Semester	T.E. Semester V– Computer Engineering
Subject	Probabilistic Graphical Model (PGM)
Subject Professor In-charge	Prof .Ravindra Sangle
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Assignment Number:	01
Assignment Question:	What probabilistic models are employed for recommendation systems in e-commerce platforms?
Description:	**simplified example illustrating how a probabilistic recommendation system could work for an online fashion retailer.**

Example: Personalized Fashion Recommendations for an Online Retailer

Scenario: Imagine you're a data scientist working for an online fashion retailer called "FashionFusion." FashionFusion wants to improve its recommendation system to boost user engagement and sales. They decide to use probabilistic models for more accurate and personalized recommendations.

1. **Data Collection:**
   FashionFusion collects user data, including past purchase history, browsing behavior, demographics, and click-through rates on previous recommendations.

2. **Feature Engineering:**
   - Features are created from the collected data, such as:
   - User demographics (e.g., age, gender, location)
   - Past purchase history (e.g., categories of clothing bought)
   - Product attributes (e.g., brand, color, size)
   - User behavior (e.g., time spent on product pages, frequency of visits)

3. **Probabilistic Matrix Factorization**:
   FashionFusion uses a probabilistic matrix factorization model to understand user-item interactions. This model uncovers latent factors

that influence user preferences and item characteristics.

For example, it might discover that users who purchased high-end shoes in the past tend to also buy designer handbags.

4. **Bayesian Personalized Ranking (BPR):**

   To generate personalized fashion rankings for each user, FashionFusion employs a BPR model.

   Let's say a user, Sarah, is looking for shoes. BPR calculates the probability that Sarah prefers one pair of shoes over another based on her past behavior.

   It also considers factors like Sarah's unique preferences and specific shoe characteristics.

5. **Contextual Information:**

   FashionFusion includes contextual information in the recommendation system.

   For instance, they use Bayesian neural networks to model how factors like the current season, weather, and Sarah's location influence her fashion preferences.

6. **A/B Testing:**

   FashionFusion conducts A/B testing to evaluate the performance of the new probabilistic recommendation system.

   They randomly assign users to two groups: Group A with the probabilistic recommendations and Group B with the old recommendations.

   Key metrics like click-through rates, conversion rates, and revenue per user are tracked.

| Input | Product Clustering | Feature Processing | Data Augmentation | Model | Prediction |
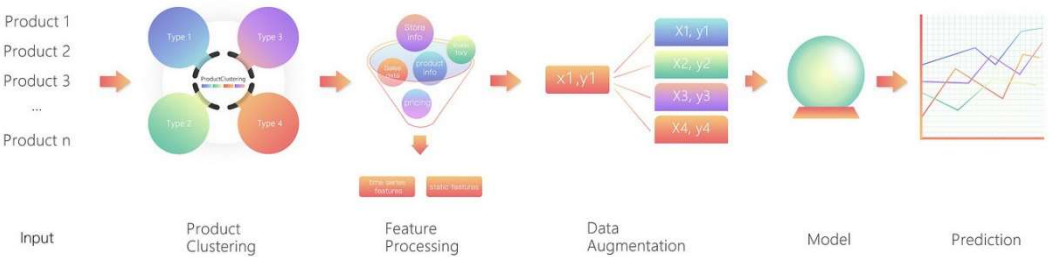
Results:

Sarah, a FashionFusion customer, logs into her account. She's shown a selection of shoes, and they feel more tailored to her style and needs. This personalization keeps her engaged.

Sarah clicks on a pair of shoes recommended by the system, adds them to her cart, and eventually makes a purchase.

FashionFusion's sales and conversion rates increase because users like Sarah are more likely to buy items recommended to them.

The probabilistic system also provides uncertainty estimates, which Sarah finds helpful when exploring new fashion styles.

	A/B testing reveals that Group A, the group with probabilistic recommendations, outperforms Group B in all key metrics, demonstrating the effectiveness of the new recommendation system.