![תמונה שמכילה טקסט, אוסף תמונות

התיאור נוצר באופן אוטומטי](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RD0RXhpZgAATU0AKgAAAAgABAE7AAIAAAAUAAAISodpAAQAAAABAAAIXpydAAEAAAAWAAAQ1uocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAANeQ15XXqNeZ16og15PXnteR15UAAAWQAwACAAAAFAAAEKyQBAACAAAAFAAAEMCSkQACAAAAAzM1AACSkgACAAAAAzM1AADqHAAHAAAIDAAACKAAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Software Engineering Department  
Braude College

Capstone Project Phase B – 61999

**Anomaly recognition in citation networks using Beta Wavelet Graph Neural Network**

**24-1-R-13**

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# **Abstract**

This research addresses the challenge of identifying anomalies in graph-structured data. By combining Isolation Forest algorithm and the use of the Beta Wavelet Graph Neural Network (BWGNN), we propose a novel approach that effectively captures complex relationships within graphs represented as a nested structure of anomalies at serval layers. Our method leverages Isolation Forest to detect potential outliers and BWGNNs to learn graph-based representations, enabling accurate anomaly identification.

Node embeddings are generated through the Node2Vec approach to cluster the data and initialize the anomaly detection process using the Isolation Forest methodology at different threshold levels (5%, 10%, and 20%). The homogeneous and heterogeneous BWGNN models are further used to refine the anomaly structure. Importantly, at each following step, the process is reinitialized by removing the found anomalies and Isolation Forest application, reinforcing the robustness of our methodology. Through detailed analysis and visualization of results, this research provides a comprehensive understanding of the methodologies used and their impact on detecting anomalies within dynamic datasets.

# **Introduction**

Anomaly detection in complex datasets, particularly those with intricate relational structures, remains a challenging task in domains such as finance, cybersecurity, and social network analysis. Traditional methods often fall short due to the dynamic nature of real-world data and the complexities inherent in graph-based representations.

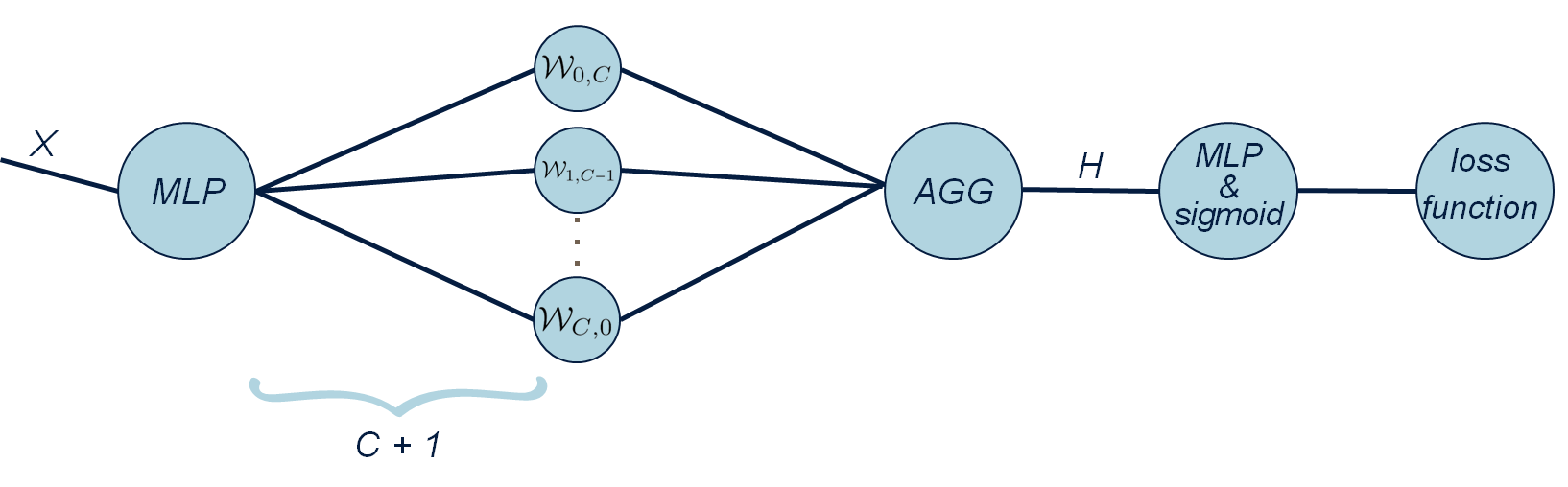
To address these limitations, this book presents a novel approach that leverages the power of Graph Neural Networks (GNNs) and anomaly detection techniques. Specifically, we focus on the Beta Wavelet Graph Neural Networks (BWGNNs), a class of GNNs designed to capture both local and global structural information within graphs.

A cornerstone of our approach is the integration of Isolation Forest, a robust anomaly detection algorithm. By combining the BWGNNs with Isolation Forest, we are able to effectively identify anomalous nodes in graph datasets, even in the presence of noise, outliers, and evolving data characteristics.

To enhance the adaptability of our system, we introduce dynamic thresholding. This mechanism allows us to adjust the criteria for anomaly detection based on the distribution of anomaly scores, ensuring that the system remains responsive to changes in the data.

Throughout this book, we provide a comprehensive exploration of the methodologies employed, including the Node2Vec algorithm for generating vector embeddings and the iterative refinement of our anomaly detection models. We also present a thorough evaluation of different threshold levels and comparisons between the homogeneous and heterogeneous BWGNN models to determine the most effective approach.

By offering a blend of theoretical insights, practical implementations, and in-depth analysis, this book aims to advance the modern techniques in graph-based anomaly detection, aiming to advance the understanding and application of these methods in real-world scenarios.

 Figure 1: BWGNN's Architecture.

# **Background and Related Work**

## **Embeddings**

In the realm of graph analysis, where intricate relationships and complex structures abound, embeddings serve as a powerful bridge between raw data and meaningful insights. These low-dimensional representations distill the essence of high-dimensional graph data, capturing the nuances of node connectivity and structural patterns.

A foundation of graph embedding techniques is the ability to learn latent representations that reflect the underlying semantics of the graph. By mapping nodes to dense vectors, embeddings enable machines to grasp the relationships between entities and make informed predictions.

Among the most prominent embedding algorithms are:

* **Node2Vec:** This method employs random walks to explore the graph's topology, capturing both local and global structural information.
* **GraphSAGE:** A more versatile approach that aggregates information from a node's neighborhood, facilitating inductive learning on unseen data.
* **DeepWalk:** Inspired by natural language processing techniques, DeepWalk leverages random walks to learn distributed representations of nodes.

These algorithms, and others, have reformed the field of graph analysis, empowering researchers to tackle a wide range of challenges, from recommendation systems to community detection and anomaly detection.

## **Clustering**

The art of grouping similar data points, finds a powerful application in graph analysis. By identifying communities or clusters within a graph, we can uncover hidden patterns, understand the underlying structure, and gain valuable insights.

Several techniques have been developed to tackle this task.

Among the most prominent are:

* **K-Means Clustering:** A classic approach that partitions data into a predetermined number of clusters, minimizing the within-cluster variance.
* **Spectral Clustering:** Employing the eigenvalues of the graph Laplacian, this method effectively captures the community structure inherent in graphs.
* **DBSCAN:** A density-based algorithm that groups points based on local density, making it particularly suitable for detecting outliers and irregularly shaped clusters.

These techniques, each with its own strengths and weaknesses, have proven invaluable in various graph analysis applications, from social network analysis to biological networks and beyond.

## **Cora Dataset**

The Cora dataset, a basis of graph-based machine learning research, presents a challenging yet valuable benchmark for evaluating graph neural networks (GNNs). This dataset comprises 2,708 scientific publications, interconnected by a network of 5,429 citations. Each publication is precisely categorized into one of seven classes, reflecting its primary research topic, such as neural networks, machine learning, or information retrieval. To ease analysis, the Cora dataset provides a sparse feature vector for each publication, consisting of 1,433 binary values. These values indicate the presence or absence of specific words from a carefully curated dictionary of 1,433 unique terms commonly found in the relevant scientific fields.

This powerful dataset serves as an ideal testbed for a variety of tasks, including node classification, link prediction, and community detection. By tackling these challenges, researchers can assess the effectiveness of GNNs and other graph-based algorithms in extracting meaningful insights from complex network structures.

## **Node2Vec Algorithm**

A powerful algorithm for graph embedding, leverages random walks to create low-dimensional vector representations of nodes. By treating nodes as words and random walks as sentences, Node2Vec effectively captures both local and global structural information within a graph. Inspired by the success of word embedding techniques like Skip-Gram, Node2Vec employs a similar approach to learn meaningful representations for nodes. Random walks are simulated to explore the graph's topology, and the resulting paths are fed into a Skip-Gram model to generate node embeddings.

A key innovation of Node2Vec lies in its ability to balance breadth-first search (BFS) and depth-first search (DFS) through hyperparameters and . This flexibility allows Node2Vec to capture a wider range of structural patterns, making it a versatile tool for various graph analysis tasks, including node classification, link prediction, and clustering.

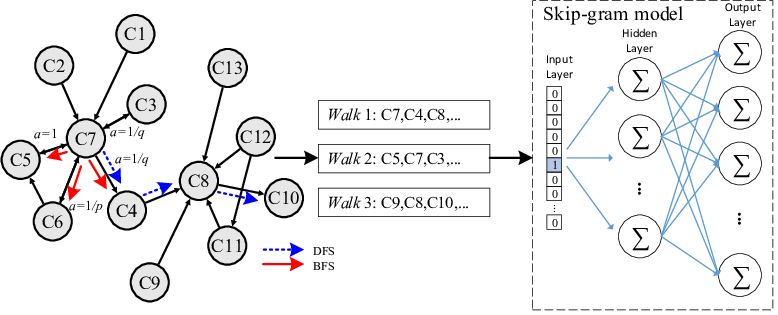


Figure 2: The conceptual framework of node2vec.

## **Isolation Forest**

An anomaly detection algorithm who operates on a fundamentally different principle than traditional methods. Rather than relying on distance or density measures, it isolates data points by recursively partitioning the data space using random feature selection and split values. This process can be visualized as a binary tree, where anomalies, deviating significantly from normal data, are often isolated with fewer splits.

By constructing multiple such trees and calculating the average path length to isolate each data point, Isolation Forest assigns an anomaly score. Shorter paths, indicative of easier isolation, suggest a higher likelihood of being an anomaly. This approach is particularly effective for high-dimensional data, as it avoids the curse of dimensionality commonly faced by distance-based methods.

Isolation Forest offers several advantages:

* **Computational Efficiency:** Its recursive partitioning and random selection make it efficient for large datasets.
* **Robustness to High Dimensionality:** It handles high-dimensional data effectively, avoiding the pitfalls of distance-based methods.
* **Automatic Thresholding:** Isolation Forest determines the anomaly threshold automatically, eliminating the need for labeled data.

These strengths have made Isolation Forest a popular choice in diverse applications, including fraud detection, network security, and industrial monitoring, where accurate anomaly detection is crucial.

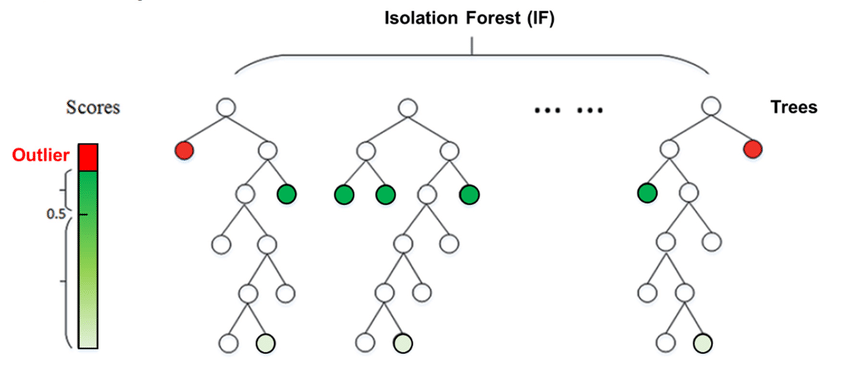


Figure 3: Isolation Forest Demonstration.

## **Kernel and Residual Sets**

The Kernel and Residual Sets serve as fundamental building blocks for distinguishing between normal and anomalous nodes. The Kernel Set, comprising nodes deemed normal, forms the core structure of the graph. These nodes, typically identified through clustering or anomaly detection techniques like Isolation Forest, represent the typical patterns and behaviors within the graph.

In contrast, the Residual Set encompasses nodes flagged as anomalous, deviating from the norm established by the Kernel Set. These outliers, exhibiting unexpected patterns, are often further analyzed or removed to refine the model's focus on the core structure.

By segregating nodes into Kernel and Residual Sets, anomaly detection algorithms can train more effectively. The Kernel Set provides a representative sample of normal behavior, enabling the model to learn the graph's underlying patterns. Meanwhile, the Residual Set highlights anomalies that might skew the learning process if not properly handled. This approach is particularly valuable in iterative processes where the graph structure evolves over time. By continuously identifying and removing anomalies, the Kernel Set can be refined, leading to a more accurate and robust model.

## **Threshold Calculation**

serves as the gatekeeper, separating normal data points from anomalies. Anomalies, often characterized by their deviation from the norm, are identified by their position relative to a predefined threshold.

Anomaly scores, calculated using statistical measures or machine learning models like Isolation Forest, quantify the degree of deviation. By setting a threshold, we can classify data points as anomalies or normal based on their scores. This threshold can be determined using various strategies:

* **Fixed Percentiles:** A common approach is to select a fixed percentile of scores, such as the bottom 5% or 1%. This assumes a relatively stable distribution of anomalies.
* **Dynamic Thresholding:** For more adaptive scenarios, dynamic thresholding techniques can be employed. These methods adjust the threshold based on factors like data distribution, recent trends, or feedback mechanisms.

The choice of threshold significantly impacts the sensitivity and specificity of anomaly detection. A lower threshold might capture more anomalies but increase the risk of false positives, while a higher threshold might reduce false positives but potentially miss genuine anomalies. Striking the right balance is essential for effective anomaly detection.

## **Node removal and graph updating**

Are indispensable components of graph analysis, particularly in iterative anomaly detection. By eliminating anomalous nodes, we can refine the graph structure, ensuring that subsequent analyses are based on a more representative dataset.

The process of node removal involves not only deleting the identified anomalies but also updating the graph's topology. This may include re-indexing nodes and adjusting edges to reflect the changes. This iterative approach allows for continuous refinement, improving the model's ability to learn from the core structure of the graph.

By removing anomalies, we can focus the model's attention on the normal patterns within the graph. This enhances the model's sensitivity to subtle anomalies and improves the accuracy of future predictions.

## **Iterative anomaly detection**

A strategic approach to refining anomaly identification, involves multiple rounds of analysis. In each iteration, the graph is updated by removing identified anomalies, prompting a re-evaluation of the remaining nodes. This iterative process enables the model to adapt to evolving patterns and uncover subtler anomalies that may have been obscured in earlier stages.

Initially, the model focuses on detecting anomalies within the raw data. However, as iterations progress, the graph becomes refined, allowing the model to delve deeper into the data's intricacies. By iteratively removing anomalies and retraining the model, we can significantly improve the accuracy and robustness of the anomaly detection system. This iterative refinement process is particularly valuable in real-world applications where graph structures are dynamic and complex, ensuring that the model remains adaptable to changing patterns.

## **BWGNN Homo**

Operates on homogeneous graphs, where all nodes and edges belong to the same type. In this context, the BWGNN model learns representations of nodes by aggregating information from both neighbors and their neighbors' neighbors, considering both forward and backward propagation.

## **BWGNN Hetero**

Designed for heterogeneous graphs, where nodes and edges can have different types. This allows for modeling more complex real-world scenarios with diverse relationships. In a heterogeneous graph, the BWGNN model learns representations by considering the specific types of nodes and edges, enabling it to capture the unique characteristics of different relationships within the graph.

# **Research and Development Process**

The goal of this research was to effectively identify and remove anomalous nodes from a graph-based dataset, ensuring accurate anomaly detection. Initially, we aimed to embed the graph data into a vector space. Two embedding options were considered: using Graph Convolutional Networks (GCNs) and Node2Vec. While GCNs could capture node features based on their neighbors, we ultimately chose Node2Vec because it provided more flexibility in capturing the structural properties of nodes without relying heavily on the graph's specific features.

For detecting anomalies, we initially considered using K-means clustering, which groups nodes based on similarity. However, this approach was limited by its reliance on assumptions about the data distribution and its difficulty in handling high-dimensional data. As a result, we shifted to using Isolation Forest, which offered greater flexibility and was well-suited for handling complex, high-dimensional datasets. Once the data was embedded into vectors, the next step was anomaly detection using Isolation Forest. We needed a way to classify nodes as anomalous or normal based on their isolation scores. One consideration was to mark all nodes with negative scores as residual (anomalous), as the Isolation Forest algorithm typically produces both negative and positive scores. However, we opted for a threshold-based approach instead. This allowed for greater flexibility in adjusting the sensitivity of anomaly detection, avoiding the rigidity of a simple negative score cutoff. By setting a threshold (e.g., 5%, 10%, 20%), we ensured that the model could adapt to the distribution of scores in the data, improving accuracy.

Next, we divided the nodes into kernel and residual sets. The kernel nodes represented the normal data, while the residual nodes represented the anomalies. The choice of kernel nodes was guided by the necessity to train the model on reliable, non-anomalous data.

During the training phase, the model was iteratively refined. Two training approaches were considered: one using all nodes for training, and the other using only the kernel nodes. We chose the latter approach to avoid contamination of the training process with anomalous data, ensuring the model could learn effectively.

Finally, the process of removing anomalous nodes from the graph was carefully designed. By iteratively identifying and removing anomalies, we ensured that the graph’s structure became progressively cleaner, allowing for more accurate anomaly detection in subsequent iterations.

This thorough consideration of different methods and the final choices made allowed us to build a robust system for anomaly detection in graph-based datasets.

# **Solution**

The final phase of the project required a comprehensive evaluation of the anomaly detection system's performance across various configurations. Six distinct experimental runs were conducted, including the BWGNN (Hetero) model with thresholds of 5%, 10%, and 20%, followed by the BWGNN (Homo) model with identical thresholds. Each iteration adhered to a standardized protocol, beginning with graph preprocessing and vector embedding utilizing Node2Vec. Anomalies were identified through the application of the Isolation Forest algorithm, with a dynamically calculated threshold derived from the anomaly scores. The outcomes of each run were carefully documented, including histograms and iteration-specific tables who presented the identified anomalies. This precise evaluation enabled a thorough comparison of how different threshold settings and model variants influenced the detection accuracy and overall efficacy of the anomaly detection system.

## **Data Preprocessing**

A critical initial phase in data analysis and modeling, was executed for the Cora dataset within the project framework. Utilizing DGL (Deep Graph Library), the raw data was loaded and prepared for subsequent analysis. The preprocessing steps encompassed data normalization, feature formatting verification, and the strategic division of the dataset into training and testing subsets. This preparatory stage ensured that the data was optimally structured for subsequent processes, including embedding and anomaly detection. Furthermore, additional preprocessing techniques, such as handling missing values, encoding categorical variables, or scaling features, were implemented as necessitated by the specific algorithms employed in the project.

## **Building a Graph**

A crucial step that involves converting the dataset into a graph structure that can be analyzed using graph-based algorithms. In the project, this involves constructing a NetworkX graph () from the DGL graph representation. This step enables the use of algorithms like Node2Vec, which require a standard graph format to generate node embeddings. Building the graph typically includes defining nodes and edges based on the dataset's relationships and features. This structure allows for the application of various graph algorithms, facilitating the transformation of raw data into a format suitable for advanced analysis and modeling

## **Embedding with Node2Vec**

Node2Vec is an algorithm used to generate vector representations of nodes in a graph, capturing their structural properties and relationships. In the project, Node2Vec embeddings are computed to represent each node as a vector in a continuous vector space. This involves performing random walks on the graph to sample node neighborhoods and learning embeddings that capture both local and global graph structures. The resulting vectors are used to identify patterns and anomalies within the graph. Node2Vec is effective for capturing the latent features of nodes, which are crucial for detecting anomalies and training graph-based models.

## **Isolation Forest**

An anomaly detection algorithm designed to identify outliers by isolating data points from the rest of the dataset. In the project, Isolation Forest is applied to the node embeddings to compute anomaly scores. The algorithm works by randomly selecting features and splitting the data points, with anomalies being those that are more easily isolated. The anomaly scores derived from this process are used to identify nodes that deviate significantly from the norm. This method is particularly useful for high-dimensional data, such as node embeddings, where traditional methods may struggle.

## **Create Kernel and Residual Nodes by Maintaining a Dynamic Threshold**

In the project, creating kernel and residual nodes involves dynamically adjusting the threshold for anomaly detection based on the anomaly scores derived from the Isolation Forest algorithm. After computing the anomaly scores for each node, a dynamic threshold is calculated to distinguish between normal and anomalous nodes. This threshold is set by selecting a percentile from the distribution of scores, such as the bottom 5%, meaning that nodes with scores below this percentile are classified as anomalous. This approach ensures that the threshold adapts to the distribution of the scores, making the anomaly detection process more flexible and accurate as it accounts for varying data patterns. By continuously updating the threshold in each iteration, the model can manage changes in data characteristics and refine the identification of anomalies. This dynamic adjustment helps in maintaining a robust detection mechanism throughout the analysis, improving the overall effectiveness of the anomaly detection process.

## **Train the BWGNN Algorithm**

Training the BWGNN (Beta Wavelet Graph Neural Network) algorithm involves using the kernel and residual nodes to update the model. The BWGNN algorithm leverages graph-based features and embeddings to learn patterns and relationships within the data. During training, the model adjusts its parameters based on the normal and anomalous nodes, improving its ability to classify nodes correctly. This training process refines the model's predictions, enhancing its effectiveness in detecting anomalies. The results are recorded and analyzed to evaluate the performance of the model.

## **Remove Anomalous Nodes**

Removing anomalous nodes is an important step in refining the graph and improving the model's accuracy. After identifying the final set of anomalous nodes through the BWGNN algorithm, these nodes are removed from the graph copy (). This step involves updating the graph's structure by eliminating the nodes and adjusting edges accordingly. Removing anomalous nodes helps to clean the graph, allowing for more accurate anomaly detection in subsequent iterations. This process ensures that the model focuses on the core structure of the graph, improving its ability to identify subtle anomalies.

# **Results**

The primary outcomes of the project are systematically organized within distinct folders and files, reflecting the iterative nature and achievements of the anomaly detection system. These comprehensive results encompass histograms of anomaly scores, in-depth iteration-specific findings, and a concise summary of the final outcomes.

## **Histogram** **Anomaly Score Distributions**

The project yielded a series of histograms, stored within a designated folder, which graphically describe the distribution of anomaly scores for each iterative cycle. These histograms serve as a visual representation of how anomaly scores are distributed across nodes in each iteration. Moreover, they facilitate an evaluation of the efficacy of the thresholding process.

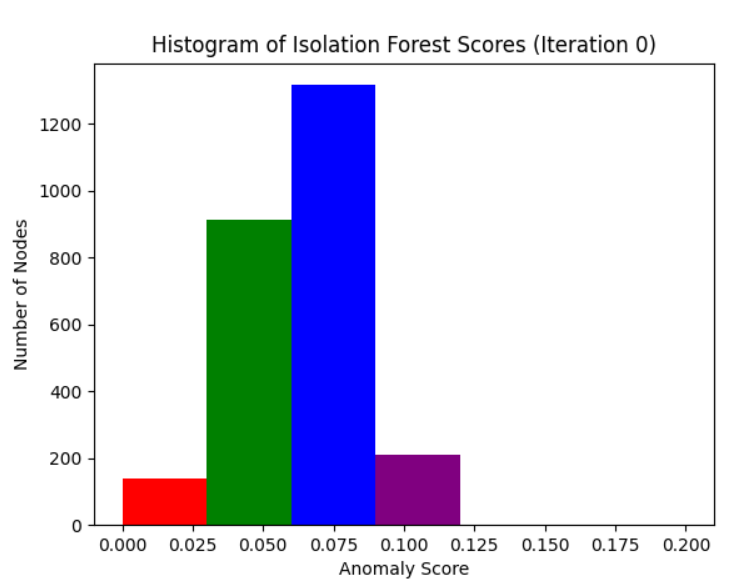


Figure 4: Anomaly score distribution across the first iteration.

תמונה שמכילה טקסט, צילום מסך, תרשים, עלילה

התיאור נוצר באופן אוטומטי

Figure 5: Overall display of the histogram folder.

## **Tracking Anomalies Across Iterations**

A distinct folder houses the detailed outcomes of each iterative cycle within the anomaly detection process. For each iteration, a specific file is generated, containing comprehensive tables of identified anomalous nodes. These tables are carefully constructed based on the predefined criteria outlined in the code, filtering nodes classified as anomalous and subsequently saved in CSV format for in-depth analysis. The file arrangement reflects the iteration number and incorporates information pertaining to the nodes that were flagged as anomalies.

## **The Graphical Representation of Anomalies**

The peak of the anomaly detection process is encapsulated within a comprehensive CSV file, providing a summary of the overall findings. This combined file presents a comprehensive overview of the anomalies identified across all iterative cycles. The column structure of this file is carefully adjusted to reflect the iteration numbers, thus offering a coherent visualization of the anomalies detected throughout the entire process.

# **Goals and Evaluations**

The primary goal of the project was to develop an effective anomaly detection system using a combination of graph neural networks (BWGNN Homo or BWGNN Hetero) and isolation forest techniques. This system was designed to identify anomalous nodes in a graph-based dataset, specifically utilizing the Cora dataset as a case study. The project aimed to accomplish several key goals.

## **Graph Representation and Embeddings**

Convert graph data into meaningful vector embeddings using Node2Vec. This involved building a graph, generating embeddings, and using these embeddings for further analysis.

## **Anomaly Detection**

Implement the Isolation Forest algorithm to detect anomalies in the vector embeddings. This required setting an appropriate threshold for distinguishing anomalous nodes and normal nodes.

## **Dynamic Thresholding**

The goal is to create a mechanism that adjusts the threshold for identifying anomalies based on scores from each iteration, ensuring that the model adapts to evolving data. By dynamically recalculating the threshold, the detection process becomes more flexible and accurate. Running the code with thresholds of 5%, 20%, and 10% allows evaluation of the detection's sensitivity. A 5% threshold captures extreme outliers, likely improving precision but detecting fewer anomalies. A 20% threshold identifies more anomalies but may introduce more false positives (classify more normal data points as anomalies). The 10% threshold strikes a balance, aiming to detect a reasonable number of anomalies while minimizing false positives. Comparing these results helps assess the trade-off between precision and recall.

## **Model Training and Evaluation**

Train the BWGNN Homo or BWGNN Hetero model on the graph data, using the identified kernel and residual nodes to refine the model and improve its performance in anomaly detection.

## **Iterative Improvement**

Evaluate the performance of the anomaly detection system iteratively, refining the model and thresholding strategy based on results from each iteration.

# **Insights**

The outcomes of the project offer a comprehensive understanding of the anomaly detection process facilitated by the BWGNN and Isolation Forest. The histograms expose the distribution of anomaly scores, while the iteration-specific tables provide detailed insights into the nodes identified as anomalies. The final summary file merges these findings into a cohesive overview. By analyzing these results, one can assess the efficacy of the anomaly detection approach, the accuracy of the dynamic thresholding mechanism, and the performance of the employed models. The iterative refinement process underscores the model's capacity to adapt and enhance over time, culminating in a robust and effective anomaly detection system.

## **Effectiveness of Node2Vec**

The Node2Vec algorithm proved highly effective in generating meaningful vector embeddings from the graph data, which were crucial for the anomaly detection process. These embeddings captured the structural and relational aspects of the nodes, facilitating better anomaly detection. This conclusion was derived from the overall improvement in anomaly detection accuracy when using these embeddings.

## **Isolation Forest Performance**

The Isolation Forest algorithm proved to be a well-suited choice for anomaly detection in this project. Through its ability to effectively separate anomalous nodes from normal ones using a dynamic thresholding approach, it demonstrated strong performance across multiple iterations. By adjusting the threshold based on the distribution of anomaly scores, Isolation Forest adapted well to the varying data characteristics, maintaining accuracy and precision in detecting anomalies. The results confirmed that Isolation Forest, with its efficiency and scalability, was an excellent choice for handling the complex structure of the graph-based data, validating its effectiveness in the overall anomaly detection process.

## **Dynamic Thresholding**

Through the analysis of different threshold levels—5%, 10%, and 20%—the project determined that a 10% threshold provided the best balance between identifying true anomalies and minimizing false positives. This conclusion was based on the results, where the 10% threshold achieved higher recall while maintaining precision. This balance was critical to the project’s goal of prioritizing recall in anomaly detection.

## **Iterative Refinement**

The iterative process of anomaly detection, coupled with model refinement and dynamic threshold adjustment, underscored the importance of continuously updating the system. This approach led to progressively better performance and more accurate anomaly detection across iterations, as observed in the iteration-specific result files.

## **Visualization and Reporting**

The generated histograms, iteration-specific tables, and result summaries provided valuable insights into the anomaly detection process. These visual and tabular outputs facilitated a comprehensive understanding of the system's performance, particularly in relation to threshold adjustments and their impact on recall.

## **Iterative Improvement**

The iterative improvement approach in this project highlighted its significant impact on refining anomaly detection performance. By repeatedly applying the anomaly detection process and updating the model, the system demonstrated enhanced accuracy in identifying anomalies over successive iterations. Each iteration allowed for the dynamic adjustment of thresholds and the reassessment of anomaly scores, leading to progressively better detection results. This iterative refinement not only improved the precision and recall of the anomaly detection but also ensured that the model adapted to changing data patterns. The consistent refinement process underscored the value of iterative learning in achieving more reliable and effective anomaly detection outcomes.

# **Conclusions**

The choice of four iterations in our process proved effective, as it allowed the model to refine the anomaly detection while maintaining accuracy. Further iterations are likely to converge since the kernel set increasingly represents normal nodes in the nested anomalies. The results align well with those achieved by our supervisors in their project, confirming the validity of our approach.

The histograms across different thresholds—5%, 10%, and 20%—showed overall similarities but with key differences. At the 20% threshold, more nodes were flagged as anomalies, including some non-anomalous nodes, making it more assertive in detection. This suggests that the 20% threshold was less precise in distinguishing true anomalies from normal data. The 5% threshold, on the other hand, captured only the most extreme anomalies but missed some subtler ones. The 10% threshold struck a balance, detecting a reasonable number of true anomalies while minimizing false positives, making it the optimal choice.

While the results are strong and the anomaly detection process has been effective, it may be worth exploring alternative methods to Isolation Forest, such as Kernel Sum, to potentially enhance detection accuracy and address more complex data structures.

Figure 6: Rates of anomalies detected through iteration

# **References**

[1] Isolation Forest Algorithm; [Liu et al., 2008] Fei Tony Liu, Kai Ming Ting, and Zhi-Hua Zhou. Isolation Forest. Proceedings of the 2008 IEEE International Conference on Data Mining, 413-422. arXiv:0810.2613

[2] Dynamic Thresholding; [Iglewicz and Hoaglin, 1993] B. Iglewicz and D.C. Hoaglin. How to Detect Outliers. Wiley Series in Probability and Statistics. ISBN: 978-0471170710

[3] Node2Vec Algorithm; [Grover and Leskovec, 2016] Aditya Grover and Jure Leskovec. Node2Vec: Scalable Feature Learning for Networks. Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD), 855-864. arXiv:1607.00653

[4] Threshold Sensitivity Analysis; [Chandola et al., 2009] V. Chandola, A. Banerjee, and V. Kumar. Anomaly Detection: A Survey. ACM Computing Surveys (CSUR), 41(3), 1-58. doi:10.1145/1541880.1541882

[5] Iterative Improvement in Anomaly Detection; [Hodge and Austin, 2004] V.J. Hodge and J.S. Austin. A Survey of Outlier Detection Methodologies. Artificial Intelligence Review, 22(2), 85-126. doi:10.1023/B

[6] <https://wiki.datrics.ai/isolation-forest-model>

[7] <https://www.researchgate.net/figure/The-conceptual-framework-of-node2vec_fig2_327125660>