```
from fastai.collab import *
from fastai.tabular import *

user,item,title = 'userId','movieId','title'

from google.colab import drive
drive.mount('/content/drive')

path_data = "/content/drive/My Drive/ml-100k/u.data"

ratings = pd.read_csv(path_data, delimiter='\t', header=None,
                      names=[user,item,'rating','timestamp'])
ratings.head()
```

	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

```
path_item = "/content/drive/My Drive/ml-100k/u.item"

movies = pd.read_csv(path_item,  delimiter='|', encoding='latin-1', header=None,
                     names=[item, 'title', 'date', 'N', 'url', *[f'g{i}' for i in range(19)
movies.head()
```

	movieId	title	date	N	
0	1	Toy Story (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Toy%20Sto
1	2	GoldenEye (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?GoldenEye'
2	3	Four Rooms (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Four%20Roo
3	4	Get Shorty (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Get%20Sho
4	5	Copycat (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Copycat%20

```
len(ratings)
```

```
100000
```

```
rating_movie = ratings.merge(movies[[item, title]])
rating_movie.head()
```

	userId	movieId	rating	timestamp	title
0	196	242	3	881250949	Kolya (1996)
1	63	242	3	875747190	Kolya (1996)
2	226	242	5	883888671	Kolya (1996)
3	154	242	3	879138235	Kolya (1996)
4	306	242	5	876503793	Kolya (1996)

```
data = CollabDataBunch.from_df(rating_movie, seed=42, valid_pct=0.1, item_name=title)
```

```
data.show_batch()
```

userId	title	target
286	Raiders of the Lost Ark (1981)	4.0
733	Heat (1995)	4.0
751	Eraser (1996)	2.0
416	Cool Runnings (1993)	3.0
60	They Made Me a Criminal (1939)	5.0

```
y_range = [0,5.5]
```

```
learn = collab_learner(data, n_factors=40, y_range=y_range, wd=1e-1)
```

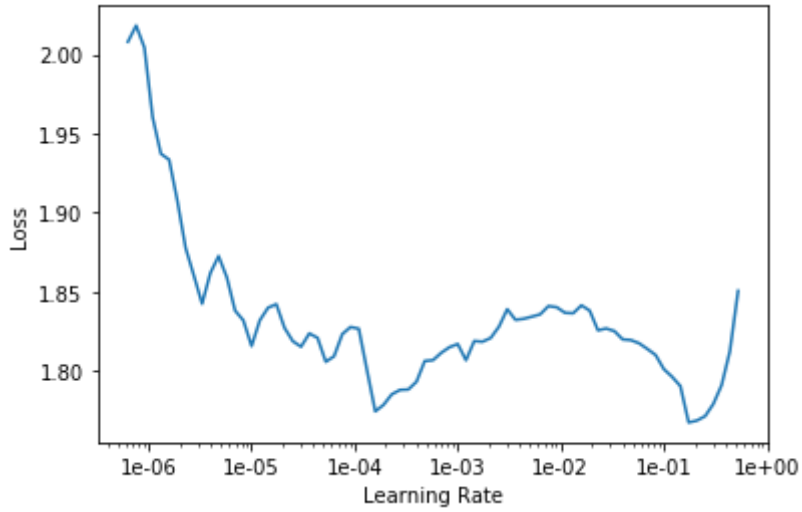
```
learn.lr_find()
learn.recorder.plot(skip_end=15)
```

0.00% [0/1 00:00<00:00]

epoch	train_loss	valid_loss	time

6.12% [86/1406 00:00<00:09 1.9066]

```
LR Finder is complete, type {learner_name}.recorder.plot() to see the graph.
```



```
learn.fit_one_cycle(5, 5e-3)
```

epoch	train_loss	valid_loss	time
0	0.938342	0.950220	00:09
1	0.855565	0.890425	00:09
2	0.777465	0.837364	00:09
3	0.663846	0.812185	00:09
4	0.554260	0.811192	00:09

```
learn.save('dotprod')
```

Analysis

```
learn.load('dotprod');
```

```
learn.model
```

```
EmbeddingDotBias(
  (u_weight): Embedding(944, 40)
  (i_weight): Embedding(1654, 40)
  (u_bias): Embedding(944, 1)
  (i_bias): Embedding(1654, 1)
)
```

```
g = rating_movie.groupby(title)['rating'].count()
top_movies = g.sort_values(ascending=False).index.values[:1000]
top_movies[:10]
```

```
array(['Star Wars (1977)', 'Contact (1997)', 'Fargo (1996)', 'Return of the Jedi (198
       'English Patient, The (1996)', 'Scream (1996)', 'Toy Story (1995)', 'Air Force
       'Independence Day (ID4) (1996)'], dtype=object)
```

```
g
```

```
title
'Til There Was You (1997)                  9
1-900 (1994)                               5
101 Dalmatians (1996)                    109
12 Angry Men (1957)                      125
187 (1997)                                41
                                        ...
Young Guns II (1990)                      44
Young Poisoner's Handbook, The (1995)     41
Zeus and Roxanne (1997)                    6
unknown                                    9
Á köldum klaka (Cold Fever) (1994)         1
Name: rating, Length: 1664, dtype: int64
```

Bias

```
movie_bias = learn.bias(top_movies, is_item=True)
movie_bias.shape
```

```
torch.Size([1000])
```

```
mean_ratings = rating_movie.groupby(title)['rating'].mean()
movie_ratings = [(b, i, mean_ratings.loc[i]) for i,b in zip(top_movies,movie_bias)]
```

```
mean_ratings
```

```
title
'Til There Was You (1997)                2.333333
1-900 (1994)                             2.600000
101 Dalmatians (1996)                    2.908257
12 Angry Men (1957)                      4.344000
187 (1997)                               3.024390
                                           ...
Young Guns II (1990)                     2.772727
Young Poisoner's Handbook, The (1995)    3.341463
Zeus and Roxanne (1997)                  2.166667
unknown                                  3.444444
Á köldum klaka (Cold Fever) (1994)       3.000000
Name: rating, Length: 1664, dtype: float64
```

```
item0 = lambda o:o[0]
```

```
sorted(movie_ratings, key=item0)[:15]
```

```
[(tensor(-0.3813),
  'Children of the Corn: The Gathering (1996)',
  1.3157894736842106),
 (tensor(-0.3568),
  'Lawnmower Man 2: Beyond Cyberspace (1996)',
  1.7142857142857142),
 (tensor(-0.2719), 'Mortal Kombat: Annihilation (1997)', 1.9534883720930232),
 (tensor(-0.2706), 'Cable Guy, The (1996)', 2.339622641509434),
 (tensor(-0.2545), 'Free Willy 3: The Rescue (1997)', 1.7407407407407407),
 (tensor(-0.2521), "Joe's Apartment (1996)", 2.2444444444444445),
 (tensor(-0.2497), 'Crow: City of Angels, The (1996)', 1.9487179487179487),
 (tensor(-0.2462), 'Striptease (1996)', 2.2388059701492535),
 (tensor(-0.2373), 'Barb Wire (1996)', 1.9333333333333333),
 (tensor(-0.2351), 'Island of Dr. Moreau, The (1996)', 2.1578947368421053),
 (tensor(-0.2269), "McHale's Navy (1997)", 2.1884057971014492),
 (tensor(-0.2257), 'Bio-Dome (1996)', 1.903225806451613),
 (tensor(-0.2167), 'Grease 2 (1982)', 2.0),
 (tensor(-0.2158), 'Leave It to Beaver (1997)', 1.8409090909090908),
 (tensor(-0.2122), 'Lawnmower Man, The (1992)', 2.4461538461538463)]
```

```
sorted(movie_ratings, key=lambda o: o[0], reverse=True)[:15]
```

```
[(tensor(0.6077), "Schindler's List (1993)", 4.466442953020135),
 (tensor(0.5842), 'Titanic (1997)', 4.2457142857142856),
 (tensor(0.5669), 'Shawshank Redemption, The (1994)', 4.445229681978798),
 (tensor(0.5616), 'Silence of the Lambs, The (1991)', 4.28974358974359),
 (tensor(0.5568), 'L.A. Confidential (1997)', 4.161616161616162),
 (tensor(0.5327), 'Rear Window (1954)', 4.3875598086124405),
 (tensor(0.5189), 'Star Wars (1977)', 4.3584905660377355),
 (tensor(0.4994), 'Good Will Hunting (1997)', 4.262626262626263),
 (tensor(0.4978), 'Usual Suspects, The (1995)', 4.385767790262173),
 (tensor(0.4897), 'As Good As It Gets (1997)', 4.196428571428571),
 (tensor(0.4712), 'Godfather, The (1972)', 4.283292978208232),
 (tensor(0.4687), 'Casablanca (1942)', 4.45679012345679),
 (tensor(0.4675), "One Flew Over the Cuckoo's Nest (1975)", 4.291666666666667),
 (tensor(0.4541), 'Boot, Das (1981)', 4.203980099502488),
 (tensor(0.4535), 'To Kill a Mockingbird (1962)', 4.292237442922374)]
```

Weights

```
movie_w = learn.weight(top_movies, is_item=True)
movie_w.shape
```

```
torch.Size([1000, 40])
```

```
movie_pca = movie_w.pca(3)
movie_pca.shape
```

```
torch.Size([1000, 3])
```

```
fac0,fac1,fac2 = movie_pca.t()
movie_comp = [(f, i) for f,i in zip(fac0, top_movies)]
```

```
sorted(movie_comp, key=itemgetter(0), reverse=True)[:10]
```

```
[(tensor(1.3075), 'Jungle2Jungle (1997)'),
 (tensor(1.2797), 'Home Alone 3 (1997)'),
 (tensor(1.1827), 'Leave It to Beaver (1997)'),
 (tensor(1.1513), 'Congo (1995)'),
 (tensor(1.1311), "McHale's Navy (1997)"),
 (tensor(1.1191), 'D3: The Mighty Ducks (1996)'),
 (tensor(1.0935), 'Grease 2 (1982)'),
 (tensor(1.0925), 'Bio-Dome (1996)'),
 (tensor(1.0629), 'Children of the Corn: The Gathering (1996)'),
 (tensor(1.0545), 'Batman & Robin (1997)')]
```

```
sorted(movie_comp, key=itemgetter(0))[:10]
```

```
[(tensor(-1.0984), 'Wrong Trousers, The (1993)'),
 (tensor(-1.0879), 'Close Shave, A (1995)'),
 (tensor(-1.0627), 'Lawrence of Arabia (1962)'),
 (tensor(-1.0282), 'Casablanca (1942)'),
 (tensor(-1.0144), 'Chinatown (1974)'),
 (tensor(-1.0134), 'Third Man, The (1949)'),
 (tensor(-1.0114),
  'Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb (1963)'),
 (tensor(-0.9895), 'Ran (1985)'),
 (tensor(-0.9584), 'Some Folks Call It a Sling Blade (1993)'),
 (tensor(-0.9443), 'Apocalypse Now (1979)')]
```

```
movie_comp = [(f, i) for f,i in zip(fac1, top_movies)]
```

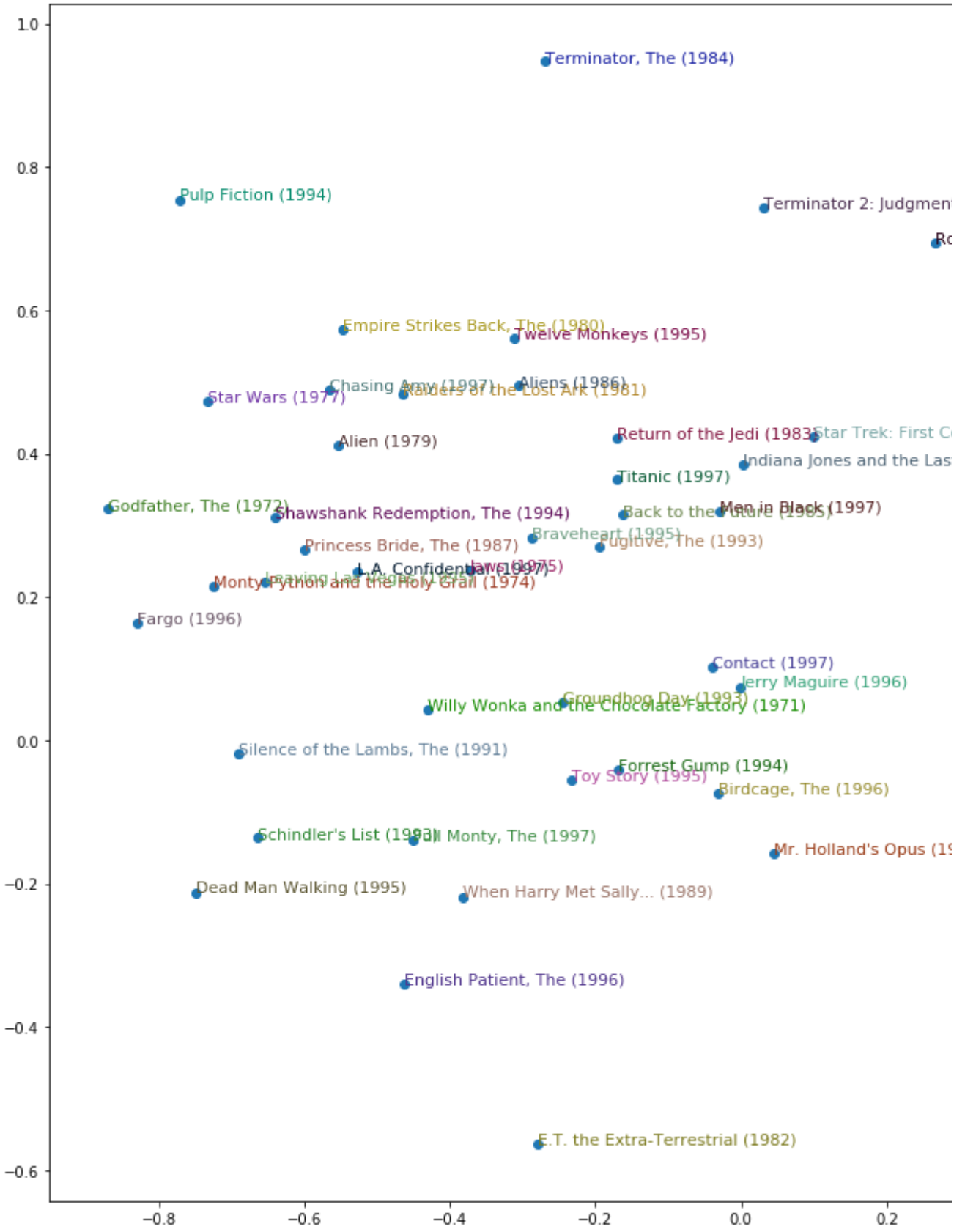
```
sorted(movie_comp, key=itemgetter(0), reverse=True)[:10]
```

```
[(tensor(1.1364), 'Braveheart (1995)'),
 (tensor(1.0621), 'Raiders of the Lost Ark (1981)'),
 (tensor(1.0124), 'Titanic (1997)'),
 (tensor(0.9562), "It's a Wonderful Life (1946)"),
 (tensor(0.8933), 'Forrest Gump (1994)'),
 (tensor(0.8854), 'Star Wars (1977)'),
 (tensor(0.8754), 'American President, The (1995)'),
 (tensor(0.8524), 'Return of the Jedi (1983)'),
 (tensor(0.8523), 'Sleepless in Seattle (1993)'),
 (tensor(0.8481), 'Hunt for Red October, The (1990)')]
```

```
sorted(movie_comp, key=itemgetter(0))[:10]
```

```
[(tensor(-0.9019), 'Ready to Wear (Pret-A-Porter) (1994)'),
 (tensor(-0.8789), 'Keys to Tulsa (1997)'),
 (tensor(-0.8060), 'Nosferatu (Nosferatu, eine Symphonie des Grauens) (1922)'),
 (tensor(-0.8016), 'Beavis and Butt-head Do America (1996)'),
 (tensor(-0.7950), 'Jude (1996)'),
 (tensor(-0.7905), 'Trainspotting (1996)'),
 (tensor(-0.7502), 'Lost Highway (1997)'),
 (tensor(-0.7454), 'Serial Mom (1994)'),
 (tensor(-0.7245), 'Brazil (1985)'),
 (tensor(-0.7182), 'Very Brady Sequel, A (1996)')]
```

```
idxs = np.random.choice(len(top_movies), 50, replace=False)
idxs = list(range(50))
X = fac0[idxs]
Y = fac2[idxs]
plt.figure(figsize=(15,15))
plt.scatter(X, Y)
for i, x, y in zip(top_movies[idxs], X, Y):
    plt.text(x,y,i, color=np.random.rand(3)*0.7, fontsize=11)
plt.show()
```


Terminator, The (1984)
Pulp Fiction (1994)
Terminator 2: Judgmen
Empire Strikes Back, The (1980)
Twelve Monkeys (1995)
Chasing Amy (1997)
Aliens (1986)
Star Wars (1977)
Raiders of the Lost Ark (1981)
Return of the Jedi (1983)
Star Trek: First C
Alien (1979)
Indiana Jones and the Las
Titanic (1997)
Godfather, The (1972)
Shawshank Redemption, The (1994)
Back to the Future (1985)
Men in Black (1997)
Braveheart (1995)
Princess Bride, The (1987)
Fugitive, The (1993)
L.A. Confidential (1997)
Jaws (1975)
Monty Python and the Holy Grail (1974)
Fargo (1996)
Contact (1997)
Jerry Maguire (1996)
Groundhog Day (1993)
Willy Wonka and the Chocolate Factory (1971)
Silence of the Lambs, The (1991)
Forrest Gump (1994)
Toy Story (1995)
Birdcage, The (1996)
Schindler's List (1993)
Full Monty, The (1997)
Mr. Holland's Opus (19
Dead Man Walking (1995)
When Harry Met Sally... (1989)
English Patient, The (1996)
E.T. the Extra-Terrestrial (1982)
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−0.6
−0.4
−0.2
0.0
0.2