Using Graphs for High Quality Recommendations

PyData
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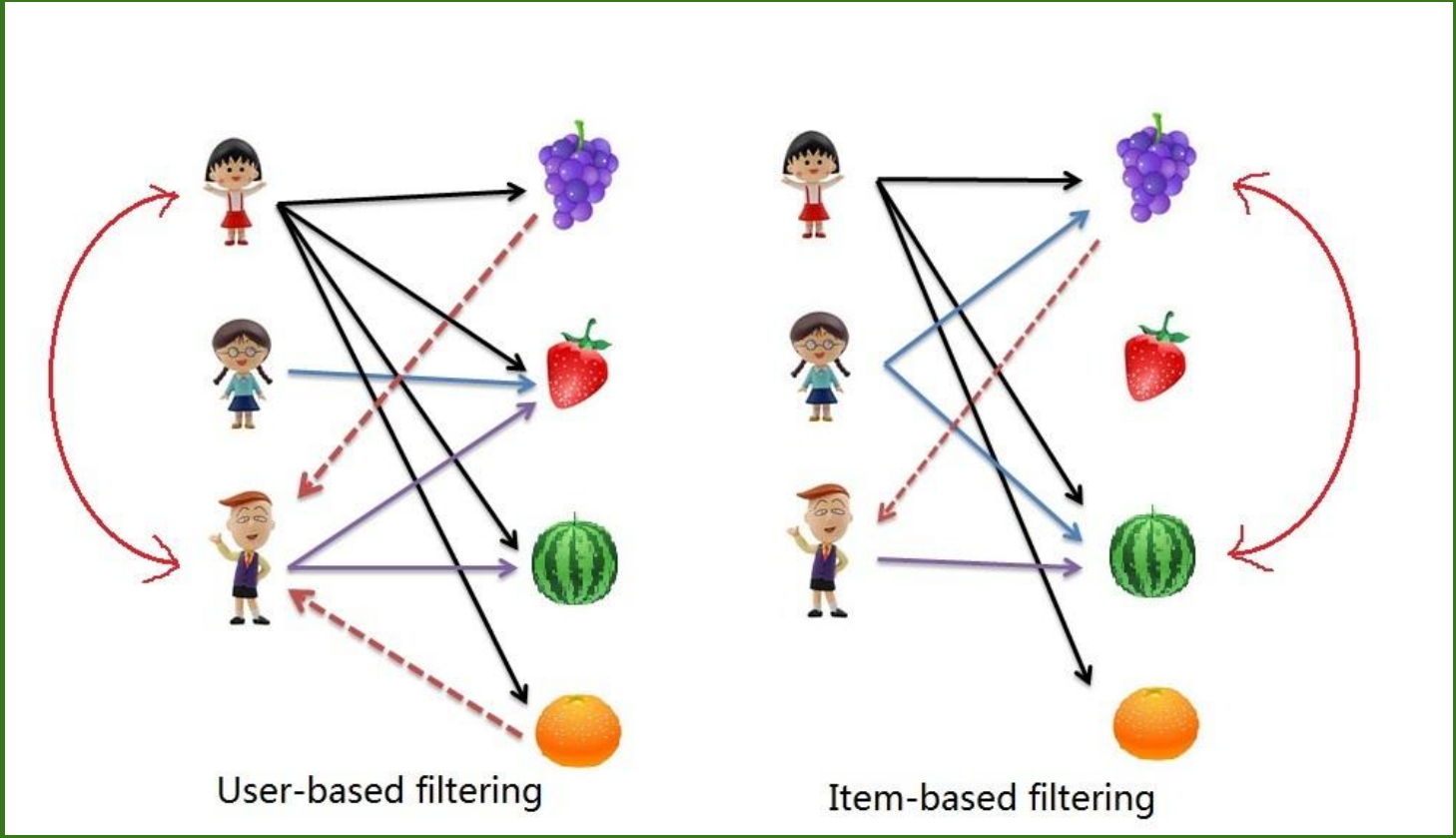
What are we trying to do?

We would like to identify a cluster of buyers and send a product recommendations email to the cluster

The Problem

Collaborative filtering (CF) methods are great for individual recommendations but hard for clusters.

Collaborative filtering for recommendations



I use GraphLab Create for easy to implement recommender systems

Core version is open source
https://dato.com/products/create/

```
m = graphlab.recommender.create(data_frame,
                                user_id='user',
                                item_id='movie')
recs = m.recommend()
```

It is harder to use CF methods when making recommendations for a group

- not optimized for finding clusters
- coefficients are hard to interpret
- lack of distance measurement for k-means clustering
- ratings on TpT are useless

Why want clusters anyways?

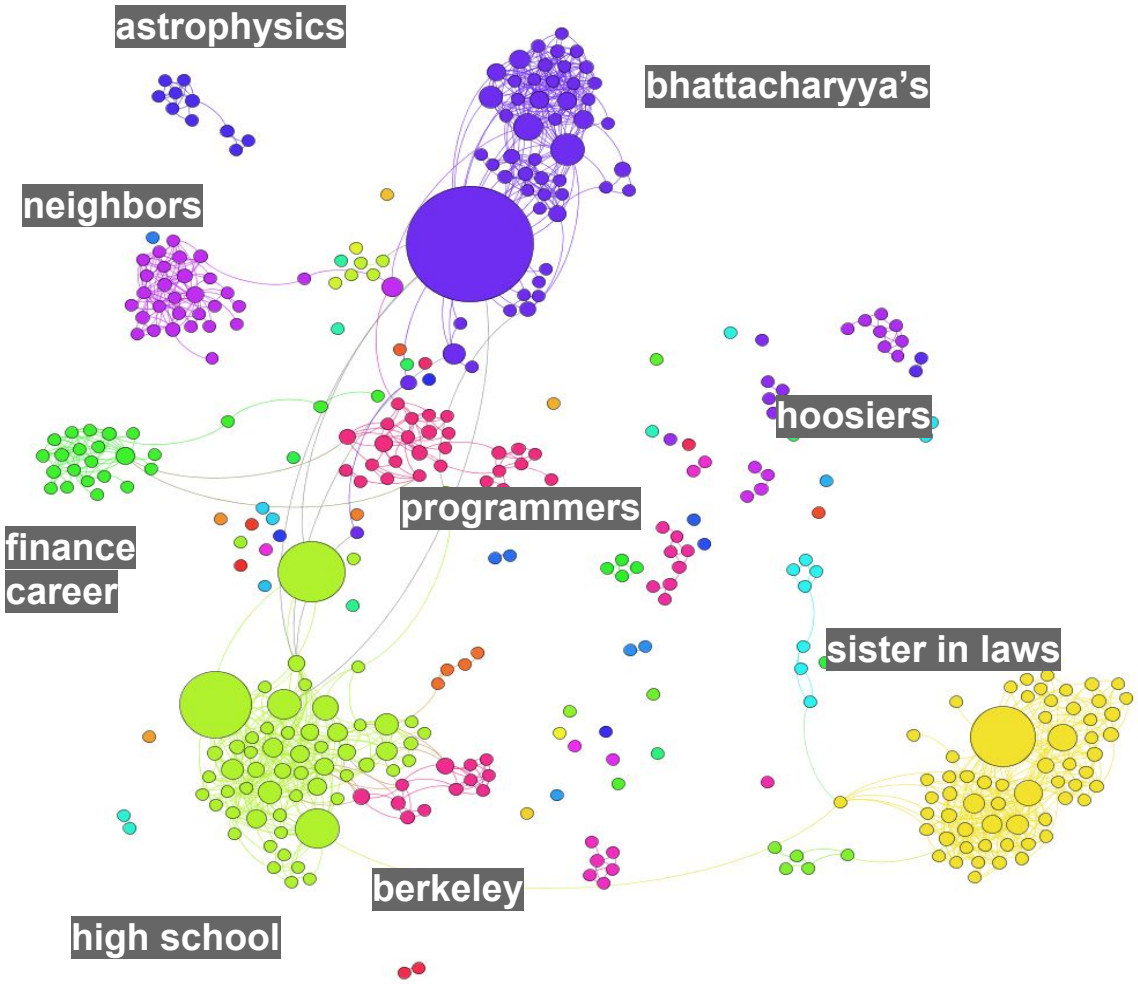
Clusters at TpT

- natural groupings inform buyer behavior
- teachers just getting started may not have long purchase history but are likely to be very similar to others
- can reduce complexity of CF recommendations by pre-clustering users

The Solution

Cluster Users by Creating a Graph

My LinkedIn Network



All we are given is a list of users and items they have purchased

user_id	item_id	item_name
206067	1020240	Rotation and Revolution Model: Sun, Earth and ...
3927028	1498533	Naming Compounds Puzzle - A Fun Chemical Nomen...
3927028	821435	Ionic Bonding Task Cards
3927028	355690	Make Your Own Color By Number Clipart Collecti...
268012	1100472	Introduction to Meso-America Vocabulary
268012	882788	Aztec, Mayan, & Incan Graphic Organizer
268012	1417449	Rise of Empires (Maya, Inca, Aztec)

How to construct the graph:

- each user is a node
- there is an edge between two users if they have made a common purchase
- multiple common purchases will get a higher edge weight

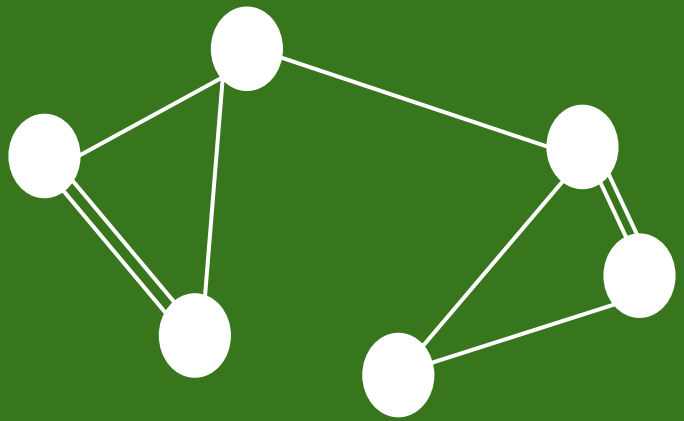
Graphs in Python

- NetworkX
- GraphLab Create (now called Dato)
- igraph

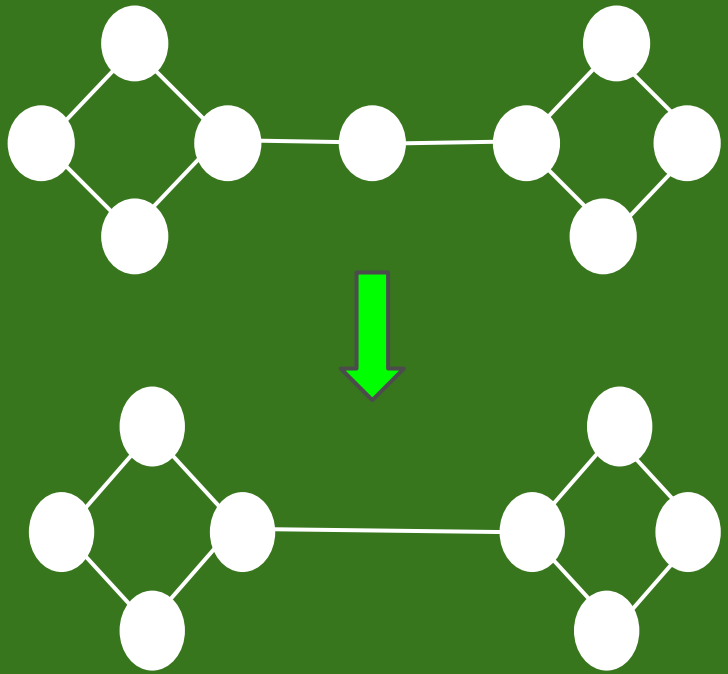
Graphs (not in Python)

- Gephi

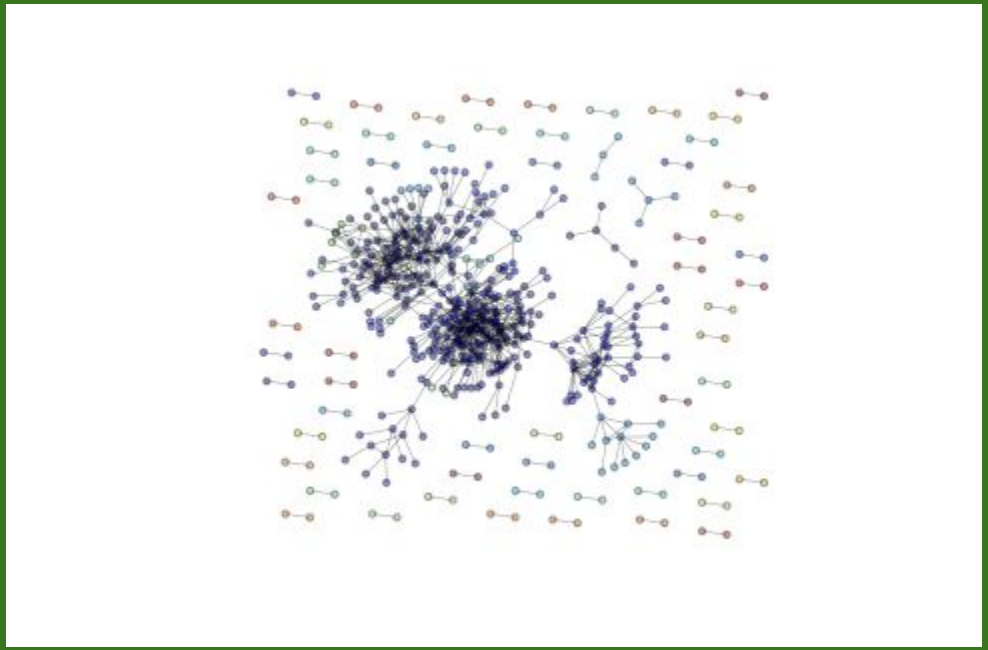
example of a simple graph
users = nodes
common purchases = edges



reduce complexity by removing all nodes with degree = 2



run community detection algorithm and clusters begin to emerge ...



What do the clusters mean?

Need to look incorporate item info to determine physical intuition of cluster

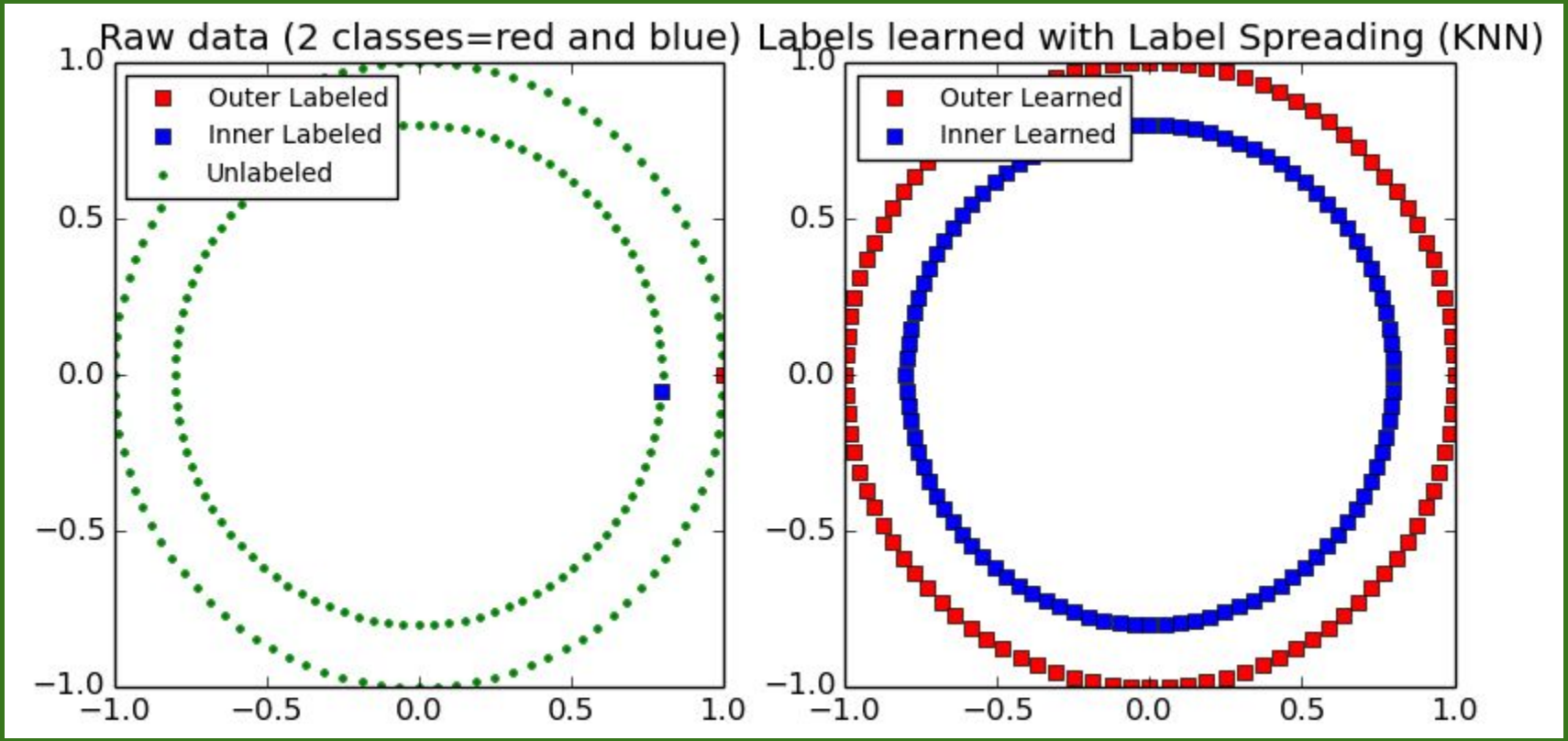
item_id	name
506116	Solving Systems of Equations by Graphing and S...
1080423	Exponent Rules Valentine's Day Coloring Activity
1415508	Trigonometry {SOH CAH TOA} Coloring Activity
590706	Factoring a Greatest Common Factor (GCF) Drag ...
1196123	Algebra: Graphing and Writing Compound Inequal...
967719	Multiplying Polynomials {FOIL} Coloring Activity
1013496	Systems of Equations Relay Races
426830	Algebra 1: Quadratic Equations (Unit 8) - Unit...

Another Problem

Community detection is hard to do at scale

Another Solution

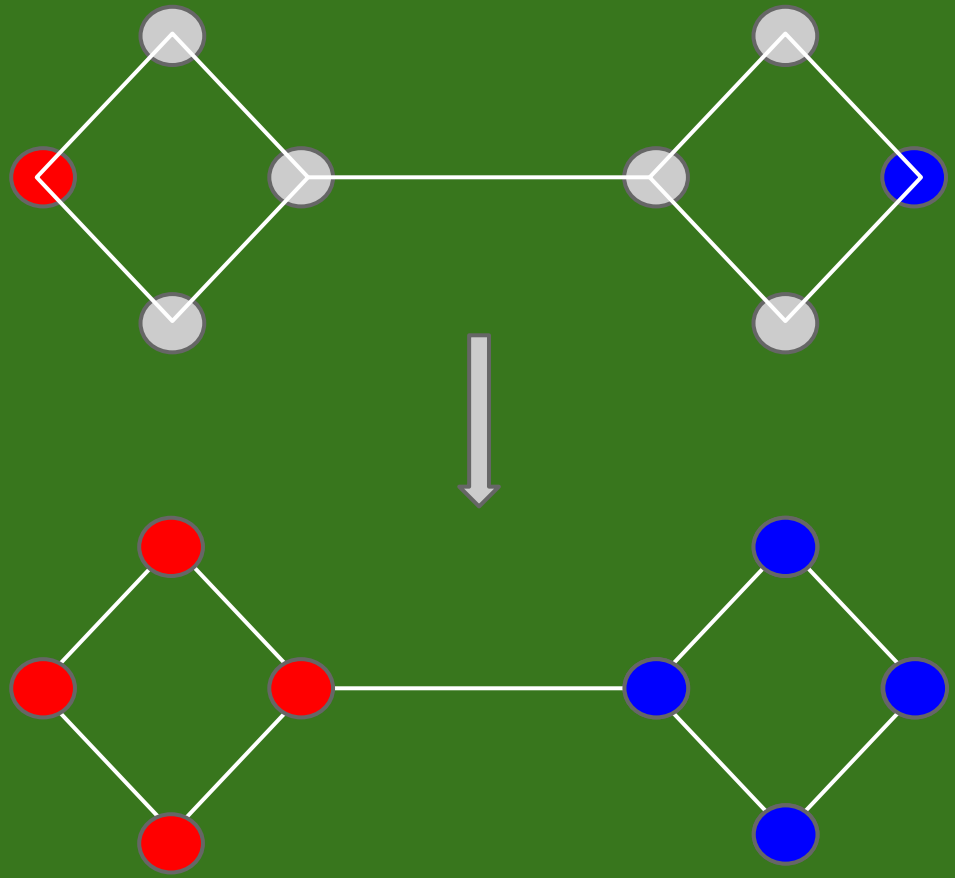
Label propagation



Two step process:

- **Run community detection on a fraction of the users to determine clusters**
- **Use *label propagation* to fill in the rest**

Label propagation in clusters



Recommendation algorithm can be as simple as choosing the most purchased by a cluster

Clustering also helps restrict number of user-item pairs in CF recommender systems

Let’s do some real Python ...

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