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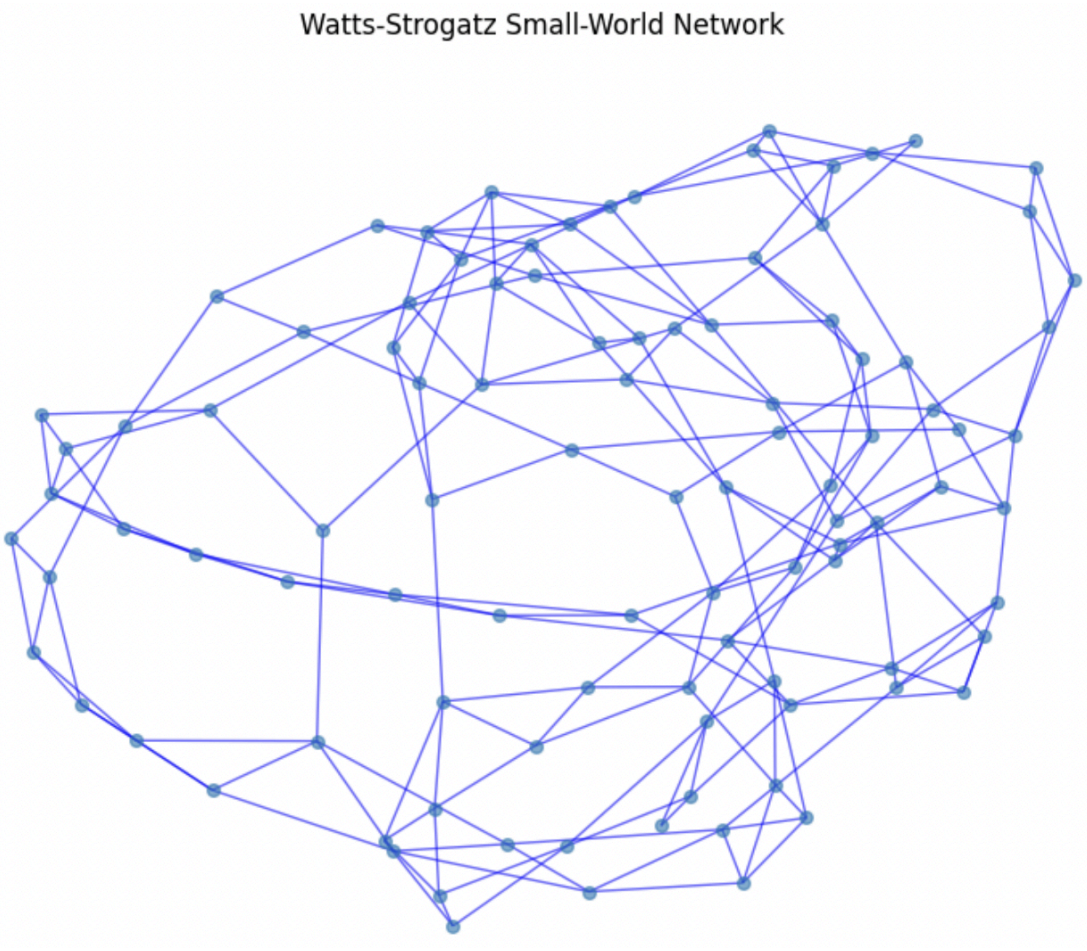
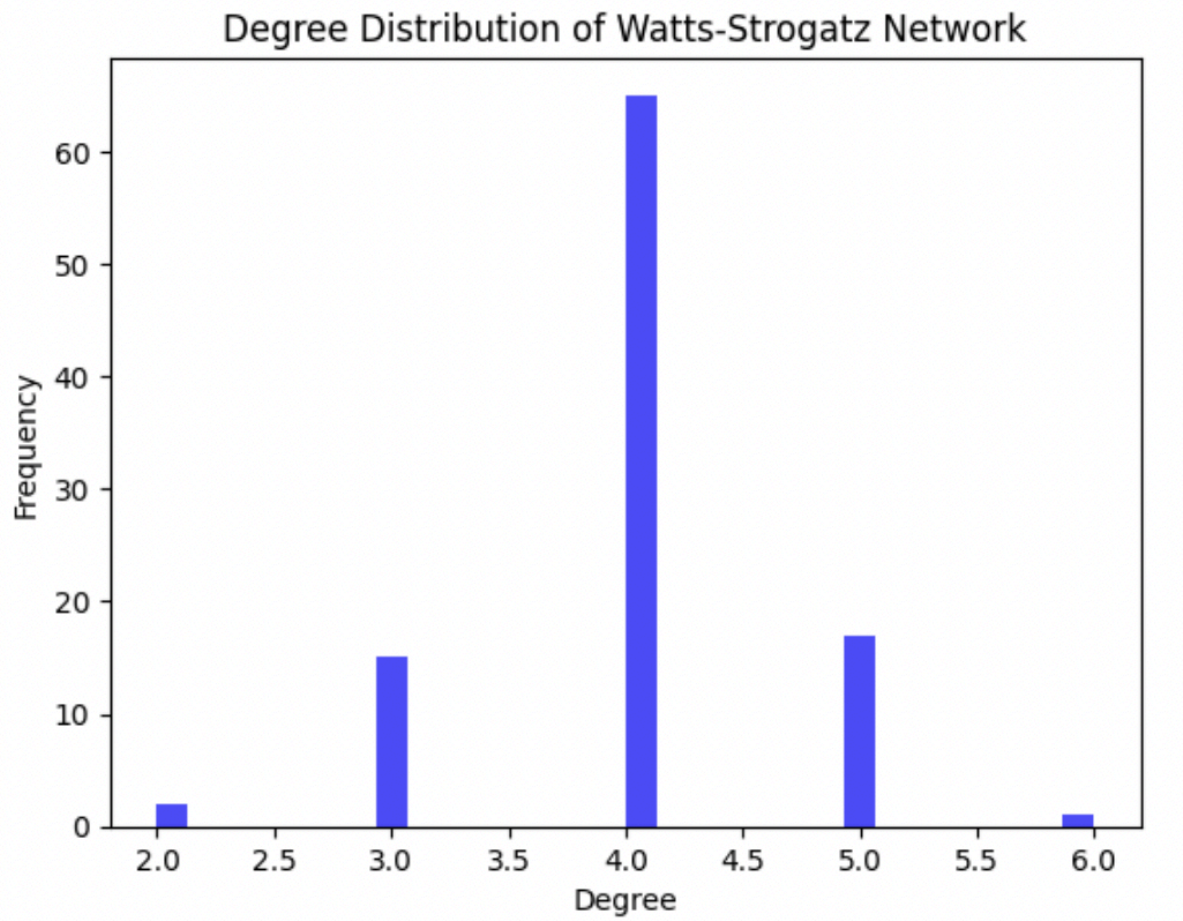
SNA Experiment-5

```python
import networkx as nx
import matplotlib.pyplot as plt

# Function to generate a Watts-Strogatz Small-World Network
def watts_strogatz(n, k, p):
    """
    Parameters:
    n (int): Number of nodes
    k (int): Each node is connected to k nearest neighbors in a ring topology
    p (float): Probability of rewiring an edge
    """
    # Generate the Watts-Strogatz small-world graph
    G = nx.watts_strogatz_graph(n, k, p)

    return G

# Parameters for the Watts-Strogatz model
n = 100  # Number of nodes
k = 4    # Each node is initially connected to 4 nearest neighbors
p = 0.1  # Rewiring probability

# Generate the Watts-Strogatz graph
G_ws = watts_strogatz(n, k, p)

# Plot the graph
plt.figure(figsize=(8, 6))
nx.draw(G_ws, node_size=30, with_labels=False, font_size=10, edge_color='b', alpha=0.6)
plt.title("Watts-Strogatz Small-World Network")
plt.show()

# Degree Distribution
degree_sequence = [d for n, d in G_ws.degree()]
plt.hist(degree_sequence, bins=30, color='b', alpha=0.7)
plt.title("Degree Distribution of Watts-Strogatz Network")
plt.xlabel('Degree')
plt.ylabel('Frequency')
plt.show()
```





The **Watts-Strogatz model** is a small-world network model that captures the balance between regular lattice structures and random networks. It is widely used in various fields due to its ability to model real-world complex networks with **short average path lengths and high clustering coefficients**. Some key applications include:

1. Social Network Analysis

- Modeling friendships, professional connections, and online social media structures (e.g., Twitter, Facebook).
- Understanding **information flow** and the **spread of influence** or misinformation in networks.

2. Biological Networks

- Representing **neural networks** in the brain to study information transfer and cognitive processes.
- Analyzing **gene regulatory networks** and **protein interaction networks** to understand biological complexity.

3. Epidemiology & Disease Spread

- Studying the **spread of diseases** in populations by considering social contact networks.
- Designing **effective vaccination strategies** and predicting outbreaks.

4. Technological & Communication Networks

- Analyzing the structure of the **Internet** and **power grids** for resilience and efficiency.
- Optimizing **peer-to-peer networks** and data transfer in distributed systems.

5. Transportation & Infrastructure Networks

- Modeling **airline networks**, **road networks**, and **subway systems** to improve traffic flow and connectivity.
- Enhancing **logistics and supply chain efficiency**.

6. Cognitive & Linguistic Networks

- Studying **semantic networks** in language processing.
- Understanding **how concepts are connected** in human cognition.

7. Financial Networks

- Examining **interconnections between banks and financial institutions** to assess systemic risk.
- Modeling **stock market correlations** to predict market dynamics.