ScanSphere

An Advanced Network Mapper and Analysis Tool

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Project Description

Context

Network scanners and vulnerability analysis tools are invaluable in discovering fingerprinting data about network hosts.

- Host OS
- Open/Closed Ports
- IoT Devices

Goal

Network mapper tool that generates a high-level map of a network.

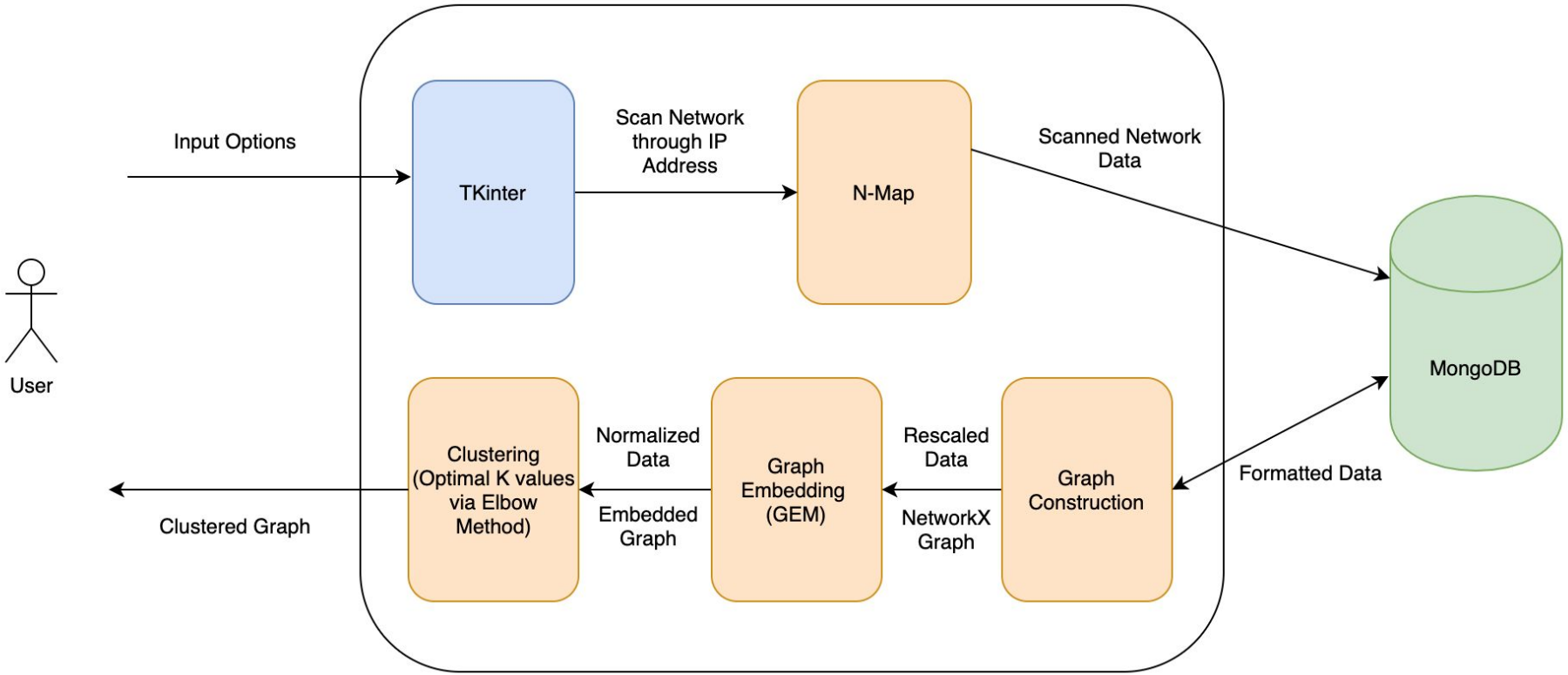
- Hosts are clustered according to their fingerprint similarity.
- Graph Embedding techniques to tackle dimensionality.

Goal

This tool provides network administrators:

- Holistic view of the network
- Assists them in real-time security decisions regarding threat management and analytics.

High Level Overview



Implementation

Implementation

Data Collection

- Using Python's *Nmap* library to scan network
- Collecting information using IP addresses
- Prepares raw nmap data for database transfer to MongoDB server

Graph Construction

- Sorting the raw Nmap data into nodes and edges
- Generating Host nodes, Attribute nodes, and edges in MongoDB server
- Using Python's *NetworkX* library to construct a directed, weighted graph

Graph Embedding Methods (GEM)

- Using graph embedding techniques (GEM library) on constructed graph
- Structural Deep Network Embedding (SDNE)
- Node2Vec

Implementation

Clustering

- Using Elbow Method to determine the optimal number of clusters (called *k*) with the dimensionally reduced data
- Implemented K-Means clustering
- Plotted the generated clusters

GUI

- Using Python's *Tkinter* library to build the tool's GUI
- Inputs:
  - IP Address
  - Filter attributes
- Outputs:
  - Clustered embedded Graph

Data Collection

- Uses Python's *python-nmap* library to manipulate nmap scan results
- *Python-nmap* offers:
  - Port Scanning
  - Host Name
  - OS Family
  - OS Generation
  - OS Vender
- ScanSphere has three scanning options for the network:
  - Scan a single IP Address
  - Scan a range of IP Addresses
  - Scan several specific IP Addresses

All Clusters

+ Create Database

NAMESPACES

ScanData

- attributes
- counter
- edges
- nmapData
- nodes

ScanData.nmapData

COLLECTION SIZE: 6.09KB TOTAL DOCUMENTS: 42 INDEXES TOTAL SIZE: 36KB

Find Indexes Aggregation Search BETA

INSERT DOCUMENT

FILTER {"filter":"example"}

Find Reset

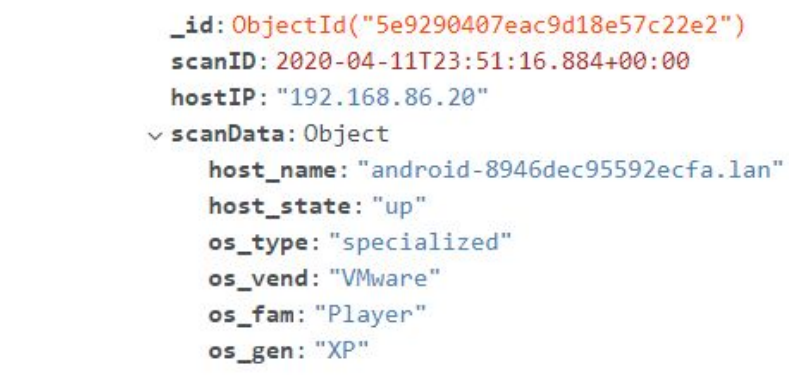
QUERY RESULTS 1-20 OF MANY


```
_id: ObjectId("5e9290407eac9d18e57c22e2")
scanID: 2020-04-11T23:51:16.884+00:00
hostIP: "192.168.86.20"
scanData: Object
    host_name: "android-8946dec95592ecfa.lan"
    host_state: "up"
    os_type: "specialized"
    os_vend: "VMware"
    os_fam: "Player"
    os_gen: "XP"
```

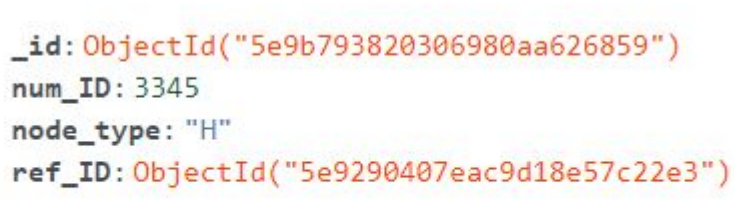
Graph Construction

- Uses the raw Nmap data collected to create nodes and edges
- Two types of nodes:
  - Host: Contains each scanned host
  - Attributes: Contains each attribute_key/value pair collected in the scan
- Creating edges:
  - Contains the edge between host node and attribute node with the appropriate weight
- Uses Python's *NetworkX* library with the addition of nodes and edges to construct a directed and weighted graph

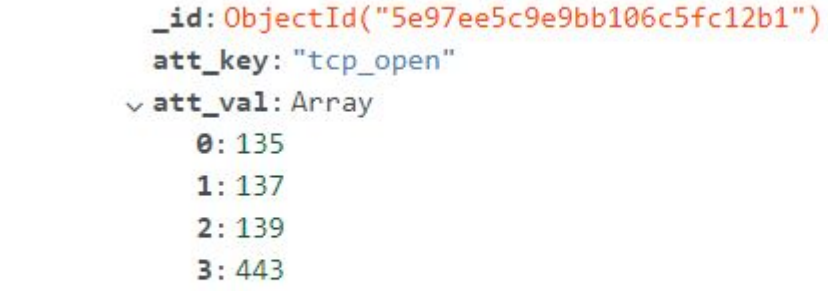
nmapData



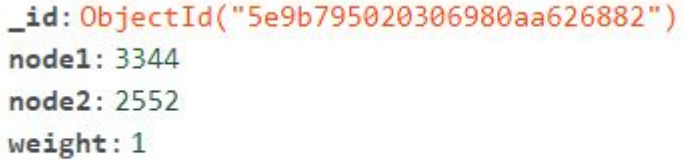
nodes



attributes



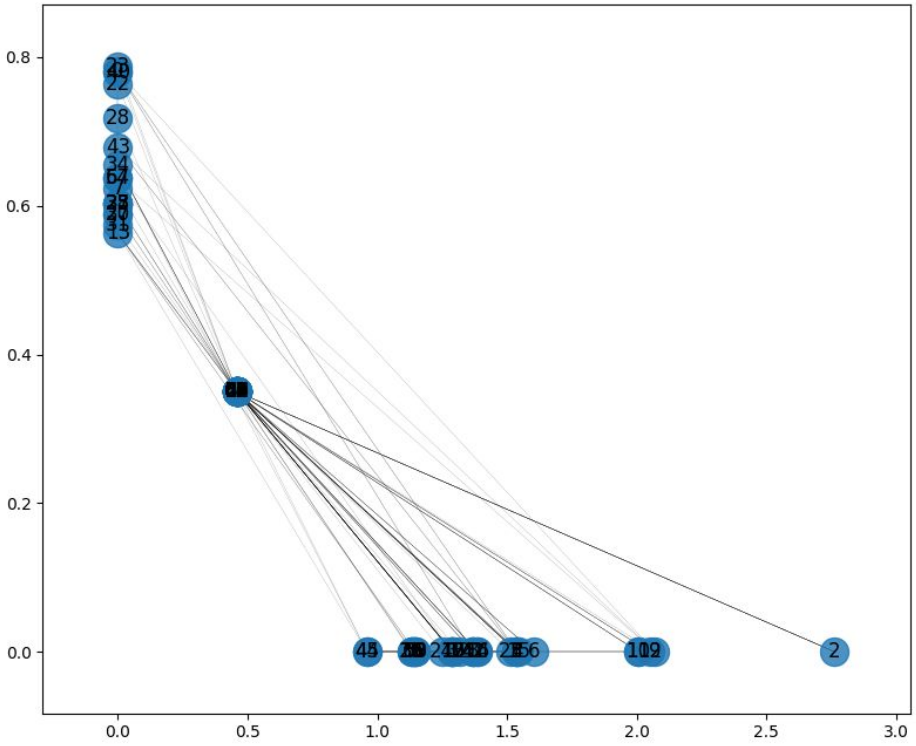
edges



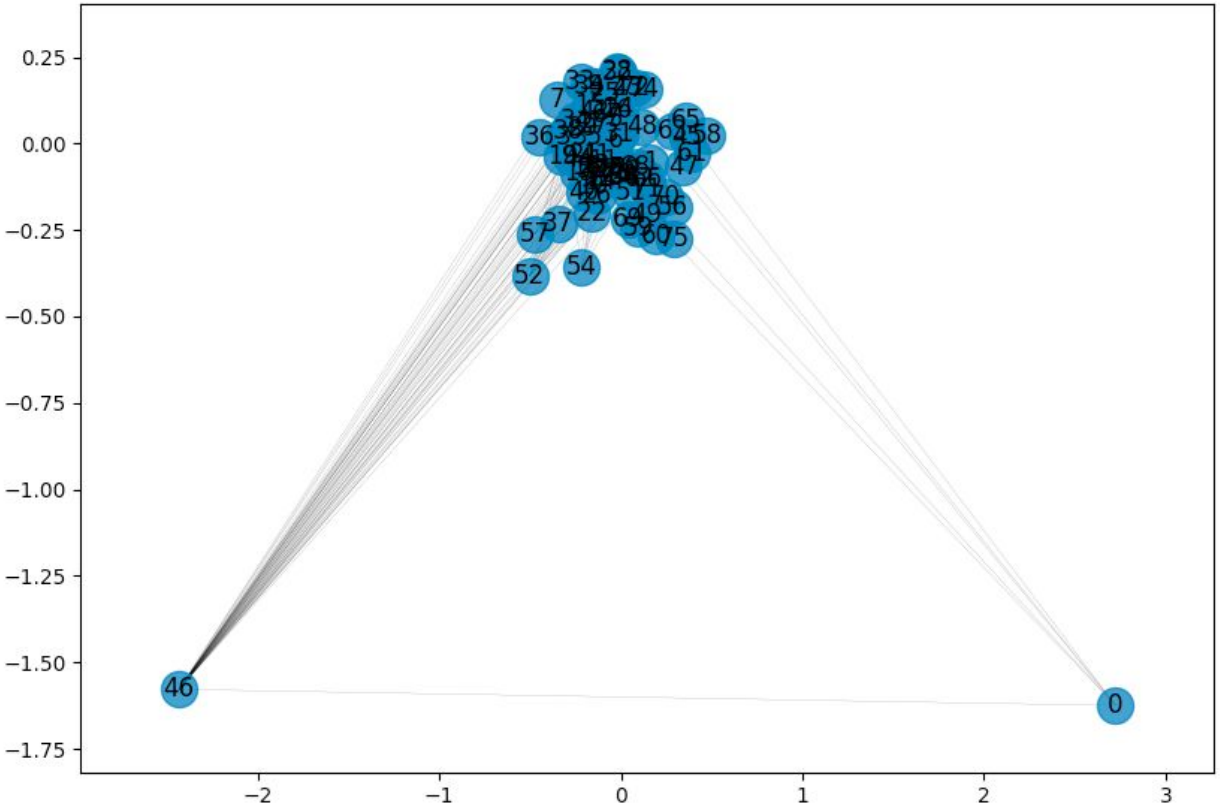
Graph Embedding Methods (GEM)

- Using Python's *GEM* library to embed the graph using SDNE and node2vec:
  - Lower Dimensionality
  - Directed
  - Weighted
- Structural Deep Network Embedding (SDNE)
  - Captures highly non-linear structures by using *first* and *second* order proximities
  - No random walks
- Node2Vec
  - Takes random walks while investigating neighboring nodes
  - Utilizes BFS and DFS as parameters to decide next node walk

Structural Deep Network Embedding (SDNE)



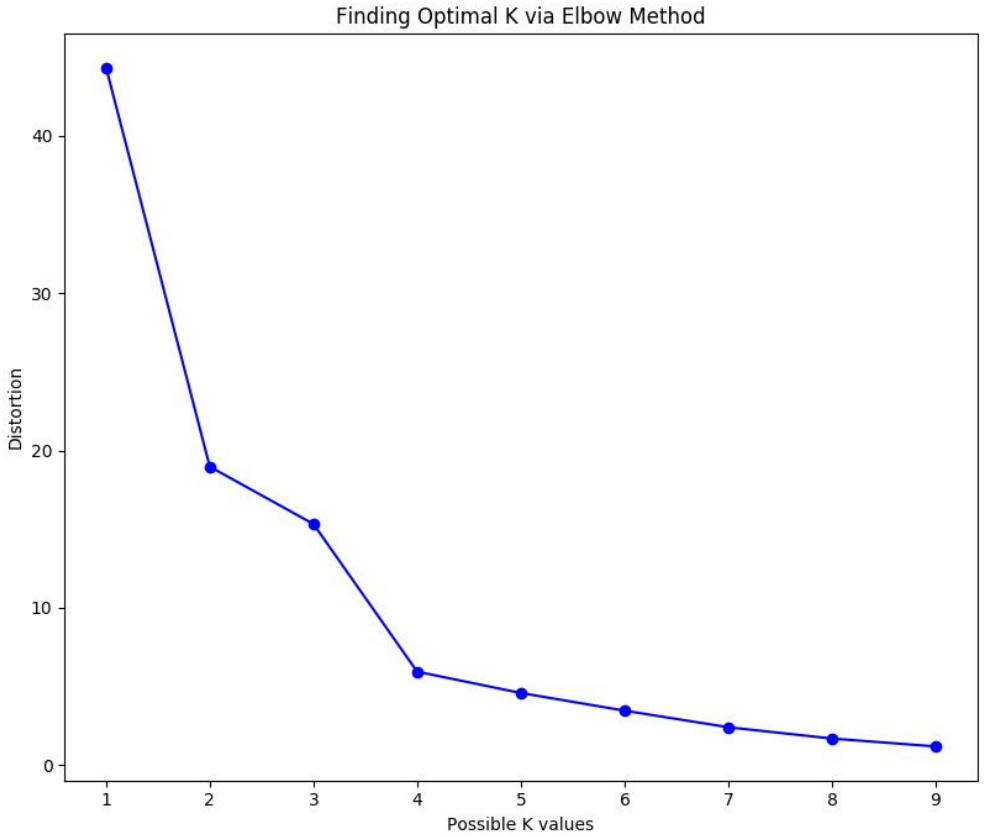
node2vec



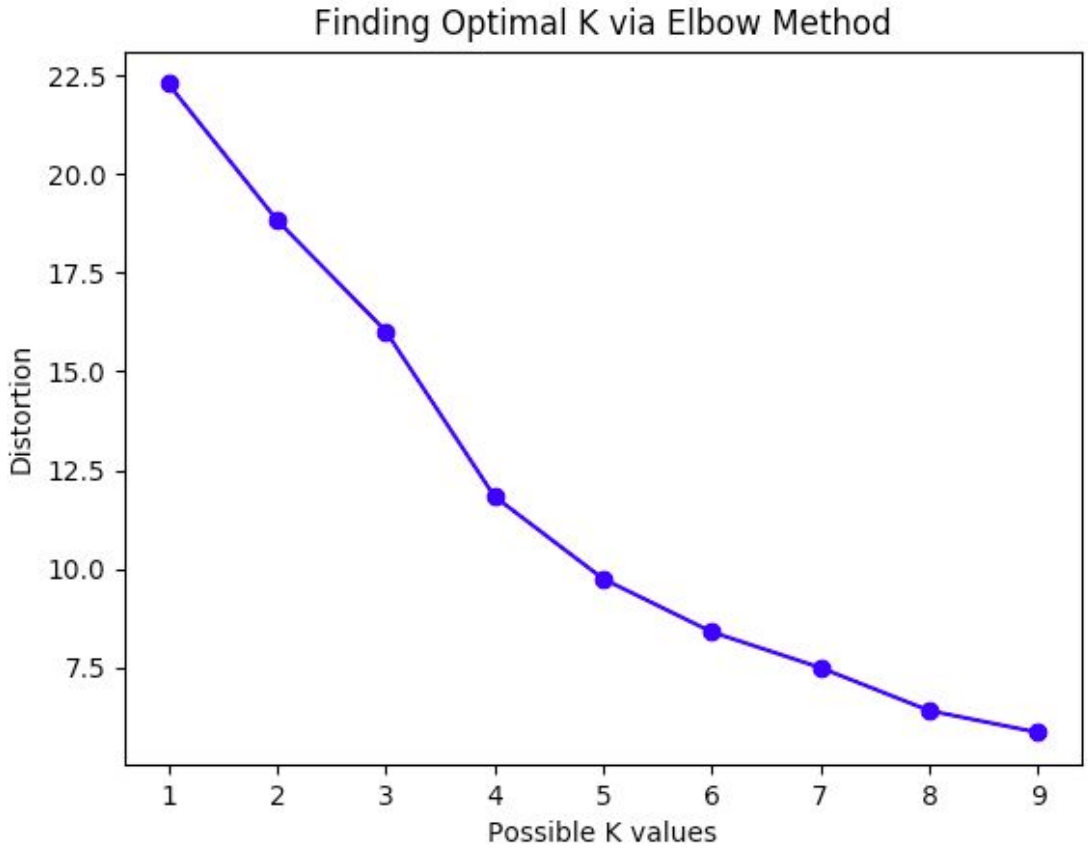
Clustering

- Using Python's *sklearn* library for K-Means Clustering
- Elbow method:
  - K-means clustering on our dataset
  - Determine a range of k values
  - From k, different clusters are generated
- Each dataset value will belong to a cluster

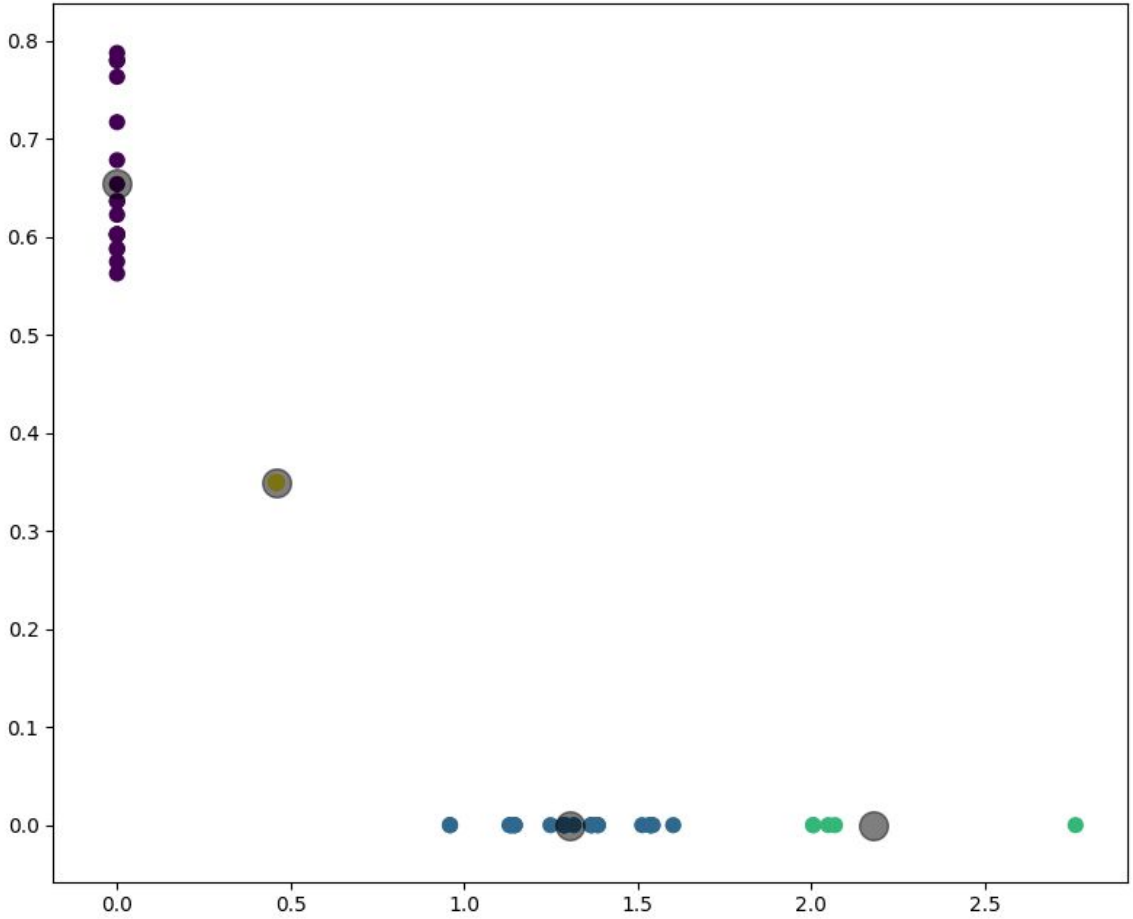
Elbow Method (SDNE)



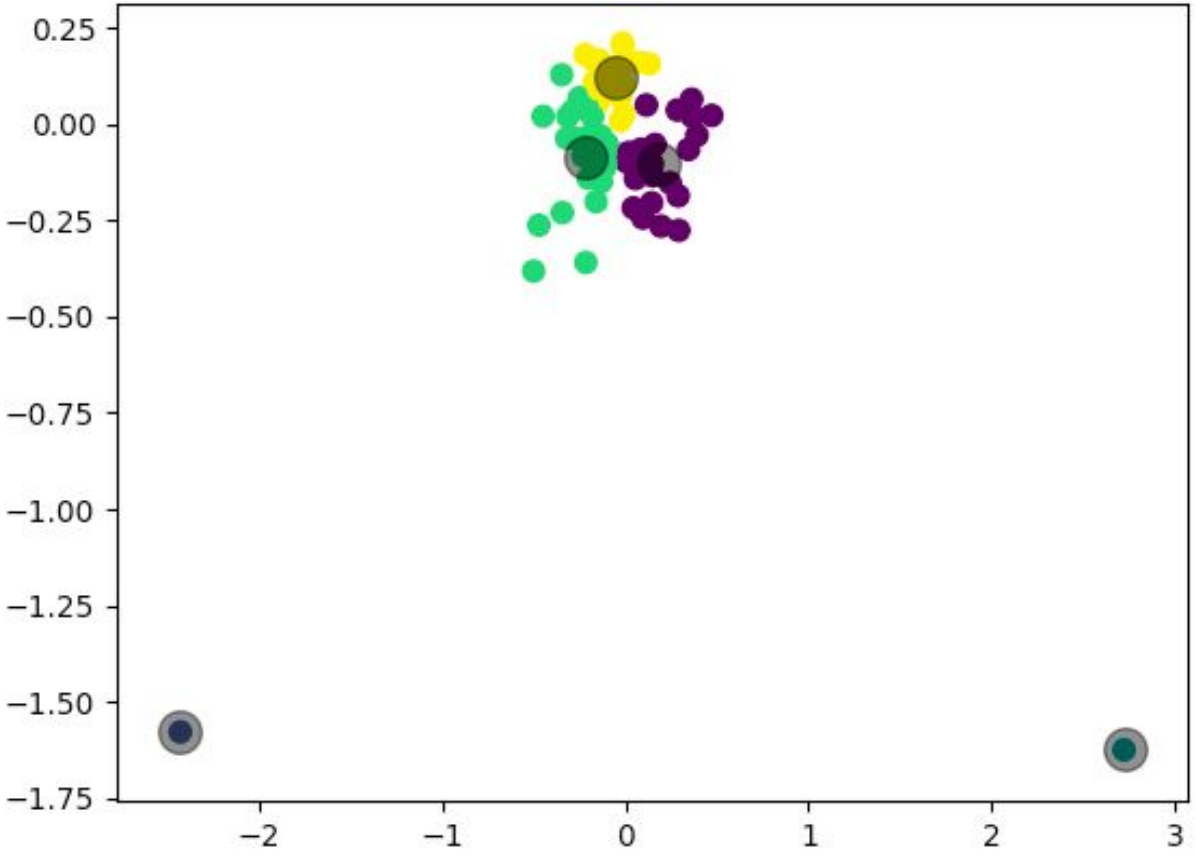
Elbow Method (node2vec)



K-Means (SDNE)



K-Means (node2vec)



SEE DEMO VIDEO