### **1. Click-Through Rate (CTR)**

* **Definition**: The ratio of users who click on a recommended product to the total number of users who view the recommendations.
* **Why it matters**: A higher CTR indicates that the recommendations are relevant and capture the users' interest.
* **Formula**: CTR=Number of clicks on recommended productsNumber of users viewing recommendations×100\text{CTR} = \frac{\text{Number of clicks on recommended products}}{\text{Number of users viewing recommendations}} \times 100CTR=Number of users viewing recommendationsNumber of clicks on recommended products​×100

### **2. Conversion Rate**

* **Definition**: The percentage of users who click on a recommended product and make a purchase.
* **Why it matters**: This shows how well the recommended products align with users' purchase intent.
* **Formula**: Conversion Rate=Number of purchases from recommendationsNumber of users viewing recommendations×100\text{Conversion Rate} = \frac{\text{Number of purchases from recommendations}}{\text{Number of users viewing recommendations}} \times 100Conversion Rate=Number of users viewing recommendationsNumber of purchases from recommendations​×100

### **3. Engagement Rate**

* **Definition**: Measures how engaged users are with the recommended products (e.g., viewing details, adding to cart, or saving for later).
* **Why it matters**: Engagement rate can indicate whether the recommendations resonate with users, even if they don't convert immediately.
* **Formula**: Engagement Rate=Number of interactions (e.g., views, saves, shares, adds to cart)Number of users viewing recommendations×100\text{Engagement Rate} = \frac{\text{Number of interactions (e.g., views, saves, shares, adds to cart)}}{\text{Number of users viewing recommendations}} \times 100Engagement Rate=Number of users viewing recommendationsNumber of interactions (e.g., views, saves, shares, adds to cart)​×100

### **4. Average Order Value (AOV) from Recommendations**

* **Definition**: The average dollar amount spent by users who make purchases through recommendations.
* **Why it matters**: If recommendations consistently lead to higher-value purchases, it’s a sign that the system is effectively surfacing desirable products.
* **Formula**: AOV=Total revenue from recommended productsNumber of orders from recommendations\text{AOV} = \frac{\text{Total revenue from recommended products}}{\text{Number of orders from recommendations}}AOV=Number of orders from recommendationsTotal revenue from recommended products​

### **5. Recommendation Relevance Score**

* **Definition**: A score based on user feedback (e.g., thumbs up/down or star rating) regarding how relevant the recommended products are.
* **Why it matters**: Direct user feedback provides valuable insights into whether the recommendations align with user intent.
* **Formula**: Aggregate user ratings (e.g., average out of 5 stars) for the recommended products.

### **6. Bounce Rate on Recommended Products**

* **Definition**: The percentage of users who click on a recommended product but leave without interacting further (e.g., without viewing details or adding to cart).
* **Why it matters**: A high bounce rate suggests that while the recommendation may be intriguing, it doesn’t align with user expectations after they click.
* **Formula**: Bounce Rate=Number of users who clicked a recommended product and left without further actionNumber of users who clicked a recommended product×100\text{Bounce Rate} = \frac{\text{Number of users who clicked a recommended product and left without further action}}{\text{Number of users who clicked a recommended product}} \times 100Bounce Rate=Number of users who clicked a recommended productNumber of users who clicked a recommended product and left without further action​×100

### **7. Product Diversity in Recommendations**

* **Definition**: Measures how diverse the recommended products are across categories, sellers, or price ranges.
* **Why it matters**: If recommendations are overly similar, they may not cover the full range of user intent. Diversity in recommendations can enhance user experience by offering a broader selection.
* **Formula**: Track the number of unique categories, price ranges, or sellers represented in a set of recommendations.

### **8. Time to First Click on Recommended Products**

* **Definition**: The average time it takes for a user to click on one of the recommended products after they are presented.
* **Why it matters**: Shorter time to first click can indicate that the recommendations are quickly recognized as relevant by the user.
* **Formula**: Time to First Click=Total time between recommendation display and first clickNumber of users who clicked on a recommendation\text{Time to First Click} = \frac{\text{Total time between recommendation display and first click}}{\text{Number of users who clicked on a recommendation}}Time to First Click=Number of users who clicked on a recommendationTotal time between recommendation display and first click​

### **9. Session Length Following a Recommendation**

* **Definition**: Measures how long users stay on Etsy after interacting with a recommendation.
* **Why it matters**: A longer session suggests that the user is engaged and finding the recommendations useful, leading them to continue browsing.
* **Formula**: Average Session Length=Total session duration after clicking a recommendationNumber of users who clicked a recommendation\text{Average Session Length} = \frac{\text{Total session duration after clicking a recommendation}}{\text{Number of users who clicked a recommendation}}Average Session Length=Number of users who clicked a recommendationTotal session duration after clicking a recommendation​

### **10. Recommendation Accuracy (Embedding Similarity Score)**

* **Definition**: Measures the similarity score between the uploaded image’s embedding and the embeddings of recommended products.
* **Why it matters**: This is a technical metric that shows how closely the recommended images match the visual content of the uploaded image, ensuring the CNN is working effectively.
* **Formula**: Accuracy=Average cosine similarity or Euclidean distance between query image and recommended images\text{Accuracy} = \text{Average cosine similarity or Euclidean distance between query image and recommended images}Accuracy=Average cosine similarity or Euclidean distance between query image and recommended images

### **11. User Retention Rate Post-Interaction**

* **Definition**: Measures the percentage of users who return to Etsy after engaging with recommended products.
* **Why it matters**: This metric reflects how well the recommendations influence long-term user satisfaction and loyalty.
* **Formula**: Retention Rate=Number of users returning after engaging with recommendationsTotal number of users who engaged with recommendations×100\text{Retention Rate} = \frac{\text{Number of users returning after engaging with recommendations}}{\text{Total number of users who engaged with recommendations}} \times 100Retention Rate=Total number of users who engaged with recommendationsNumber of users returning after engaging with recommendations​×100

### **12. Precision and Recall of the Recommendations:**

* **Precision**: The percentage of relevant recommendations out of the total recommended products.
  + **Why it matters**: A high precision means the recommendations are generally relevant to the user’s search intent.
  + **Formula**: Precision=Number of relevant recommended productsTotal number of recommended products\text{Precision} = \frac{\text{Number of relevant recommended products}}{\text{Total number of recommended products}}Precision=Total number of recommended productsNumber of relevant recommended products​
* **Recall**: The percentage of relevant recommended products out of the total relevant products available in the database.
  + **Why it matters**: A high recall means the system is surfacing a good variety of relevant products from the database.
  + **Formula**: Recall=Number of relevant recommended productsTotal number of relevant products in the dataset\text{Recall} = \frac{\text{Number of relevant recommended products}}{\text{Total number of relevant products in the dataset}}Recall=Total number of relevant products in the datasetNumber of relevant recommended products​

### **13. User Satisfaction Rate**

* **Definition**: Collect user feedback after a search session, asking users how satisfied they are with the recommendation results.
* **Why it matters**: This is a direct measure of how well the recommendations align with user expectations and intent.
* **Formula**: User Satisfaction Rate=Number of positive feedback ratingsTotal number of feedback ratings×100\text{User Satisfaction Rate} = \frac{\text{Number of positive feedback ratings}}{\text{Total number of feedback ratings}} \times 100User Satisfaction Rate=Total number of feedback ratingsNumber of positive feedback ratings​×100