**Path-based Knowledge-graph Recommendation System Counterfactual Analysis**

**Introduction**

Recommender systems are pivotal in guiding user choices in various domains by suggesting products, services, or information tailored to their preferences. However, the complexity of these systems often results in a lack of transparency, making it difficult for users to understand the basis of specific recommendations. This thesis proposes the development of a counterfactual analysis framework applied to path-based knowledge-graph recommender systems. The aim is to improve the explainability of these systems by analyzing how different hypothetical attributes of products might influence the recommendations.

**Objectives**

1. To develop a counterfactual framework capable of evaluating how changes in product attributes could affect the recommendations in a knowledge graph-based system.
2. To identify and evaluate the influence of relevant attributes and behavioral scenarios on the products recommended by the system.

**Methodology**

1. Framework Development:

Develop a counterfactual analysis framework that inputs a recommended path and outputs how the recommendation might change with different hypothetical product attributes.

Extract all attributes and interactions related to a recommended product and identify all products linked to these attributes, to collect assumingly most relevant scenario space for a given recommended product.

1. Attribute Selection and Community Detection:

Apply community detection algorithms within the knowledge graph to cluster connected attributes and products based on their relevance and interaction.

Filter attributes by setting a threshold for selection, prioritizing those within the same community as the recommended product.

1. Counterfactual Scenario Testing:

Conduct isolated analysis for each attribute by computing the recommendation score for paths altered by hypothetical attributes.

Compare these scores against the scores of top recommended products to determine if the altered product would still be recommended.

1. Evaluation:

Test the framework with various sets of attributes and user scenarios to evaluate its effectiveness in enhancing recommendation explainability.

**Expected Outcomes**

Enhanced User Insight: Achieve a deeper understanding of the user profile through transparent recommendation rationales.

Strategic Market Analysis: Provide market analysts with refined tools for understanding consumer behavior, aiding in the development of more effective marketing strategies.

Diversified Recommendations: Generate options for greater diversity in product recommendations, potentially enhancing user engagement and retention rates.

**Significance**

This thesis will contribute to the fields of recommender systems and user experience by offering a novel approach to explain recommendations through counterfactual reasoning. This approach will assist businesses in refining their recommendation algorithms based on user feedback and behavior analysis.