CS 7641 Machine Learning
Assignment 3

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Due Sunday April 1st, 2018 11:59pm

Introduction

This assignment explores unsupervised learning and dimensitonality reduction. It begins by examining clustering algorithms, specifically k-means and expectation maximization. It then proceeds to cover four dimensionality reduction algorithms: principal components analysis, individual components analysis, randomized projections, and random forests. After running these six algorithms on the original datasets and observing the results, the results are then piped into a neural network learner for further examination.

Datasets chosen

The datasets chosen were the same datasets chosen for assignment 1. The first dataset is the US permanent visa dataset. This dataset is interesting due to its potential to aid in the visa application process from a cost and time savings potential. It could also enable confidence in those interested in applying for a US permanent visa but doubting their chances of acceptance. At the end of the day, the goal is it to try to determine the application result before time, money, nd other resources are spent.

The second dataset is a home sale price prediction dataset taken from an ongoing Kaggle competiton. This dataset is interesting for two primary reasons: real-world applicability and participating in a Kaggle challenge. First, modeling home prices is both a difficult and lucrative task. If one can succesfully model home sale prices on large sets of data, he/she can make large amounts of money investing in real estate when he/she detects outliers in listed price vs. what it is expected to sell for. This applies to flipping, investing, and remodeling. Second, the dataset is part of an ongoing Kaggle competition that does not have a winning solution yet. By taking part of the competition, the dataset presents the opportunity to work towards a winning solution and advance ones algorithms over time.

Part 1: Clustering Algorithms

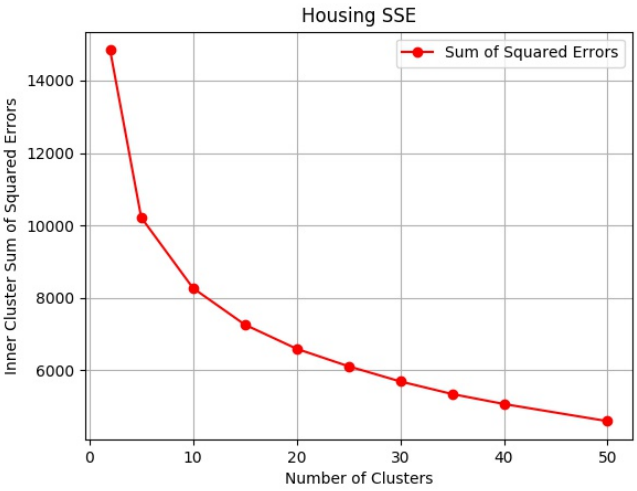
Introduction

K-means clustering is the first algorithm applied to the datasets and expectation maximization is the second. Both algorithms work by clustering: gathering groups of instances together based upon their features. The rationale is that similar instances will likely be labeled the same way–such as identical visa applications obtaining the same outcome.

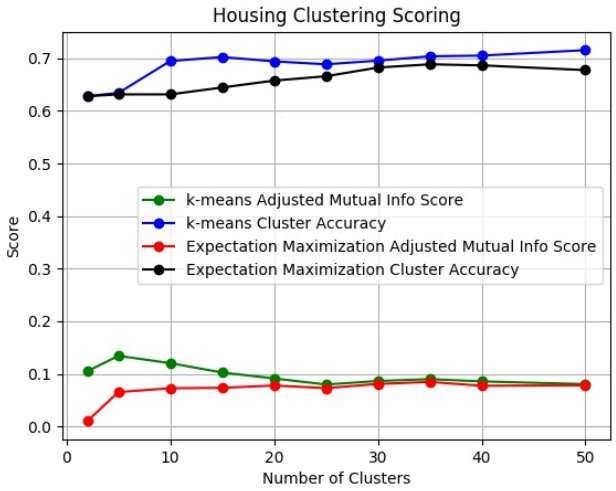
1) k-means clustering

Overview

K-means works by clustering n instances into k-clusters of similarity using least-squares Euclidean distance between the instances. In practice, the algorithm converges on 'mean' for each cluster that is representative of the members of that cluster. A variety of cluster sizes were tested to find the best parameters possible.



Sum of Square Errors for Clusters vs. Clusters



Scoring for k-means and expectation maximization

Clusters	2	5	10	15	20	25	30	35	40	50
SSE	108717	71834	47453	37701	31090	27611	25517	23874	22410	20267
k-Means AMI	0.105	0.134	0.120	0.103	0.091	0.080	0.086	0.090	0.086	0.081
k-Means ACC	0.628	0.634	0.695	0.702	0.694	0.688	0.695	0.704	0.705	0.715
EM AMI	0.010	0.065	0.073	0.073	0.078	0.073	0.081	0.085	0.077	0.078
EM ACC	0.628	0.631	0.631	0.644	0.657	0.666	0.682	0.688	0.686	0.677

Simulated Annealing Results w/ .15 Cooling

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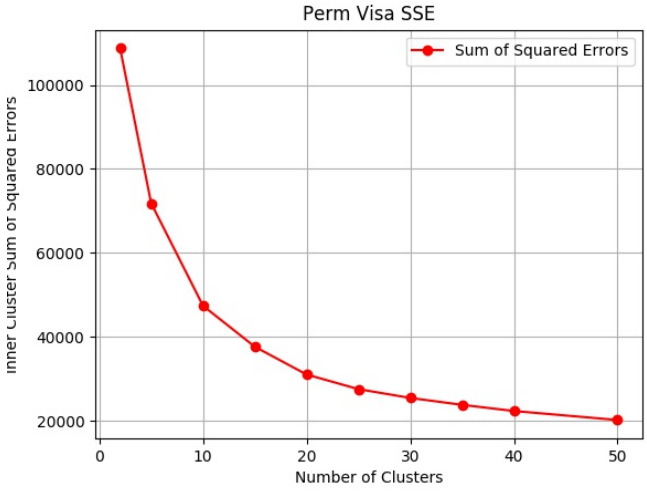
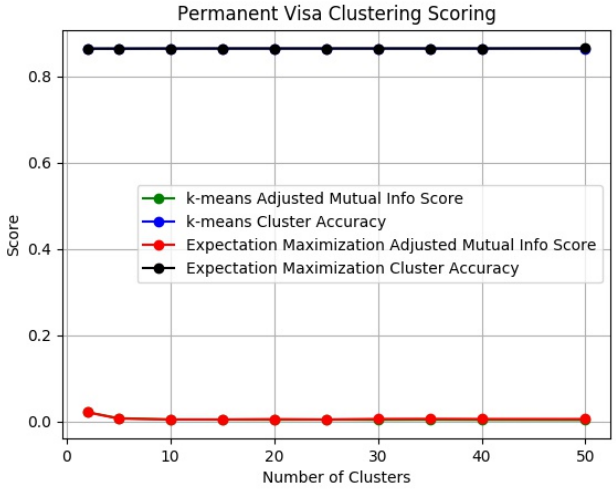
2) Expectation Maximization

Overview

Text



Sum of Square Errors for Clusters vs. Clusters



Scoring for k-means and expectation maximization

Part 2: Dimensionality Reduction Algorithms

Introduction

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1) Principal Components Analysis (PCA)

Overview

Text

Analysis

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2) Independent Components Analysis (ICA)

Overview

Text

Analysis

IText

3) Randomized Projections

Overview

Text

Analysis

IText

4) TODO Choose

Overview

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Analysis

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Conclusion

Todo conclusion