Fourier Analysis and Deep Learning Technical Report

Rosa Garza
Lillian González Albino
Sylvia Nwakanma

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Abstract

In this research, we apply Fourier analysis as a tool to extract important features from a given dataset and use the features as predictors for a deep learning model. As opposed to other methods like the spacial model, the Fourier analysis provides precise information about the behavior of coalitions while not removing any of the data. Using spectral analysis it is easy to interpret and find the coalitions with the largest effects on the data thus making them good predictors. Since we will be working with large datasets, we will use a partitioning technique described in [1] that will reduce the size or our working set by removing redundant information without altering the data.

1 Preliminaries

Definition 1.1. [3] The **Johnson Graph** $J(n, k)$ has vertices given by the k-subsets of $\{1, \cdots, n\}$ with two vertices connected if and only if their intersection has size $k - 1$.

2 Work

Algorithm to compute adjacency matrix from a Johnson graph.

Result: Eigen vectors of Adjacency Matrix of Johnson Graph
initialize;
Set *alphabet* of size n in lexicographical order;
Set k length of pairs;
Define *tuplelist* = combinations of *alphabet* of length k, no repetition, in lexicographical order;
Define Adj = zero matrix of size $nk * nk$;
for *i in tuplelist* ***as*** *row index* **do**
  for *j in tuplelist* ***as*** *column index* **do**
    if $|tuplelist[i] \cap tuplelist[j]| = k - 1$ **then**
      change $Adj[i, j] = 1$
    end
  end
end
Define *eigenvecs* = eigen vectors of Adj;

3 Future Work

References

[1] Uminsky, David Thomas. "Generalized Spectral Analysis for Large Sets of Approval Voting Data." Harved Mudd College, 2003, pp. 19–33.

[2] Lawson, B., Orrison, M., Uminsky, D. (2006). Spectral analysis of the supreme court. Mathematics Magazine, 79(5), 340-346. http://dx.doi.org/10.2307/27642969

[3] Weisstein, Eric W. "Johnson Graph." From MathWorld–A Wolfram Web Resource. http://mathworld.wolfram.com/JohnsonGraph.html