MOVIE RECOMMENDATIONS

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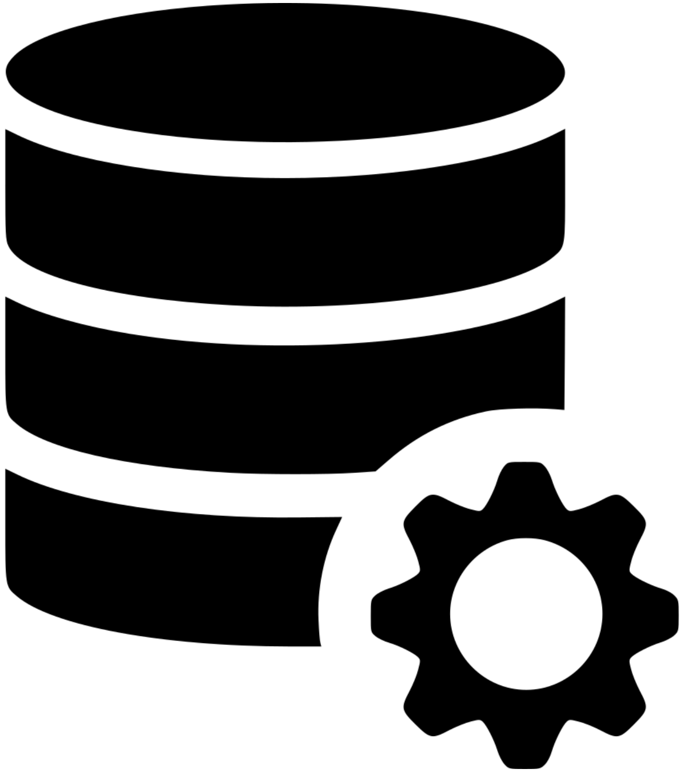
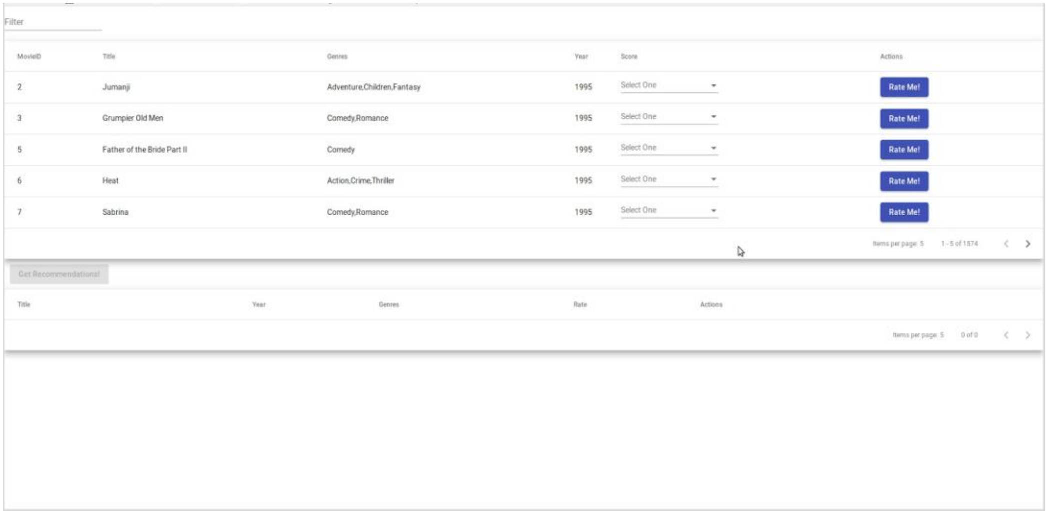
OUR DATASET:



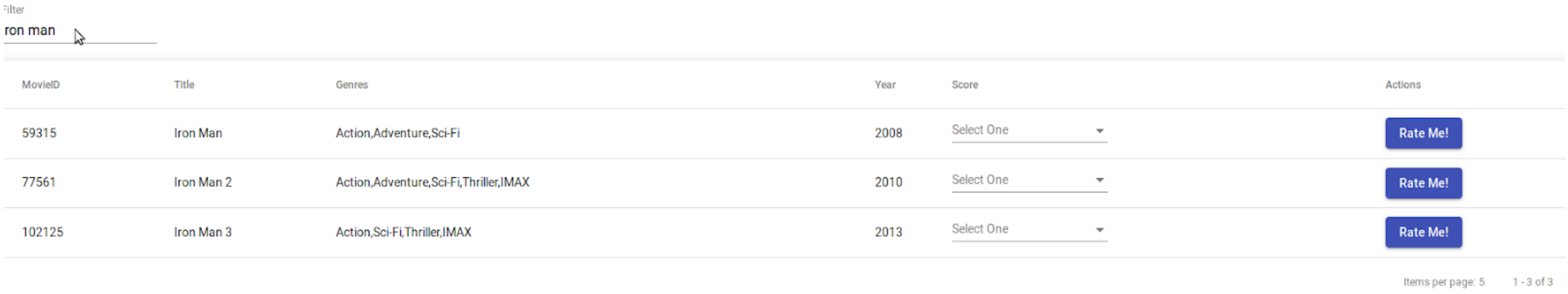
- Movie Lens Latest Dataset
- 58,000 movies
- 27 million ratings
- 280,000 users
- Last updated on 09/2018
- http://grouplens.org/datasets/movielens/latest/

TECHNOLOGIES USED

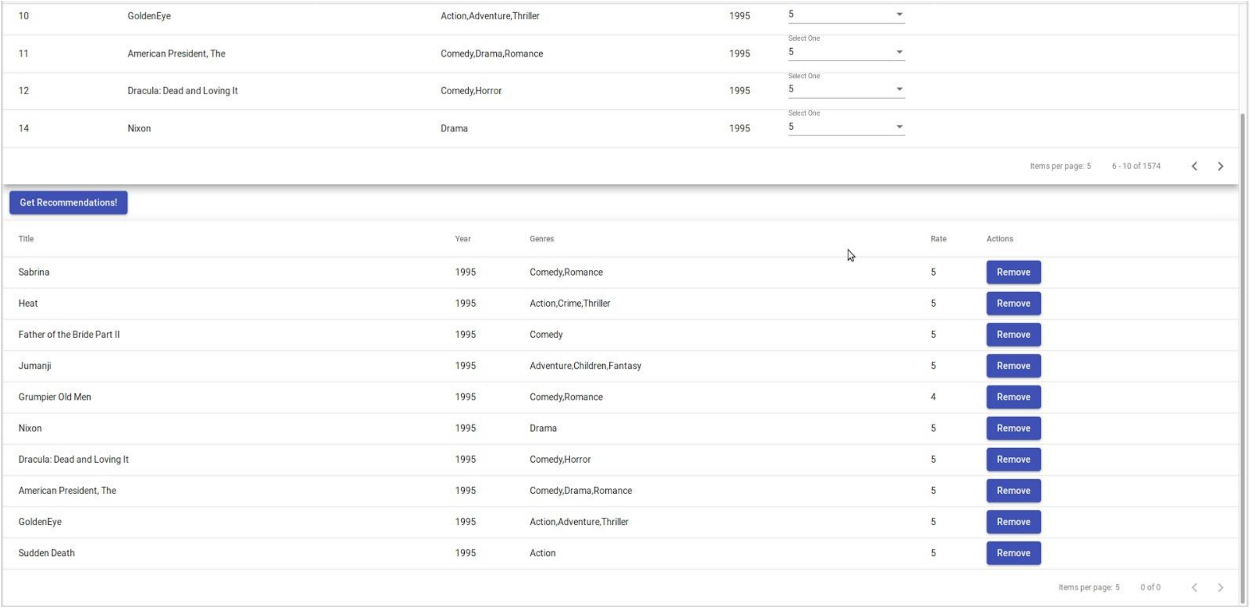


- Angular 2 for GUI
- Node and Express for Back-end
- CSV Database converted to MongoDB to make retrieval faster
- Python for running the actual recommendation algorithm

HOW TO USE IT:



- Select 10 or more movies or TV shows
- Rate them on a scale of 5
- Click on get recommendations
- Bazinga!



TECHNIQUE

- Pre-processing
- Collaborative Filtering
  - Main method SVD (Non-Probabilistic)
  - Also tested with KNN Item-Item, and User-User

USER-USER AND ITEM-ITEM SIMILARITY

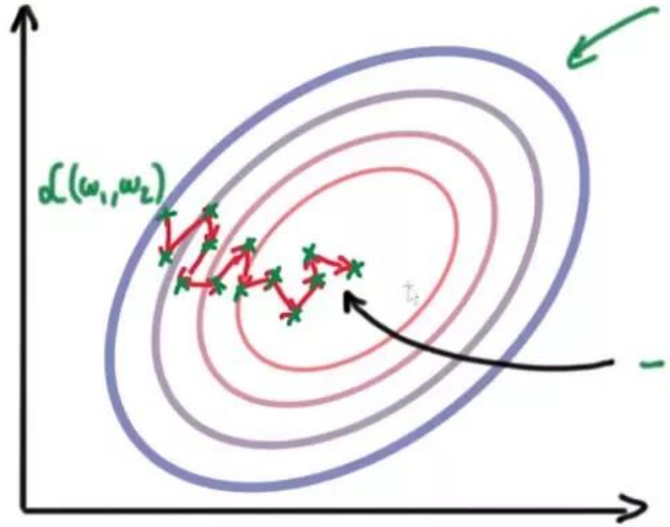
$$\hat{r}_{ui} = \mu_u + \frac{\sum\limits_{v \in N_i^k(u)} \text{sim}(u, v) \cdot (r_{vi} - \mu_v)}{\sum\limits_{v \in N_i^k(u)} \text{sim}(u, v)}$$

- KNNs with means
  For user-user similarity,
  Take k nearest neighbors of the user. Use their ratings to estimate yours. Add user bias.

Similarly, the test is performed for item-item matrix

- KNNs with z scores(normalizing) is performed for user-user and item-item.

SINGULAR VALUE DECOMPOSITION



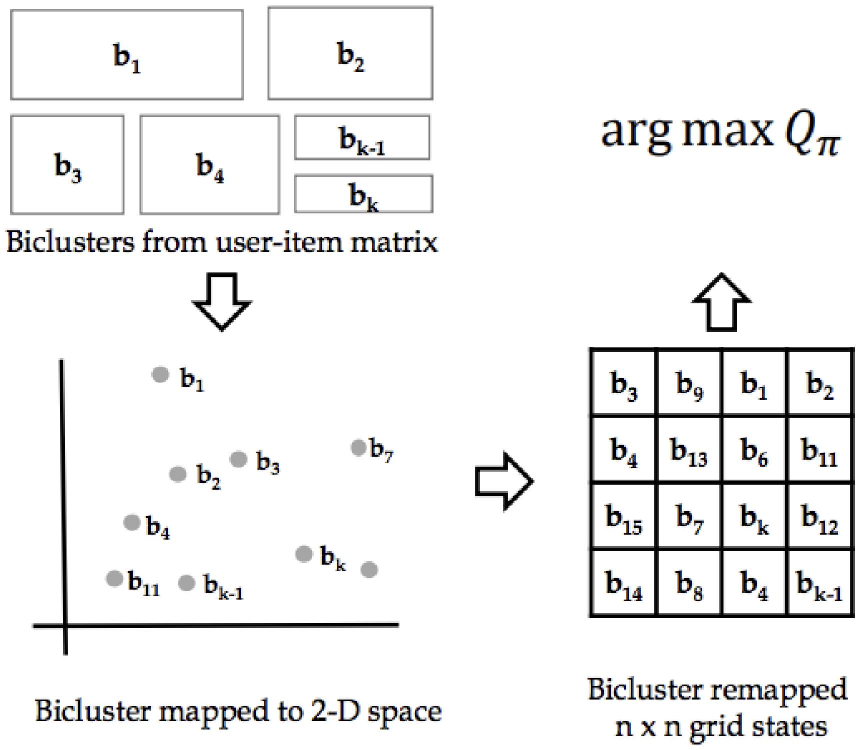
The prediction $\hat{r}_{ui}$ is set as:

$$\hat{r}_{ui} = \mu + b_u + b_i + q_i^T p_u$$

$$\sum_{r_{ui} \in R_{train}} \left(r_{ui} - \hat{r}_{ui}\right)^2 + \lambda \left(b_i^2 + b_u^2 + ||q_i||^2 + ||p_u||^2\right)$$

$$\mathbf{R} \approx \mathbf{P} \times \mathbf{Q}^T = \hat{\mathbf{R}}$$

REINFORCEMENT LEARNING WITH BI-CLUSTERING



$$\mathrm{R}(s_t, a_t, s_{t+1}) = \text{Jaccard\_Distance}(U_{s_t}, U_{s_{t+1}}) = \frac{|U_{s_t} \cap U_{s_{t+1}}|}{|U_{s_t} \cup U_{s_{t+1}}|}.$$

EXPERIMENTS

Results	**KNN means User-Based**	**KNN means Item-Based**	**KNN Z-scores User-Based**	**KNN Z-scores Item-Based**	**SVD**
RMSE	0.895	0.880	0.887	0.892	**0.873**
MAE	0.678	0.669	0.674	0.671	0.672
Fit Time	0.59	9.97	10.30	0.59	4.75
Test Time	1.37	6.65	11.56	1.40	**0.17**

TESTING WITH DIFFERENT GENRES OF MOVIE

raphael@raphael: ~/Documents/adaptiveSystems/finalProject

File Edit View Search Terminal Help

```
raphael@raphael:~/Documents/adaptiveSystems/finalProject$ time python finalProject.py
##################### MOVIES SELECTED BY THE USER ################################
Logan (2017) Action|Sci-Fi  Rating:  5.0
Three Musketeers, The (1993) Action|Adventure|Comedy|Romance  Rating:  5.0
Last of the Mohicans, The (1992) Action|Romance|War|Western  Rating:  5.0
Goldfinger (1964) Action|Adventure|Thriller  Rating:  5.0
Gladiator (2000) Action|Adventure|Drama  Rating:  5.0
Scarface (1983) Action|Crime|Drama  Rating:  4.0
Pearl Harbor (2001) Action|Drama|Romance|War  Rating:  5.0
Lara Croft: Tomb Raider (2001) Action|Adventure  Rating:  3.0
Fast and the Furious, The (2001) Action|Crime|Thriller  Rating:  4.0
Planet of the Apes (2001) Action|Adventure|Drama|Sci-Fi  Rating:  5.0
Minority Report (2002) Action|Crime|Mystery|Sci-Fi|Thriller  Rating:  3.0
Men in Black II (a.k.a. MIIB) (a.k.a. MIB 2) (2002) Action|Comedy|Sci-Fi  Rating:  4.0
Jackass: The Movie (2002) Action|Comedy|Documentary  Rating:  5.0
City of God (Cidade de Deus) (2002) Action|Adventure|Crime|Drama|Thriller  Rating:  5.0
Dark Knight, The (2008) Action|Crime|Drama|IMAX  Rating:  5.0
Matrix Reloaded, The (2003) Action|Adventure|Sci-Fi|Thriller|IMAX  Rating:  5.0
Kung Fu Panda (2008) Action|Animation|Children|Comedy|IMAX  Rating:  5.0
Avatar (2009) Action|Adventure|Sci-Fi|IMAX  Rating:  5.0
Avengers, The (2012) Action|Adventure|Sci-Fi|IMAX  Rating:  5.0
Man of Steel (2013) Action|Adventure|Fantasy|Sci-Fi|IMAX  Rating:  3.0
How to Train Your Dragon 2 (2014) Action|Adventure|Animation  Rating:  5.0
Deadpool (2016) Action|Adventure|Comedy|Sci-Fi  Rating:  5.0
Guardians of the Galaxy 2 (2017) Action|Adventure|Sci-Fi  Rating:  3.0
Doctor Strange (2016) Action|Adventure|Sci-Fi  Rating:  5.0
Lion King, The (1994) Adventure|Animation|Children|Drama|Musical|IMAX  Rating:  5.0
Mulan (1998) Adventure|Animation|Children|Comedy|Drama|Musical|Romance  Rating:  5.0
Tarzan (1999) Adventure|Animation|Children|Drama  Rating:  5.0
Incredibles, The (2004) Action|Adventure|Animation|Children|Comedy  Rating:  5.0
################### RECOMMENDATION ################################################
# 1  -  Intouchables (2011)  -  Comedy, Drama
# 2  -  Inception (2010)  -  Action, Crime, Drama, Mystery, Sci-Fi, Thriller, IMAX
# 3  -  WALL·E (2008)  -  Adventure, Animation, Children, Romance, Sci-Fi
# 4  -  Finding Nemo (2003)  -  Adventure, Animation, Children, Comedy
# 5  -  Batman Begins (2005)  -  Action, Crime, IMAX
# 6  -  Good, the Bad and the Ugly, The (Buono, il brutto, il cattivo, Il) (1966)  -  Action, Adventure, Western
# 7  -  Life Is Beautiful (La Vita è bella) (1997)  -  Comedy, Drama, Romance, War
# 8  -  Green Mile, The (1999)  -  Crime, Drama
# 9  -  Up (2009)  -  Adventure, Animation, Children, Drama
# 10  -  Monsters, Inc. (2001)  -  Adventure, Animation, Children, Comedy, Fantasy

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raphael@raphael:~/Documents/adaptiveSystems/finalProject$
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TESTING WITH SUPER-HERO MOVIES

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Get Recommendations!

1 - Avengers, The (2012) - Action, Adventure, Sci-Fi, IMAX
2 - Batman Begins (2005) - Action, Crime, IMAX
3 - Star Trek (2009) - Action, Adventure, Sci-Fi, IMAX
4 - X-Men: Days of Future Past (2014) - Action, Adventure, Sci-Fi
5 - Toy Story 3 (2010) - Adventure, Animation, Children, Comedy, Fantasy, IMAX
6 - Guardians of the Galaxy (2014) - Action, Adventure, Sci-Fi
7 - X2: X-Men United (2003) - Action, Adventure, Sci-Fi, Thriller
8 - X-Men: First Class (2011) - Action, Adventure, Sci-Fi, Thriller, War
9 - Dark Knight Rises, The (2012) - Action, Adventure, Crime, IMAX
10 - Captain America: The Winter Soldier (2014) - Action, Adventure, Sci-Fi, IMAX

Title	Year	Genres	Rate	Actions
Deadpool	2016	Action,Adventure,Comedy,Sci-Fi	5	Remove
Incredibles, The	2004	Action,Adventure,Animation,Children,Comedy	5	Remove
X-Men	2000	Action,Adventure,Sci-Fi	5	Remove
Dark Knight, The	2008	Action,Crime,Drama,IMAX	5	Remove
Avengers: Age of Ultron	2015	Action,Adventure,Sci-Fi	5	Remove
Iron Man	2008	Action,Adventure,Sci-Fi	5	Remove
Superman Returns	2006	Action,Adventure,Sci-Fi,IMAX	4	Remove
Amazing Spider-Man, The	2012	Action,Adventure,Sci-Fi,IMAX	5	Remove
Captain America: Civil War	2016	Action,Sci-Fi,Thriller	5	Remove
Despicable Me 2	2013	Animation,Children,Comedy,IMAX	5	Remove

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FUTURE IMPROVEMENTS

- Implement Content Based recommendation
- Make the system Hybrid
- Filtering genre and popularity
- Save the user preferences based on genre
- Complete the Reinforcement Learning approach