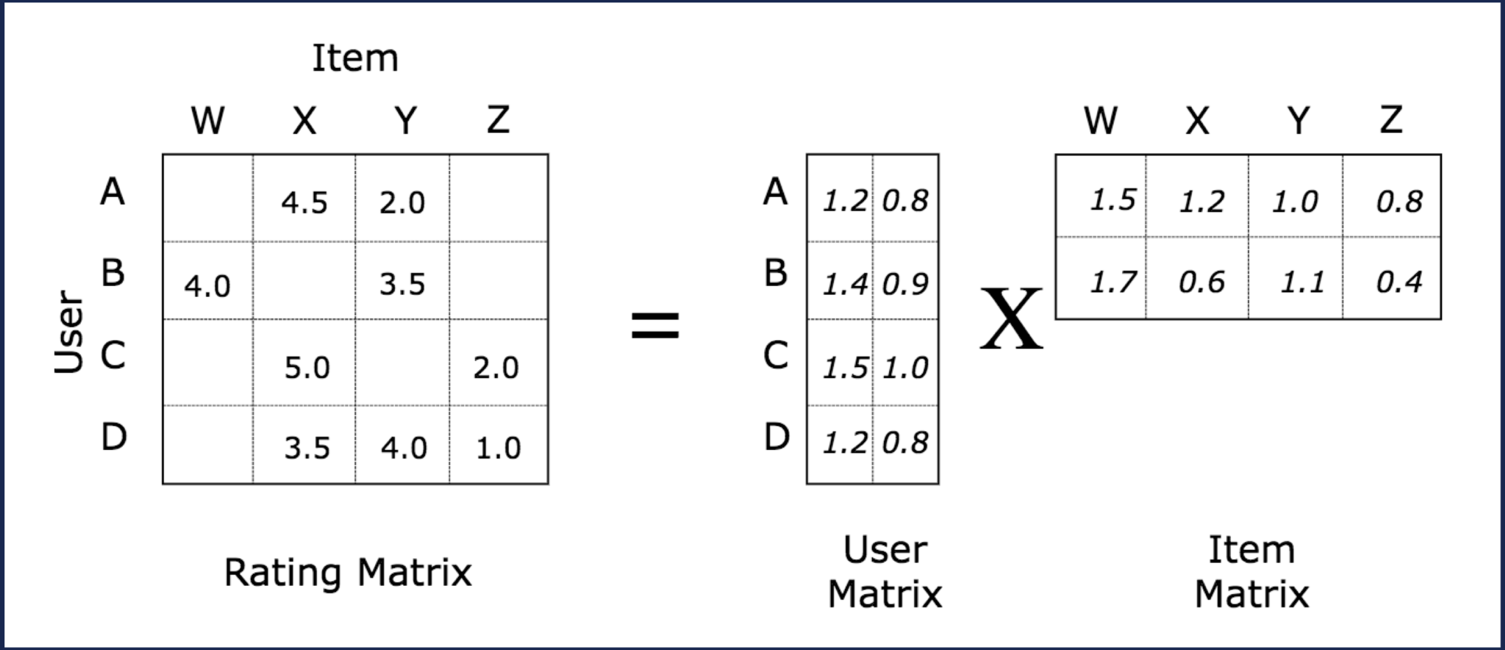
Recommender Workshop

Part 3: Matrix Factorization

Recommender Workshop Agenda

- Part 1: Introduction
    - Overview of Machine Learning Process, Amazon SageMaker
    - Hands-on: Data Exploration
- Part 2: Collaborative Filtering
    - Core Concepts for Recommendations
    - Hands-on: K-Means Clustering
- Part 3: Matrix Factorization (You Are Here)
    - Refining Recommendations
    - Hands-on: Factorization Machine
- Part 4: Hyperparameter Tuning
    - Key Concepts
    - Hands-on: Hyperparameter Tuning

Recommender: Matrix Factorization



Item

User

$$\begin{array}{c|cccc} & W & X & Y & Z \\ \hline A & & 4.5 & 2.0 & \\ B & 4.0 & & 3.5 & \\ C & & 5.0 & & 2.0 \\ D & & 3.5 & 4.0 & 1.0 \end{array} = \begin{array}{c|cc} A & 1.2 & 0.8 \\ B & 1.4 & 0.9 \\ C & 1.5 & 1.0 \\ D & 1.2 & 0.8 \end{array} \times \begin{array}{cccc} W & X & Y & Z \\ \hline 1.5 & 1.2 & 1.0 & 0.8 \\ 1.7 & 0.6 & 1.1 & 0.4 \end{array}$$

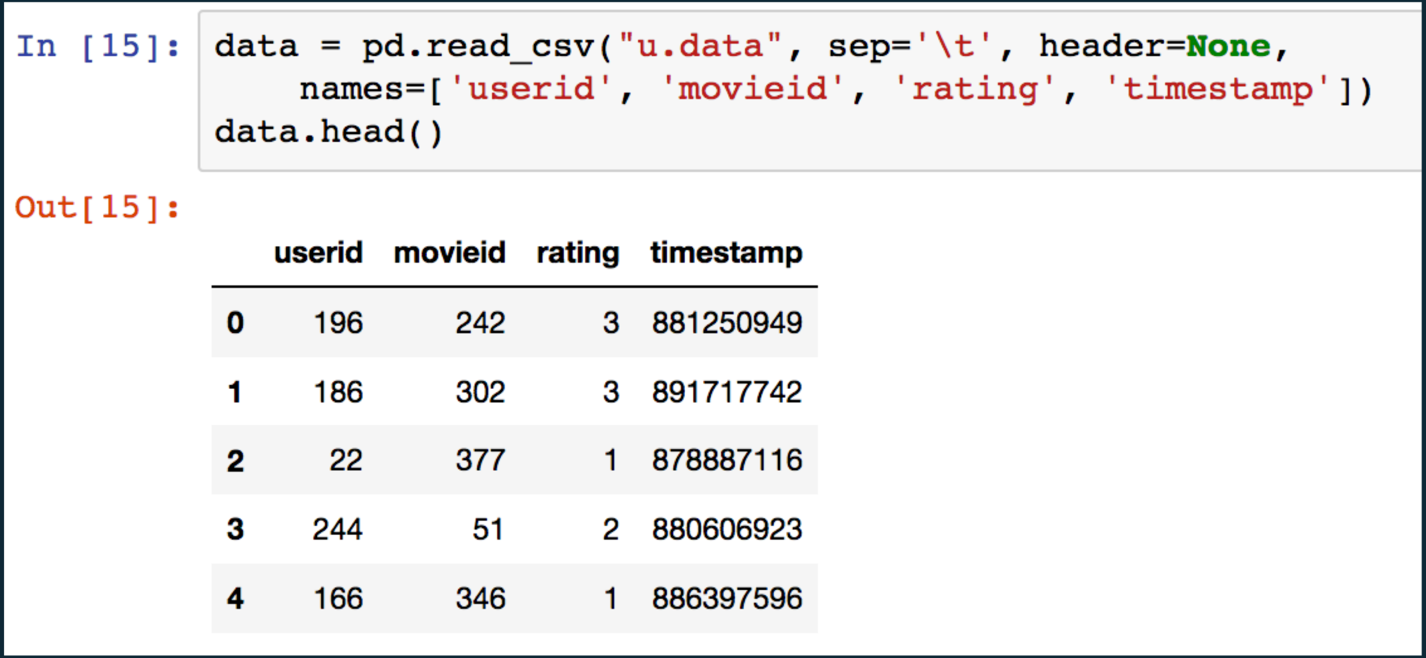
Rating Matrix

User Matrix

Item Matrix

Our Data Set: Movielens

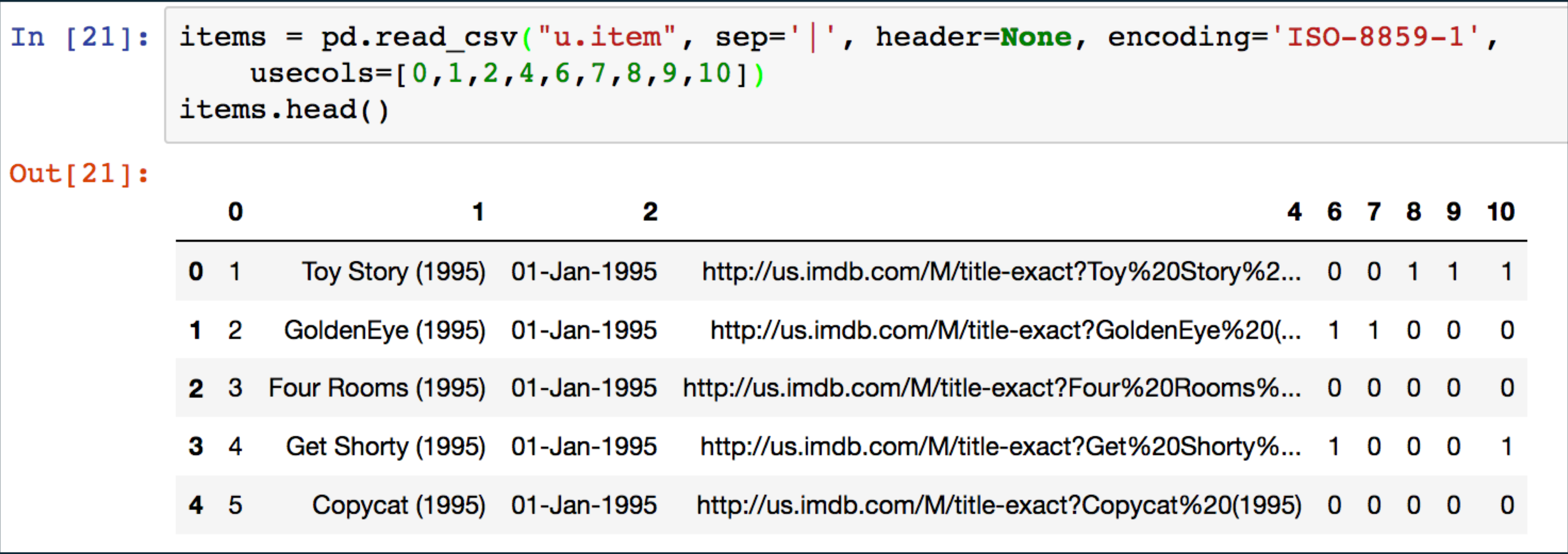
- Public Data Set produced by **GroupLens Research**
- https://grouplens.org/datasets/movielens/



```
In [15]: data = pd.read_csv("u.data", sep='\t', header=None,
              names=['userid', 'movieid', 'rating', 'timestamp'])
         data.head()
```

```
Out[15]:
      userid  movieid  rating  timestamp
   0     196      242       3  881250949
   1     186      302       3  891717742
   2      22      377       1  878887116
   3     244       51       2  880606923
   4     166      346       1  886397596
```

Item Information

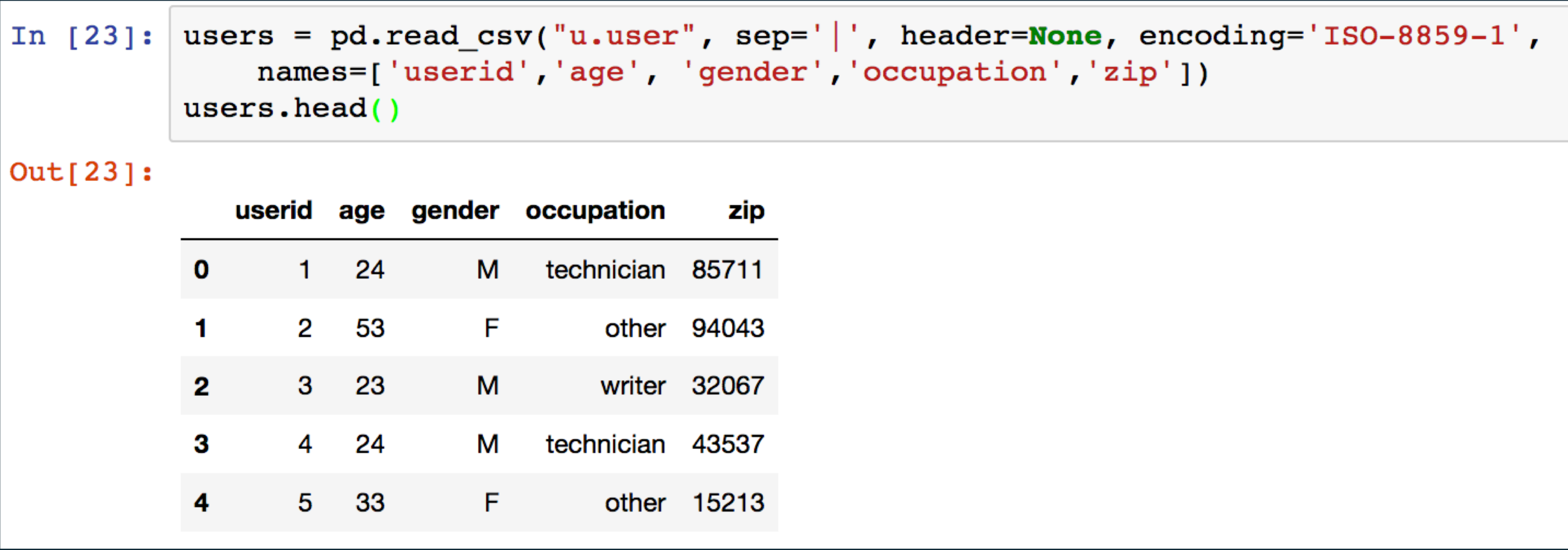


```
In [21]: items = pd.read_csv("u.item", sep='|', header=None, encoding='ISO-8859-1',
             usecols=[0,1,2,4,6,7,8,9,10])
         items.head()
```

Out[21]:

	0	1	2	4	6	7	8	9	10
0	1	Toy Story (1995)	01-Jan-1995	http://us.imdb.com/M/title-exact?Toy%20Story%2...	0	0	1	1	1
1	2	GoldenEye (1995)	01-Jan-1995	http://us.imdb.com/M/title-exact?GoldenEye%20(...	1	1	0	0	0
2	3	Four Rooms (1995)	01-Jan-1995	http://us.imdb.com/M/title-exact?Four%20Rooms%...	0	0	0	0	0
3	4	Get Shorty (1995)	01-Jan-1995	http://us.imdb.com/M/title-exact?Get%20Shorty%...	1	0	0	0	1
4	5	Copycat (1995)	01-Jan-1995	http://us.imdb.com/M/title-exact?Copycat%20(1995)	0	0	0	0	0

User Information



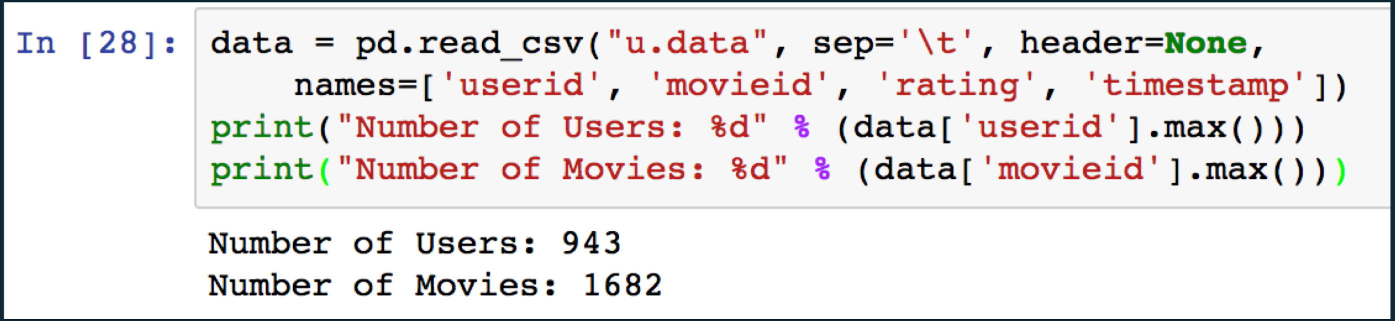
In [23]:

```
users = pd.read_csv("u.user", sep='|', header=None, encoding='ISO-8859-1',
     names=['userid','age', 'gender','occupation','zip'])
users.head()
```

Out[23]:

	userid	age	gender	occupation	zip
0	1	24	M	technician	85711
1	2	53	F	other	94043
2	3	23	M	writer	32067
3	4	24	M	technician	43537
4	5	33	F	other	15213

Visualising The Data



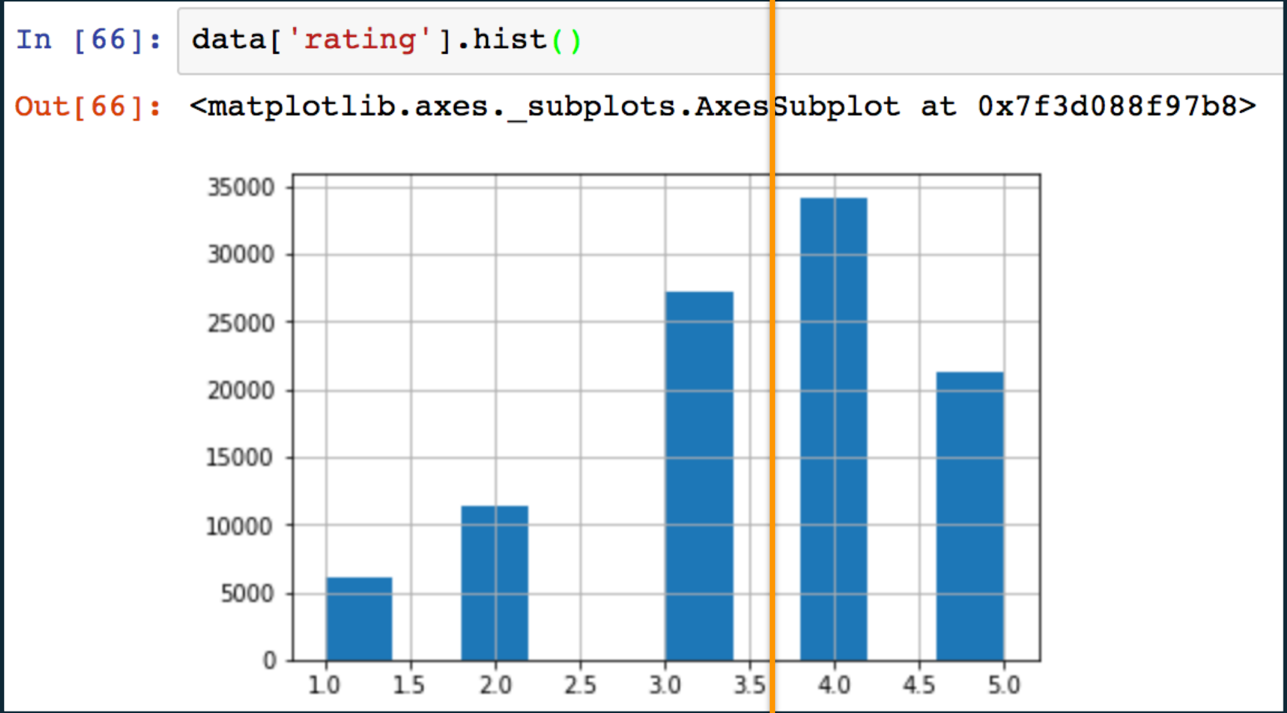
```
In [28]: data = pd.read_csv("u.data", sep='\t', header=None,
             names=['userid', 'movieid', 'rating', 'timestamp'])
         print("Number of Users: %d" % (data['userid'].max()))
         print("Number of Movies: %d" % (data['movieid'].max()))

         Number of Users: 943
         Number of Movies: 1682
```

Total Feature Count = Users + Movies

= **2625 Features**

Data Preparation: Binary Classification



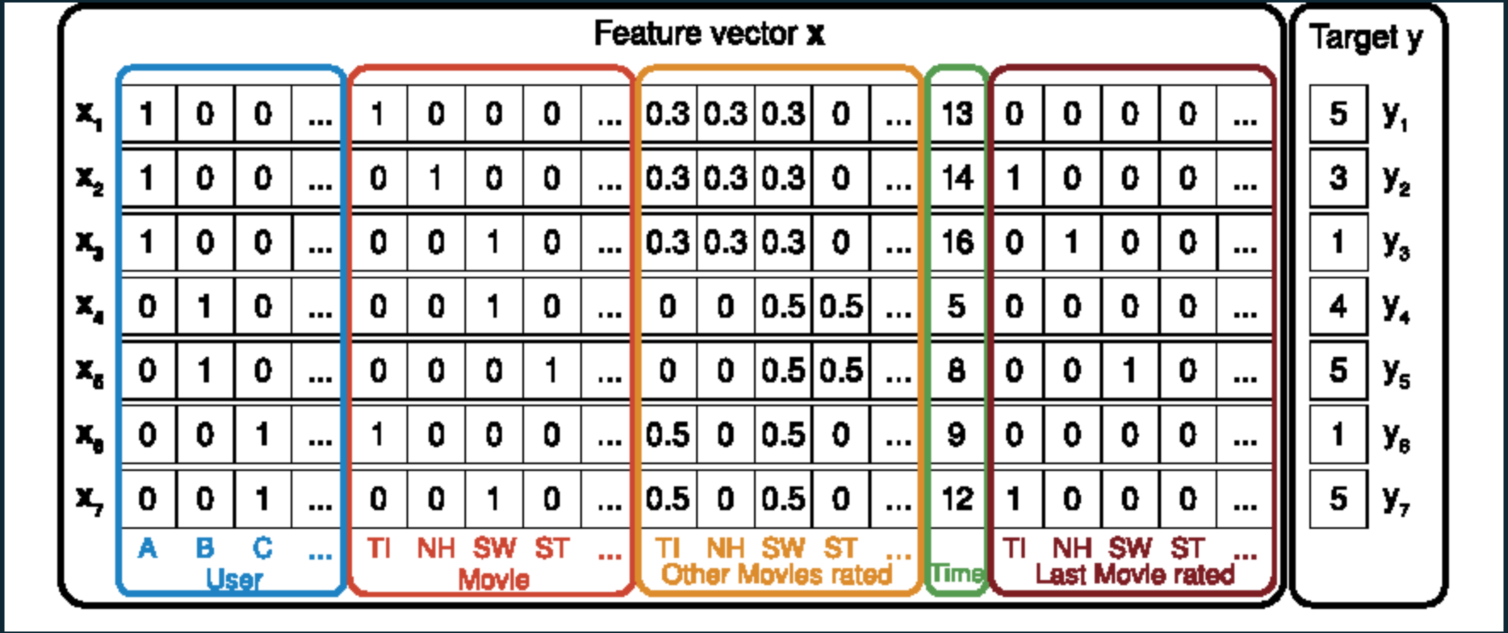
```
In [66]: data['rating'].hist()

Out[66]: <matplotlib.axes._subplots.AxesSubplot at 0x7f3d088f97b8>
```

Not Liked

Liked

Factorization Machines



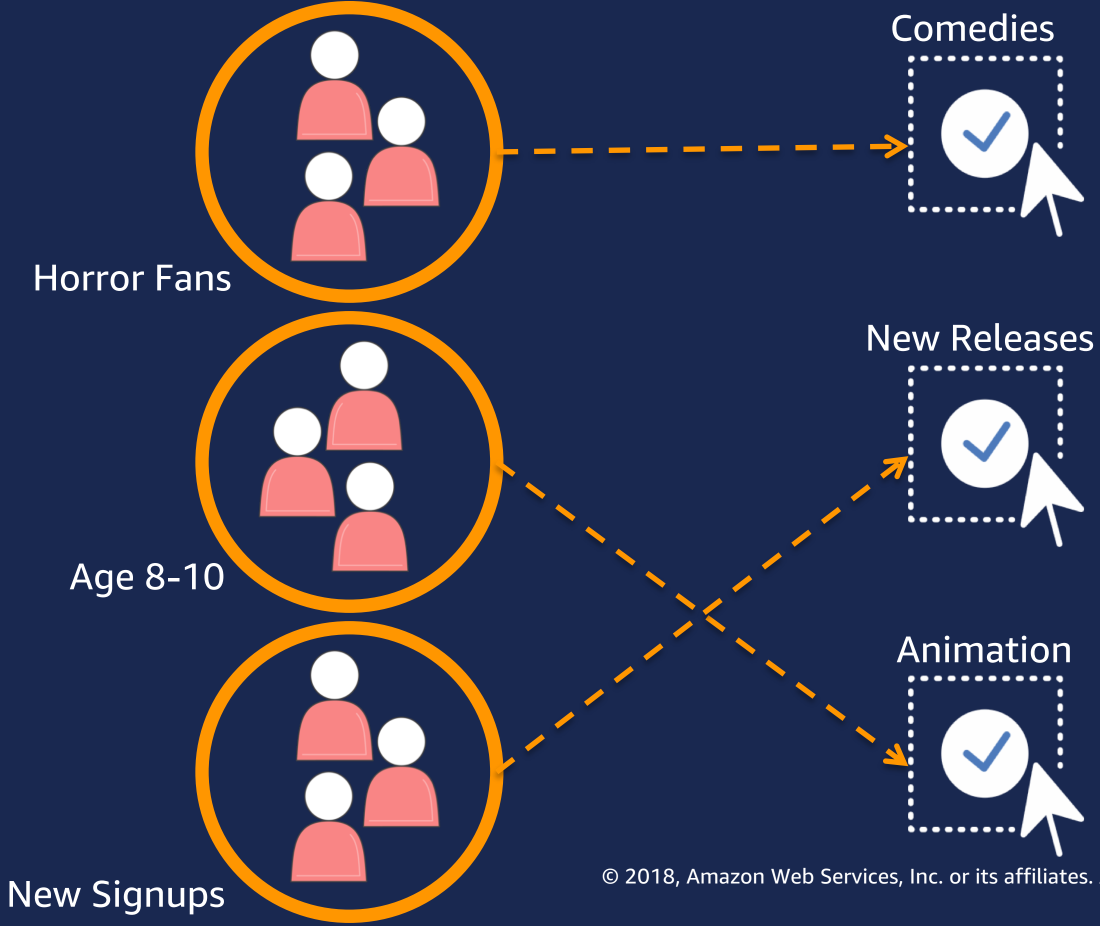
Feature vector **x**

	User				Movie					Other Movies rated					Time	Last Movie rated					Target y	
	A	B	C	...	TI	NH	SW	ST	...	TI	NH	SW	ST	...	Time	TI	NH	SW	ST	...		
x_1	1	0	0	...	1	0	0	0	...	0.3	0.3	0.3	0	...	13	0	0	0	0	...	5	y_1
x_2	1	0	0	...	0	1	0	0	...	0.3	0.3	0.3	0	...	14	1	0	0	0	...	3	y_2
x_3	1	0	0	...	0	0	1	0	...	0.3	0.3	0.3	0	...	16	0	1	0	0	...	1	y_3
x_4	0	1	0	...	0	0	1	0	...	0	0	0.5	0.5	...	5	0	0	0	0	...	4	y_4
x_5	0	1	0	...	0	0	0	1	...	0	0	0.5	0.5	...	8	0	0	1	0	...	5	y_5
x_6	0	0	1	...	1	0	0	0	...	0.5	0	0.5	0	...	9	0	0	0	0	...	1	y_6
x_7	0	0	1	...	0	0	1	0	...	0.5	0	0.5	0	...	12	1	0	0	0	...	5	y_7

Recommender Workshop Activity

- ~~Log into https://bootrun.awsapps.com/start~~
- ~~Change to us-east-1 region~~
- Find the Amazon SageMaker service
- Find Notebooks
- Open the notebook instance and find within the repo path:
    - 03_factorization_machines.ipynb

Putting it together



1. Cluster individual users into groups
2. Train models for each genre
3. Generate predictions using the model that aligns best to the application context

Next: Part 4