FRIEND RECOMMENDATION SYSTEM

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Information Retrieval Systems

Outline

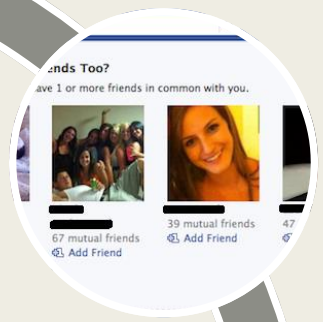
- Problem Definition
- Methodology
- Input Data
- Results

Introduction

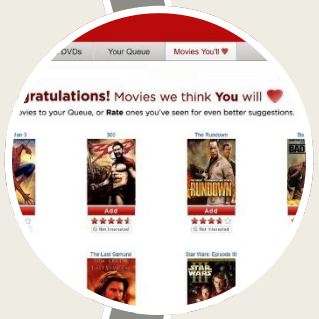
- Social networks growing in popularity and importance
  - *Change the human social behavior*
- Why recommendation systems?
  - *Successful recommendations increase sell*
  - *Based on previous knowledge*
- Some have already provided such systems;
  - *Based on analysis of user A's friends network and Friends Of Friends (FOF)*

Problem Definition

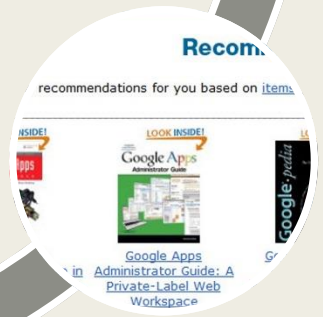
How do they do that?



Facebook suggests people you may be (or should be) friends with



Netflix suggests movies you might like



Amazon suggests products to buy.

- The central problem is to propose relevant parameters for nodes relationship using the information from the social network topology and statistical properties obtained by using classical metrics of complex networks

Input Data

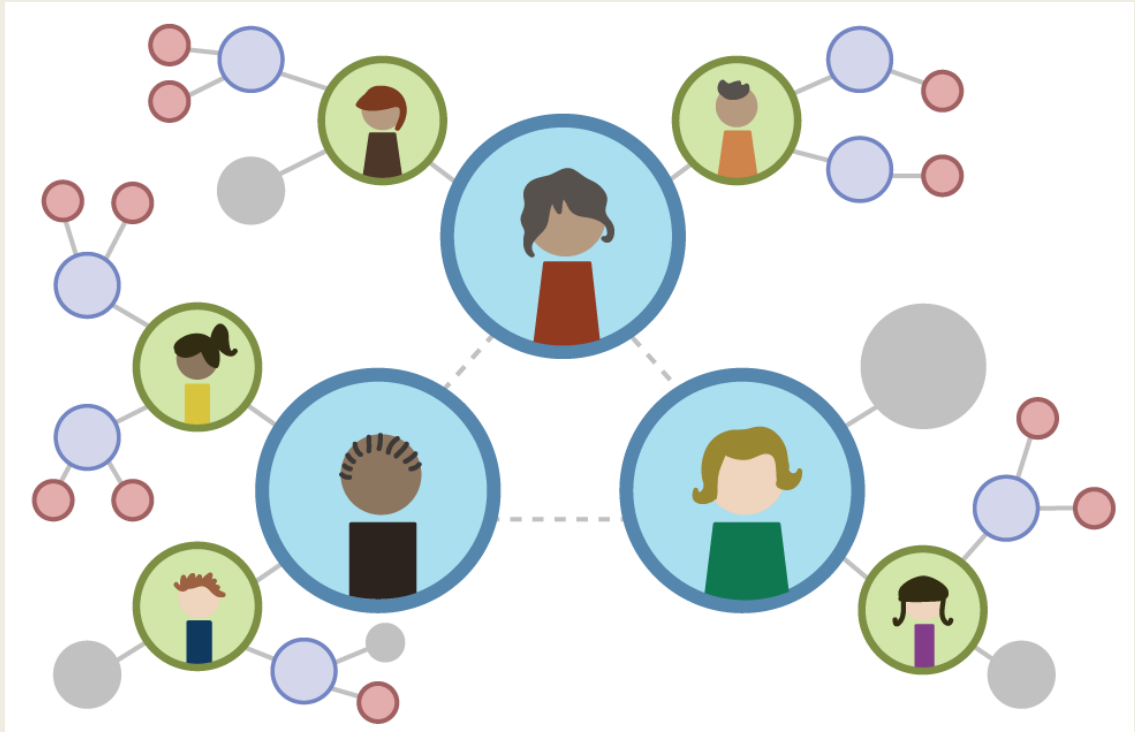
- Provided by University of Washington
- Nodes: 63,731
- Directed Edges: 2,545,686

Methodology

- Construct the social graph
- Calculate the indexes
- Adjust weights of indexes
- Ordering

Construct the social graph

- Initially we have $\sim 2{,}5M$ edges.
- We remove the unidirectional edges.
- Finally, we have $\sim 1.5M$ edges.
- We store the social graph in matrix in which each row contains two numeric user identifiers.



First Index: Common Friends

- Defined as number of adjacent nodes that are linked at the same time to **node i** and **node j**
- i is center node (**our node vi**) and j is the node being ordered

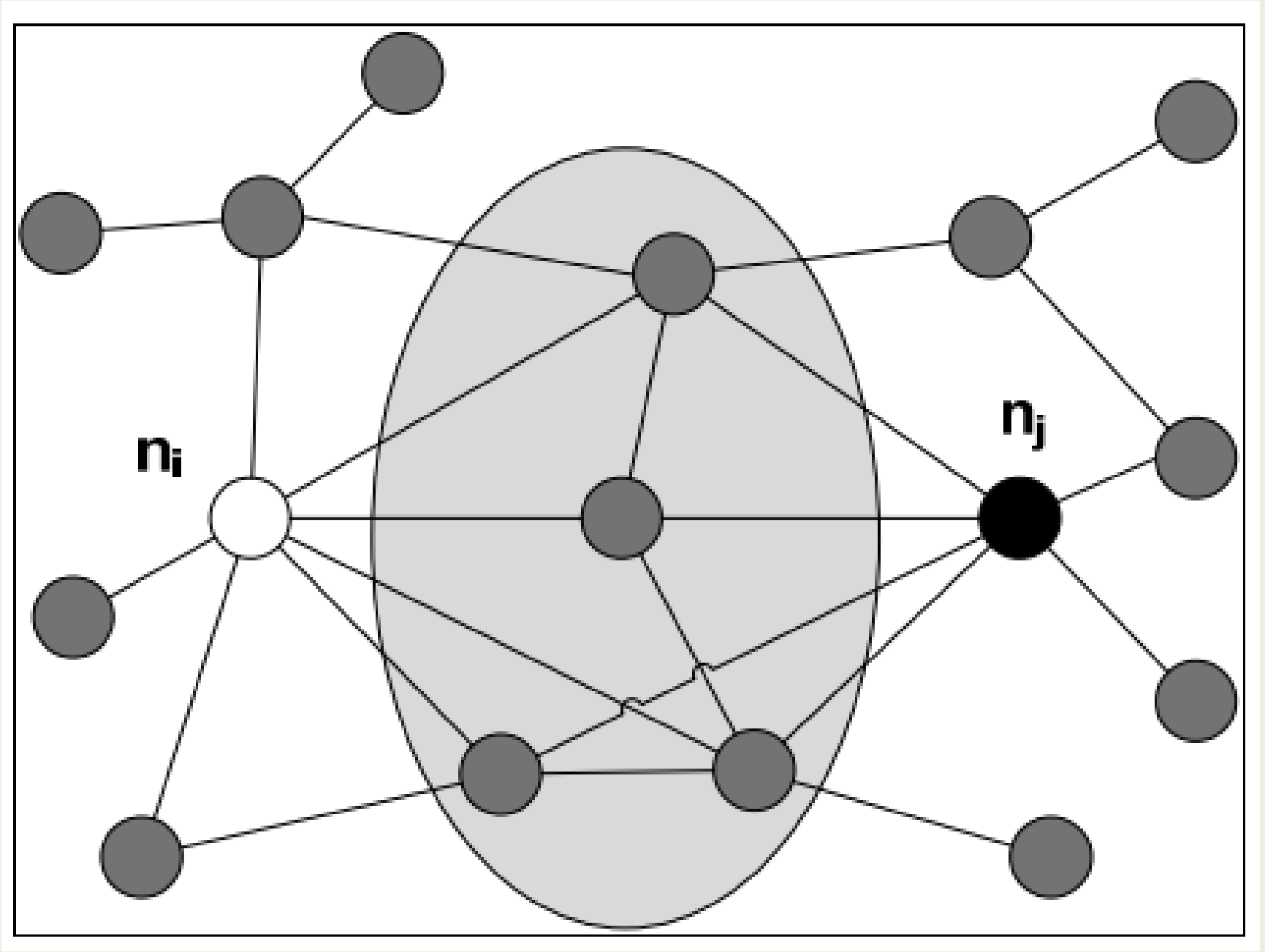
$$I_{1_{ij}} = |C_i \cap C_j|$$

Second Index: Density of the result of first index

- Measures the cohesion level inside the group formed by common friends of person i and person j
- If the value is small, then people inside this group are not well-related

$$D_C = \frac{\sum_{i \in C}(\sum_{j \in C}(M_{ij}))}{(|C| * (|C| - 1))/2}$$

$$I_{2\,ij} = D_{C_i \cap C_j}$$


n_i
n_j

Third Index: Variation of First Index

Consider the following hypothetical situation.

- Two of your friends are Alice and Bob.
- Alice has only two friends (you and one other person).
- Bob has 7 billion friends.

Since Alice is highly selective in terms of friendship, and is a friend of yours, you are likely to have a lot in common with Alice's other friend. On the other hand, Bob is indiscriminate and there is little reason to believe that you should be friendly with any particular one of Bob‘s other friends.

Third Index (cont'd)

- Suppose Alice and Bob has n common friends. (Alice is the central node)

$$I_3 = \frac{n}{\#\ of\ Bob's\ friends}$$

Adjust weights of indexes

- First, normalize the indexes
- Try with one index
- Get the importance of indexes
- Adjust the weights according to their importance

Testing

- Randomly choose a real friend connection; call the two friends F1 and F2.
- Remove their friendship from the graph.
- Compute friend recommendations for F1 and F2.
- Determine the rank of F1 in F2's list of recommended friends.
- Put their friendship back in the graph.

Evaluation Metric

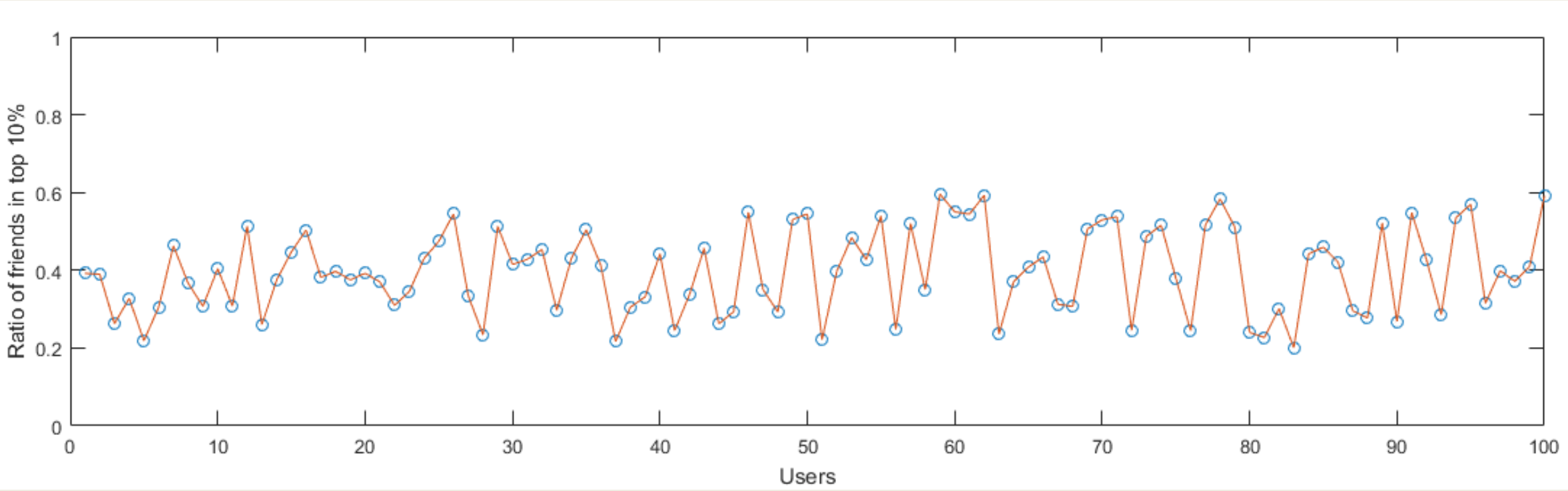
The performance of the recommendation is evaluated as follows;

$$Eval = \frac{\#\ of\ actual\ friends\ in\ top\ 10\%\ recommendatio}{\#\ of\ top\ 10\%\ recommendation}$$

Recommendation Order	User ID	Is Friend?
1	45362	Yes
2	67	Yes
3	1598	No
4	75	Yes
5	4562	No
6	75866	No
7	1732	Yes

Results

- Results of 100 randomly selected users;



Reference

- Silva, Nitai B., et al. "A graph-based friend recommendation system using genetic algorithm." *Evolutionary Computation (CEC), 2010 IEEE Congress on*. IEEE, 2010.
- "Social Networking and Recommendation Systems." Social Networking and Recommendation Systems. Web. 28 Mar. 2016.