## **Problem Statement**

In today's digital landscape, organizations manage vast repositories of visual content. The ability to efficiently search and interpret this content using natural language queries presents a sophisticated technical challenge, requiring a combination of computer vision, natural language processing (NLP), and scalable system design.

Your task is to **design and implement an enterprise-grade visual search system** that enables users to locate relevant images based on natural language queries while providing AI-driven explanations for the search results. Given the complexity of this problem, a highly optimized and scalable solution is expected.

This challenge requires a strategic approach to system design, efficiency optimization, and explainability in AI-driven search.

## **Key Requirements**

### **1. Data Processing & Embedding Generation**

* Utilize the provided dataset (accessible via photos\_url.csv and download\_images.py).
* Implement efficient image embedding extraction using modern vision models.
* Design a scalable storage solution for the generated embeddings to ensure quick retrieval.

### **2. Semantic Search Implementation**

* Develop a **robust semantic search** mechanism to match textual queries with relevant images.
* The system should return **the top 5 most relevant images** for each query.
* Optimize search operations to maintain a **latency of under 3-5 seconds**.

### **3. AI-Powered Explanation Generation**

* Implement a component that generates **concise yet insightful explanations** for why an image is relevant to a given query.
* The explanations should refer to **specific visual elements, attributes, and context** within the image.
* Ensure explanations are business-appropriate and technically sound.

### **4. Scalable System Architecture**

* Develop a **production-ready API** using FastAPI.
* Implement a **clean and intuitive web interface** for users to interact with the system.
* Ensure the system is **containerized** using Docker and ready for **cloud deployment**.
* Optimize the system for handling **high concurrency and large-scale datasets**.

## **Dataset Access & Setup**

1. The dataset is provided in photos\_url.csv.
2. Use the provided download\_images.py script to retrieve image files.
3. Implement a **preprocessing pipeline** to generate embeddings and store them efficiently.

## **Evaluation Criteria**

Your solution will be evaluated based on the following aspects:

* **Technical Depth**: Quality of algorithms used for embedding generation, search accuracy, and explanation generation.
* **System Performance**: Efficiency of the search mechanism, latency, and scalability.
* **Architectural Design**: Maintainability, deployment readiness, and API efficiency.
* **Explainability & UX**: Clarity and effectiveness of AI-generated explanations and the user interface.

## **Expectations from Applicants**

This challenge requires strategic thinking and technical expertise. Your solution should not only be **technically sound but also optimized for real-world use cases**. Consider edge cases, system constraints, and user experience while designing your solution.

## **Good Luck!**