Module 6: Unsupervised Learning

1 Features Selection

1.1 Wrapping

1.1.1 Hill Climbing Search.

1.1.1.1 Stochastic Hill Climbing.

1.1.1.2 Random Restart Hill Climbing.

1.1.1.3 First-Choice Hill Climbing.

1.1.1.4 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.1.1.5 **Coding Assignment 36.**

1.1.2 Simulated Anealing Search.

1.1.2.1 Simulated Anealing.

1.1.2.2 Algorithm.

1.1.2.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.1.2.4 **Coding Assignment 37.**

1.1.3 Beam Search.

1.1.3.1 Local beam Search.

1.1.3.2 Stochastic Beam Search.

1.1.3.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.1.3.4 **Coding Assignment 38.**

1.1.4 Genetic Algorithms.

1.1.4.1 Cross Over.

1.1.4.2 Mutation.

1.1.4.3 Fitness Functions.

1.1.4.4 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.1.4.5 **Coding Assignment 39.**

1.1.5 Forward Search.

1.1.5.1 Algorithm.

1.1.5.2 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.1.5.3 **Coding Assignment 40.**

1.2 **Portfolio Mini Project 17 on Wrapping.**

1.3 Filtering

1.3.1 Principal Components Analysis

1.3.1.1 Principles of Self Organization.

1.3.1.2 Self Organized Feature Analysis.

1.3.1.3 Multi Feature Datasets.

1.3.1.4 Covariance Matrices.

1.3.1.5 Projection Matrices.

1.3.1.6 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.3.1.7 **Coding Assignment 41.**

1.3.1.8 Orthogonal Complements.

1.3.1.9 Principal Components Analysis Problem Setting and Objective.

1.3.1.10 The Code.

1.3.1.11 Principal Components Analysis as Encoder or Compressor.

1.3.1.12 The Principal Components Analysis Algorithms.

1.3.1.13 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**

1.3.1.14 **Coding Assignment 42.**
1.3.1.15 **Portfolio Mini Project 18 on Principal Components Analysis.**
1.3.2 Independent Components Analysis
1.3.2.1 Entropy.
1.3.2.2 Maximum Entropy Principle.
1.3.2.3 Mutual Information.
1.3.2.4 Kullback Leibler Divergence.
1.3.2.5 Mutual Information as Objective Function.
1.3.2.6 Maximum Mutual Information Principle.
1.3.2.7 Infomax and Redundance Reduction.
1.3.2.8 Spatially Coherent and Incoherent features.
1.3.2.9 Natural Gradient Learning for Independent Components Analysis.
1.3.2.10 **Portfolio Mini Project 19 on Independent Components Analysis**

2 Retrieval
2.1 Retrieval as Nearest Neighbour Search.
2.2 K-NN Algorithm.
2.2.1 Different distance metrics in K-NN Algorithm.
2.2.2 Complexity of Brute Force Search.
2.2.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
2.2.4 **Coding Assignment 43.**
2.2.5 K-D Tree representation of K-NN Algorithm.
2.2.5.1 NN Search with K-D Trees.
2.2.5.2 Approximating K-NN search using K-D Tree Algorithm.
2.2.5.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
2.2.5.4 **Coding Assignment 44.**
2.2.5.5 Limitations of K-D Trees.
2.2.6 Locality Sensitive Hashing as alternative to K-D Trees.
2.2.7 Defining Random Bins.
2.2.8 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
2.2.9 **Coding Assignment 45.**
2.3 **Portfolio Project 14 on Retrieval.**
3 Clustering
3.1 Basic Clustering Problem.
3.2 Clustering as Unsupervised Classification.
3.3 K-Means Clustering.
3.3.1 K-Means Clustering in Eucleadian Space.
3.3.2 K-Means Clustering as Optimization.
3.3.2.1 Coordinate Descent.
3.3.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
3.3.4 **Coding Assignment 46.**
3.4 K-Means ++ Clustering.
3.4.1 Good Initialization.
3.4.2 Choosing the number of clusters.
3.4.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
3.4.4 **Coding Assignment 47.**
3.5 Probabalistic Clustering Models.

- 3.5.1 Univariate and Multivariate Normal Distributions.
- 3.5.2 Cluster Parameters as Natural Parameters.
- 3.5.3 Soft Cluster Assignments.
- 3.5.4 Bayes Rule.
- 3.5.5 Running Expectation maximization Iteratively.
- 3.5.6 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
- 3.5.7 **Coding Assignment 48.**

3.6 **Portfolio Project 15 on Clustering.**

4 Recommendation

4.1 Non-Personalized and Stereotype-based Recommender Systems.
- 4.1.1 Ranking and Scoring.
- 4.1.2 Product Association Recommenders.
- 4.1.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
- 4.1.4 **Coding Assignment 49.**

4.2 Content based Recommender Systems.
- 4.2.1 TF-IDF and Content based Filtering.
- 4.2.2 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
- 4.2.3 **Coding Assignment 50.**
- 4.2.4 **Portfolio Mini Project 20 on Recommender Systems.**

4.3 Colaborative Filtering.
- 4.3.1 User-User Collaborative Filtering.
  - 4.3.1.1 Trust Based Recommendation.
  - 4.3.1.2 Impact of Bad Ratings.
  - 4.3.1.3 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
  - 4.3.1.4 **Coding Assignment 51.**
- 4.3.2 Item-item Collaborative Filtering.
  - 4.3.2.1 The Algorithm.
  - 4.3.2.2 Strengths and Weaknesses.
  - 4.3.2.3 Item based Collaborative Filtering.
  - 4.3.2.4 **Sample Python code demonstration along with detailed explanation for Coding Assignment.**
  - 4.3.2.5 **Coding Assignment 52.**
  - 4.3.2.6 **Portfolio Mini Project 21 on Collaborative Filtering.**

4.4 **Portfolio Project 16 on Recommendation.**