Friend Recommendation System using Ensemble Voting

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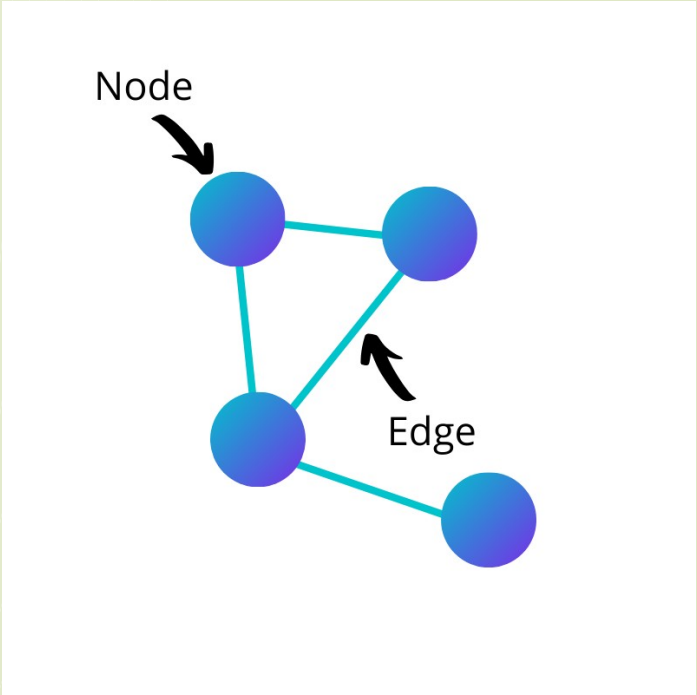
Objective

- Given two users who are not friends on social media, predict whether or not the two users would become friends in the future.
- Three persons P1, P2, P3 form a length-3 following chain if a person P1 follows person P2, and person P2 follows P3. Given a length-3 following chain, it may make sense to recommend to P1 to follow person P3.



Source: https://towardsdatascience.com/how-to-get-started-with-social-network-analysis-6d527685d374

Data

- Data Resource: https://snap.stanford.edu/data/
- Dataset: Facebook dataset
- About the data:
  - The Facebook dataset contains 4039 users and 88,234 friend connections distributed among the 4039 users
  - Number of triangles is 1612010
  - File size: 1MB

Steps

- Load the datasheet.
- Extract features from the given data. Jaccardian, Adam index, Common Neighbours, Resource Allocation, and Preferential Attachments are the features extracted from the data.
- Eliminate nodes which don’t have any connection
- Split train/test set
- Perform Machine Learning to get accuracy score
- Tune the model to enhance the accuracy

Features

- Lests assume A,B to be two members, and their friends are represented as sets.
  - A= {1,2,3,4,5} B = {4, 5, 6, 7}
- ***Jaccard similarity index*** compares members for two sets to see which members are shared and which are distinct.
  - J(A, B) = UNION(A,B) = UNION(A,B)/ INTERSECTION(A,B)
  - J(A,B) = 2/7
- ***Common Neighbors***: Number of mutual friends between two individuals
  - CN(A,B) = UNION(A,B)
  - CN(A,B) = 2

Features

- ***Resource Allocation Index*** is measure that calculates amount of resource that a node can send to destination node via its neighbors
  - $RA(A,B) = \psi (x \in CN(A,B)) \sum (1 / CN(x))$
- ***Preferential Attachment*:** More number of mutual friends, more influential the person is
  - $PA(A,B) = CN(A) * CN(B)$
  - $PA(A,B) = 5*4 = 20$
- ***Adamic Adar Index***: Higher the value, if amount of shared links between two nodes are higher
  - $RA(A,B) = \psi (x \in CN(A,B)) \sum (1 / \log|CN(x)|)$

Algorithm

- Ensemble of :
  - ANN
  - Logistic
  - Naïve Bayes
  - SVM, Decision Tree, Random Forest (Considered but not used)

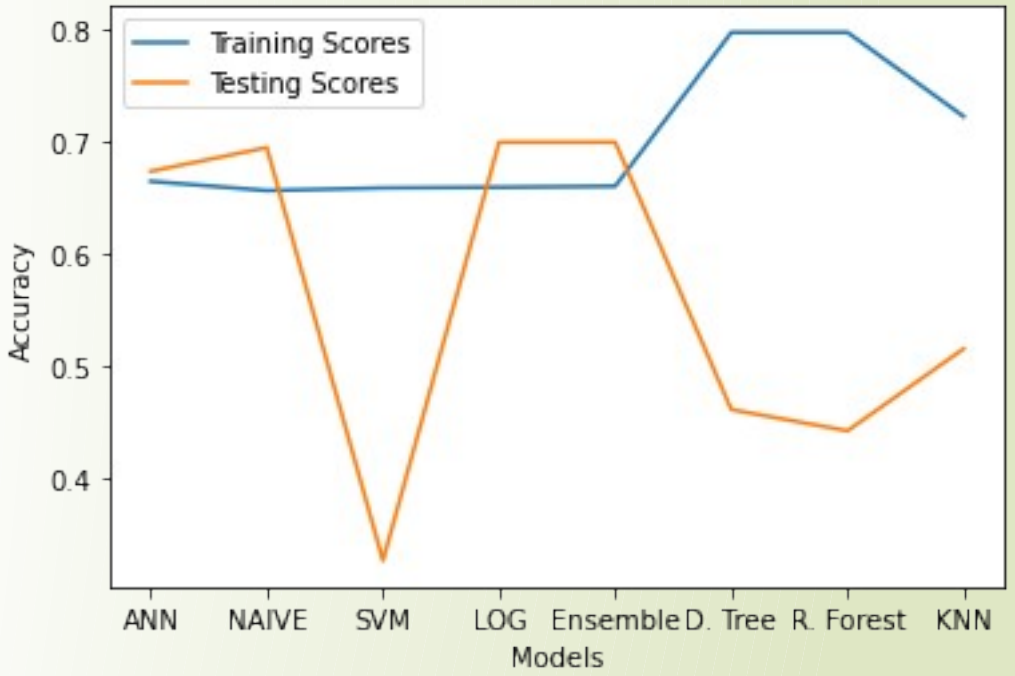
- Weighted Voting Strategy:
  - Find the classifier with maximum accuracy and provide maximum weight for this classifier
  - Eliminate classifiers that overfit/undefit
  - Vote other classifiers relatively based on their accuracy
  - Eliminate classifiers whose accuracy is less than the threshold

Weighted Voting – Approach Illustration

	ANN	Naïve Bayes	SVM	Logistic	Decision Tree	Random Forest	KNN
Test Accuracy	67.3	69.5	32.6	69.9	46.1	44.2	51.5
Train Accuracy	66.4	65.6	65.8	65.9	79.7	79.7	72.2
Votes	4	5	0	5	0	0	0

- SVM, KNN, Decision Tree, Random Forest – Overfitting. Hence, Eliminated
- Logistic has the highest Accuracy (69.9%).
- Assumed Variance = 2% . Relative Voting,
  - 68% - 70% = 5 points
  - 66% - 68% = 4 points
  - 64% - 66% = 3 points
  - 62% - 64% = 2 points
  - 60% - 62% = 1 point
  - <60% = Elimination

Results



Ensemble of Weighted Voting Model:

- Training Accuracy: 66%
- Testing Accuracy: 69.9%

References

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