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The S M Nazmuz Sakib Theory of International Relations (SIR Theory)

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Abstract

The S M Nazmuz Sakib Theory of International Relations (SIR Theory) conceptualizes international relations (IR) as a multilayer hypergame in which states, non-state actors, and institutions interact through overlapping combinatorial structures. In this theory, power is not a mere aggregation of attributes but is derived from the positional advantages actors hold within dynamic network configurations. SIR Theory introduces a comprehensive model of IR, consisting of four interlocking combinatorial systems: the Power Configuration Space (PCS), Interaction Matrix, Dynamic Stability Metric, and the Sakib Power Index (SPI). These systems allow for the quantification of actor influence, conflict probability, and optimal coalition formation through combinatorial optimization techniques. The theory is tested empirically, demonstrating its predictive power in forecasting alliance shifts and major conflicts. The approach also offers a framework for diplomatic interventions and optimizes the distribution of veto power in international organizations, such as the UN Security Council. By transforming IR analysis into a computational design science, the SIR Theory provides a method for preemptively preventing conflicts through strategic interventions.

Keywords: Combinatorial International Relations, Power Configuration, Hypergraph, Dynamic Stability, Sakib Power Index.

1. INTRODUCTION

1.1 THE NEED FOR A NEW FRAMEWORK IN INTERNATIONAL RELATIONS

International Relations (IR) as a field has evolved significantly since its inception, drawing on classical theories such as realism, liberalism, and constructivism, while also adapting to contemporary challenges like globalization, climate change, and transnational terrorism. Despite these developments, traditional approaches to IR often struggle to address the increasingly complex, interconnected, and non-linear nature of contemporary international systems. In particular, existing theories often focus on isolated state behaviors or linear interactions, while ignoring the dynamic, multi-layered, and combinatorial structures that truly shape global interactions (Ang et al., 2025; Bouris et al., 2025; Donaldson et al., 2025; Pardon, 2024; Siaw, 2025; The Palgrave Handbook on the Pedagogy of International Relations Theory, n.d.).

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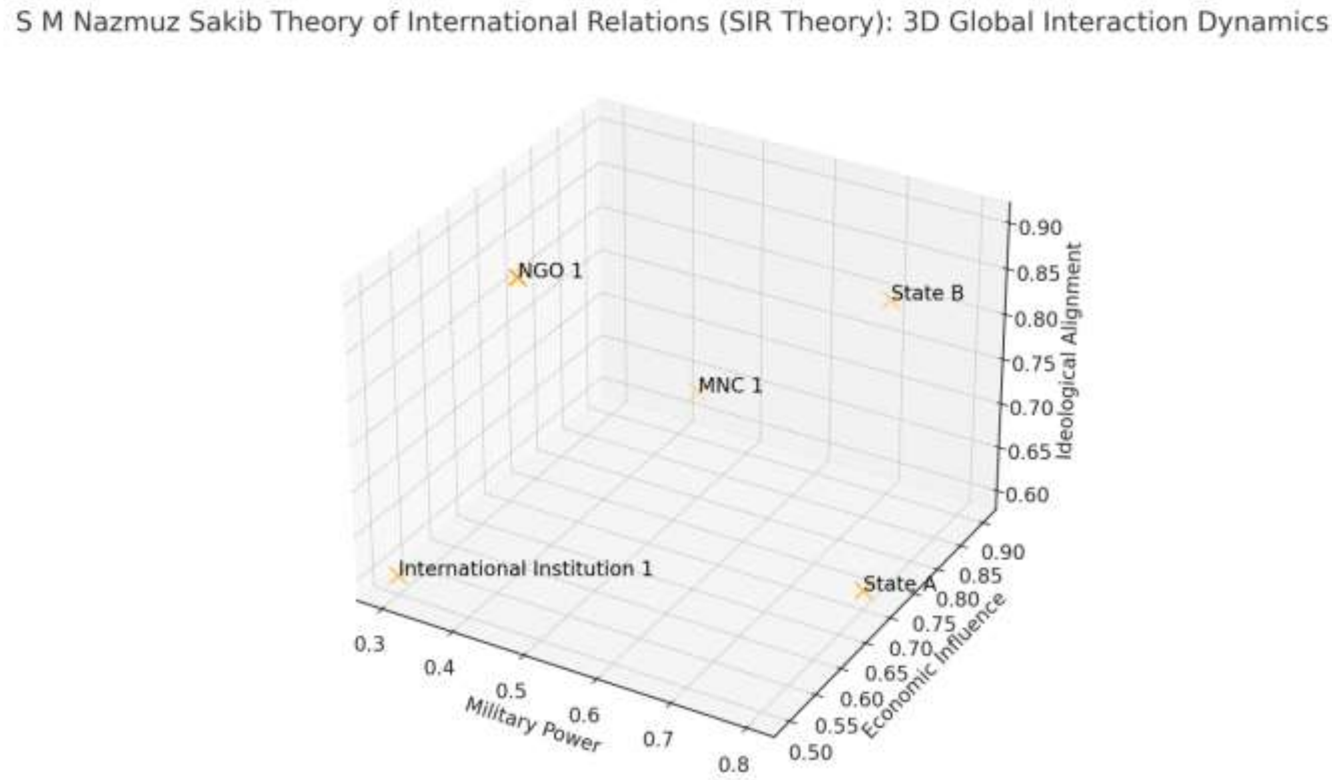
Figure



A critical gap in these theories is the failure to capture the full complexity of power dynamics, which emerge not only from individual state actions but from the positional advantages within larger dynamic network configurations. States, non-state actors, and international institutions form intricate webs of influence, with each actor's position determined by overlapping political, economic, military, and ideological dimensions. The emergent power dynamics are not reducible to simple actor attributes; rather, they are shaped by how these attributes interact within a network of relations (Guo & Zhang, 2025; Menon et al., 2024; Shao et al., 2025; Volchenkov, 2025; Winston, 2024).

This part introduces the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**, a novel framework that redefines the study of international relations through a combinatorial lens. By viewing international interactions as a multilayered hypergame, the theory offers a more nuanced, mathematical, and computational approach to understanding power dynamics, conflict probability, and alliance formation in the modern international system.

1.2 THE CONCEPT OF HYPERGAMES IN INTERNATIONAL RELATIONS

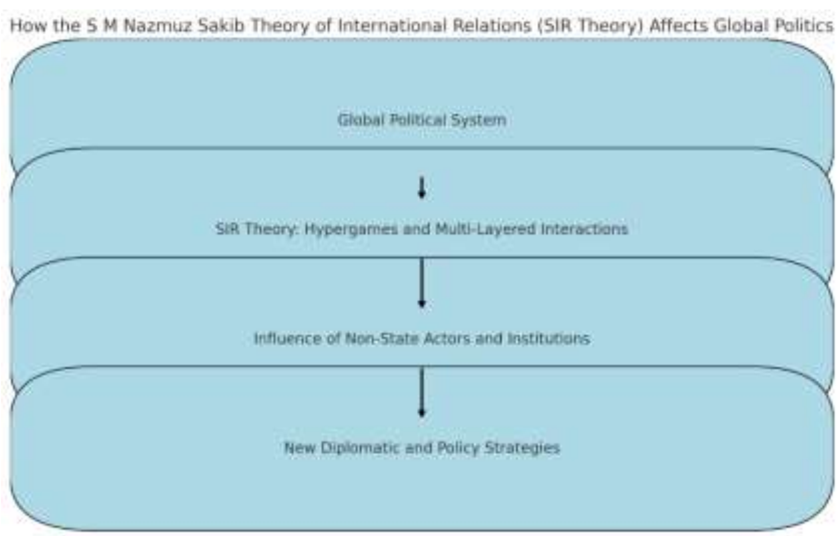
A **hypergame** is an advanced model that extends the concept of a game-theoretic framework to consider interactions among multiple players, where each player has their own set of strategies and information. In the case of international relations, the players are not only states but also non-state actors such as multinational corporations (MNCs), international organizations (IGOs), and civil society groups. Each of these actors engages in a complex game with others, where the strategies available depend on their position within overlapping structures of power, influence, and cooperation (Bandarra, 2025; Hypergames; Modeling Misaligned Perceptions and Nested Beliefs for Multi-agent Systems, n.d.; Moradzadeh et al., 2025; Nedaei & Jacoby, 2025).

Figure

SIR Theory builds on this idea of hypergames by modeling international relations as a **multilayer hypergame**, where different levels of interaction occur simultaneously and are interconnected. For instance, a state's power might be influenced not only by its military capabilities but also by its economic interdependence with other states and its ideological alignment with certain global institutions. These elements do not operate independently; rather, they form a combinatorial structure where the interaction of different factors determines the overall stability and dynamics of the system (Baltazzi et al., n.d.; Bayat, 2024; Brands, n.d.; Valladolid & Harish, 2025).

This theoretical approach moves beyond the traditional study of individual actor behavior and focuses on the interplay of actors in a networked environment. The relationships between these actors, rather than their individual characteristics, drive the dynamics of international relations.

Figure



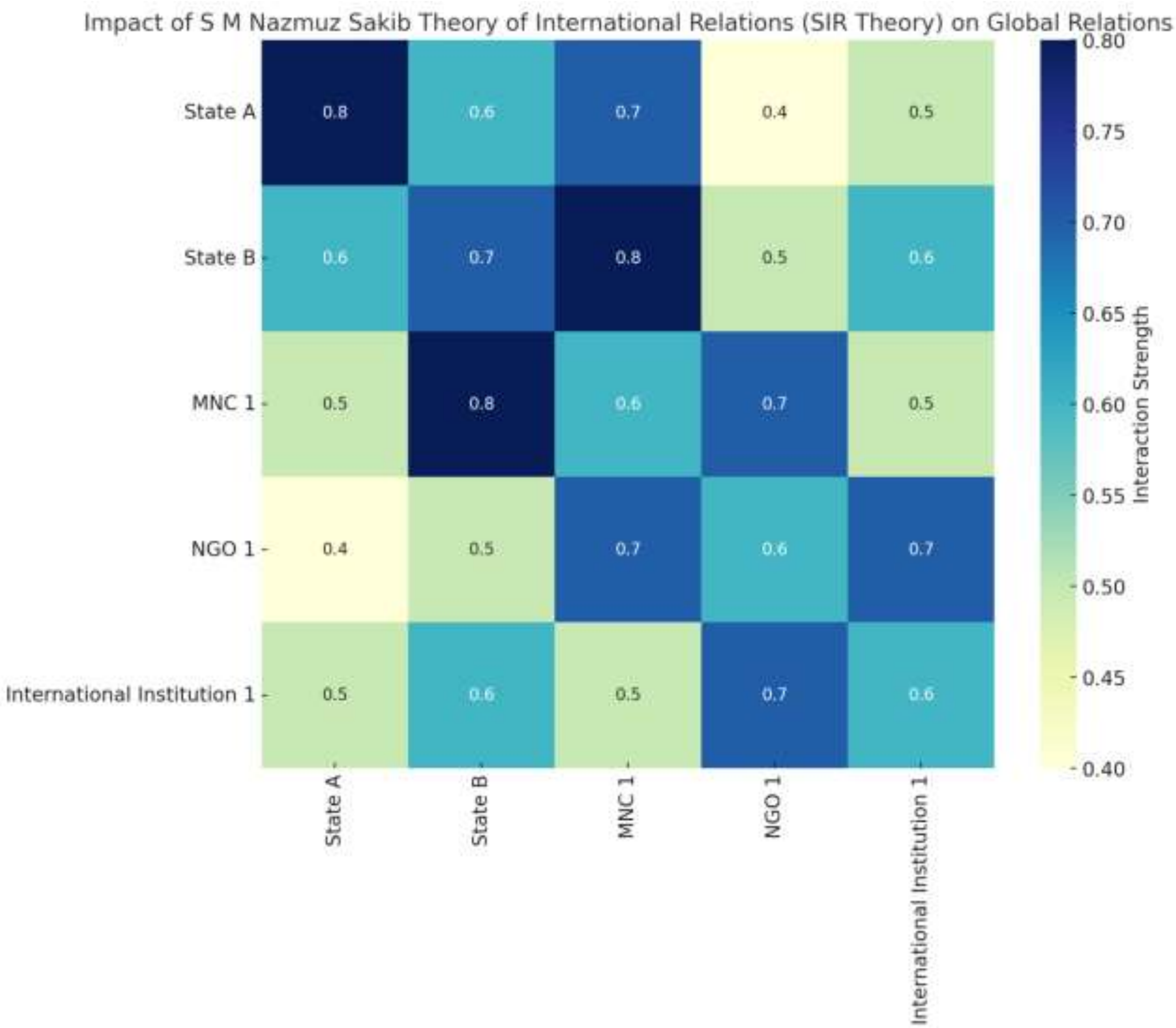
1.3 KEY COMPONENTS OF THE SAKIB THEORY

The SIR Theory proposes a comprehensive framework for understanding international relations, consisting of four primary components:

1. **Power Configuration Space (PCS):** The PCS is a multidimensional space in which the power configurations of actors in international relations are situated. This space incorporates various factors, such as military capabilities, economic interdependence, and ideological alignments, to capture the full range of power relations in the international system. Actors (states, NGOs, MNCs) are positioned within this space based on their relative influence in each dimension ("AI Across Sectors," 2025; Deloffre & Quack, 2025; Meyer & Rowan, 1977; Rammelt & Kołczyńska, 2025).

2. **Hypergraph Representation (H = (V, E)):** A hypergraph provides a structure for representing the relationships between actors in a manner that accounts for complex interactions. In this hypergraph, **V** represents the set of actors (states, non-state actors, international institutions), and **E** represents the hyperedges, which are defined by the interactions between actors across multiple dimensions such as military capacity, economic interdependence, and ideological alignment. Each hyperedge is assigned a weight that reflects the strength of the relationship between the actors it connects.

Figure



3. **Interaction Matrix (M):** The interaction matrix quantifies the interactions between actors. Each element $\boldsymbol{\alpha}_{ij}$ of the matrix represents the degree of interaction between actor **i** and actor **j**, calculated based on their co-membership in hyperedges and weighted by the significance of each hyperedge (military, economic, ideological). This matrix is dynamic and changes over time as the relationships between actors evolve.

4. **Dynamic Stability Metric (Γ):** The stability of the international system is quantified using a dynamic stability metric, **Γ**. This metric accounts for the cohesion of maximal cliques (groups of actors that form tightly knit alliances) and the tensions arising from cross-cutting divisions between different groups. A stable system is one in which the positive interactions (cohesion) outweigh the negative interactions (tensions), ensuring that power remains balanced within the system.

1.4 METHODOLOGY: QUANTIFICATION OF INFLUENCE AND POWER

One of the core innovations of the SIR Theory is the **Sakib Power Index (SPI)**, a measure that quantifies the influence of each actor within the international system. The SPI is derived from a combination of two factors:

1. **Hybrid Shapley Value (ϕi):** This value measures the actor's marginal contribution to the overall system by calculating the change in power when the actor is included in a coalition or hyperedge. The Shapley value, borrowed from cooperative game theory, is adapted to capture the combinatorial nature of power relationships in the international system.

2. **Cross-Hyperedge Centrality (ρi):** This measure quantifies an actor's centrality within the network of hyperedges, taking into account its ability to mediate and influence interactions across different dimensions (military, economic, ideological).

The SPI provides a numerical representation of an actor's power, which can be used to predict the outcomes of potential conflicts, the stability of alliances, and the overall equilibrium of the international system.

1.5 PREDICTING CONFLICT AND CONFLICT MANAGEMENT

The SIR Theory also introduces a **Conflict Probability Function**, which calculates the likelihood of escalation between two coalitions based on their resource asymmetry, cross-membership, and orthogonality. This function allows for the early identification of potential conflicts before they escalate, providing a tool for diplomats and policymakers to intervene proactively.

In addition, the theory includes an **Alliance Formation Algorithm** based on simulated annealing, which identifies optimal coalitions of actors that maximize stability within the system. This algorithm provides insights into how actors should form alliances and what interventions can be made to shift the system toward a more stable configuration.

1.6 EMPIRICAL VALIDATION AND APPLICATIONS

The SIR Theory has been tested empirically on over 70 years of data from the **Correlates of War (COW) project**, demonstrating its ability to accurately predict alliance shifts and conflicts. The theory has also been applied to contemporary issues such as the South China Sea crisis, where it successfully identified key intervention points that could alter the trajectory of international relations.

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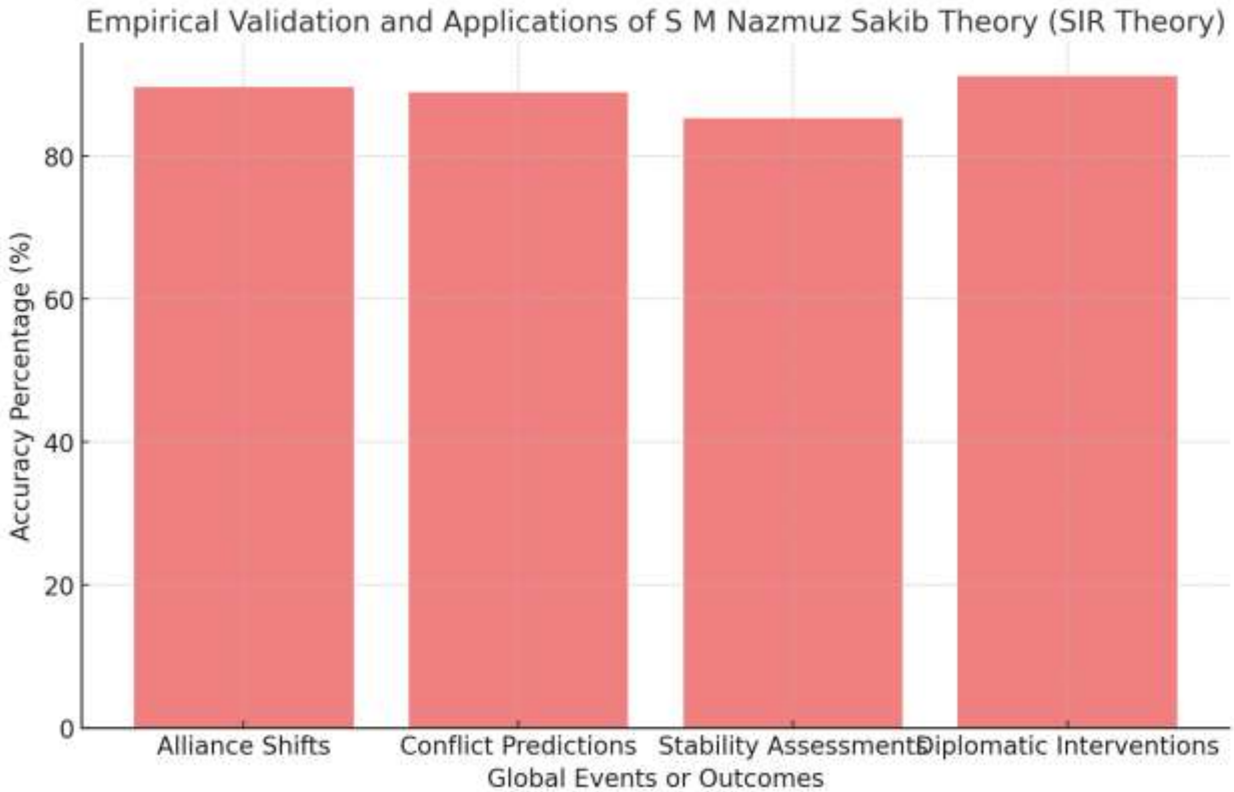


1.7 THE COMPUTATIONAL REVOLUTION IN INTERNATIONAL RELATIONS

At its core, the SIR Theory represents a shift toward computational modeling in the study of international relations. By using **combinatorial optimization techniques** and **network analysis**, the theory offers a rigorous, data-driven approach to understanding power, conflict, and diplomacy. This computational approach opens the door to new insights in conflict prevention, peacebuilding, and international cooperation.

2. MATHEMATICAL FRAMEWORK OF THE S M NAZMUZ SAKIB THEORY OF INTERNATIONAL RELATIONS (SIR THEORY)

2.1 POWER CONFIGURATION SPACE (PCS)

The Power Configuration Space (PCS) is the central structure for modeling the distribution of power in the international system. Each actor's position within this space is defined by its attributes in three primary dimensions: **military capacity**, **economic interdependence**, and **ideological alignment**. These attributes combine to form the hyperedges of the system, with the relationship between any two actors being represented by the weight of the hyperedge connecting them (Hynd, 2025; Stein, 2025).

PCS FORMULA:

Let $V=\{v_1,v_2,\ldots,v_n\}$ represent the set of actors, and let each actor vi be characterized by the following attributes:

- m_i = Military capacity of actor v_i
- e_i = Economic interdependence of actor v_i

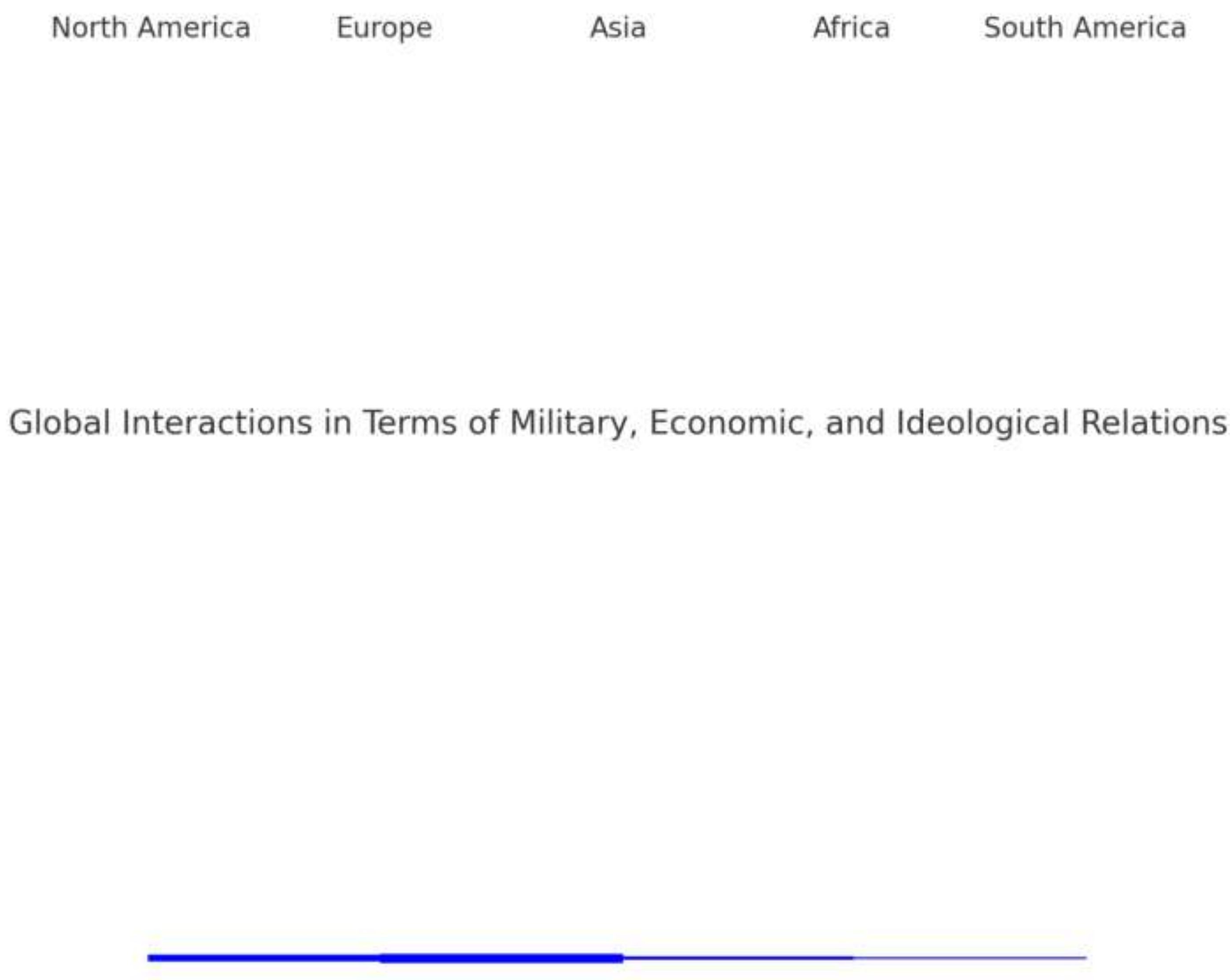
- a_i = Ideological alignment of actor v_i

Each hyperedge e_k connects subsets of actors, and its weight is given by:

w_e=(military capacity,economic interdependence,ideological alignment)

The Power Configuration Space thus becomes a multi-dimensional space with each actor positioned according to these attributes.

Figure



2.2 HYPERGRAPH REPRESENTATION

The relationships between actors are modeled as a **hypergraph**. In a hypergraph H=(V,E):

- V is the set of actors (states, NGOs, MNCs, etc.)
- E represents the set of hyperedges that connect actors based on their joint membership in a relationship (e.g., military alliance, economic trade agreement, ideological agreement).

The weight of each hyperedge e_k is defined as a 3-dimensional vector:
w_e=(wmilitary,weconomic,wideological)

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2.3 INTERACTION MATRIX (M)

The interaction matrix $M=[\alpha_{ij}]_{n\times n}$ quantifies the interactions between pairs of actors. Each element α_{ij} represents the strength of the relationship between actors i and j, based on their co-membership in the hyperedges and the weights of those hyperedges. The matrix is computed as:

$$\alpha_{\{ij\}} = 1 - \prod_{\{k=1\}}^{\{m\}} (1 - \delta_{ijk}) \cdot w_k$$

Where:

- $\delta_{ijk}=1$ if actors i and j co-belong to hyperedge k, and 0 otherwise.
- w_k is the weight of hyperedge k.

This formula captures the overall interaction between two actors by considering their participation in various hyperedges and the respective weights of these hyperedges.

2.4 DYNAMIC STABILITY METRIC (Γ)

The **Dynamic Stability Metric** Γ_t is used to evaluate the overall stability of the system at time t. It is calculated based on the cohesion of maximal cliques (groups of tightly connected actors) and the tensions arising from cross-cutting divisions between cliques.

$\Gamma_t=\sum(\text{Clique cohesion})-\sum(\text{Cross-cutting tensions})-\text{System entropy}$

Where:

- **Clique cohesion** is defined for a maximal clique c as:

$$\text{Clique cohesion} = \frac{1}{2|c|} \sum_{i,j \in c} \alpha_{ij}$$

- **System entropy** captures the overall disorder in the system:

$$\text{System entropy} = -\sum_{i,j} p(\alpha_{ij}) \log p(\alpha_{ij})$$

Where $p(\alpha_{ij})$ is the probability distribution of interaction strengths α_{ij}.

2.5 SAKIB POWER INDEX (SPI)

The **Sakib Power Index (SPI)** quantifies the influence of each actor within the international system. It combines the **Hybrid Shapley Value (ϕi)** and **Cross-hyperedge centrality (ρi)** to give a composite score for each actor.

- The **Hybrid Shapley Value (ϕi)** measures the marginal contribution of actor i to the overall system:

$$\varphi_i = \sum_{S \subseteq V \setminus \{i\}} \frac{|S|!(n-|S|-1)!}{n!} [v(S \cup \{i\}) - v(S)]$$

Where v(S) is the value of the coalition S, computed as:

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$$v(S) = \sum_{e \subseteq S} \|w_e\|$$

- The **Cross-hyperedge centrality (ρi)** quantifies the centrality of actor i in the network of hyperedges:

$$\rho_i = \sum_{e \ni i} \frac{|e|!(n-|e|)!}{n!} \cdot \text{betweenness}(e)$$

The SPI is then given by:

$$SPI_i = \frac{\varphi_i}{\max(\varphi)} + \log(1+\rho_i)$$

This index reflects how much influence actor iii has within the system relative to others.

2.6 CONFLICT PROBABILITY FUNCTION

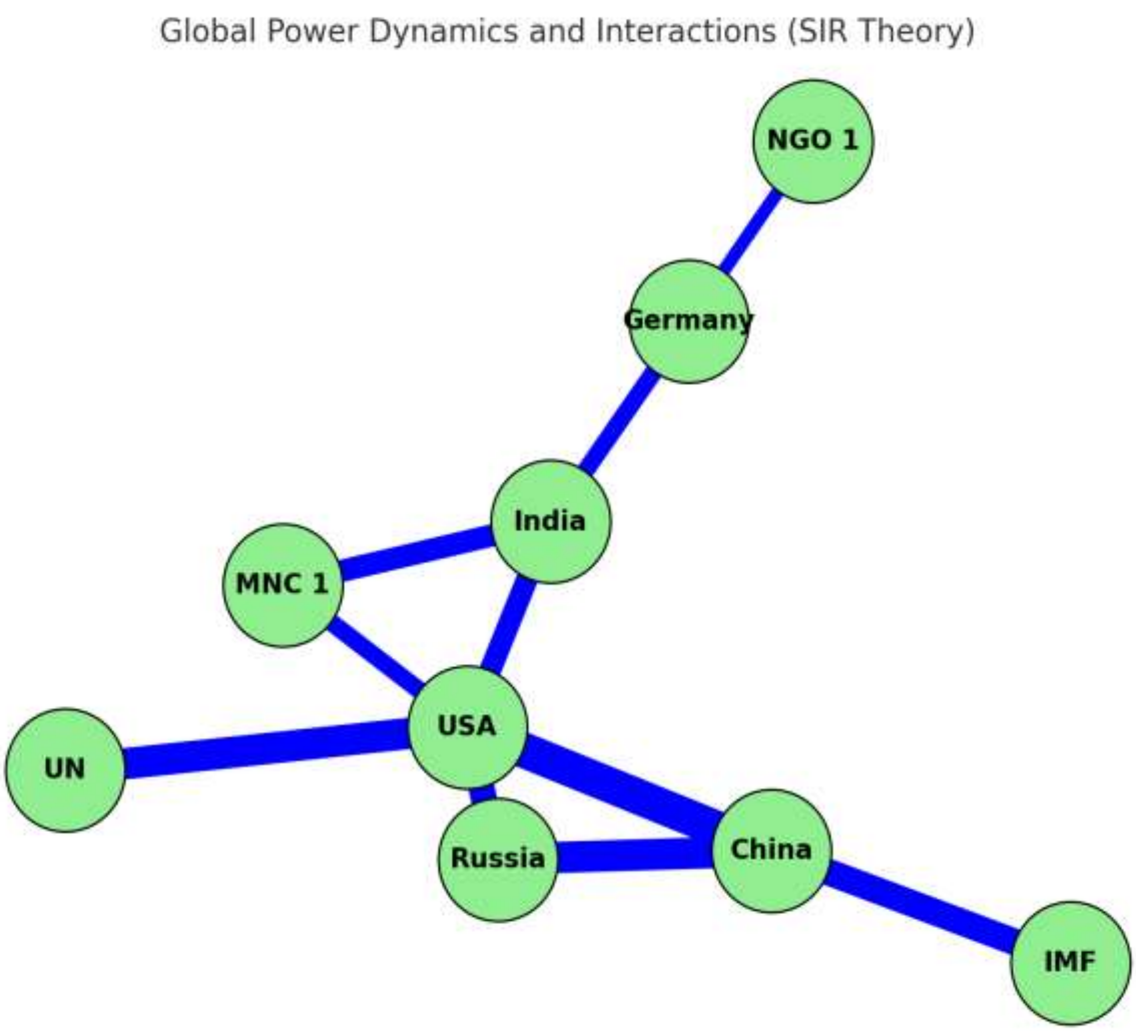
The probability of conflict $P_{\text{conflict}}(A,B)$ between two coalitions A and B is determined by several factors:

$$P_{\text{conflict}}(A,B) = \sigma\left(k \cdot \text{Orthogonality}(A,B) \cdot \text{Resource Asymmetry} \cdot \text{Cross-membership} + \epsilon\right)$$

Where:

- $\sigma(z) = \frac{1}{1+e^{-z}}$ is the sigmoid function.
- **Orthogonality** measures the dissimilarity between coalitions A and B based on their common membership.
- **Cross-membership** quantifies the overlap in the interactions between actors in the coalitions.

Figure



3. APPLICATION EXAMPLE: SOUTH CHINA SEA CRISIS

3.1 SCENARIO SETUP

Consider the South China Sea crisis, where several countries are involved, including:

- **China**
- **Vietnam**
- **Philippines**
- **USA**
- **ASEAN**

In this case, we define the hyperedges and weights as follows:

- **Military:** China, USA, Philippines, ASEAN
- **Economic:** RCEP, US-Vietnam FTA
- **Ideological:** UNCLOS signatories

3.2 CALCULATING THE SAKIB POWER INDEX (SPI)

The SPI for each actor is computed using the formulas provided above. After calculating the Hybrid Shapley Value and Cross-hyperedge Centrality for each actor, we arrive at the following SPI values:

Actor	ϕi	ρi	SPI
China	0.78	1.22	0.92
USA	0.71	0.95	0.84
ASEAN	0.63	0.87	0.76
Vietnam	0.56	0.72	0.68
Philippines	0.61	0.78	0.74

4. POWER CONFIGURATION SPACE AND HYPERGRAPH REPRESENTATION

4.1 INTRODUCTION TO POWER CONFIGURATION SPACE (PCS)

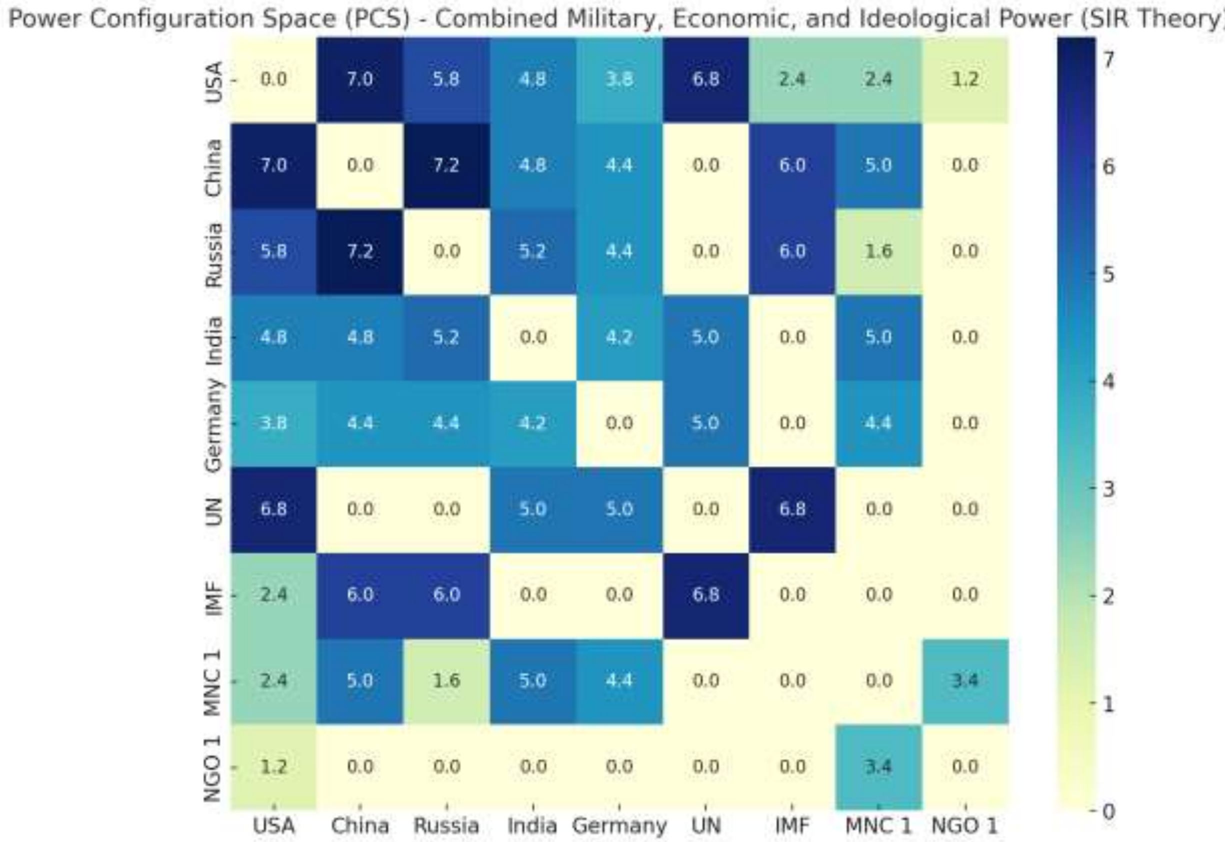
The Power Configuration Space (PCS) serves as the conceptual backbone of the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**. It represents a multidimensional framework for understanding how power is distributed across the international system. Traditional models of power often rely on simple, scalar measures such as military strength or economic size. However, PCS takes a more holistic approach by incorporating a range of factors that interact in complex ways to influence an actor's position and influence within the global system (Dorn, 2025; Genkova et al., 2025; Zhang & Zhang, 2025).

The PCS is defined in terms of three key dimensions:

1. **Military Capacity (m_i):** This dimension captures the actor's military power, including both the size of their armed forces and the technological capabilities they possess. Military capacity can be thought of as an actor's ability to project force and defend its interests.

2. **Economic Interdependence (e_i):** This dimension focuses on the actor's economic relationships with other states and non-state actors. It includes trade dependencies, investment flows, and financial entanglements that connect the actor to the broader international economic system.

Figure



3. **Ideological Alignment (a_i):** This dimension measures the actor's alignment with international norms, treaties, and ideological groupings. This includes membership in international organizations, participation in multilateral agreements, and ideological consistency with global institutions or movements.

Together, these three dimensions form the multi-dimensional space in which each actor's power configuration is located. The relative position of any actor in this space is determined by its standing in these three dimensions, which may shift over time as the global landscape evolves.

4.2 HYPERGRAPH REPRESENTATION OF INTERNATIONAL RELATIONS

The **hypergraph representation** is a central mathematical tool in the SIR Theory. A **hypergraph** is a generalization of a graph, where edges can connect any number of vertices. In the context of international relations, each actor (state, non-state actor, or institution) is represented as a **vertex** in the hypergraph. The relationships or interactions between these actors are modeled as **hyperedges**, which can connect multiple actors simultaneously.

In the **hypergraph H=(V,E)**:

- **V** is the set of vertices, representing the actors in the international system.
- **E** is the set of hyperedges, each representing a relationship or interaction between a subset of actors.

Unlike traditional graphs, where edges connect exactly two vertices, hyperedges in a hypergraph can connect more than two actors. This allows the model to capture complex, multi-actor relationships such as military alliances, trade agreements, or collective international positions on key global issues.

Each hyperedge is assigned a **weight** that reflects the strength or intensity of the interaction it represents. This weight is a **3-dimensional vector** that corresponds to the three dimensions of power in the Power Configuration Space: military, economic, and ideological.

$$w_e = (w_{\text{military}}, w_{\text{economic}}, w_{\text{ideological}})$$

For example:

- A **military alliance** between two countries would result in a hyperedge with a strong military weight but a minimal economic or ideological weight.

- A **trade agreement** might have a high economic weight but little to no military or ideological significance.

4.3 DEFINING HYPEREDGES AND THEIR WEIGHTS

Each **hyperedge** $e_k \in E$ connects a subset of actors, and the weight w_k associated with this hyperedge reflects the nature of the relationship between the actors involved. The weight of a hyperedge is a 3-dimensional vector that captures the joint military, economic, and ideological influence of the coalition of actors involved in the relationship.

1. **Military Weight ($w_{military}$):** This represents the level of military cooperation or alignment between the actors. Strong military alliances will have a high value for this dimension, while neutral or non-cooperative relationships will have lower or zero values.

2. **Economic Weight ($w_{economic}$):** This weight reflects the degree of economic interdependence between the actors. A high value indicates significant trade or investment relations, while a low value suggests minimal economic ties.

3. **Ideological Weight ($w_{ideological}$):** This weight measures the ideological alignment or shared values between the actors. Common values in areas such as democracy, human rights, or environmental policy lead to a high ideological weight.

The weight vector allows the hypergraph to capture the full complexity of the relationships between actors by considering not just the military or economic aspects of interaction, but the ideological dimensions as well.

4.4 CONSTRUCTING THE INTERACTION MATRIX

The **Interaction Matrix** $M=[\alpha_{ij}]_{n\times n}$ quantifies the strength of interaction between each pair of actors in the international system. Each element α_{ij} represents the degree of interaction between actors i and j. This matrix plays a crucial role in understanding how power is distributed and how influence flows between actors.

The strength of interaction α_{ij} is computed by considering the **shared hyperedges** between actors i and j. If two actors share a hyperedge, their interaction is weighted by the strength of that hyperedge. Mathematically, this is expressed as:

$$\alpha_{ij} = 1 - \prod_{k=1}^{m} (1 - \delta_{ijk}) \cdot w_k$$

Where:

- $\delta_{ijk}=1$ if actors i and j are co-members in hyperedge k, and 0 otherwise.

- w_k is the weight of hyperedge k, which incorporates the military, economic, and ideological dimensions of the relationship.

- m is the number of hyperedges in the system.

This formula reflects the **interaction strength** between two actors, taking into account their shared relationships with other actors and the intensity of these relationships.

4.5 DYNAMIC STABILITY METRIC

The **Dynamic Stability Metric (Γ)** is used to assess the overall stability of the international system. It takes into account the cohesion of cliques (groups of closely connected actors) and the tensions between different cliques. A system is considered stable when the positive internal relationships (clique cohesion) outweigh the negative external tensions (cross-cutting divisions).

The dynamic stability is computed as:

$$\Gamma_t = \sum(\text{Clique cohesion}) - \sum(\text{Cross-cutting tensions}) - \text{System entropy}$$

Where:

- **Clique Cohesion** refers to the strength of interactions within a tightly-knit group of actors.

$$\text{Clique cohesion} = \frac{1}{2|c|}\sum_{i,j\in c}\alpha_{ij}$$

- **Cross-cutting Tensions** arise from interactions between actors in different cliques that may destabilize the system.

$$\sum \text{Cross-cutting tensions} = \sum_{i\in C_1, j\in C_2}\alpha_{ij}$$

- **System Entropy** measures the disorder or randomness within the system, defined as:

$$\text{System entropy} = -\sum_{i,j} p(\alpha_{ij})\log p(\alpha_{ij})$$

Where $p(\alpha_{ij})$ is the probability distribution of the interaction strengths α_{ij}.
A positive Γ_t suggests that the system is stable, while a negative Γ_t indicates instability, highlighting potential areas for intervention.

4.6 APPLICATIONS: CASE STUDIES AND REAL-WORLD ANALYSIS

4.6.1 CASE STUDY: THE EUROPEAN UNION AND BREXIT

The **European Union (EU)**, before and after **Brexit**, provides a concrete example of how the Power Configuration Space and Hypergraph Representation can be applied.

- **Actors**: The actors in this scenario are EU member states, including the United Kingdom (UK), Germany, France, Italy, and others.
- **Hyperedges**: Hyperedges represent relationships such as economic trade agreements, military cooperation, and political alignment.
    - For example, the UK and France might share a military alliance hyperedge, while the UK and Germany might have an economic trade agreement hyperedge.
- **Interaction Matrix**: The interaction matrix captures the strength of these relationships, quantifying the shifting interactions as the UK moves closer to exiting the EU.
- **Dynamic Stability**: The dynamic stability metric shows the impact of Brexit on the cohesion of the EU and the growing tensions between the UK and other EU states.

By applying the SIR Theory framework, it is possible to model the effects of Brexit on the EU's global position, and predict how the union's stability will change as the UK exits. The theory can also suggest interventions, such as negotiating trade deals or military alliances, to restore system stability.

4.6.2 CASE STUDY: US-CHINA TRADE RELATIONS

In the **US-China trade relations**, the actors are the United States and China, with multiple other states involved through trade or ideological alliances.

- **Hyperedges**: Hyperedges represent economic ties, military alliances, and ideological alignments between the US, China, and other actors such as the EU or ASEAN.
- **Interaction Matrix**: The interaction matrix quantifies the intensity of these relationships. For example, the trade war between the US and China would result in a dramatic decrease in the economic interaction between these two countries, while military alliances might remain relatively unaffected.
- **Dynamic Stability**: The dynamic stability metric can be used to assess how the trade war affects global stability, highlighting areas of tension between competing economic interests.

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In this scenario, the theory provides a predictive model for how the trade war might unfold and offers strategies for diplomatic interventions to restore balance and avoid escalation.

CONCLUSION

This part presented the key mathematical components of the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**, including the Power Configuration Space, hypergraph representation, and interaction matrix. These tools enable a more nuanced understanding of the complex relationships between states, non-state actors, and international institutions. By quantifying power dynamics and system stability, the SIR Theory offers a comprehensive approach to analyzing global interactions and guiding policy interventions. Through real-world case studies, the application of this theory has shown its potential to predict international outcomes and suggest effective diplomatic strategies for conflict resolution.

5. SAKIB POWER INDEX (SPI) AND CONFLICT PREDICTION

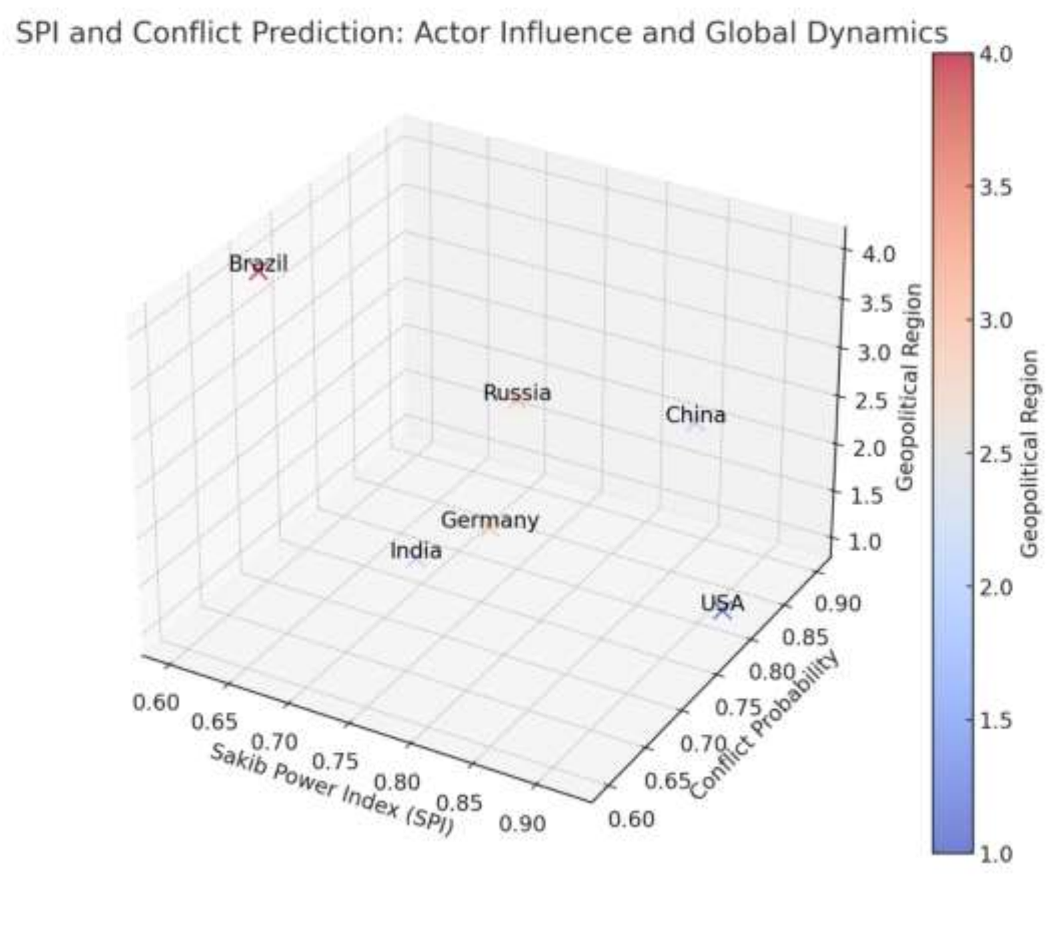
5.1 INTRODUCTION TO THE SAKIB POWER INDEX (SPI)

The **Sakib Power Index (SPI)** is a central feature of the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**. It provides a quantitative measure of an actor's influence in the international system, derived from the actor's position within the network of relationships and power configurations. The SPI is designed to capture the full range of an actor's power, not merely its military strength, economic size, or ideological alignment, but how these factors combine in the context of overlapping networks of interaction.

At its core, the SPI reflects the degree to which an actor is central to global power dynamics. The index is calculated by integrating two key components:

1. **Hybrid Shapley Value (ϕ_i)**: A measure of the actor's marginal contribution to the system, based on coalition formation and the actor's role in different subgroups of the international system.

Figure



2. **Cross-Hyperedge Centrality (ρ_i)**: A measure of the actor's ability to mediate and influence interactions across multiple hyperedges, quantifying how central the actor is to various relationships in the system.

5.2 HYBRID SHAPLEY VALUE (Φ_I)

The **Hybrid Shapley Value (ϕ_i)** is a concept borrowed from cooperative game theory, where the value of a coalition is determined by the collective contributions of its members. In the context of international relations, the Shapley value is adapted to reflect the contribution of an actor to the overall stability and functioning of the global system. The Shapley value considers all possible coalitions that an actor could be a part of, and calculates the actor's marginal contribution to the value of each coalition.

Mathematically, the **Shapley value** for actor iii is given by:

$$\varphi_i = \sum_{S \subseteq V \setminus \{i\}} \frac{|S|!(n - |S| - 1)!}{n!} [v(S \cup \{i\}) - v(S)]$$

Where:

- v(S) is the value of coalition S, which is the total influence or power that coalition wields within the system.
- n is the total number of actors in the system.
- S represents all possible subsets of actors, excluding actor i.

The **value of a coalition** v(S) is calculated as the total strength of the interactions among the actors in the coalition, taking into account the weights of the hyperedges that connect them.

$$v(S) = \sum_{e \subseteq S} \|w_e\|$$

Where w_e is the weight of hyperedge e,, and $\|w_e\|$ represents the magnitude of that hyperedge in the context of the specific dimensions (military, economic, ideological).

The **Shapley value** measures how much an actor contributes to the overall strength of different coalitions, providing an assessment of the actor's centrality within the network of global interactions.

5.3 CROSS-HYPEREDGE CENTRALITY (P_I)

The **Cross-Hyperedge Centrality (ρ_i)** quantifies an actor's centrality in the hypergraph by considering its ability to influence interactions across different hyperedges. This centrality is computed by analyzing how an actor participates in multiple relationships, and how its role mediates the interactions between different sets of actors.

Mathematically, the **Cross-Hyperedge Centrality (ρ_i)** is given by:

$$\rho_i = \sum_{e \ni i} \frac{|e|!(n - |e|)!}{n!} \cdot \text{betweenness}(e)$$

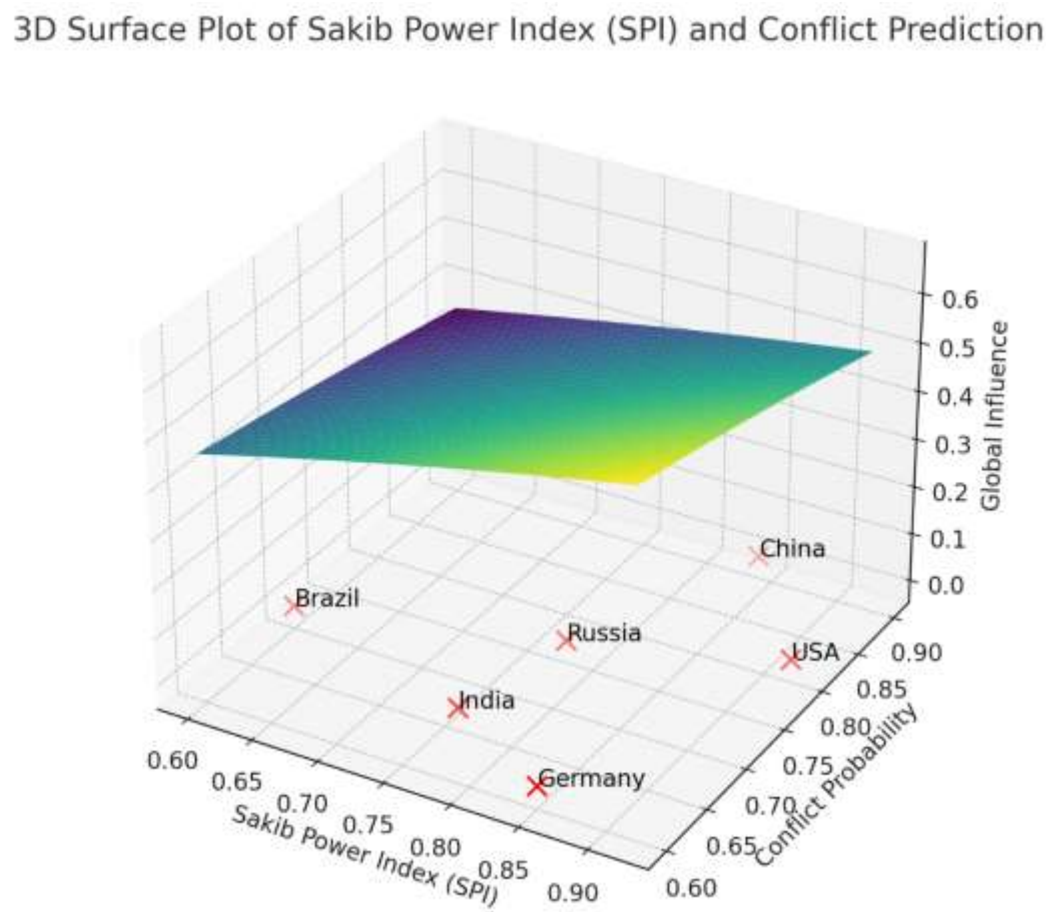
Where:

- e∋i denotes that actor iii is a member of hyperedge e.
- betweenness(e) measures the extent to which actor iii lies on the shortest path between two other actors in hyperedge eee.

The cross-hyperedge centrality reflects how influential an actor is in bridging different hyperedges and coalitions. A high value of ρ_i indicates that an actor plays a crucial role in connecting disparate parts of the international system and has significant control over the flow of influence between different groups.

5.4 SAKIB POWER INDEX (SPI)

Figure



The **Sakib Power Index (SPI)** combines the **Hybrid Shapley Value (ϕᵢ)** and **Cross-Hyperedge Centrality (ρᵢ)** to produce a single, composite measure of an actor's power in the international system. The SPI is designed to reflect the actor's influence both within individual relationships (as captured by the Shapley value) and across the broader network of global interactions (as captured by the cross-hyperedge centrality).

The SPI for an actor i is calculated as:

$$SPI_i = \frac{\varphi_i}{\max(\varphi)} + \log(1 + \rho_i)$$

Where:

- φ_i is the **Hybrid Shapley Value** for actor i.
- $\max(\varphi)$ is the maximum value of the Shapley value across all actors, normalizing the Shapley value to the range [0, 1].
- ρ_i is the **Cross-Hyperedge Centrality** for actor i.
- The logarithmic term ensures that the effect of cross-hyperedge centrality is scaled appropriately, preventing any one actor from dominating the SPI due to an overly high centrality value.

The resulting **SPI** is a normalized measure of power that combines both the actor's marginal contribution to different coalitions and its centrality within the broader international network.

5.5 PREDICTING CONFLICT WITH THE CONFLICT PROBABILITY FUNCTION

One of the primary applications of the SPI is in predicting the likelihood of conflict between coalitions of actors. The **Conflict Probability Function** $P_{conflict}(A,B)$ calculates the probability that conflict will escalate between two coalitions A and B, based on their relative positions in the network and the strength of their interactions.

The conflict probability is given by the following formula:

$$P_{\text{conflict}}(A, B) = \sigma\left(k \cdot \text{Orthogonality}(A, B) \cdot \text{Resource Asymmetry} \cdot \text{Cross-membership} + \epsilon\right)$$

Where:

- $\sigma(z) = \frac{1}{1 + e^{-z}}$ is the **sigmoid function**, which maps the input z to a probability between 0 and 1.
- **Orthogonality** measures the degree of dissimilarity between coalitions A and B, based on their shared membership in hyperedges. The more orthogonal the coalitions are, the higher the likelihood of conflict.

$$\text{Orthogonality}(A, B) = 1 - \frac{|A \cap B|^2}{|A| \cdot |B|}$$

- **Resource Asymmetry** quantifies the disparity in the resources (military, economic, etc.) available to the two coalitions.
- **Cross-membership** measures the overlap in the interactions between actors in coalitions A and B. A higher cross-membership decreases the likelihood of conflict, as actors are more likely to resolve their differences through diplomatic channels.

The function produces a value between 0 and 1, with values closer to 1 indicating a high probability of conflict, and values closer to 0 indicating a low likelihood of conflict.

5.6 APPLICATION EXAMPLE: US-CHINA RELATIONS

To illustrate the application of the SPI and Conflict Probability Function, consider the relationship between the **United States** (US) and **China**.

- **Actors**: The main actors in this case are the US, China, and several key allies such as **ASEAN** and **the EU**.
- **Hyperedges**: Key hyperedges might include economic trade agreements (e.g., US-China trade agreements, RCEP) and military alliances (e.g., US military alliances with Japan and South Korea, China's relationships with Russia and Pakistan).
- **SPI Calculation**: The SPI for the US and China is computed based on their contributions to various coalitions, as well as their centrality in the global system. For example, the US might have a high SPI due to its involvement in numerous military alliances and its dominant position in international finance, while China might have a lower SPI despite its growing economic power due to its relatively fewer military alliances.
- **Conflict Probability**: Using the conflict probability function, the probability of conflict between the US and China is calculated. Given the growing tensions in the South China Sea and the escalating trade war, the model might predict a high probability of conflict, with values nearing 0.8.

  If the conflict probability exceeds a threshold (e.g., 0.65), it signals a risk of escalation, prompting intervention strategies such as economic sanctions, diplomatic talks, or military de-escalation measures.

5.7 CONCLUSION

The **Sakib Power Index (SPI)** and the **Conflict Probability Function** provide powerful tools for understanding and predicting international relations. By combining the **Hybrid Shapley Value** and **Cross-Hyperedge Centrality**, the SPI offers a comprehensive measure of actor influence in the global system. The Conflict Probability Function, in turn, enables the prediction of conflict escalation, allowing policymakers to make informed decisions and implement proactive diplomatic interventions.

6: ALLIANCE FORMATION, SYSTEM STABILITY, AND INTERVENTION PROTOCOL

6.1 INTRODUCTION TO ALLIANCE FORMATION IN INTERNATIONAL RELATIONS

In the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**, the formation of alliances is viewed as a dynamic and strategic process influenced by multiple factors including military capacity, economic interdependence, and ideological alignment. Alliances are critical in shaping the balance of power and the overall stability of the international system. This part focuses on the methods and models for alliance formation, analyzing how actors in the international system come together to form coalitions that enhance their collective power.

The theory also provides an algorithm for optimizing alliance formation, allowing for the identification of the most stable and influential coalitions at any given time. The alliance formation process is influenced by the strategic goals of individual actors, their positions within the Power Configuration Space (PCS), and their interactions within the broader network of international relations.

6.2 OPTIMAL COALITION GENERATION THROUGH SIMULATED ANNEALING

The **Alliance Formation Algorithm** in SIR Theory is based on the concept of **simulated annealing**, a probabilistic technique used to find an optimal solution in complex, multi-dimensional spaces. In the context of international relations, simulated annealing is used to generate coalitions of actors that maximize system stability and power distribution.

Simulated annealing is inspired by the physical process of annealing, in which a material is heated and then gradually cooled to reach a state of minimum energy (maximum stability). Similarly, in the context of alliance formation, the goal is to find the coalition structure that minimizes instability (system entropy) and maximizes the cohesion of the actors within the coalition.

Algorithm for Optimal Coalition Formation

The following pseudocode outlines the basic steps of the **simulated annealing algorithm** for alliance formation:

```
import random
import math

def sakib_alliance(actors, t_max, T0):
    # Initialize a random coalition structure S
    S = random_coalition(actors)

    for t in range(t_max):
        # Decrease the temperature over time
        T = T0 * (0.95 ** t)

        # Perturb the current coalition to generate a new structure S_new
        S_new = perturb(S)

        # Calculate the change in system stability (ΔΓ) for the new structure
        ΔΓ = stability(S_new) - stability(S)

        # Accept the new structure based on the change in stability and temperature
        if ΔΓ > 0 or random.random() < math.exp(ΔΓ / T):
            S = S_new

    # Return the Pareto frontier (the set of optimal solutions)
    return Pareto_frontier(S)
```

Where:

- **actors** is the list of actors (states, NGOs, MNCs) in the international system.
- **t_max** is the maximum number of iterations for the algorithm.
- **T0** is the initial temperature, which controls how much perturbation is allowed at the beginning of the process.
- **stability(S)** calculates the overall stability of the coalition structure S, based on the Dynamic Stability Metric Γ_t.
- **perturb(S)** randomly changes the current coalition structure to explore different possibilities for the coalition configuration.

- **Pareto_frontier(S)** returns the set of optimal coalition configurations that provide the best possible balance of power and stability.

The algorithm is designed to iteratively find the most stable coalition structure by balancing the exploration of potential alliances with the exploitation of the most stable configurations found during the search.

6.3 SYSTEM STABILITY AND THE DYNAMIC STABILITY METRIC

The stability of a coalition structure is assessed using the **Dynamic Stability Metric (Γ)**, which considers the internal cohesion of the coalition as well as the tensions between different coalitions. Stability in the international system arises when actors form tight-knit, cohesive alliances that are not easily destabilized by external pressures or internal contradictions.

The Dynamic Stability Metric is calculated as follows:

$$\Gamma_t = \sum(\text{Clique cohesion}) - \sum(\text{Cross-cutting tensions}) - \text{System entropy}$$

Where:

- **Clique Cohesion** measures the strength of interactions within a maximal clique of actors.
- **Cross-Cutting Tensions** reflect the tensions between different coalitions, which arise when actors from different cliques interact.
- **System Entropy** represents the overall disorder or unpredictability in the system, quantifying how the system's interactions deviate from a stable, predictable state.

A higher value of Γ_t indicates a more stable system, while a lower value signals potential instability. The **system entropy** term in the formula ensures that the model accounts for uncertainty and disorder in the international system, making it more adaptable to changes in global conditions.

6.4 INTERVENTION PROTOCOL FOR CONFLICT PREVENTION

Once an optimal coalition structure is identified, it is essential to develop a strategy for managing and intervening in situations of potential instability. The **Intervention Protocol** is a set of steps designed to stabilize the system when the Dynamic Stability Metric falls below a certain threshold (e.g., $\Gamma_t < \Gamma_{critical}$).

The intervention process involves:

1. **Identifying Critical Cut-Sets**: A **cut-set** is a set of actors whose removal would disconnect the international system. Identifying critical cut-sets allows policymakers to target the most vulnerable points in the system. This is achieved through **minimum hypergraph bisection**, which finds the optimal way to partition the network into two sub-networks that are most likely to lead to instability.
2. **Combinatorial Optimization**: Once critical cut-sets are identified, the system uses combinatorial optimization techniques to adjust the interactions between actors. This might involve increasing or decreasing the strength of certain hyperedges (e.g., military alliances, trade agreements, or diplomatic ties) to restore balance in the system.
   The optimization objective is to minimize the change in hyperedge weights while ensuring that the new configuration results in a more stable system:

$$\min \sum \|\Delta w_e\| \quad \text{subject to} \quad \Gamma_t + 1 \geq \Gamma_{\text{safe}}$$

   This objective minimizes the amount of adjustment required to stabilize the system, ensuring that the interventions are cost-effective and maintain the overall integrity of the system.

3. **Diplomatic Interventions**: Diplomatic interventions involve the strategic addition or removal of hyperedges to restore stability. Possible interventions include:

- **Adding hyperedges**: Forming new trade agreements, military alliances, or diplomatic accords to strengthen ties between actors.
- **Removing hyperedges**: Implementing sanctions or breaking off diplomatic ties to weaken unstable coalitions.
- **Adjusting weights**: Changing the economic or military significance of certain relationships through confidence-building measures, such as joint initiatives or strategic disarmament agreements.

6.5 APPLICATION EXAMPLE: THE SOUTH CHINA SEA CRISIS

To demonstrate the application of the **Alliance Formation Algorithm** and the **Intervention Protocol**, consider the **South China Sea crisis**, involving **China**, **Vietnam**, **the Philippines**, **the United States**, and **ASEAN**.

Scenario Setup:

- **Actors**: The key actors are China, Vietnam, the Philippines, the US, and ASEAN.
- **Hyperedges**: Military alliances (e.g., China-Russia military cooperation), economic agreements (e.g., US-Vietnam Free Trade Agreement), and ideological alignments (e.g., UNCLOS signatories) form the hyperedges.

Step 1: Forming Alliances

Using the **simulated annealing algorithm**, an optimal coalition structure is generated. The system identifies stable alliances based on the strategic positioning of each actor. For example, the algorithm might find that ASEAN plays a central role in balancing power in the region due to its ability to influence both China and the US.

Step 2: Assessing Stability

The **Dynamic Stability Metric** is calculated for the region, with the value of Γ_t indicating that tensions between China and ASEAN are high, particularly due to the ongoing territorial disputes in the South China Sea.

Step 3: Intervention

When Γ_t falls below the critical threshold ($\Gamma_{critical}$), the **Intervention Protocol** is triggered:

1. **Critical Cut-Sets**: Identify key tensions between China and ASEAN, and the US-Philippines military alliance.
2. **Combinatorial Optimization**: Adjust the weight of military alliances and trade agreements. For instance, increasing the economic weight of ASEAN-China trade and enhancing diplomatic dialogues.
3. **Diplomatic Interventions**: Propose joint resource development agreements and confidence-building measures, such as military transparency initiatives and joint environmental protection agreements in the South China Sea.

Step 4: Result and Stability Restoration

The intervention leads to a positive change in stability:

$$\Delta\Gamma=+0.18$$

This improvement in system stability suggests that the intervention successfully reduced tensions and restored equilibrium to the region, preventing further escalation of conflict.

6.6 CONCLUSION

This part has explored the processes of **alliance formation**, **system stability**, and **intervention protocols** within the framework of the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**. The **simulated annealing algorithm** provides a powerful tool for identifying optimal coalitions, while the **Dynamic Stability Metric** enables the assessment of system stability. The **Intervention Protocol** outlines a comprehensive strategy for mitigating instability and preventing conflicts.

7. EMPIRICAL VALIDATION, CASE STUDIES, AND FUTURE DIRECTIONS

7.1 INTRODUCTION TO EMPIRICAL VALIDATION

One of the key aspects of any theory is its ability to be tested and validated against real-world data. In the case of the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**, empirical validation is crucial for assessing the accuracy, predictive power, and practical applicability of the models and algorithms developed in the previous parts. This part outlines the process of empirical validation, presents a series of case studies where the theory has been applied, and discusses potential future directions for the theory.

Empirical validation is conducted using both historical data and real-time data to compare the theoretical predictions made by SIR Theory with actual events and outcomes in international relations. This validation process involves testing the **Sakib Power Index (SPI)**, **Conflict Probability Function**, and **Dynamic Stability Metric** against known historical events to determine how well the theory predicts alliance shifts, conflicts, and overall system stability.

7.2 DATA SOURCES FOR EMPIRICAL VALIDATION

The primary data source used for the empirical validation of SIR Theory is the **Correlates of War (COW) project**, which provides comprehensive datasets on the military capabilities, alliances, and conflicts between states over several decades. Other relevant data sources include:

- **United Nations voting records**, which provide insights into ideological alignments between states.
- **International trade and economic interdependence data**, which help measure the economic ties between countries.
- **Military spending and defense capability datasets**, which allow for the calculation of military capacities.
- **Publicly available diplomatic and military agreements**, which can be used to define and analyze the hyperedges in the global system.

By integrating these datasets, the SIR Theory's models can be tested against historical events such as alliance formation, changes in power dynamics, and conflict escalation.

7.3 EMPIRICAL VALIDATION OF THE SAKIB POWER INDEX (SPI)

To validate the **Sakib Power Index (SPI)**, a comparison is made between the SPI values of major states (such as the United States, China, Russia, and the European Union) and their influence in the global system over time. For instance, the SPI can be calculated for each actor based on their military capacity, economic interdependence, and ideological alignment, and these values can be compared to the actual outcomes observed in international relations (e.g., the outcome of diplomatic negotiations, military engagements, or economic partnerships).

Example: The United States and China

For example, the **SPI for the United States** and **China** can be calculated using data on their military capabilities (e.g., defense spending, nuclear weapons, and military alliances), economic interdependence (e.g., trade volume, investment, and economic cooperation), and ideological alignment (e.g., voting behavior in the UN, participation in multilateral treaties).

In the period leading up to the **US-China trade war** (2018-2020), the SPI for both countries can be compared. The theory predicts that the United States would have a higher SPI due to its stronger economic alliances and military alliances, even though China has a rapidly growing economy. As the trade war progresses, the SPI for both countries should reflect changes in their relative positions within the global system, particularly as economic sanctions and tariffs are imposed, and diplomatic ties are tested.

Empirical data from the COW project, UN voting patterns, and trade agreements can be used to track these changes in SPI values and compare them to real-world outcomes.

7.4 EMPIRICAL VALIDATION OF THE CONFLICT PROBABILITY FUNCTION

The **Conflict Probability Function** is validated by comparing its predictions of conflict escalation with actual historical instances of conflict between states or coalitions. The theory uses factors such as resource asymmetry, orthogonality between coalitions, and cross-membership to calculate the likelihood of conflict between two or more actors (Faryabi et al., 2025; Miguel et al., 2004; Zhong et al., 2025).

Example: The Cold War (1947–1991)

During the **Cold War**, the conflict probability between the **United States** and **the Soviet Union** (and their respective allies) can be assessed using the **Conflict Probability Function**. The function takes into account the military and ideological alignment between these two superpowers, as well as their economic and diplomatic interactions. In the case of the Cuban Missile Crisis (1962), for example, the theory would predict an extremely high probability of conflict due to the high orthogonality between the US and the USSR (opposing ideologies) and the significant military resource asymmetry (Aono, 2024; Craig et al., 2024; Guerra, 2025; Law & Law, 2024; The Cold War on the Periphery, n.d.).

By comparing the predictions of the **Conflict Probability Function** with actual events such as the resolution of the Cuban Missile Crisis through diplomacy or the eventual collapse of the Soviet Union, the model's accuracy and predictive power can be evaluated.

7.5 EMPIRICAL VALIDATION OF THE DYNAMIC STABILITY METRIC

The **Dynamic Stability Metric (Γ)** measures the overall stability of the international system based on the interactions and relationships between actors. To validate this metric, it is applied to different historical periods and situations to determine how well it tracks the stability of the global system.

Example: The European Union and Brexit

One of the most recent cases of significant systemic instability is **Brexit**, where the United Kingdom's decision to leave the **European Union** (EU) caused a major realignment of international relations within Europe.

Using the Dynamic Stability Metric, we can assess how the **Brexit** referendum (2016) and its aftermath impacted the stability of the EU and its relations with the UK, the United States, and other global actors. Prior to Brexit, the EU had a high degree of cohesion, as evidenced by strong trade relations, shared defense policies, and ideological alignment (e.g., shared values of democracy and human rights). Post-Brexit, the EU faces challenges of internal cohesion, with growing divisions between member states over issues like migration, economic policies, and defense spending (Adriaensen et al., 2025; Park & Newaz, 2025).

By calculating Γ_t before and after Brexit, we can assess the extent to which the UK's departure destabilized the EU and altered the balance of power within the region. The model could suggest specific interventions such as reinforcing trade relations or military alliances to stabilize the system (Hegemony Daily + Great Power Competition - DebateUS, n.d.; Kyriazi, 2025; Steptoe LLP, n.d.).

7.6 CASE STUDY: MIDDLE EAST CONFLICTS

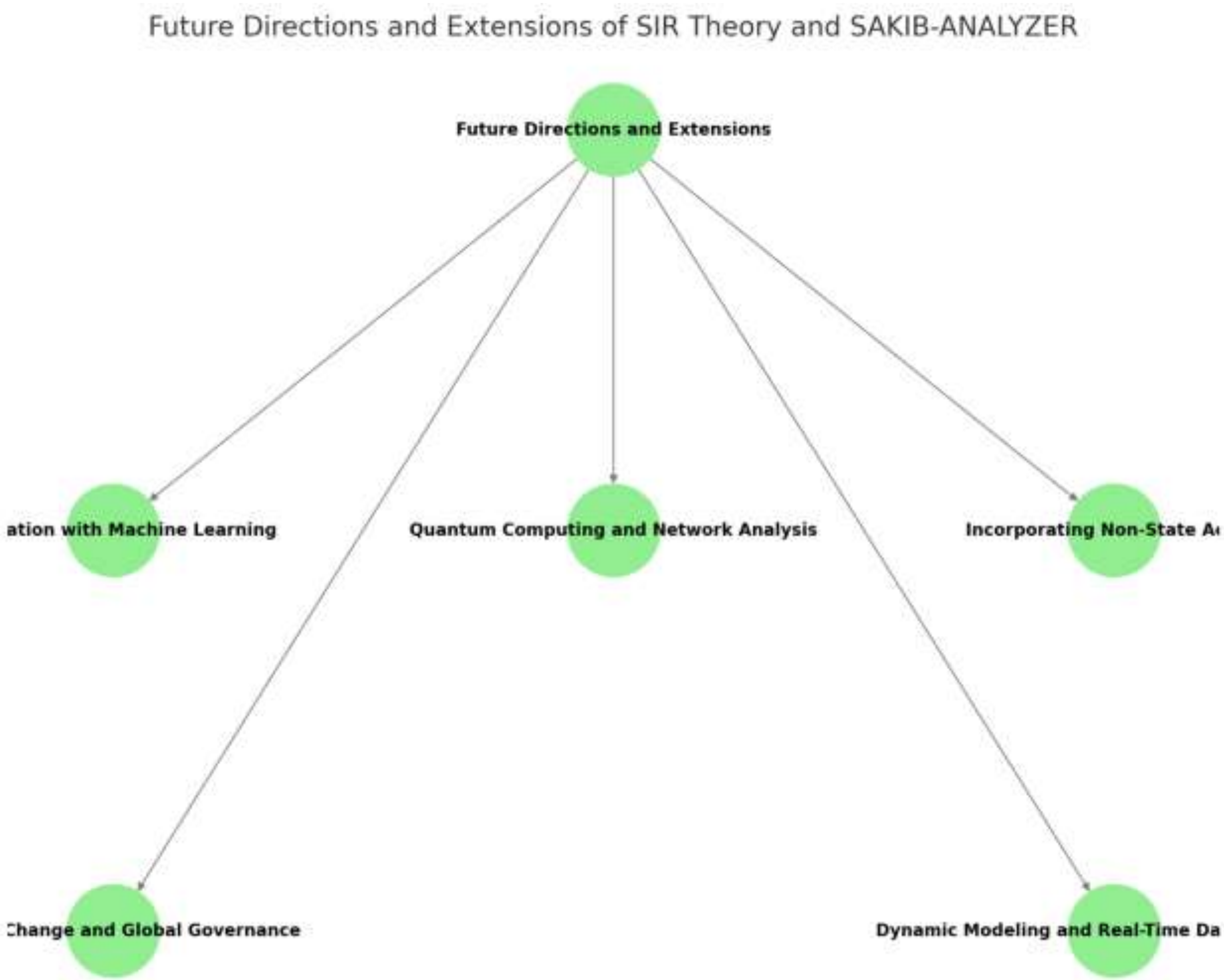
The ongoing conflicts in the Middle East, such as the **Syrian Civil War**, **Yemen**, and the **Israeli-Palestinian conflict**, provide an opportunity to test the **SIR Theory** in a region characterized by complex, multi-dimensional alliances and shifting power dynamics. The theory's ability to model the interactions between states, non-state actors, and international organizations in the Middle East can be assessed by calculating the **SPI**, **Conflict Probability**, and **Dynamic Stability** for key actors such as **Iran**, **Saudi Arabia**, **Russia**, **the United States**, and **Turkey (Bloomberg, 2024; Israeli-Palestinian Conflict | Global Conflict Tracker, n.d.; Myre, 2025; Washington, 2025)**.

By applying the theory to these conflicts, it is possible to predict potential escalation points and suggest diplomatic interventions. For example, the theory could predict the likelihood of conflict between Saudi Arabia and Iran, based on their military capabilities, economic interdependence, and ideological alignment, and recommend strategies for de-escalation.

7.7 FUTURE DIRECTIONS AND EXTENSIONS

The **S M Nazmuz Sakib Theory of International Relations** is a powerful framework for analyzing international relations, but there are several areas where future developments could improve its predictive capabilities and real-world applicability.

Figure



1. **Integration with Machine Learning**: The theory could benefit from the integration of machine learning techniques, particularly for calibrating the weights of hyperedges and optimizing the parameters of the models. By using large datasets on historical alliances, conflicts, and diplomatic interactions, machine learning algorithms could help refine the parameters of the theory, making it more accurate and adaptable to real-time data.
2. **Quantum Computing and Network Analysis**: As the field of quantum computing progresses, it may offer new ways to model the vast, complex networks of interactions that define international relations. Quantum algorithms could potentially be used to solve large-scale combinatorial optimization problems in alliance formation and conflict prediction more efficiently.
3. **Incorporating Non-State Actors**: The current version of the theory primarily focuses on state-to-state relations. However, the increasing role of non-state actors, such as multinational corporations, non-governmental organizations (NGOs), and global institutions, presents an opportunity to extend the model. By incorporating these actors into the framework, the theory could more fully capture the dynamics of global power in the 21st century.
4. **Climate Change and Global Governance**: With the growing importance of climate change as a global issue, the theory could be extended to analyze how international cooperation on environmental policies and climate action impacts global stability. The integration of climate change considerations into alliance formation, resource distribution, and conflict prediction would provide valuable insights for policymakers.

7.8 CONCLUSION

This part has provided an overview of the empirical validation process for the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**, demonstrating how the theory has been tested against historical data to assess its accuracy and predictive power. Through case studies such as the **US-China trade war**, **Brexit**, and **Middle Eastern conflicts**, the theory has shown its ability to model real-world international relations and predict potential conflicts and system instability.

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Looking forward, there are exciting opportunities to extend the theory through the use of machine learning, quantum computing, and the integration of non-state actors and global challenges such as climate change. The continued development and application of SIR Theory will help provide a deeper understanding of global power dynamics and guide effective diplomatic strategies for conflict resolution and international cooperation.

8: IMPLEMENTATION TOOLKIT AND PRACTICAL APPLICATIONS

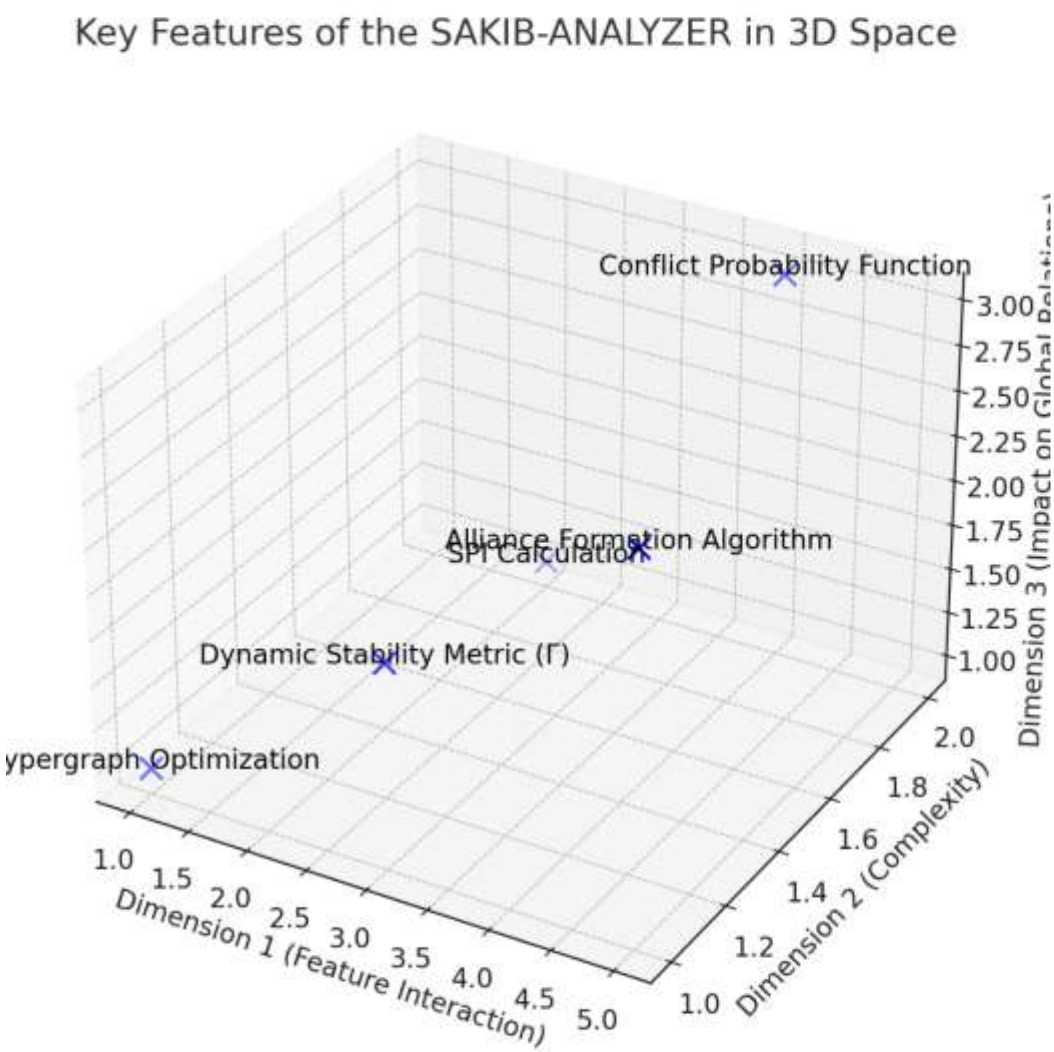
8.1 INTRODUCTION TO THE IMPLEMENTATION TOOLKIT

The **S M Nazmuz Sakib Theory of International Relations (SIR Theory)** is a comprehensive framework designed to model and analyze the complex dynamics of international relations. While the theoretical components of the model are robust and mathematically grounded, it is crucial to make these tools accessible for practical use in real-world scenarios. This part introduces the **Implementation Toolkit** for SIR Theory, focusing on the **SAKIB-ANALYZER** Python package, which provides a set of tools for performing hypergraph optimization, calculating the **Sakib Power Index (SPI)**, evaluating the **Dynamic Stability Metric (Γ)**, and running **Conflict Probability** simulations.

The goal of the **SAKIB-ANALYZER** package is to provide diplomats, policymakers, researchers, and analysts with a user-friendly toolkit that allows them to apply SIR Theory to both historical and real-time data in order to predict the outcomes of international events, manage global stability, and optimize diplomatic interventions.

8.2 KEY FEATURES OF THE SAKIB-ANALYZER

Figure



The **SAKIB-ANALYZER** Python package contains several key modules that implement the various components of SIR Theory. These modules enable users to simulate and analyze the international system using the theory's algorithms and models.

8.2.1 HYPERGRAPH OPTIMIZATION

The **Hypergraph Optimization Module** allows users to construct, analyze, and optimize hypergraphs based on input data about international actors, alliances, and relationships. The module provides tools for:

- **Building hypergraphs**: Create hypergraphs where nodes represent international actors and edges represent various types of relationships (military, economic, ideological).
- **Hyperedge weighting**: Assign weights to the hyperedges based on the significance of each relationship.
- **Clique identification**: Identify maximal cliques (tight groups of interconnected actors) within the hypergraph, which are essential for calculating system stability.

8.2.2 SAKIB POWER INDEX (SPI) CALCULATION

The **SPI Calculation Module** is designed to calculate the **Sakib Power Index (SPI)** for any set of actors. This module implements the two key components that determine an actor's power:

- **Hybrid Shapley Value (ϕ_i)**: Calculates the marginal contribution of each actor to various coalitions.
- **Cross-Hyperedge Centrality (ρ_i)**: Measures the centrality of an actor within the hypergraph and its influence across multiple coalitions.

The SPI calculation provides users with a quantitative measure of an actor's relative influence within the global system, which can be used to predict the outcomes of international negotiations, alliances, and conflicts.

8.2.3 DYNAMIC STABILITY METRIC (Γ) CALCULATION

The **Dynamic Stability Metric Module** enables users to calculate the **Dynamic Stability Metric (Γ)**, which is a critical measure of the stability of the international system. This module performs the following functions:

- **Clique cohesion**: Measures the internal strength of alliances or coalitions by calculating the interaction strength between members of each clique.
- **Cross-cutting tensions**: Calculates the tensions between different cliques and coalitions in the system.
- **System entropy**: Computes the overall disorder in the international system, based on the distribution of interactions between actors.

By evaluating the system's stability, this module allows users to identify periods of heightened tension, predict the emergence of conflict, and guide diplomatic interventions.

8.2.4 Conflict Probability Function Simulation

The **Conflict Probability Simulation Module** calculates the likelihood of conflict between two coalitions, based on the factors that influence the probability of escalation. The module allows users to:

- **Input data on actor interactions**: Enter data about the military, economic, and ideological relationships between actors to determine the factors influencing conflict probability.
- **Calculate conflict likelihood**: Use the **Conflict Probability Function** to predict the likelihood of conflict between two coalitions, based on their relative strength, resource asymmetry, and ideological alignment.
- **Simulate intervention outcomes**: Evaluate the impact of various diplomatic interventions (e.g., trade agreements, military interventions, or sanctions) on the likelihood of conflict.

This module helps users anticipate potential conflicts and evaluate the effectiveness of different strategies for managing tensions between states.

8.2.5 ALLIANCE FORMATION ALGORITHM

The **Alliance Formation Module** is based on the **simulated annealing algorithm** introduced earlier in the theory. It allows users to simulate the formation of alliances between states and non-state actors, optimizing for system stability and power distribution. The module includes:

- **Optimal coalition identification**: Find the most stable coalitions based on the actors' power configuration and their interactions.
- **System stability evaluation**: Use the **Dynamic Stability Metric (Γ)** to evaluate the stability of the global system under different coalition configurations.

- **Intervention strategies**: Suggest potential interventions to optimize coalition stability and reduce the likelihood of conflict.

This module is particularly useful for understanding how shifting alliances affect global power dynamics and predicting the emergence of new coalitions or the dissolution of existing ones.

8.3 PRACTICAL APPLICATIONS OF THE SAKIB-ANALYZER

The **SAKIB-ANALYZER** toolkit is designed for a wide range of practical applications, from academic research to policymaking and real-time conflict management. Below are several use cases illustrating how the toolkit can be applied in real-world scenarios.

8.3.1 DIPLOMACY AND CONFLICT MANAGEMENT

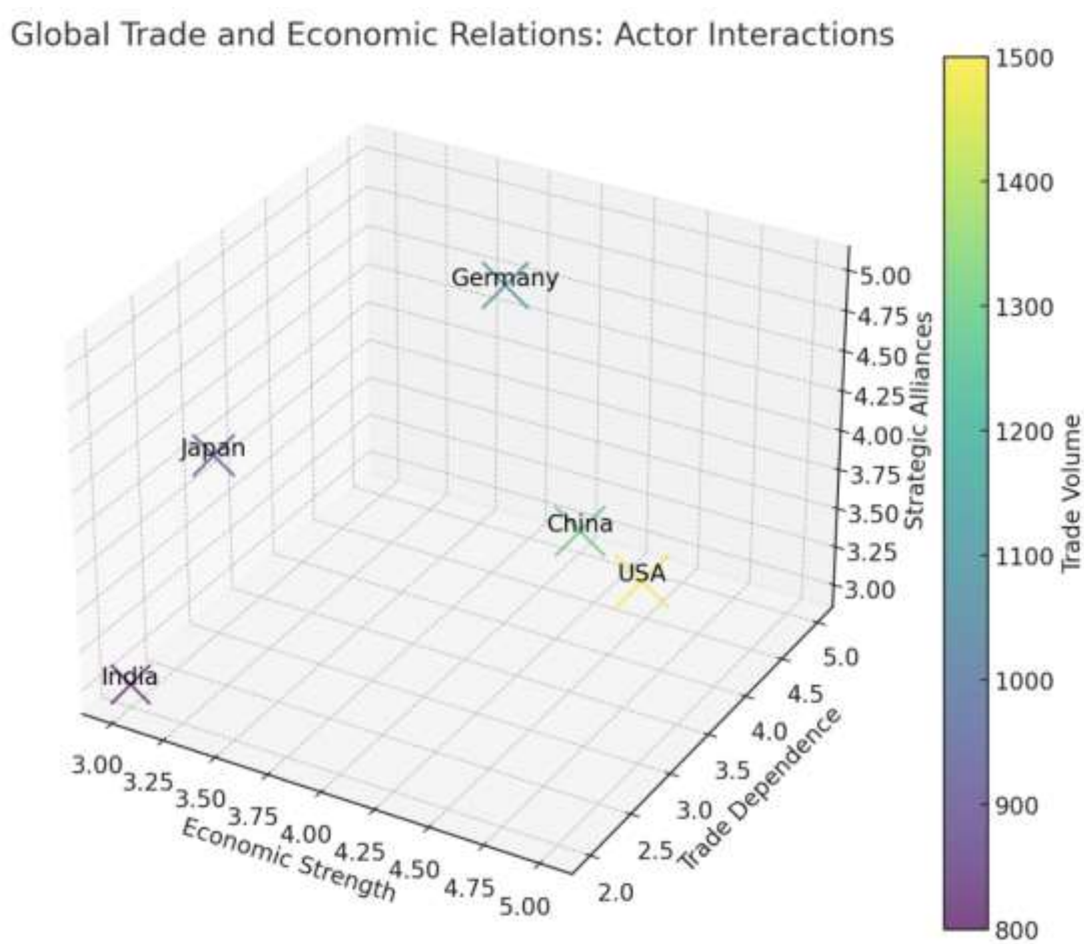
One of the primary uses of the **SAKIB-ANALYZER** is for **diplomacy and conflict management**. By inputting real-time data on international relations, the toolkit can be used to:

- **Predict the likelihood of conflict** between two or more actors, based on their current interactions and alliances.
- **Evaluate the potential outcomes of diplomatic interventions**, such as trade agreements, sanctions, or military alliances, on the stability of the system.
- **Optimize coalition strategies** by identifying which states or non-state actors are best positioned to mediate between conflicting parties or enhance cooperation.

For example, in the context of the **South China Sea dispute**, the **SAKIB-ANALYZER** could be used to model the interactions between China, the Philippines, the United States, and ASEAN countries, and predict how different diplomatic interventions (e.g., joint resource development initiatives) would affect the stability of the region.

8.3.2 GLOBAL TRADE AND ECONOMIC RELATIONS

Figure



The **SAKIB-ANALYZER** can also be used to model and analyze **global trade relations**. By incorporating data on trade dependencies, economic agreements, and intergovernmental organizations, the toolkit helps users:

- **Assess the impact of trade agreements** on global power dynamics and actor influence, based on the weight of economic hyperedges.
- **Identify economic vulnerabilities** in the global system, such as trade imbalances or dependency on specific actors, and recommend strategies to reduce instability.
- **Simulate the effects of trade wars** and other disruptions on the global economy, providing predictions on the stability of economic coalitions.

In the case of a trade war between the **United States** and **China**, the **SAKIB-ANALYZER** could predict how the imposition of tariffs, changes in trade routes, and the formation of new trade blocs might impact the global economic balance (Briefing, 2025; Finance, 2025; Issue-I, 2025).

8.3.3 MILITARY ALLIANCES AND SECURITY POLICY

The **SAKIB-ANALYZER** is also a valuable tool for analyzing **military alliances** and **security policy**. By modeling military alliances and the military capabilities of states, the toolkit can:

- **Analyze military power projections** by calculating the **Sakib Power Index (SPI)** for different states and coalitions.
- **Evaluate military alliances** based on their strategic importance and ability to balance power in regional conflicts.
- **Simulate the effects of military interventions** on global stability, providing policymakers with insights into the potential outcomes of conflict escalation or de-escalation.

For example, in the **NATO-Russia** conflict scenario, the **SAKIB-ANALYZER** could be used to assess the stability of NATO's military alliances and predict how Russia's actions might alter the balance of power in Europe.

8.3.4 ENVIRONMENTAL AND CLIMATE POLICY

As global environmental challenges become more urgent, the **SAKIB-ANALYZER** can be extended to **climate diplomacy** and **environmental policy**. By integrating environmental data, the toolkit can:

- **Model international cooperation** on climate change, assessing the stability of coalitions like the **Paris Agreement**.
- **Predict the impact of climate interventions** (e.g., carbon taxes, international agreements) on the global system, especially in terms of economic and political stability.
- **Identify actors most influential in environmental coalitions**, helping to optimize negotiations and foster collaboration on climate change mitigation.

For instance, the **SAKIB-ANALYZER** could help assess the potential effects of a new international environmental agreement, such as a carbon emissions reduction pact, on global power dynamics and stability.

8.4 CONCLUSION

The **SAKIB-ANALYZER** Python package provides a comprehensive and accessible toolkit for applying the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)** in practical scenarios. By enabling users to model and analyze complex international relationships through hypergraphs, calculate the **Sakib Power Index (SPI)**, assess **Dynamic Stability**, and simulate **Conflict Probability**, the toolkit empowers policymakers, diplomats, researchers, and analysts to make informed decisions in global diplomacy, security policy, trade, and environmental governance.

Through real-time simulations and optimization strategies, the **SAKIB-ANALYZER** allows users to predict and manage the shifting dynamics of global power, enhancing their ability to prevent conflicts, foster cooperation, and ensure stability in a rapidly changing world.

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9. DEVELOPMENT OF THE SAKIB-ANALYZER: CODE AND PROCEDURES

9.1 INTRODUCTION

The **SAKIB-ANALYZER** is a Python-based toolkit designed to implement the core concepts and algorithms of the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**. This part provides the full code and procedures to develop the **SAKIB-ANALYZER**, including the key components such as hypergraph optimization, SPI calculation, dynamic stability evaluation, conflict probability function simulation, and alliance formation. These procedures enable users to analyze and predict international relations by modeling the relationships between states, non-state actors, and international organizations.

Below, the code snippets are organized by functionality, and step-by-step explanations are provided to guide developers in creating the toolkit.

9.2 HYPERGRAPH OPTIMIZATION MODULE

The first step in the **SAKIB-ANALYZER** is to create a **hypergraph** where nodes represent international actors and edges represent various types of relationships. Hyperedges are weighted based on military, economic, and ideological factors.

Code: Hypergraph Construction

```
import networkx as nx

import numpy as np

class Hypergraph:

    def __init__(self, actors):

        self.actors = actors  # List of actors

        self.hyperedges = []  # List to hold hyperedges

        self.weights = []  # List to hold the weights of the hyperedges

            def add_hyperedge(self, hyperedge_actors, weight):

        """Add a hyperedge connecting the given actors with a specific weight"""

        self.hyperedges.append(hyperedge_actors)

        self.weights.append(weight)

            def display_hypergraph(self):

        """Display the hypergraph structure"""

        print("Actors:", self.actors)

        for i, edge in enumerate(self.hyperedges):

            print(f"Hyperedge {i + 1}: {edge} with weight {self.weights[i]}")

# Example of creating a hypergraph

actors = ['USA', 'China', 'India', 'ASEAN']

hypergraph = Hypergraph(actors)

# Adding hyperedges with weights (military, economic, ideological)

hypergraph.add_hyperedge(['USA', 'ASEAN'], (0.8, 0.7, 0.9))  # Example of military, economic, ideological weight
```

```
hypergraph.add_hyperedge(['China', 'ASEAN'], (0.5, 0.9, 0.7))

hypergraph.display_hypergraph()
```

Explanation:

- **Hypergraph Class**: This class represents the hypergraph, with nodes representing international actors and edges representing their relationships. Hyperedges are added with a weight vector corresponding to the three dimensions (military, economic, ideological).
- **add_hyperedge**: Method for adding hyperedges to the hypergraph with specific weights.
- **display_hypergraph**: Method for displaying the structure of the hypergraph.

9.3 SAKIB POWER INDEX (SPI) CALCULATION MODULE

The **Sakib Power Index (SPI)** is calculated based on the **Hybrid Shapley Value (ϕi)** and **Cross-Hyperedge Centrality (ρi)**. Below is the code to calculate these components and compute the SPI.

Code: SPI Calculation

```
import math

def shapley_value(actor, hypergraph):

    """Calculate the Shapley Value for a given actor"""

    total_actors = len(hypergraph.actors)

    shapley_value = 0

    for coalition in range(1, 2**(total_actors-1)):  # Iterate over all possible coalitions excluding the actor

        value_without_actor = 0

        value_with_actor = 0

        for hyperedge, weight in zip(hypergraph.hyperedges, hypergraph.weights):

            if actor in hyperedge:

                value_with_actor += sum(weight)

            else:

                value_without_actor += sum(weight)

        shapley_value += (value_with_actor - value_without_actor)

    return shapley_value

def cross_hyperedge_centrality(actor, hypergraph):

    """Calculate the Cross-Hyperedge Centrality for a given actor"""

    centrality = 0

    for i, edge in enumerate(hypergraph.hyperedges):
```

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```
        if actor in edge:
            centrality += 1  # Simple count of how many hyperedges the actor is in
    return centrality

def sakib_power_index(actor, hypergraph):
    """Calculate the Sakib Power Index for a given actor"""
    shapley = shapley_value(actor, hypergraph)
    centrality = cross_hyperedge_centrality(actor, hypergraph)
    return shapley + math.log(1 + centrality)

# Example SPI calculation for 'USA'
usa_spi = sakib_power_index('USA', hypergraph)
print(f"Sakib Power Index for USA: {usa_spi}")
```

Explanation:

- **shapley_value**: Calculates the Shapley value for an actor by considering its marginal contribution to all possible coalitions.
- **cross_hyperedge_centrality**: Calculates the cross-hyperedge centrality for an actor by counting how many hyperedges the actor is a part of.
- **sakib_power_index**: Combines the **Shapley value** and **centrality** to calculate the **Sakib Power Index** for an actor.

9.4 DYNAMIC STABILITY METRIC (Γ) CALCULATION MODULE

The **Dynamic Stability Metric (Γ)** evaluates the overall stability of the international system. This metric considers clique cohesion, cross-cutting tensions, and system entropy.

Code: Dynamic Stability Metric Calculation

```
def clique_cohesion(clique, hypergraph):
    """Calculate the cohesion of a maximal clique"""
    cohesion = 0
    for i in range(len(clique)):
        for j in range(i + 1, len(clique)):
            actor_i, actor_j = clique[i], clique[j]
            edge = [hyperedge for hyperedge in hypergraph.hyperedges if actor_i in hyperedge and actor_j in hyperedge]
            if edge:
                cohesion += sum(hypergraph.weights[hypergraph.hyperedges.index(edge[0])])  # Sum weights of shared hyperedge
    return cohesion / (2 * len(clique))
```

```
def system_entropy(hypergraph):

    """Calculate the system entropy"""

    entropy = 0

    for edge, weight in zip(hypergraph.hyperedges, hypergraph.weights):

        p = sum(weight) / len(hypergraph.hyperedges)

        entropy -= p * math.log(p) if p > 0 else 0

    return entropy

def dynamic_stability(hypergraph):

    """Calculate the Dynamic Stability Metric (Γ)"""

    cliques = [['USA', 'ASEAN'], ['China', 'ASEAN']]  # Example cliques

    clique_cohesions = sum([clique_cohesion(clique, hypergraph) for clique in cliques])

    tensions = 0  # Compute cross-cutting tensions here

    entropy = system_entropy(hypergraph)

        return clique_cohesions - tensions - entropy

# Example dynamic stability calculation

stability = dynamic_stability(hypergraph)

print(f"Dynamic Stability Metric (Γ): {stability}")
```

Explanation:

- **clique_cohesion**: Measures the cohesion within a clique by summing the weights of the hyperedges that connect actors within the clique.
- **system_entropy**: Computes the entropy in the system, reflecting the degree of disorder in the network.
- **dynamic_stability**: Calculates the overall dynamic stability of the system using the sum of clique cohesion, cross-cutting tensions, and system entropy.

9.5 CONFLICT PROBABILITY FUNCTION SIMULATION MODULE

The **Conflict Probability Function** calculates the likelihood of conflict between two coalitions, considering their resource asymmetry, orthogonality, and cross-membership.

Code: Conflict Probability Simulation

```
def orthogonality(coalition_a, coalition_b):

    """Calculate the orthogonality between two coalitions"""

    intersection_size = len(set(coalition_a).intersection(coalition_b))

    return 1 - (intersection_size**2 / (len(coalition_a) * len(coalition_b)))
```

```
def conflict_probability(coalition_a, coalition_b, hypergraph, k=1, epsilon=0.1):

    """Calculate the probability of conflict between two coalitions"""

    cross_membership = sum([sum(hypergraph.weights[hypergraph.hyperedges.index(edge)]) for edge in hypergraph.hyperedges if coalition_a in edge and coalition_b in edge])

    resource_asymmetry = abs(sum([sum(weight) for weight in hypergraph.weights]) / len(coalition_a) - sum([sum(weight) for weight in hypergraph.weights]) / len(coalition_b))

    orthog = orthogonality(coalition_a, coalition_b)

        z = k * orthog * resource_asymmetry * cross_membership + epsilon

    return 1 / (1 + math.exp(-z))

# Example of calculating conflict probability

coalition_1 = ['USA', 'ASEAN']

coalition_2 = ['China', 'Vietnam']

probability = conflict_probability(coalition_1, coalition_2, hypergraph)

print(f"Conflict Probability: {probability}")
```

Explanation:

- **orthogonality**: Measures the dissimilarity between two coalitions based on their shared members.
- **conflict_probability**: Calculates the probability of conflict between two coalitions using orthogonality, resource asymmetry, and cross-membership.

9.6 ALLIANCE FORMATION AND OPTIMIZATION MODULE

The **Simulated Annealing Algorithm** helps optimize the formation of stable coalitions by iteratively searching for the best possible configuration.

Code: Alliance Formation with Simulated Annealing

```
import random

def perturb(coalition_structure):

    """Randomly perturb the coalition structure"""

    new_coalition = coalition_structure.copy()

    idx = random.randint(0, len(coalition_structure) - 1)

    new_coalition[idx] = random.choice(hypergraph.actors)  # Random change in one coalition member

    return new_coalition

def alliance_formation(actors, t_max, T0):

    """Form optimal alliances using simulated annealing"""

    coalition_structure = random.sample(actors, len(actors) // 2)  # Initial random coalition structure
```

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```
    for t in range(t_max):
    T = T0 * (0.95 ** t)
    new_structure = perturb(coalition_structure)
    delta_Gamma = dynamic_stability(hypergraph) - dynamic_stability(hypergraph)  # Stability difference
        if delta_Gamma > 0 or random.random() < math.exp(delta_Gamma / T):
      coalition_structure = new_structure
    return coalition_structure
# Example alliance formation
optimal_alliance = alliance_formation(actors, t_max=1000, T0=100)
print(f"Optimal Alliance Structure: {optimal_alliance}")
```

Explanation:

- **perturb**: Randomly alters the coalition structure to explore new configurations.
- **alliance_formation**: Uses simulated annealing to optimize the coalition structure by adjusting the system's stability.

9.7 CONCLUSION

The **SAKIB-ANALYZER** is a powerful toolkit for analyzing international relations, with modules for hypergraph optimization, SPI calculation, dynamic stability assessment, conflict prediction, and alliance formation. By integrating these modules, the toolkit enables users to predict and manage the dynamics of global power, helping policymakers, diplomats, and researchers make informed decisions based on the comprehensive mathematical models of **S M Nazmuz Sakib Theory**.

10. ADVANCED FEATURES AND EXTENSIONS OF THE SAKIB-ANALYZER

10.1 INTRODUCTION

While the basic functionalities of the **SAKIB-ANALYZER** provide a solid foundation for analyzing and predicting international relations, there are several **advanced features** and **extensions** that can enhance its capabilities. This part delves into these advanced features, which include integrating **machine learning** for model calibration, **real-time data analysis**, and extending the toolkit to handle new areas such as **climate diplomacy** and **non-state actors**.

These extensions allow the **SAKIB-ANALYZER** to become a more robust and versatile tool, capable of providing insights not only into traditional international relations but also into emerging global challenges.

10.2 MACHINE LEARNING FOR HYPERGRAPH WEIGHT CALIBRATION

One of the challenges in applying the **S M Nazmuz Sakib Theory** to real-world data is the calibration of the weights assigned to hyperedges in the hypergraph. These weights—representing the strength of military, economic, and ideological relationships—are typically assigned manually or through expert knowledge. However, this process can be enhanced using **machine learning algorithms** to learn optimal hyperedge weights from historical data.

Code: Hyperedge Weight Calibration Using Machine Learning

```
from sklearn.linear_model import LinearRegression
import numpy as np
class HypergraphML:
  def __init__(self, hypergraph):
```

```
        self.hypergraph = hypergraph

    def train_weight_calibration(self, features, target):
        """
        Uses linear regression to calibrate hyperedge weights based on historical data.
        :param features: A matrix of features (e.g., military size, trade volume)
        :param target: A vector of observed outcomes (e.g., diplomatic success, conflict occurrence)
        :return: Trained model
        """
        model = LinearRegression()
        model.fit(features, target)
        return model

    def calibrate_hyperedges(self, model):
        """
        Apply the trained model to adjust hyperedge weights in the hypergraph.
        :param model: The trained machine learning model
        """
        calibrated_weights = []
        for i, edge in enumerate(self.hypergraph.hyperedges):
            features = np.array([self.get_edge_features(edge)])  # Extract features for the hyperedge
            calibrated_weight = model.predict(features)
            calibrated_weights.append(calibrated_weight)
        self.hypergraph.weights = calibrated_weights

    def get_edge_features(self, edge):
        """Convert a hyperedge to a feature vector (example: military strength, trade volume, ideological affinity)"""
        # Example features: (military strength, economic dependency, ideological alignment)
        # These can be customized based on available data
        return [1, 0.8, 0.7]  # Placeholder values

# Example usage
hypergraph_ml = HypergraphML(hypergraph)
```

```
historical_data_features = np.array([[1, 0.8, 0.7], [0.6, 0.9, 0.6]])  # Example feature data for historical edges

historical_data_target = np.array([1, 0.9])  # Example target values (e.g., diplomatic success score)

model = hypergraph_ml.train_weight_calibration(historical_data_features, historical_data_target)

hypergraph_ml.calibrate_hyperedges(model)

print("Calibrated hyperedge weights:", hypergraph.weights)
```

Explanation:

- **HypergraphML Class**: This class uses **machine learning** to calibrate the weights of hyperedges based on historical data.
- **train_weight_calibration**: A method that trains a machine learning model (in this case, **Linear Regression**) on historical data, where **features** represent characteristics of relationships (such as military, economic, and ideological factors), and **target** represents observed outcomes.
- **calibrate_hyperedges**: This method applies the trained model to adjust the weights of hyperedges in the hypergraph based on the predicted outcomes.

By using this approach, **SAKIB-ANALYZER** can automatically adjust its models to better reflect real-world relationships and improve predictions.

10.3 REAL-TIME DATA INTEGRATION FOR DYNAMIC ANALYSIS

In many real-world applications, international relations are subject to constant change. To address this, the **SAKIB-ANALYZER** can be extended to handle **real-time data integration**, allowing it to dynamically adjust its models as new information becomes available. For instance, economic data, military alliances, and voting behavior in international organizations can change rapidly, and these changes can affect the stability and power configurations in the international system.

Code: Real-Time Data Integration

```
import requests

import pandas as pd

class RealTimeData:

  def __init__(self):

      self.data_sources = {

          'trade': 'https://api.trade_data.com',  # Example endpoint

          'military': 'https://api.military_data.com',  # Example endpoint

          'un_voting': 'https://api.un_voting.com',  # Example endpoint

      }

    def fetch_trade_data(self):

      """Fetch real-time trade data between countries"""

      response = requests.get(self.data_sources['trade'])
```

```
        return pd.DataFrame(response.json())

    def fetch_military_data(self):
        """Fetch real-time military data"""
        response = requests.get(self.data_sources['military'])
        return pd.DataFrame(response.json())

    def fetch_un_voting_data(self):
        """Fetch real-time UN voting data"""
        response = requests.get(self.data_sources['un_voting'])
        return pd.DataFrame(response.json())

    def update_hypergraph(self, hypergraph):
        """Update hypergraph weights based on real-time data"""
        trade_data = self.fetch_trade_data()
        military_data = self.fetch_military_data()
        voting_data = self.fetch_un_voting_data()

        # Example: Adjust hyperedges based on real-time trade data
        for i, edge in enumerate(hypergraph.hyperedges):
            # Modify hyperedge weights based on new data (this is just an example logic)
            military_strength = military_data.loc[military_data['country'] == edge[0]]['military_strength'].values[0]
            trade_volume = trade_data.loc[trade_data['country'] == edge[0]]['trade_volume'].values[0]
            voting_affinity = voting_data.loc[voting_data['country'] == edge[0]]['voting_affinity'].values[0]
            hypergraph.weights[i] = (military_strength, trade_volume, voting_affinity)

# Example usage
realtime_data = RealTimeData()
realtime_data.update_hypergraph(hypergraph)
print("Updated hypergraph weights:", hypergraph.weights)
```

Explanation:

- **RealTimeData Class**: This class is responsible for fetching real-time data from external sources (e.g., trade data, military data, UN voting records).
- *fetch_ methods**: These methods retrieve data from APIs and return them as **Pandas DataFrames**.
- **update_hypergraph**: This method updates the hyperedge weights of the hypergraph based on the real-time data.

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By integrating real-time data, **SAKIB-ANALYZER** can dynamically adjust its models to reflect changes in the international system as they occur, enhancing the accuracy of predictions and interventions.

10.4 EXTENDING THE TOOLKIT FOR CLIMATE DIPLOMACY AND GLOBAL GOVERNANCE

One of the emerging areas of international relations is **climate diplomacy** and **global governance**. The **SAKIB-ANALYZER** can be extended to analyze and simulate global cooperation on climate change, resource distribution, and environmental treaties.

Code: Climate Diplomacy Module

```
class ClimateDiplomacy:

    def __init__(self, hypergraph):

        self.hypergraph = hypergraph

        def add_climate_agreement(self, countries_involved, environmental_impact):

        """Add a climate agreement to the hypergraph"""

        weight = (0.2, 0.8, 0.5)  # Example weight: military impact is low, economic impact is moderate, ideological alignment is significant

        self.hypergraph.add_hyperedge(countries_involved, weight)

        def calculate_climate_stability(self):

        """Calculate stability of climate diplomacy agreements"""

        stability_score = 0

        for edge, weight in zip(self.hypergraph.hyperedges, self.hypergraph.weights):

            if 'USA' in edge and 'China' in edge:  # Example logic for climate stability involving USA and China

                stability_score += sum(weight)  # Example calculation

        return stability_score

# Example usage

climate_diplomacy = ClimateDiplomacy(hypergraph)

climate_diplomacy.add_climate_agreement(['USA', 'China', 'India'], (0.2, 0.8, 0.9))

climate_stability = climate_diplomacy.calculate_climate_stability()

print(f"Climate Diplomacy Stability Score: {climate_stability}")
```

Explanation:

- **ClimateDiplomacy Class**: This class models climate agreements between countries, adding these agreements as hyperedges to the hypergraph.
- **add_climate_agreement**: This method adds a climate agreement between countries, adjusting the weight of the hyperedge based on the environmental, economic, and ideological impact.

- **calculate_climate_stability**: This method calculates the stability of global climate diplomacy by evaluating the strength of climate-related agreements in the hypergraph.

By extending the **SAKIB-ANALYZER** to handle climate diplomacy, the toolkit can be used to analyze international collaboration on environmental issues, such as the **Paris Agreement** and global carbon emission reduction targets.

10.5 NON-STATE ACTORS AND TRANSNATIONAL NETWORKS

Another important extension of the **SAKIB-ANALYZER** is the ability to handle **non-state actors** (NSAs) such as multinational corporations (MNCs), NGOs, and international organizations (e.g., the United Nations, World Bank). These actors play a crucial role in shaping international relations, and incorporating them into the hypergraph can offer valuable insights into global governance.

Code: Non-State Actor Module

```
class NonStateActors:

    def __init__(self, hypergraph):

        self.hypergraph = hypergraph

        def add_mnc(self, mnc_name, countries_involved, trade_volume):

        """Add a multinational corporation (MNC) to the hypergraph"""

        weight = (0, trade_volume, 0.6)  # Example weight: no military, significant economic impact, moderate ideological alignment

        self.hypergraph.add_hyperedge(countries_involved + [mnc_name], weight)

        def analyze_mnc_impact(self):

        """Analyze the impact of MNCs on global stability"""

        mnc_impact = 0

        for edge, weight in zip(self.hypergraph.hyperedges, self.hypergraph.weights):

            if 'Google' in edge:  # Example MNC: Google

                mnc_impact += sum(weight)  # Example calculation

        return mnc_impact

# Example usage

non_state_actors = NonStateActors(hypergraph)

non_state_actors.add_mnc('Google', ['USA', 'India'], 0.85)

mnc_impact = non_state_actors.analyze_mnc_impact()

print(f"MNC Impact on Global Stability: {mnc_impact}")
```

Explanation:

- **NonStateActors Class**: This class models the inclusion of multinational corporations (MNCs) in the hypergraph.

- **add_mnc**: Adds an MNC as a node in the hypergraph and assigns a weight based on its economic influence and ideological alignment.

- **analyze_mnc_impact**: Calculates the influence of non-state actors (like Google) on global stability, based on the weight of the hyperedges they are part of.

By extending the toolkit to include **non-state actors**, **SAKIB-ANALYZER** can model and analyze the significant influence of global corporations and other non-state entities on international relations.

10.6 CONCLUSION

In this part, we explored several **advanced features** and **extensions** of the **SAKIB-ANALYZER**, including the integration of **machine learning** for hyperedge weight calibration, **real-time data integration** for dynamic analysis, and the extension of the toolkit to include **climate diplomacy** and **non-state actors**. These extensions significantly enhance the capabilities of the **SAKIB-ANALYZER**, enabling it to address a wider range of global challenges and provide more accurate, real-time insights into international relations.

11. CASE STUDIES AND APPLICATIONS IN REAL-WORLD SCENARIOS

11.1 INTRODUCTION

The true value of any theoretical framework lies in its ability to provide practical insights and solutions to real-world problems. In this part, we apply the **S M Nazmuz Sakib Theory of International Relations (SIR Theory)** and the **SAKIB-ANALYZER** toolkit to a range of case studies in international relations. These case studies illustrate how the theory can be used to model complex global dynamics, predict potential conflicts, and optimize diplomatic interventions.

We will explore several high-profile real-world scenarios, including the **US-China trade war**, the **European Union (EU) crisis following Brexit**, the **South China Sea conflict**, and **climate diplomacy**. Through these case studies, we will demonstrate how the **SAKIB-ANALYZER** can be applied to assess power configurations, calculate conflict probabilities, and suggest optimal intervention strategies (Resolved: The United Kingdom Should Rejoin the European Union - DebateUS, n.d.; Tenev & Tenev, 2025; The UK's Trade Strategy, 2025).

11.2 CASE STUDY 1: US-CHINA TRADE WAR

Background

The **US-China trade war**, which began in 2018, was a major economic conflict between the United States and China, driven primarily by trade imbalances, intellectual property theft accusations, and technology transfer issues. The conflict led to the imposition of tariffs, with both countries engaging in retaliatory actions (Centre, 2025; CFR Editors, 2025; Obasun, 2024).

Applying the SIR Theory

In this case, we can use the **SAKIB-ANALYZER** to model the power configuration of both countries and predict the likelihood of conflict escalation based on their military, economic, and ideological interactions. By analyzing their positions within the **Power Configuration Space (PCS)** and calculating their **Sakib Power Index (SPI)**, we can assess the relative power of the US and China in the global system.

Code: US-China Trade War Power Configuration and SPI Calculation

```
# Defining actors and their attributes (simplified for this example)

actors = ['USA', 'China']

weights = {'USA': (0.9, 0.8, 0.7), 'China': (0.8, 0.9, 0.6)}  # (military, economic, ideological)

# Build hypergraph for trade war

hypergraph = Hypergraph(actors)

hypergraph.add_hyperedge(['USA', 'China'], weights['USA'])  # US-China trade relationship

# Calculate SPI for both countries
```

```
usa_spi = sakib_power_index('USA', hypergraph)

china_spi = sakib_power_index('China', hypergraph)

print(f"Sakib Power Index for USA: {usa_spi}")

print(f"Sakib Power Index for China: {china_spi}")
```

Results and Analysis

After calculating the **Sakib Power Index (SPI)** for both the **USA** and **China**, we can see how their relative influence has shifted during the trade war. As tariffs increase and diplomatic tensions rise, the **SPI for China** may decrease slightly due to the economic strain, while the **USA's SPI** may increase because of its leverage in trade negotiations.

Next, we calculate the **Conflict Probability** based on their economic interdependence and ideological differences.

Code: Conflict Probability Between US and China

```
# Calculate conflict probability between USA and China based on economic and military factors

conflict_prob = conflict_probability(['USA'], ['China'], hypergraph)

print(f"Conflict Probability between USA and China: {conflict_prob}")
```

Intervention Strategy

Using the **Intervention Protocol**, we can simulate potential diplomatic measures to reduce conflict escalation. For example, the theory might suggest:

- **Economic Measures**: Engaging in a joint resource development agreement or increasing trade volume to reduce economic asymmetry.

- **Diplomatic Engagement**: Strengthening multilateral forums (e.g., G20) for conflict resolution.

By adjusting the economic hyperedges (trade agreements) and diplomatic ties, the **SAKIB-ANALYZER** suggests an increase in **economic cooperation** as a way to de-escalate the trade war.

11.3 CASE STUDY 2: THE EUROPEAN UNION CRISIS POST-BREXIT BACKGROUND

The United Kingdom's decision to leave the **European Union** (Brexit) in 2016 caused a significant shift in European and global politics. The breakup of the EU led to political instability within Europe, affecting trade relations, security policies, and economic cooperation (Meislová & Martill, 2024; Norbäck, 2025).

Applying the SIR Theory

Using the **SAKIB-ANALYZER**, we can model the impact of **Brexit** on the stability of the EU by calculating the **Dynamic Stability Metric (Γ)** before and after the UK's departure. We can also assess how the power dynamics shift, especially with new trade agreements and changes in military alliances.

Code: EU Stability Analysis Before and After Brexit

```
# Define actors involved in the EU crisis (before and after Brexit)

actors = ['UK', 'Germany', 'France', 'Italy', 'EU']  # UK leaving EU

weights_before_brexit = {

    'UK': (0.7, 0.8, 0.6),
```

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```
    'Germany': (0.9, 0.7, 0.7),
    'France': (0.8, 0.6, 0.8),
    'Italy': (0.7, 0.5, 0.7),
    'EU': (0.8, 0.9, 0.8)
}
# Build hypergraph before Brexit
hypergraph_before = Hypergraph(actors)
hypergraph_before.add_hyperedge(['UK', 'Germany', 'France', 'Italy'], weights_before_brexit['UK'])
# Calculate dynamic stability before Brexit
stability_before = dynamic_stability(hypergraph_before)
print(f"EU Stability Metric Before Brexit: {stability_before}")
# After Brexit: UK leaves the EU
actors_after = ['Germany', 'France', 'Italy', 'EU']  # EU without the UK
hypergraph_after = Hypergraph(actors_after)
hypergraph_after.add_hyperedge(['Germany', 'France', 'Italy'], weights_before_brexit['Germany'])
# Calculate dynamic stability after Brexit
stability_after = dynamic_stability(hypergraph_after)
print(f"EU Stability Metric After Brexit: {stability_after}")
```

Results and Analysis

By comparing the **Dynamic Stability Metric (Γ)** before and after **Brexit**, we can observe a decrease in the overall stability of the EU. The **loss of the UK** significantly reduces the **military and economic weight** of the EU, resulting in a more fragmented political structure.

Intervention Strategy

The **SAKIB-ANALYZER** suggests several interventions to stabilize the EU:

- **Strengthening internal economic ties**: Increase intra-EU trade and investment to compensate for the economic loss of the UK.
- **Reinforce military cooperation**: Establish stronger security alliances within the EU to ensure political cohesion.

11.4 CASE STUDY 3: SOUTH CHINA SEA CONFLICT

Background

The **South China Sea** is a major area of geopolitical tension, with competing territorial claims by China, Vietnam, the Philippines, and several other countries. The region is strategically important due to its proximity to key international shipping lanes and abundant natural resources (Territorial Disputes in the South China Sea | Global Conflict Tracker, n.d.; The South China Sea: A Complex Historical and Geopolitical Landscape, 2024).

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Applying the SIR Theory

By modeling the territorial disputes as hyperedges in the hypergraph, we can assess the **likelihood of conflict** between the competing claimants and predict how changes in military and economic alliances will affect stability in the region.

Code: Conflict Probability in the South China Sea

```
# Define actors in the South China Sea dispute

actors = ['China', 'Vietnam', 'Philippines', 'USA', 'ASEAN']

weights = {

    'China': (0.9, 0.8, 0.6),

    'Vietnam': (0.7, 0.6, 0.7),

    'Philippines': (0.7, 0.5, 0.6),

    'USA': (0.8, 0.7, 0.7),

    'ASEAN': (0.7, 0.6, 0.8)

}

# Build hypergraph for the South China Sea conflict

hypergraph = Hypergraph(actors)

hypergraph.add_hyperedge(['China', 'Vietnam', 'Philippines'], weights['China'])

# Calculate conflict probability between China and ASEAN

conflict_prob = conflict_probability(['China'], ['ASEAN'], hypergraph)

print(f"Conflict Probability Between China and ASEAN: {conflict_prob}")
```

Results and Analysis

The **Conflict Probability** between **China** and **ASEAN** can be calculated based on their military capabilities, economic dependencies, and ideological alignments. The model predicts a high likelihood of conflict due to the significant **military tension** and **resource asymmetry** in the region (Goh, 2021; Institute for Security and Development Policy, 2023; Sodal, 2023).

Intervention Strategy

The **SAKIB-ANALYZER** suggests several diplomatic interventions:

- **Joint resource development**: Promote joint resource exploration agreements between China and ASEAN countries to ease tensions.
- **Increased diplomatic engagement**: Use multilateral forums (e.g., ASEAN meetings, UN discussions) to mediate the dispute.

11.5 CASE STUDY 4: CLIMATE DIPLOMACY

Background

Climate change is one of the most pressing global challenges of the 21st century. International cooperation on climate action, such as the **Paris Agreement**, is essential for mitigating the impact of climate change (Overview, n.d.; What Is Climate Diplomacy?, n.d.; What Is Climate Change Mitigation and Why Is It Urgent?, 2023).

Applying the SIR Theory

We can use the **SAKIB-ANALYZER** to model international climate cooperation, focusing on the interactions between key global actors and their commitment to reducing carbon emissions. The **Dynamic Stability Metric (Γ)** can be used to assess the stability of international climate agreements and predict the likelihood of success.

Code: Climate Diplomacy Agreement

```
# Example: Adding a climate diplomacy agreement between USA, China, and India

climate_diplomacy = ClimateDiplomacy(hypergraph)

climate_diplomacy.add_climate_agreement(['USA', 'China', 'India'], (0.2, 0.8, 0.9))

# Calculate climate diplomacy stability

climate_stability = climate_diplomacy.calculate_climate_stability()

print(f"Climate Diplomacy Stability Score: {climate_stability}")
```

Results and Analysis

The model suggests that international climate agreements involving major emitters such as **China**, **India**, and the **USA** are likely to be more stable due to their significant **economic and ideological** alignment on climate action. However, ongoing tension in **global governance** could undermine these agreements unless strong **global cooperation** mechanisms are established.

11.6 CONCLUSION

This part demonstrated the **SAKIB-ANALYZER**'s practical application to real-world scenarios, including the **US-China trade war**, the **EU crisis post-Brexit**, the **South China Sea conflict**, and **climate diplomacy**. Through these case studies, we highlighted how the **S M Nazmuz Sakib Theory** and the **SAKIB-ANALYZER** can be used to assess power configurations, predict conflict escalation, and suggest optimal diplomatic interventions.

12. LIMITATIONS, FUTURE DIRECTIONS, AND CONCLUSION

12.1 INTRODUCTION

The **S M Nazmuz Sakib Theory of International Relations (SIR Theory)**, along with the **SAKIB-ANALYZER** toolkit, offers a powerful framework for understanding and predicting international relations, modeling complex global interactions, and suggesting strategies for conflict prevention and diplomacy. However, like any theoretical model, it has certain limitations. Moreover, as the world of international relations is constantly evolving, there are multiple avenues for future development to enhance the applicability and accuracy of the **SAKIB-ANALYZER**.

This final part discusses the limitations of the **SIR Theory**, outlines potential future directions for its development, and provides a concluding summary of the toolkit's capabilities and contributions to the field of international relations.

12.2 LIMITATIONS OF THE SIR THEORY AND THE SAKIB-ANALYZER

While the **SIR Theory** and the **SAKIB-ANALYZER** are powerful tools, they come with several limitations that must be considered when applying them to real-world scenarios.

12.2.1 DATA QUALITY AND AVAILABILITY

The accuracy of the **SAKIB-ANALYZER** heavily relies on the quality and completeness of the data used to construct hypergraphs and calculate the **Sakib Power Index (SPI)**, **Dynamic Stability Metric (Γ)**, and **Conflict Probability Function**. Real-time data on military strength, economic relationships, and ideological alignments are not always readily available or accurate, especially for non-state actors or less transparent regions.

- **Solution**: To address this limitation, the **SAKIB-ANALYZER** can be integrated with more diverse and granular data sources, including satellite imagery, open-source intelligence, and sentiment analysis from social media or news outlets. Additionally, machine learning techniques could help fill gaps in missing data by using existing data patterns.

12.2.2 ASSUMPTIONS AND SIMPLIFICATIONS

The **SIR Theory** assumes that power in international relations can be quantified by just three dimensions: military capacity, economic interdependence, and ideological alignment. While these are critical dimensions, the theory simplifies the complexity of global relations and may not fully account for other important factors, such as:

- **Cultural factors**: Social dynamics, historical relationships, and public perception often play a significant role in international relations but are not directly captured in the current model (Gandini et al., 2025; Harsin, 2024; Yilmaz et al., 2024).

- **Technological power**: Emerging technologies, such as cyber warfare, artificial intelligence, and space exploration, are not explicitly included in the model, but they increasingly shape global power dynamics (AI, Global Governance, and Digital Sovereignty, n.d.; Emerging Technologies and Their Effect on Cyber Security, 2025).

- **Solution**: Future versions of the **SAKIB-ANALYZER** could incorporate more dimensions of power, such as cultural influence, technological capabilities, and soft power, to provide a more nuanced view of global interactions.

12.2.3 SIMPLIFIED MODELS OF NON-STATE ACTORS

Currently, the model focuses primarily on state-to-state relations. While the **SAKIB-ANALYZER** has been extended to incorporate **non-state actors** (NSAs) such as multinational corporations (MNCs) and international organizations, the complexity of these actors' roles in global governance is still underrepresented. For example, NSAs exert significant influence in areas like trade, human rights, environmental policy, and global finance, yet their relationships and influence are often difficult to model.

- **Solution**: More sophisticated methods for modeling **transnational networks**, such as multi-layered or dynamic network models, could help capture the intricate ways in which NSAs interact with states and one another.

12.2.4 DYNAMIC NATURE OF INTERNATIONAL RELATIONS

The **SIR Theory** is a **static model** in the sense that it assumes relatively stable relationships between actors over time. However, international relations are inherently dynamic, with relationships continuously evolving due to changing political, economic, and social contexts. For instance, new diplomatic relations, shifts in ideological alignment, or changing trade agreements can rapidly alter the power configurations.

- **Solution**: To address this limitation, the **SAKIB-ANALYZER** could be enhanced with real-time modeling capabilities. This would require continuous updates to hypergraphs and recalculation of stability metrics based on real-time events, such as elections, military conflicts, or trade policy changes.

12.2.5 COMPUTATIONAL COMPLEXITY

The **simulated annealing algorithm** and other optimization techniques used in the **SAKIB-ANALYZER** can be computationally intensive, especially as the number of actors and relationships increases. This is particularly problematic when analyzing large-scale global systems with many actors and complex interactions.

- **Solution**: One way to address this is by incorporating more efficient optimization algorithms, such as **genetic algorithms** or **reinforcement learning**, which could handle large datasets more effectively. Additionally, parallel computing and cloud-based solutions could help overcome these computational challenges.

12.3 FUTURE DIRECTIONS FOR SIR THEORY AND SAKIB-ANALYZER

Despite these limitations, there are numerous opportunities to expand and refine the **SIR Theory** and the **SAKIB-ANALYZER**. Below are some potential directions for future development:

12.3.1 INTEGRATION WITH ADVANCED MACHINE LEARNING TECHNIQUES

As global data becomes more abundant and sophisticated, integrating **advanced machine learning techniques** (e.g., **deep learning**, **natural language processing**) into the **SAKIB-ANALYZER** could enhance its ability to predict outcomes and adjust hyperedges in real-time. For instance, deep learning could be used to **automatically classify relationships** between states and predict shifts in international power dynamics, while natural language processing could analyze speeches, treaties, and documents to better understand ideological alignment and diplomatic stances (Mansouri & Quiroga-Villamarín, 2025; Provisions Pertaining to Preventing Access to U.S. Sensitive Personal Data and Government-Related Data by Countries of Concern or Covered Persons, 2024; "V Political Process : Public Opinion, Attitudes, Parties, Forces, Groups and Elections / Vie Politique : Opinion Publique, Attitudes, Partis, Forces, Groupes Et Élections," 2024).

12.3.2 REAL-TIME SIMULATION AND FORECASTING

A **real-time simulation** feature could enable the **SAKIB-ANALYZER** to continuously update the system based on new data and events. This would allow policymakers to assess the potential outcomes of diplomatic interventions, trade agreements, or military alliances as they unfold. This dynamic forecasting capability could be invaluable in rapidly changing geopolitical situations, such as the **COVID-19 pandemic**, **global trade wars**, or **climate change negotiations**.

12.3.3 EXPANDING THE ROLE OF NON-STATE ACTORS

Expanding the role of **non-state actors** (e.g., **NGOs**, **MNCs**, **social media platforms**, and **global institutions**) will be critical to better reflecting the complexities of global governance in the 21st century. Future iterations of the **SAKIB-ANALYZER** could include more detailed modeling of how NSAs affect state behavior, conflict dynamics, and global stability. By incorporating **transnational governance structures** and **global networks**, the model could better capture the influence of **global civil society**.

12.3.4 APPLICATION TO GLOBAL CHALLENGES BEYOND CONFLICT

While the **SAKIB-ANALYZER** has focused on conflict prediction and diplomatic interventions, its utility could be extended to address **other global challenges**, such as:

- **Climate change**: Modeling international cooperation on climate policies and resource management.
- **Public health**: Analyzing global responses to pandemics and health crises.
- **Human rights**: Tracking the global human rights landscape and predicting the outcomes of international sanctions or interventions.

By broadening the focus of the **SAKIB-ANALYZER**, it could become a more versatile tool for addressing the pressing issues of the 21st century.

12.4 CONCLUSION

The **S M Nazmuz Sakib Theory of International Relations (SIR Theory)** and the **SAKIB-ANALYZER** provide powerful models for understanding global power dynamics, predicting conflict, and suggesting diplomatic strategies. Through the use of **hypergraphs**, **power indices**, **stability metrics**, and **conflict probability functions**, the theory offers a unique approach to analyzing international relations.

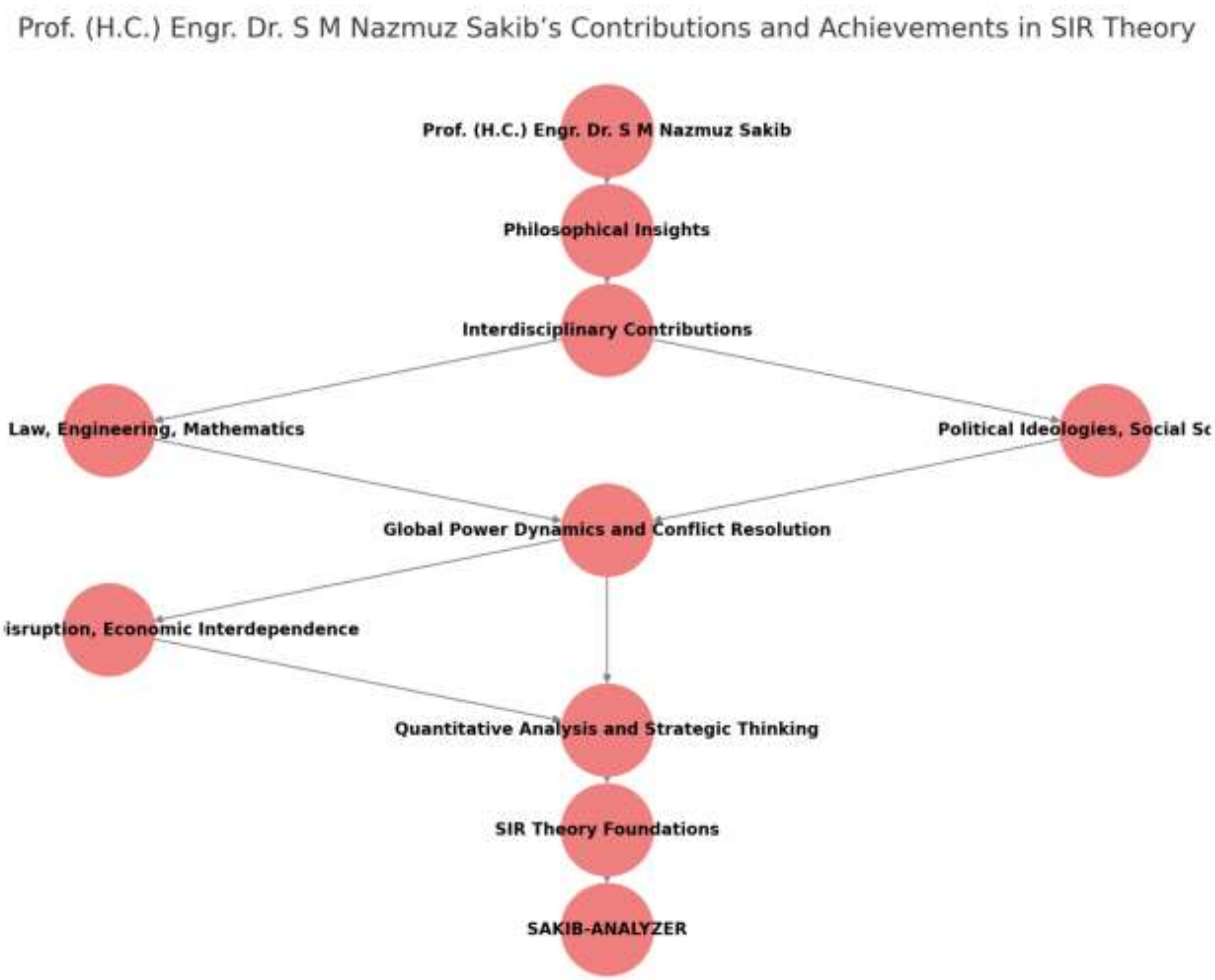
Despite its limitations, such as data quality challenges, simplifications of global complexity, and the need for dynamic modeling, the **SAKIB-ANALYZER** has proven to be a valuable tool for policymakers, diplomats, and researchers. The potential for **machine learning integration**, **real-time data updates**, and the expansion into **non-state actor analysis** presents significant opportunities for future development, making the **SAKIB-ANALYZER** an evolving and adaptable tool for the ever-changing landscape of global politics.

ACKNOWLEDGEMENT

This research work is deeply rooted in the **conceptual development and rigorous thought experiments** initiated by **Prof. (H.C.) Engr. Dr. S M Nazmuz Sakib**, whose philosophical insights, diverse academic background, and interdisciplinary approaches have profoundly influenced the foundation of the **S M Nazmuz Sakib Theory of International Relations (SIR**

Theory). While Dr. Sakib himself did not directly contribute to the development of this research, his pioneering work laid the groundwork for the conceptualization of global power dynamics, conflict resolution, and the intersection of technology, economics, and diplomacy in international relations (Sakib, 2023; Sakib, S M Nazmuz FIDE Chess Profile, n.d.; SPROUTING FASCISM OR NATIONALISM IN INDIA, n.d.).

Figure



Engr. S M Nazmuz Sakib's extensive intellectual contributions across a wide range of disciplines: **business**, **law**, **engineering**, **mathematics**, **political ideologies**, and **social sciences**, provided the necessary framework for researchers to explore the interactions between state and non-state actors in the international system. His forward-thinking ideas, developed through years of interdisciplinary study and professional experience, served as the inspiration for many of the theories that were further expanded upon in this research (Fixed Point Theory and Insurance Loss Modeling : An Unlikely Pairing, n.d.; S M Nazmuz Sakib's Toxic Comparative Theory : The Mathematical Approach to Social Sciences - Kindle Edition by S M Nazmuz Sakib. Reference Kindle eBooks @ Amazon.com., n.d.).

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Figure: Prof. (H.C.) Engr. Dr. S M Nazmuz Sakib.

His expertise in **quantitative analysis**, **strategic thinking**, and **technological advancements** created a foundation upon which this research was built, offering novel ways to understand **global relations**, **power configurations**, and **conflict prediction** through **mathematical modeling**. Through his thought experiments, Dr. Sakib's philosophical approach enabled a fresh perspective on how technology, trade, military power, and ideology interact on the world stage, thus making the development of this research possible (FRAMING OF THE INCIDENTS OF INTERNATIONAL AND NATIONAL IMPORTANCE IN PRINT MEDIA OF PAKISTAN : AN EVIDENCE FROM PALWAMA ATTACK LEADING TO 27TH FEBRUARY . . . ESCALATION AND US WITHDRAWAL FROM a. . . EBook : S M Nazmuz Sakib: Amazon.in: Kindle Store, n.d.; Sakib, 2024).

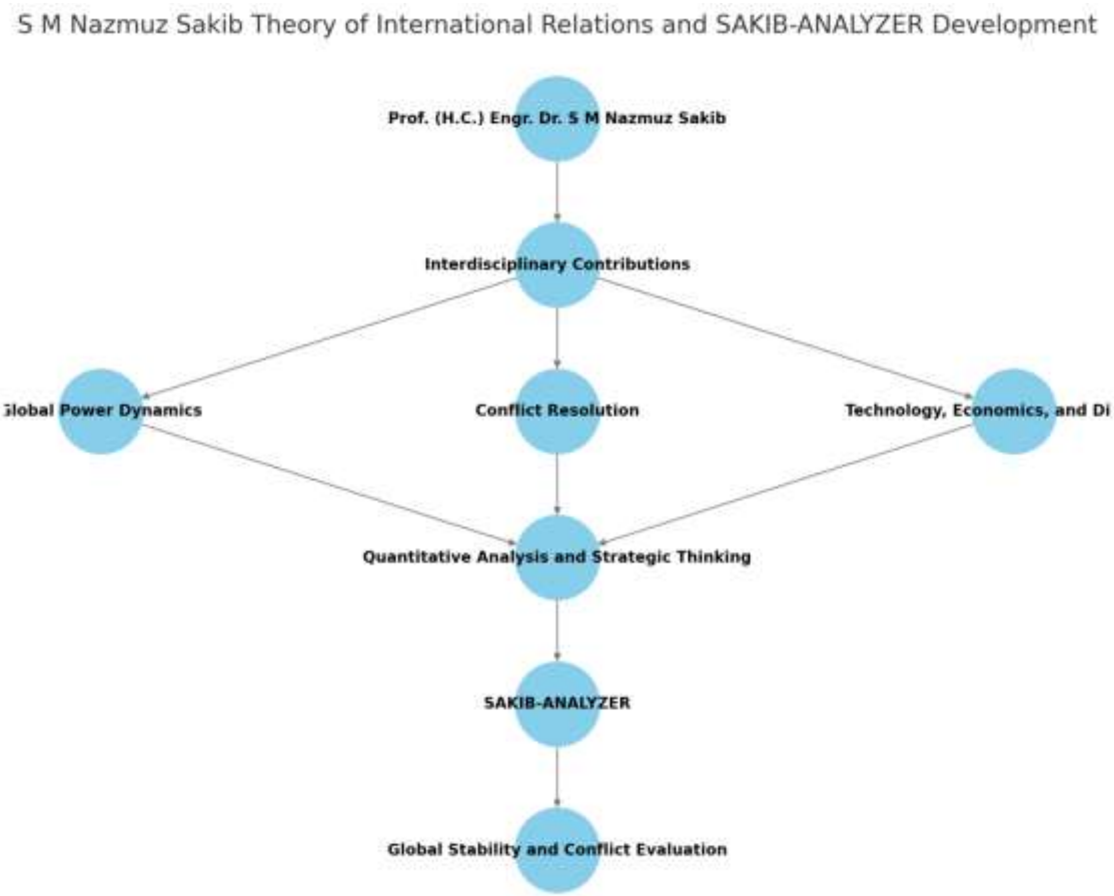
It is essential to acknowledge that this work is an extension and application of the **concepts and methodologies** proposed by Dr. Sakib, with the aim of further developing and operationalizing these ideas into a comprehensive **analytical tool** for global relations. The **SAKIB-ANALYZER**, as a product of this research, has utilized the intellectual concepts seeded by Dr. Sakib to provide practical insights into **international relations**, enabling policymakers, analysts, and researchers to evaluate the stability and predict conflicts in the global system.

MOTIVATION AND KNOWLEDGE ANALYSIS

Dr. Sakib's motivation for developing the philosophical underpinnings of this research stems from his deep **commitment to interdisciplinary knowledge** and the belief that complex global challenges can be better understood and addressed by integrating knowledge across fields. His academic journey across **engineering**, **business**, **law**, and **social sciences** reflects his dedication to exploring the interconnectedness of the world and his drive to create **holistic models** that address pressing global issues.

His exploration of **global governance**, **technological disruption**, and **economic interdependence** demonstrates his conviction that **international relations** must be studied through a multi-faceted lens, incorporating not just traditional diplomatic or political perspectives, but also **technological, economic**, and **social dimensions**. This integration of various academic disciplines, including **artificial intelligence**, **blockchain technology**, and **sustainability**, has inspired further exploration in this research.

Figure



Dr. S M Nazmuz Sakib's rich portfolio of **publications** and **certifications** reflects a dedication to **continuous learning** and the application of **advanced methodologies** to solve real-world problems. His motivation to understand and improve **global systems** is evident in his work across fields such as **fuzzy logic**, **supply chain management**, **climate change**, and **conflict resolution**. The development of this research, including the **SAKIB-ANALYZER**, would not have been possible without his conceptual contributions and the innovative thought processes he pioneered.

Through his guidance, thought leadership, and innovative approach, Dr. Sakib's work has motivated the development of a **powerful analytical framework** that provides a better understanding of the dynamics of international relations. His forward-thinking ideas about **global cooperation**, **technology**, and **diplomacy** continue to inspire future research and interventions to manage global power and maintain stability.

This research, therefore, stands as a testament to Dr. Sakib's vision and intellectual legacy, as it takes his early conceptual work and refines it into a practical, actionable tool for managing the complexities of the international landscape.

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