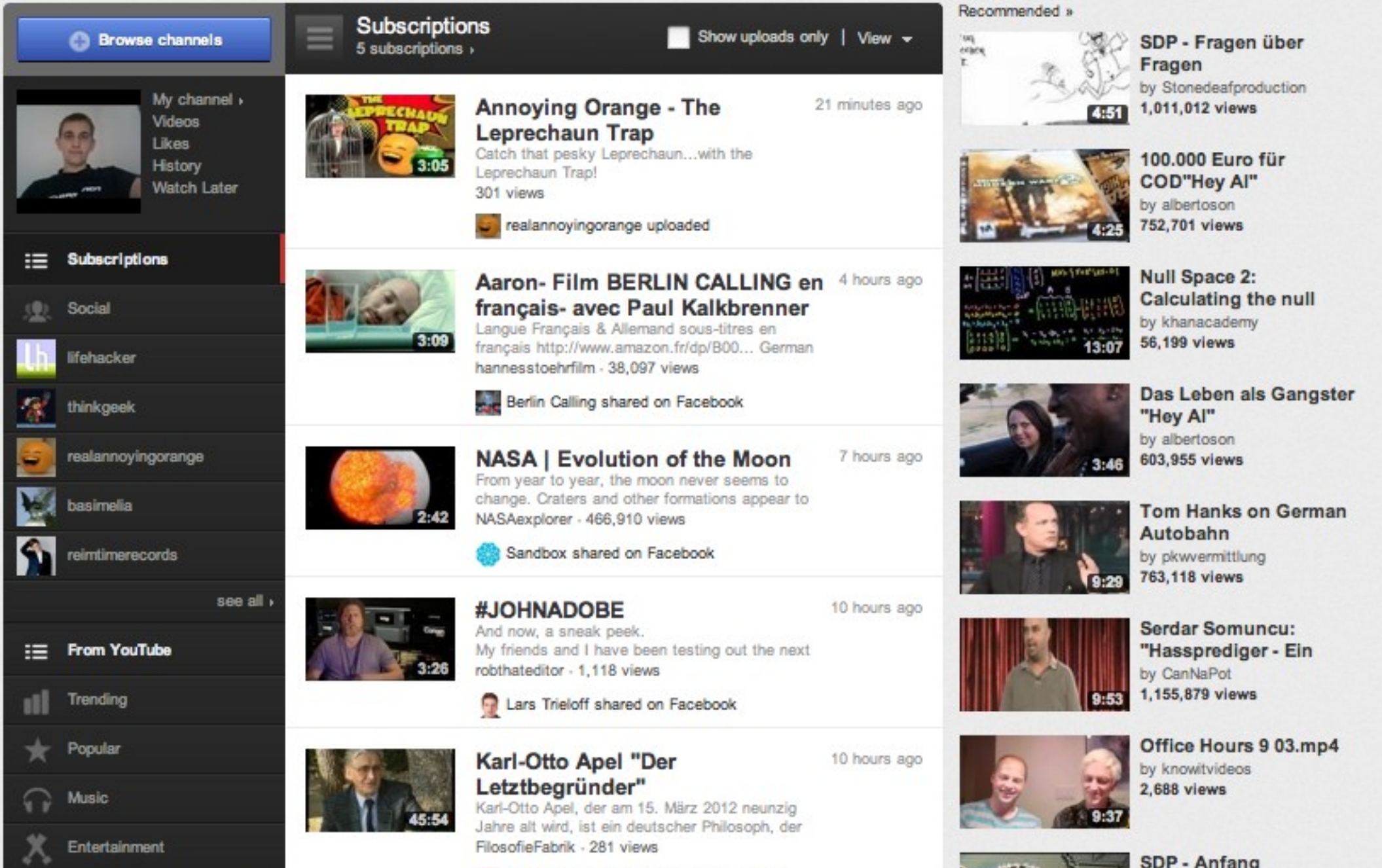
YouTube


Browse channels
My channel
Videos
Likes
History
Watch Later
Subscriptions
Social
lifehacker
thinkgeek
realannoyingorange
basimelia
reimtimerecords
see all
From YouTube
Trending
Popular
Music
Entertainment
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Catch that pesky Leprechaun...with the Leprechaun Trap!
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4 hours ago
Langue Français & Allemand sous-titres en français http://www.amazon.fr/dp/B00... German
hannesstoehrfilm · 38,097 views
Berlin Calling shared on Facebook
NASA | Evolution of the Moon
7 hours ago
From year to year, the moon never seems to change. Craters and other formations appear to
NASAexplorer · 466,910 views
Sandbox shared on Facebook
#JOHNADOBE
10 hours ago
And now, a sneak peek.
My friends and I have been testing out the next
robthateditor · 1,118 views
Lars Trieloff shared on Facebook
Karl-Otto Apel "Der Letztbegründer"
10 hours ago
Karl-Otto Apel, der am 15. März 2012 neunzig Jahre alt wird, ist ein deutscher Philosoph, der
FilosofieFabrik · 281 views
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by CanNaPot
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Office Hours 9 03.mp4
by knowitvideos
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SDP - Anfang

Naturideen.de (coming soon)

dies ist ein Testnewsletter, der die Fähigkeiten vom SemRecSys der Apaxo GmbH verdeutlichen soll. In diesem Newsletter finden Sie automatisch für Sie erstellte Empfehlungen, von denen die Apaxo GmbH im konkreten Manuel Blechschmidt denkt, dass diese Ihnen Gefallen könnten.

Falls Sie keine personalisierten Emails möchten, können Sie dies jederzeit deaktivieren.

Wir wünschen Ihnen eine schöne Herbstzeit

das Team Naturideen

Sh[illegible]pumstellung wichtige Mitteilung an alle Kund[illegible]n:
W[illegible] werden voraussichtlich noch in diesem Jahr au[illegible] eine andere Shops[illegible]ware umsteigen. Daher möchten wir Sie bitten, sich Ihre M[illegible]kli[illegible] vor[illegible] [illegible]zusp[illegible]ch[illegible] u[illegible]/oder au[illegible]zud[illegible]ck[illegible]. Lei[illegible] können wir d[illegible]se n[illegible] [illegible] Wir [illegible] Si[illegible] ab[illegible] noc[illegible] ei[illegible]al [illegible] vo[illegible] [illegible] ke[illegible]e für Sie wich[illegible]gen D[illegible]te[illegible] [illegible] gehen.

[illegible] Dank für Ihr [illegible]ständnis

Ihre persönlichen Lieblinge

Nudel und Reis Gewürz

Für Nudeln, Spaghetti und sämtliche Reisspeisen.

50 g		**1,75 €**
100 g		**2,60 €**
250 g		**5,75 €**
500 g		**10,95 €**
1 kg		**20,80 €**

Bratkartoffel Gewürzzubereitung

Fertiges Gewürz, besonders pikant. Geeignet für Bratkartoffel, fein.

50 g		**1,75 €**
100 g		**2,60 €**
250 g		**5,75 €**
500 g		**10,95 €**
1 kg		**20,80 €**

Schwarzkümmel ganz

Nigella-Saat, geeignet für Salate und Brot.

50 g		**1,70 €**
100 g		**2,50 €**
250 g		**5,50 €**
500 g		**10,45 €**
1 kg		**19,85 €**

Curry Thailändisch Gewürzzubereitung

Dieses Gewürz ist für Curry Saucen und Curry Gerichte geeignet.

50 g		**1,80 €**
100 g		**2,70 €**
250 g		**5,95 €**
500 g		**11,30 €**
1 kg		**21,50 €**

Lamm und Hammel Gewürz

Geeignet für Lamm- und Hammelfleisch.

50 g		**1,85 €**
100 g		**2,75 €**
250 g		**6,05 €**
500 g		**11,50 €**
1 kg		**21,85 €**

Tomaten Mozzarella Gewürzsalz

SONDERANGEBOT Für Tomaten Mozzarella Salat.

50 g	~~1,60 €~~	1,28 €
100 g	~~2,40 €~~	1,92 €
250 g	~~5,30 €~~	4,24 €
500 g	~~10,10 €~~	8,08 €
1 kg	~~19,20 €~~	15,36 €

Folgendes könnte Ihnen gefallen:

Braten Gewürz

Geeignet für Kalbs-, Rinder- und Schweinebraten, für Saucen sowie für Ragouts.

50 g		**1,80 €**
100 g		**2,70 €**
250 g		**5,95 €**
500 g		**11,30 €**
1 kg		**21,50 €**

Weil Sie folgendes kauften:

- Bratkartoffel Gewürzzubereitung

Suppenkräuter

Für Suppen aller Art.

50 g		**1,70 €**
100 g		**2,50 €**
250 g		**5,50 €**
500 g		**10,45 €**
1 kg		**19,85 €**

Weil Sie folgendes kauften:

- Bratkartoffel Gewürzzubereitung

Curry Madras Gewürzzubereitung

Geeignet für Reis, Mayonnaise, herzhafte Suppen und Sossen, Fleisch- und Fischgerichte, indische Gerichte.

50 g		**1,70 €**
100 g		**2,50 €**
250 g		**5,50 €**
500 g		**10,45 €**
1 kg		**19,85 €**

Weil Sie folgendes kauften:

- Bratkartoffel Gewürzzubereitung

Italienische Kräutermischung

Für Salate (Tomate, Gurke, Zucchini), Suppen, Saucen und italienische Nudelgerichte.

50 g		**1,80 €**
100 g		**2,65 €**
250 g		**5,85 €**
500 g		**11,15 €**
1 kg		**21,20 €**

Weil Sie folgendes kauften:

Americano Honig Gewürzzubereitung

Geeignet für Steaks und Braten nach amerikanischer Art.

50 g		**1,85 €**
100 g		**2,75 €**
250 g		**6,05 €**
500 g		**11,50 €**
1 kg		**21,85 €**

Weil Sie folgendes kauften:

Bohnenkraut gerebelt

Geeignet für Bohnen- und Eintopfgerichte, Gemüsesuppen, Salate.

50 g		**1,75 €**
100 g		**2,60 €**
250 g		**5,75 €**
500 g		**10,95 €**
1 kg		**20,80 €**

Weil Sie folgendes kauften:

Recommender

This talk will concentrate on recommender technology based on collaborative filtering (cf) to personalize a web site

- a lot of research is going on
- cf has shown great success in movie and music industry
- recommenders can collect data silently and use it without manual maintenance

What is a recommender?

Let *U* be a set of users of the recommendation system and *I* be the set of items from which the users can choose. A recommender *r* is a function which produces for a user u_i a set of recommended items R_k with *k* entries and a binary, transitive, antisymmetric and total relation $prefers\_over_{ui}$ which can be used for sorting the recommendations for the user. The recommender *r* is often called a top-k recommender.

$$U = \{u_1, u_2, \ldots u_m\} \quad (1)$$

$$I = \{i_1, i_2, \ldots i_n\} \quad (2)$$

$$R_k = \{R \subset I \wedge |R| = k\} \quad (3)$$

$$prefers\_over = R_k \times R_k \quad (4)$$

$$r : U \rightarrow R_k \times prefers\_over \quad (5)$$

WARNING!

The next slides contain math which takes normally 3 years to understand so don't be disappointed if you don't get it.

What should wolf and sheep eat?

Ms. Baumgartner your sun is ignoring again the food chain.

SON!

Source: http://static.nichtlustig.de/comics/full/081009.jpg

Demo Data

	Carrots	Grass	Pork	Beef	Corn	Fish
Rabbit	10	7	1	2	?	1
Cow	7	10	?	?	?	?
Dog	?	1	10	10	?	?
Pig	5	6	4	?	7	3
Chicken	7	6	2	?	10	?
Pinguin	2	2	?	2	2	10
Bear	2	?	8	8	2	7
Lion	?	?	9	10	2	?
Tiger	?	?	8	?	?	5
Antilope	6	10	1	1	?	?
Wolf	1	?	?	8	?	3
Sheep	?	8	?	?	?	2

Characteristics of Demo Data

Ratings from 1 – 10

Users: 12

Items: 6

Ratings: 43 (unusual normally 100,000 – 100,000,000)

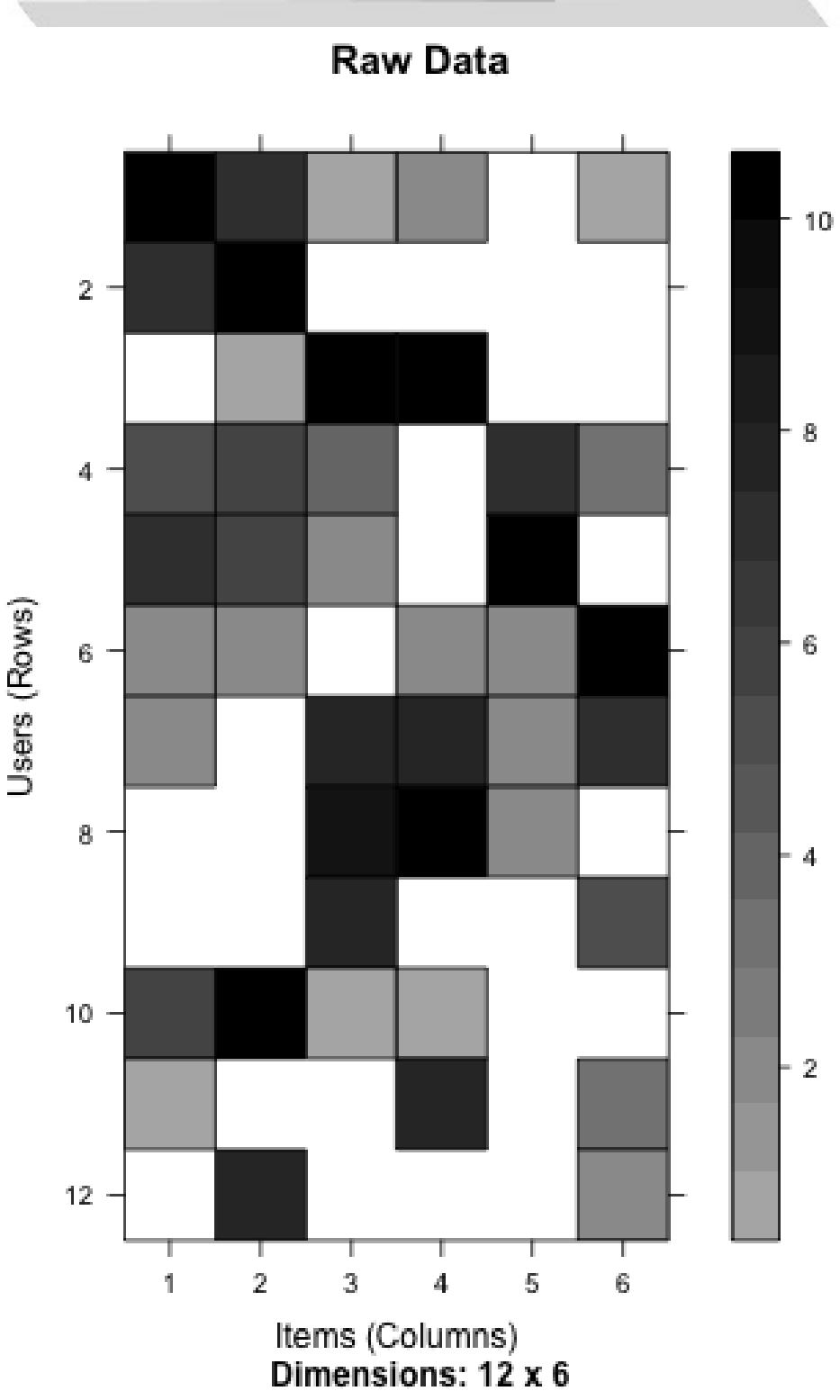
Matrix filled: ~60% (unusual normally sparse around 0.5-2%)

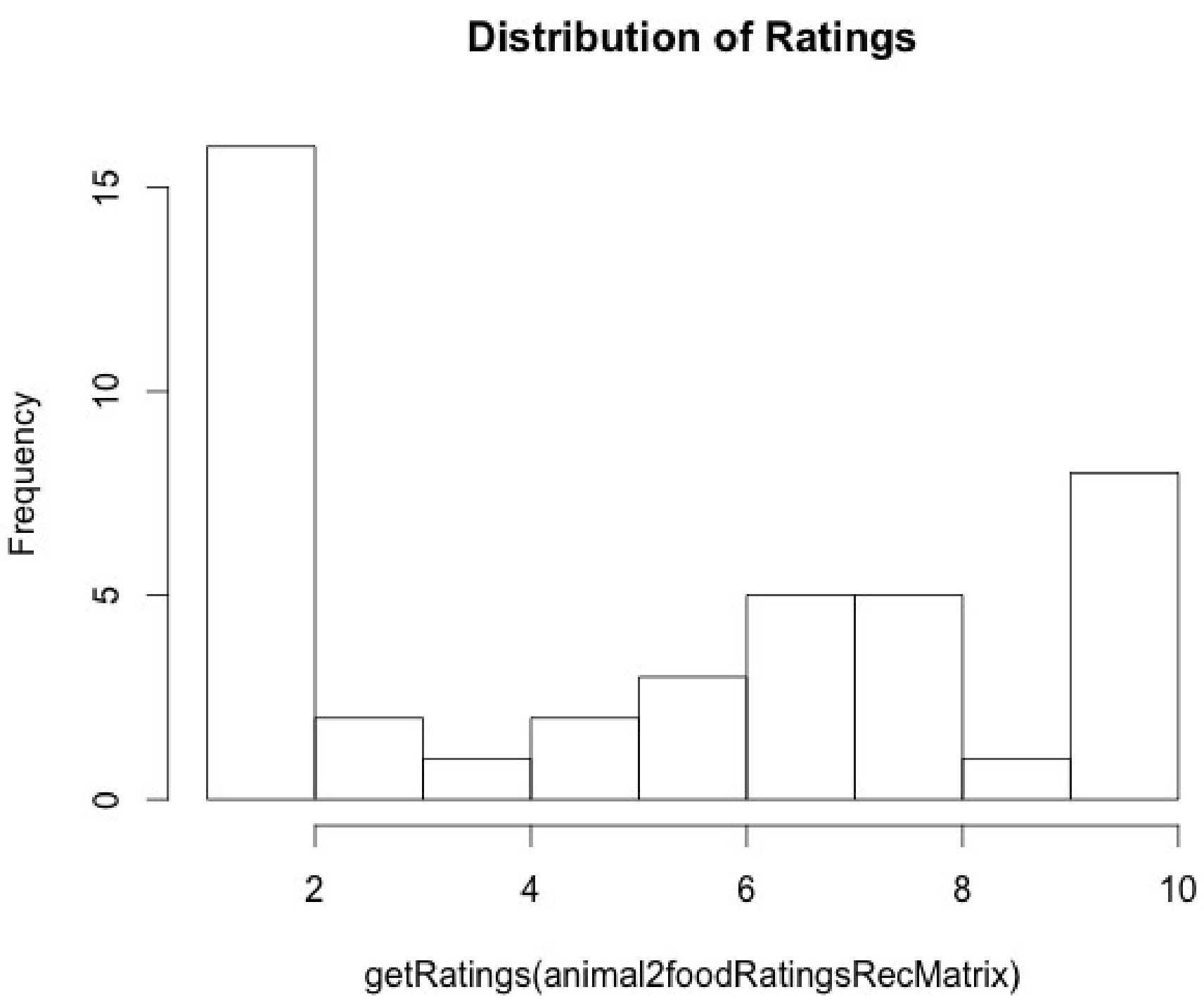
Average Number of Ratings per User: ~3.58

Average Number of Ratings per Item: ~7.17

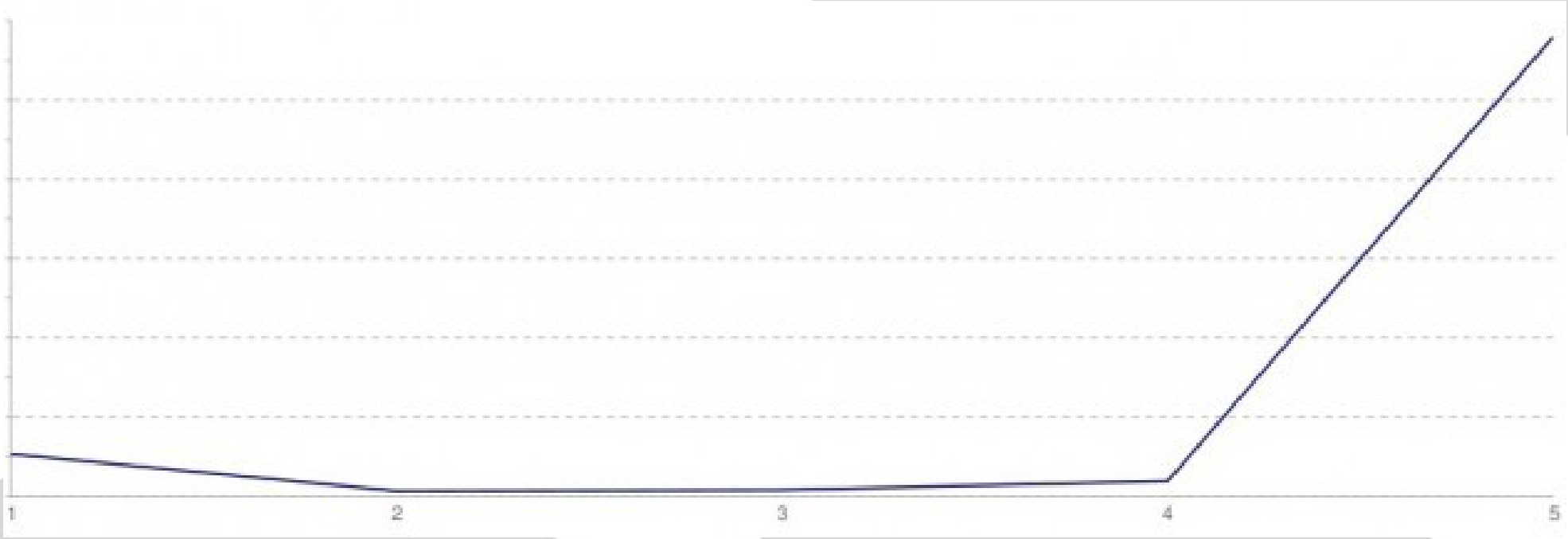
Average Rating: ~5.579

https://github.com/ManuelB/facebook-recommender-demo/tree/master/docs/BedConExamples.R


Raw Data
Users (Rows)
2
4
6
8
10
12
1
2
3
4
5
6
Items (Columns)
Dimensions: 12 x 6
10
8
6
4
2


Distribution of Ratings
Frequency
0
5
10
15
2
4
6
8
10
getRatings(animal2foodRatingsRecMatrix)

YouTube Rating Distribution



http://techcrunch.com/2009/09/22/youtube-comes-to-a-5-star-realization-its-ratings-are-useless/

Model and Memory Approaches

- Item- or User- Based Collaborative Filtering
  - Idea suggest what similair users did
- Matrix Factorization e.g Singular Value Decomposition
  - Try to create a profile based of factors for users and items

Main difference:

A model base approach tries to extract the underlying logic from the data.

User Based Approach

- Find similar or opposite animals like wolf
- Checkout what these other animals like
- Recommend this to wolf

Find animals which voted for beef, fish and carrots too

	Carrots	Grass	Pork	Beef	Corn	Fish
Wolf	1	?	?	8	?	3
Pinguin	2	2	?	2	2	10
Bear	2	?	8	8	2	7
Rabbit	10	7	1	2	?	1
Cow	7	10	?	?	?	?
Dog	?	1	10	10	?	?
Pig	5	6	4	?	7	3
Chicken	7	6	2	?	10	?
Lion	?	?	9	10	2	?
Tiger	?	?	8	?	?	5
Antilope	6	10	1	1	?	?
Sheep	?	8	?	?	?	?

Pearson Correlation

$$sim(i,j) = \frac{\sum_{u \in U}(R_{u,i} - \bar{R}_i)(R_{u,j} - \bar{R}_j)}{\sqrt{\sum_{u \in U}(R_{u,i} - \bar{R}_i)^2}\sqrt{\sum_{u \in U}(R_{u,j} - \bar{R}_j)^2}}$$

- 1 = very similar
- (-1) = complete opposite votings
- similarity between wolf and pinguin: -0.2401922
  - cor(c(8,3,1),c(2,10,2))
- similarity between wolf and bear: 0.8196562
  - cor(c(8,3,1),c(8,7,2))
- similarity between wolf and rabbit: -0.6465846
  - cor(c(8,3,1),c(2,1,10))

Weighted sum of the ratings

$$P_{u,i} = \frac{\sum_{\text{all similar items, N}} (s_{i,N} * R_{u,N})}{\sum_{\text{all similar items, N}} (|s_{i,N}|)}$$

Pork (10):

(0.8196 * 8 + (-0.6466) * 1) / (0.8196 + (-0.6465)

= 34 ~ 10

Grass (5.65):

(2*(-0.2401)+7*(-0.6465)) / ((-0.2401) + (-0.6465))

= 5,65

Corn (2,0):

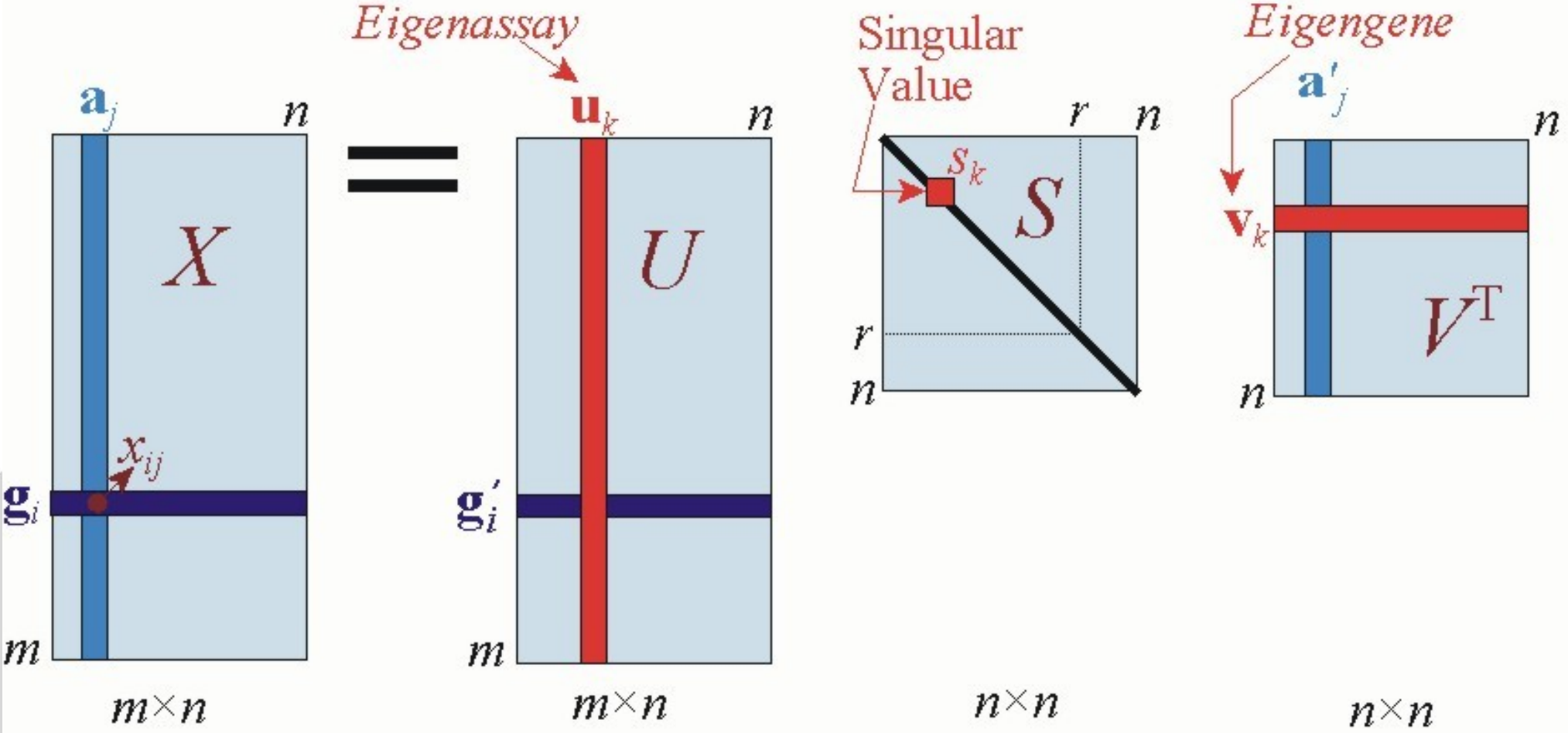
2*(-0.2401)+2*(0.8196)) / (-0.2401+0.8196) = 2,0

Predicted ratings

- Wolf should eat: Pork Rating: 10.0
- Wolf should eat: Grass Rating: 5.645701
- Wolf should eat: Corn Rating: 2.0

SVD

$$X = USV^{\mathrm{T}}$$



http://public.lanl.gov/mewall/kluwer2002.html

Factorized Matrixes

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]
[1,]	-0.2292347	-0.49430779	0.19062424	-0.07181247	0.4770710954	0.09702186
[2,]	-0.3483569	-0.15661845	-0.13851824	0.25708447	0.0703741295	-0.02256252
[3,]	-0.3297472	0.38914572	0.32911119	-0.46946360	0.1786228635	-0.06873459
[4,]	-0.2660216	-0.12401663	0.18550244	-0.06325647	-0.2337201734	-0.05392610
[5,]	-0.3113082	-0.27117554	0.02818862	-0.52761879	-0.3478782885	0.39975722
[6,]	-0.1976584	0.25772982	-0.68952087	-0.34561608	0.1476239298	-0.17702279
[7,]	-0.2850541	0.33077115	-0.19466386	0.31863281	-0.0903296719	0.21282496
[8,]	-0.3348905	0.30007430	0.10415046	0.28947114	0.3426507849	0.51552934
[9,]	-0.3124836	0.05643066	0.04066306	-0.04120880	0.1352948890	-0.57040061
[10,]	-0.2527844	-0.42862050	-0.45718586	0.12469935	-0.0632597635	0.03279939
[11,]	-0.2666849	0.14696479	0.11618986	0.16657749	-0.6246850304	-0.06685539
[12,]	-0.2907617	-0.12807178	0.22935196	0.27605156	-0.0006122159	-0.38643894

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]
[1,]	47.62782	0.00000	0.000000	0.000000	0.000000	0.000000
[2,]	0.00000	15.42104	0.000000	0.000000	0.000000	0.000000
[3,]	0.00000	0.00000	9.022838	0.000000	0.000000	0.000000
[4,]	0.00000	0.00000	0.000000	7.118305	0.000000	0.000000
[5,]	0.00000	0.00000	0.000000	0.000000	6.178605	0.000000
[6,]	0.00000	0.00000	0.000000	0.000000	0.000000	3.055463

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]
[1,]	-0.3866406	-0.44415916	-0.41411566	-0.4434746	-0.3884358	-0.36631650
[2,]	-0.4012926	-0.44857956	0.54673703	0.3995054	-0.3505078	0.23740026
[3,]	0.1978540	-0.24017864	0.07783862	0.4734199	0.2036356	-0.79467933
[4,]	-0.2452951	0.71836270	0.13325487	0.1112718	-0.5306107	-0.33481245
[5,]	0.7464186	-0.16160227	0.26340134	-0.2470840	-0.5345574	-0.02369669
[6,]	0.1817048	-0.04065689	-0.66059886	0.5883598	-0.3427756	0.25549400

Predicted Matrix (k = 2)

	Carrots	Grass	Pork	Beef	Corn	Fish
Rabbit	7.201511	8.297301	0.434417	1.707758	6.673437	2.255415
Cow	7.356298	8.464665	5.264098	6.057950	7.120983	5.225913
Dog	3.481600	3.989480	9.820541	9.425599	3.832614	6.916145
Pig	5.658174	6.510421	4.165493	4.763837	5.484533	4.090221
Chicken	7.374081	8.488613	3.745805	4.702562	7.041607	4.310466
Pinguin	2.132330	2.443739	5.858912	5.633404	2.337486	4.141430
Bear	3.166465	3.629539	8.419829	8.114452	3.453418	5.979882
Lion	4.162801	4.775999	9.130007	8.932443	4.417707	6.685987
Tiger	5.168496	5.940595	6.611528	6.862983	5.186942	5.437517
Antilope	7.265590	8.369202	1.285779	2.481336	6.786286	2.789224
Wolf	3.793709	4.357410	6.181260	6.226153	3.891052	4.796402
Sheep	6.011926	6.917271	4.507000	5.134227	5.832543	4.395093

Predicted Ratings

- Sheep should eat: Carrots Rating: 6.01
- Sheep should eat: Corn Rating: 5.83

What other algorithms can be used?

Similarity Measures for Item or User based:

- LogLikelihood Similarity
- Cosine Similarity
- Pearson Similarity
- etc.

Estimating algorithms for SVD:

- ALSWRFactorizer
- ExpectationMaximizationSVDFactorizer

Let's built it

Mahout - Taste

Taste is a flexible, fast collaborative filtering engine for Java.

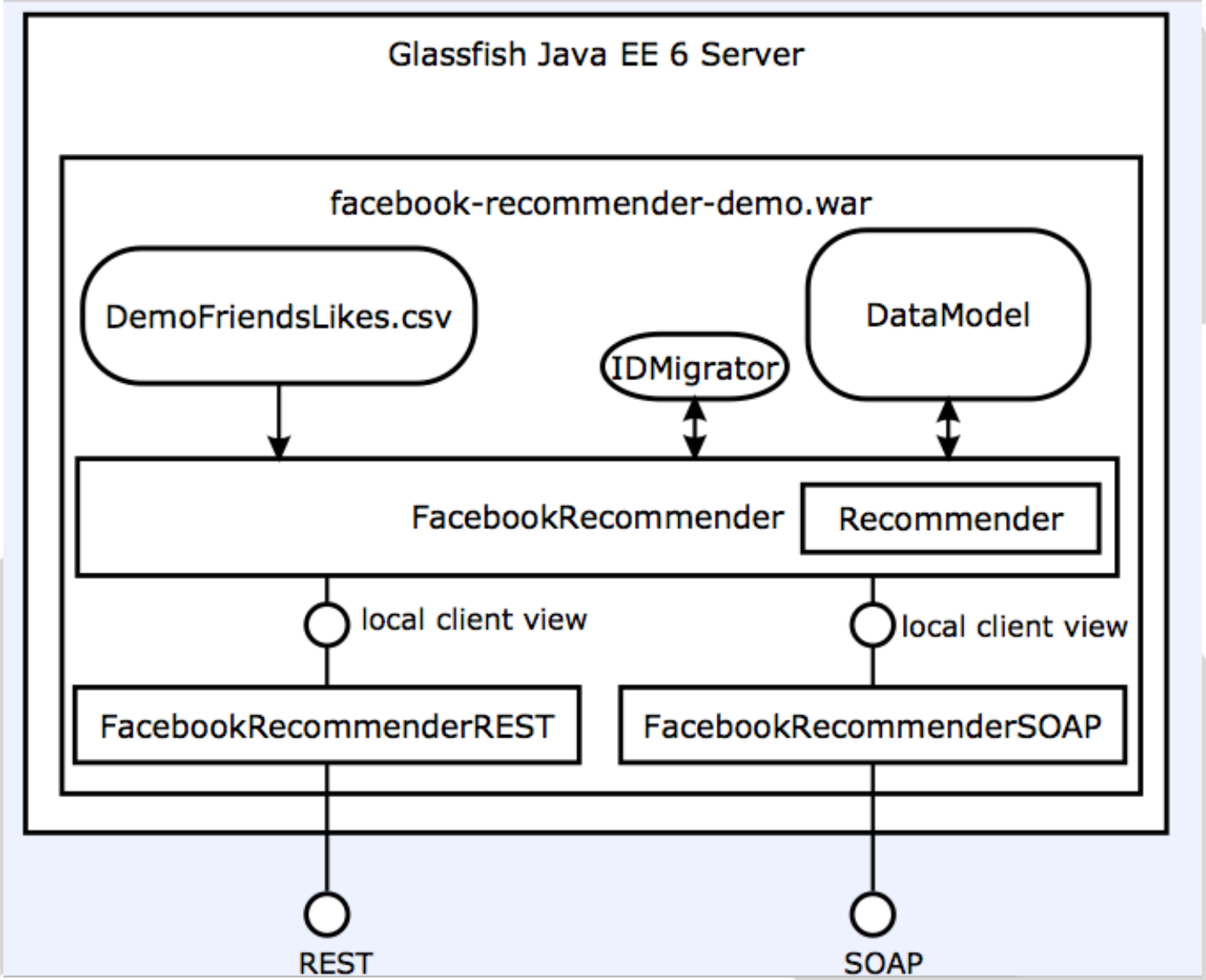
It was primarly written by Sean Owen and is part of the Apache Mahout library.

Another important author is: Sebastian Schelter

It offers all the algorithms introduced here and is Open Source

http://mahout.apache.org/taste.html

Architecture of the recommender

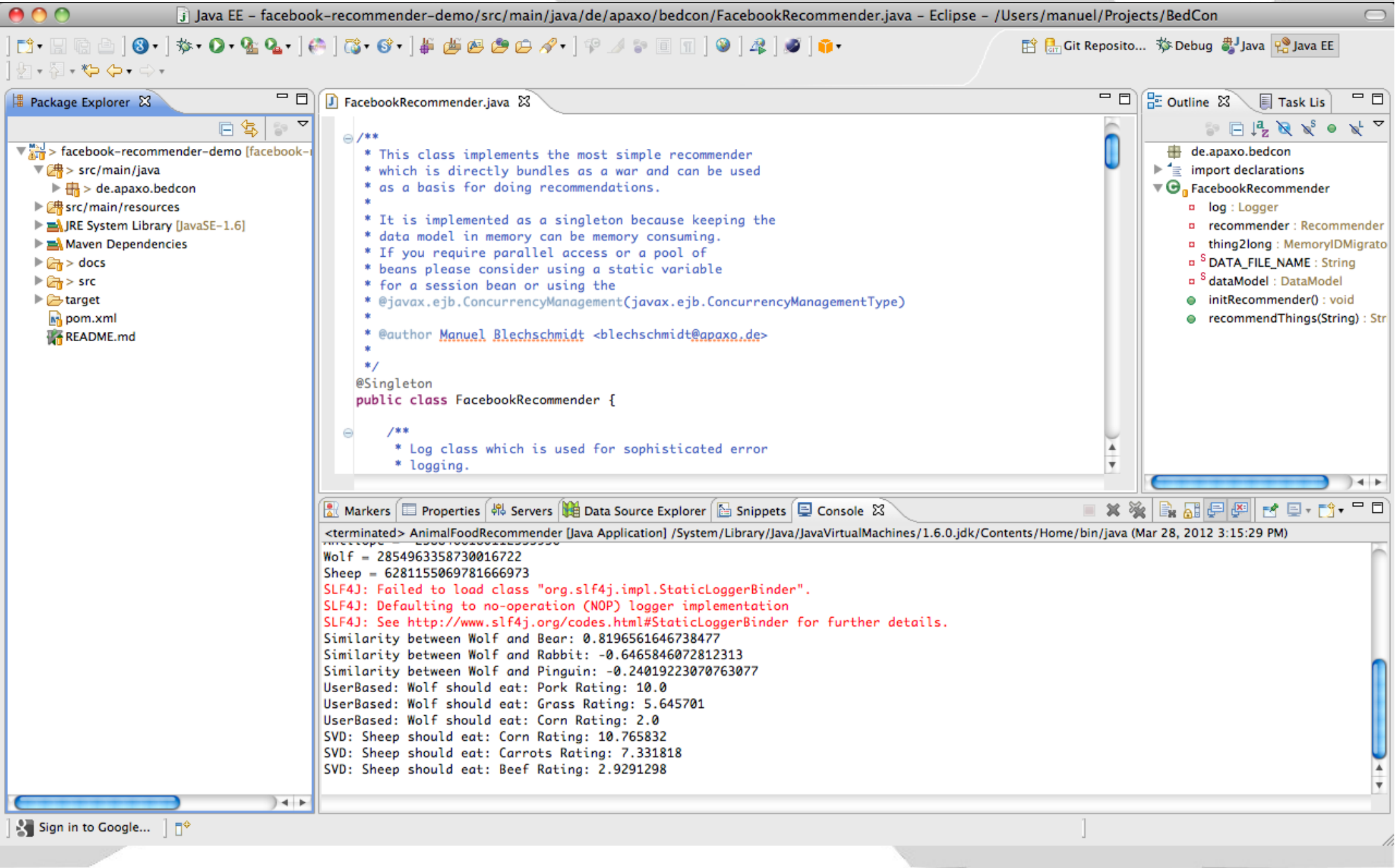


Packaging

Terminal — bash — 125×46

```
META-INF/
META-INF/MANIFEST.MF
WEB-INF/
WEB-INF/classes/
WEB-INF/classes/de/
WEB-INF/classes/de/apaxo/
WEB-INF/classes/de/apaxo/bedcon/
WEB-INF/lib/
WEB-INF/classes/de/apaxo/bedcon/FacebookRecommender.class
WEB-INF/classes/de/apaxo/bedcon/FacebookRecommenderREST.class
WEB-INF/classes/de/apaxo/bedcon/FacebookRecommenderSOAP.class
WEB-INF/classes/DemoFriendsLikes.csv
WEB-INF/lib/commons-beanutils-1.7.0.jar
WEB-INF/lib/commons-beanutils-core-1.8.0.jar
WEB-INF/lib/commons-cli-1.2.jar
WEB-INF/lib/commons-cli-2.0-mahout.jar
WEB-INF/lib/commons-codec-1.4.jar
WEB-INF/lib/commons-collections-3.2.1.jar
WEB-INF/lib/commons-configuration-1.6.jar
WEB-INF/lib/commons-digester-1.8.jar
WEB-INF/lib/commons-httpclient-3.0.1.jar
WEB-INF/lib/commons-lang-2.6.jar
WEB-INF/lib/commons-logging-1.0.3.jar
WEB-INF/lib/commons-math-2.2.jar
WEB-INF/lib/guava-r09.jar
WEB-INF/lib/hadoop-core-0.20.204.0.jar
WEB-INF/lib/jackson-core-asl-1.8.2.jar
WEB-INF/lib/jackson-mapper-asl-1.8.2.jar
WEB-INF/lib/lucene-analyzers-3.4.0.jar
WEB-INF/lib/lucene-core-3.4.0.jar
WEB-INF/lib/mahout-collections-1.0.jar
WEB-INF/lib/mahout-core-0.6.jar
WEB-INF/lib/mahout-math-0.6.jar
WEB-INF/lib/slf4j-api-1.6.1.jar
WEB-INF/lib/solr-commons-csv-3.1.0.jar
WEB-INF/lib/uncommons-maths-1.2.2.jar
WEB-INF/lib/watchmaker-framework-0.6.2.jar
WEB-INF/lib/xpp3_min-1.1.4c.jar
WEB-INF/lib/xstream-1.3.1.jar
WEB-INF/web.xml
META-INF/maven/
META-INF/maven/de.apaxo.bedcon/
META-INF/maven/de.apaxo.bedcon/facebook-recommender-demo/
META-INF/maven/de.apaxo.bedcon/facebook-recommender-demo/pom.xml
META-INF/maven/de.apaxo.bedcon/facebook-recommender-demo/pom.properties
Manuel-Blechschmidts-MacBook-Pro-2:target manuel$
```

Eclipse Project



Maven pom.xml

Terminal — vim — 158×52

```
<?xml version="1.0"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://maven.apache.org/POM/4
.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>de.apaxo.bedcon</groupId>
  <artifactId>facebook-recommender-demo</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <packaging>war</packaging>
  <name>BedCon Demo for a Facebook Recommender</name>
  <description>This projects shows how you create a war with a recommender in it based on a dataset by Facebook likes.</description>
  <dependencies>
    <dependency>
      <groupId>org.apache.mahout</groupId>
      <artifactId>mahout-core</artifactId>
      <version>0.6</version>
    </dependency>
    <dependency>
      <groupId>javax</groupId>
      <artifactId>javaee-api</artifactId>
      <version>6.0</version>
      <scope>provided</scope>
    </dependency>
    <dependency>
      <groupId>org.apache.solr</groupId>
      <artifactId>solr-commons-csv</artifactId>
      <version>3.1.0</version>
    </dependency>
  </dependencies>
  <organization>
    <name>Apaxo GmbH</name>
    <url>http://www.apaxo.de</url>
  </organization>
  <url>http://www.manuel-blechschmidt.de</url>
  <scm>
    <url>scm:git:git@github.com/ManuelB/facebook-recommender-demo</url>
    <connection>scm:git:git@github.com/ManuelB/facebook-recommender-demo</connection>
    <developerConnection>scm:git:git@github.com/ManuelB/facebook-recommender-demo</developerConnection>
  </scm>
```

```
38  <build>
39    <finalName>facebook-recommender-demo</finalName>
40    <plugins>
41      <plugin>
42        <groupId>org.glassfish</groupId>
43        <artifactId>maven-embedded-glassfish-plugin</artifactId>
44      </plugin>
45    </plugins>
46    <pluginManagement>
47      <plugins>
48        <plugin>
49          <groupId>org.glassfish</groupId>
50          <artifactId>maven-embedded-glassfish-plugin</artifactId>
51          <version>3.1.1</version>
52          <configuration>
53            <goalPrefix>glassfish</goalPrefix>
54            <app>target/${project.artifactId}.${project.packaging}</app>
55            <port>8010</port>
56          </configuration>
57        </plugin>
58      </plugins>
59    </pluginManagement>
60  </build>
61  <repositories>
62    <repository>
63      <id>glassfish-repository</id>
64      <name>Java.net Repository for Glassfish</name>
65      <url>http://download.java.net/maven/glassfish</url>
66    </repository>
67  </repositories>
68 </project>
```

Demo and live Debugging

Conclusion

Recommendation is a lot of math

You shouldn't implement the algorithms again

There are a lot of unsanswered questions

- Scalibility, Performance, Usability

You can gain a lot from good personalization

More sources

http://www.apaxo.de/

http://mahout.apache.org/

http://research.yahoo.com/

http://www.grouplens.org/

http://recsys.acm.org/

https://github.com/ManuelB/facebook-recommender-demo/

http://docs.oracle.com/javaee/6/tutorial/doc/