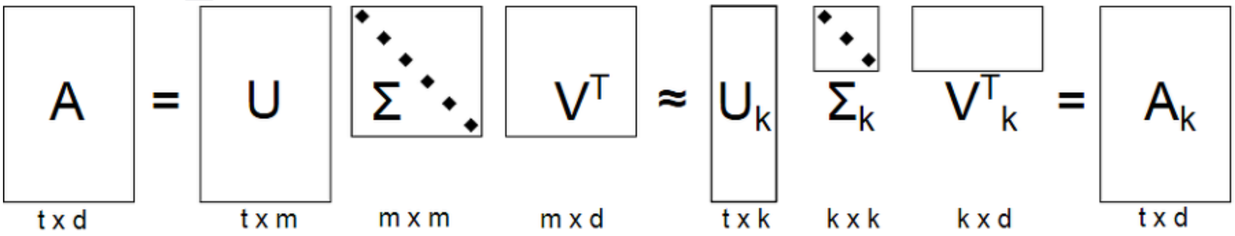
Recommender

Algorithms

Using **Collaborative Filtering** based on **SVD** to predict rate.

Collaborative Filtering is a method of making automatic predictions (filtering) about the interests of a user by collecting preferences or taste information from many users (collaborating). The underlying assumption of the collaborative filtering approach is that if a person *A* has the same opinion as a person *B* on an issue, A is more likely to have B's opinion on a different issue than that of a randomly chosen person.

Simply **SVD** is to decompose a matrix of `m x n` into three matrices(`U, Sigma, V`) as shown below. First, Use the SVD to create a matrix of user matrix(`U`), property matrix(`Sigma`) and movie matrix(`V`) using given movie ratings.



If you do this, we can get diagonal matrix(`Sigma`) which can called features. Using the computed `U`, `V`, and key features of `Sigma`, can create approximate of original matrix. So, we can predict undefined values, using created `U`, `Sigma` and `V`.

Implementations

Python is a simple language that is easy enough to understand directly. So it's not difficult to see and understand the code right away. But here are tips for Python beginners.

`lib.recommender.Recommender`

Default recommender class. You can choose which algorithm to use for the recommender system, but only SVD is currently implemented.

`lib.algorithms.factorization.SVD`

This class is basically written in `Cython`. This is because the matrix operation takes too long, so increase the calculation efficiency using `Cython`.

This class accepts parameters factors, epochs, init_mean, init_derivation, learning_rate, regression_rate.

And, there are two methods. Simply, `fit` create feature matrix and `predict` return predicted value using created feature matrix.

- `fit`

  Train with train data. Create `bias` and `param` of each user, item. `unique` is indexer to compress given data. Caculate `dot` and `error` to update `bias` and `param`. `lr` and `reg` is rate of update values.

  Calculate current errors

  ```
  dot = sum(param_item[i, f] * param_user[u, f] for f in range(self.factors))
  err = r - (mean + biase_user[u] + biase_item[i] + dot)
  ```

  Update `bias` parts at line 64-65.

  ```
  biase_user[u] += lr * (err - reg * biase_user[u])
  ```

  Update `param` parts at line 68-70.

  ```
  for f in range(self.factors):
      param_user[u, f] += lr * (err * param_item[i, f] - reg * param_user[u, f])
      param_item[i, f] += lr * (err * param_user[u, f] - reg * param_item[i, f])
  ```

- `predict`

  Return prediction value which create using `bias` and `param` matrix.

Requirements

- NumPy: is the fundamental package for scientific computing with Python.
- Pandas: is providing high-performance, easy-to-use data structures and data analysis tools for the Python.
- Cython: support compiled language, generates CPython extension modules.

install packages using pip

```
pip3 install -r requirements.txt
```

Tested @ python3.5 in Ubuntu 16.04 LTS, macOS High Sierra and Windows 10

Run as below

```
// First of all, build Cython extensions to compile .pyx
// It's speeds up computation
python setup.py build_ext --inplace

// Run recommender, -h to show additional arguments
python recommender.py [train_data_path] [test_data_path]
```

Performance

	u1	u2	u3	u4	u5
RMSE	0.957	0.943	0.936	0.933	0.933