

Assignment 2

```
In [1]: !pip install langchain_google_genai faiss-cpu pandas numpy tqdm scikit-learn
```

Requirement already satisfied: langchain_google_genai in /home/zadmin/genai/lib/python3.11/site-packages (2.1.10)

Requirement already satisfied: faiss-cpu in /home/zadmin/genai/lib/python3.11/site-packages (1.12.0)

Requirement already satisfied: pandas in /home/zadmin/genai/lib/python3.11/site-packages (2.3.2)

Requirement already satisfied: numpy in /home/zadmin/genai/lib/python3.11/site-packages (1.26.4)

Requirement already satisfied: tqdm in /home/zadmin/genai/lib/python3.11/site-packages (4.67.1)

Requirement already satisfied: scikit-learn in /home/zadmin/genai/lib/python3.11/site-packages (1.7.1)

Requirement already satisfied: filetype<2.0.0,>=1.2.0 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain_google_genai) (1.2.0)

Requirement already satisfied: google-ai-generativelanguage<0.7.0,>=0.6.18 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain_google_genai) (0.6.18)

Requirement already satisfied: langchain-core<0.4.0,>=0.3.75 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain_google_genai) (0.3.75)

Requirement already satisfied: pydantic<3,>=2 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain_google_genai) (2.11.7)

Requirement already satisfied: google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1 in /home/zadmin/genai/lib/python3.11/site-packages (from google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (2.25.1)

Requirement already satisfied: google-auth!=2.24.0,!2.25.0,<3.0.0,>=2.14.1 in /home/zadmin/genai/lib/python3.11/site-packages (from google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (2.40.3)

Requirement already satisfied: proto-plus<2.0.0,>=1.22.3 in /home/zadmin/genai/lib/python3.11/site-packages (from google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (1.26.1)

Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<7.0.0,>=3.20.2 in /home/zadmin/genai/lib/python3.11/site-packages (from google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (6.32.0)

Requirement already satisfied: googleapis-common-protos<2.0.0,>=1.56.2 in /home/zadmin/genai/lib/python3.11/site-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (1.70.0)

Requirement already satisfied: requests<3.0.0,>=2.18.0 in /home/zadmin/genai/lib/python3.11/site-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (2.32.5)

Requirement already satisfied: grpcio<2.0.0,>=1.33.2 in /home/zadmin/genai/lib/python3.11/site-packages (from google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (1.74.0)

Requirement already satisfied: grpcio-status<2.0.0,>=1.33.2 in /home/zadmin/genai/lib/python3.11/site-packages (from google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.*,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (1.74.0)

Requirement already satisfied: cachetools<6.0,>=2.0.0 in /home/zadmin/genai/lib/python3.11/site-packages (from google-auth!=2.24.0,!2.25.0,<3.0.0,>=2.14.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (5.5.2)

Requirement already satisfied: pyasn1-modules>=0.2.1 in /home/zadmin/genai/lib/python3.11/site-packages (from google-auth!=2.24.0,!2.25.0,<3.0.0,>=2.14.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (0.4.2)

Requirement already satisfied: rsa<5,>=3.1.4 in /home/zadmin/genai/lib/python3.11/site-packages (from google-auth!=2.24.0,!2.25.0,<3.0.0,>=2.14.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (4.9.1)

Requirement already satisfied: langsmith>=0.3.45 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (0.4.17)

Requirement already satisfied: tenacity!=8.4.0,<10.0.0,>=8.1.0 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (9.0.0)

ib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (9.1.2)

Requirement already satisfied: jsonpatch<2.0,>=1.33 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (1.33)

Requirement already satisfied: PyYAML>=5.3 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (6.0.2)

Requirement already satisfied: typing-extensions>=4.7 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (4.14.1)

Requirement already satisfied: packaging>=23.2 in /home/zadmin/genai/lib/python3.11/site-packages (from langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (24.2)

Requirement already satisfied: jsonpointer>=1.9 in /home/zadmin/genai/lib/python3.11/site-packages (from jsonpatch<2.0,>=1.33->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (3.0.0)

Requirement already satisfied: annotated-types>=0.6.0 in /home/zadmin/genai/lib/python3.11/site-packages (from pydantic<3,>=2->langchain_google_genai) (0.7.0)

Requirement already satisfied: pydantic-core==2.33.2 in /home/zadmin/genai/lib/python3.11/site-packages (from pydantic<3,>=2->langchain_google_genai) (2.33.2)

Requirement already satisfied: typing-inspection>=0.4.0 in /home/zadmin/genai/lib/python3.11/site-packages (from pydantic<3,>=2->langchain_google_genai) (0.4.1)

Requirement already satisfied: charset-normalizer<4,>=2 in /home/zadmin/genai/lib/python3.11/site-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (3.4.3)

Requirement already satisfied: idna<4,>=2.5 in /home/zadmin/genai/lib/python3.11/site-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (3.10)

Requirement already satisfied: urllib3<3,>=1.21.1 in /home/zadmin/genai/lib/python3.11/site-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (2.5.0)

Requirement already satisfied: certifi>=2017.4.17 in /home/zadmin/genai/lib/python3.11/site-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.10.*,!=2.2.*,!=2.3.*,!=2.4.*,!=2.5.*,!=2.6.*,!=2.7.*,!=2.8.*,!=2.9.,<3.0.0,>=1.34.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (2025.8.3)

Requirement already satisfied: pyasn1>=0.1.3 in /home/zadmin/genai/lib/python3.11/site-packages (from rsa<5,>=3.1.4->google-auth!=2.24.0,!2.25.0,<3.0.0,>=2.14.1->google-ai-generativelanguage<0.7.0,>=0.6.18->langchain_google_genai) (0.6.1)

Requirement already satisfied: python-dateutil>=2.8.2 in /home/zadmin/genai/lib/python3.11/site-packages (from pandas) (2.9.0.post0)

Requirement already satisfied: pytz>=2020.1 in /home/zadmin/genai/lib/python3.11/site-packages (from pandas) (2025.2)

Requirement already satisfied: tzdata>=2022.7 in /home/zadmin/genai/lib/python3.11/site-packages (from pandas) (2025.2)

Requirement already satisfied: scipy>=1.8.0 in /home/zadmin/genai/lib/python3.11/site-packages (from scikit-learn) (1.13.1)

Requirement already satisfied: joblib>=1.2.0 in /home/zadmin/genai/lib/python3.11/site-packages (from scikit-learn) (1.5.1)

Requirement already satisfied: threadpoolctl>=3.1.0 in /home/zadmin/genai/lib/python3.11/site-packages (from scikit-learn) (3.6.0)

Requirement already satisfied: httpx<1,>=0.23.0 in /home/zadmin/genai/lib/python3.11/site-packages (from langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (0.28.1)

Requirement already satisfied: orjson>=3.9.14 in /home/zadmin/genai/lib/python3.11/site-packages (from langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (3.11.2)

Requirement already satisfied: requests-toolbelt>=1.0.0 in /home/zadmin/genai/lib/python3.11/site-packages (from langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (1.0.0)

```
on3.11/site-packages (from langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (1.0.0)
Requirement already satisfied: zstandard>=0.23.0 in /home/zadmin/genai/lib/python3.11/site-packages (from langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (0.24.0)
Requirement already satisfied: anyio in /home/zadmin/genai/lib/python3.11/site-packages (from httpx<1,>=0.23.0->langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (4.10.0)
Requirement already satisfied: httpcore==1.* in /home/zadmin/genai/lib/python3.11/site-packages (from httpx<1,>=0.23.0->langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (1.0.9)
Requirement already satisfied: h11>=0.16 in /home/zadmin/genai/lib/python3.11/site-packages (from httpcore==1.*->httpx<1,>=0.23.0->langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (0.16.0)
Requirement already satisfied: six>=1.5 in /home/zadmin/genai/lib/python3.11/site-packages (from python-dateutil>=2.8.2->pandas) (1.17.0)
Requirement already satisfied: sniffio>=1.1 in /home/zadmin/genai/lib/python3.11/site-packages (from anyio->httpx<1,>=0.23.0->langsmith>=0.3.45->langchain-core<0.4.0,>=0.3.75->langchain_google_genai) (1.3.1)
```

```
In [2]: # Load API keys from .env file
        from dotenv import load_dotenv

        load_dotenv(override=True)
```

Out[2]: True

```
In [3]: import requests
        import pandas as pd
        import numpy as np
        from typing import List, Tuple
        from sklearn.preprocessing import normalize
        import faiss
        from langchain_google_genai import GoogleGenerativeAIEmbeddings
```

Embedding Model

```
In [4]: # Dataset URL
        DATA_URL = "https://raw.githubusercontent.com/Bluedata-Consulting/GAAPB01-training-co
        LOCAL_FILE = "assignment2dataset.csv"

        # Embedding model
        embedding_model_name = "models/embedding-001"
        embeddings = GoogleGenerativeAIEmbeddings(model=embedding_model_name)
```

```
In [5]: # Load Dataset

        def load_dataset():
            try:
                r = requests.get(DATA_URL, timeout=15)
                if r.status_code == 200:
                    with open(LOCAL_FILE, "wb") as f:
                        f.write(r.content)
                    print(f"Downloaded dataset to {LOCAL_FILE}")
                else:
                    print(f"Failed to fetch from URL, status {r.status_code}")
            except Exception as e:
                print("Download error:", e)

        # Load CSV
        df = pd.read_csv(LOCAL_FILE)
        print("Loaded dataset:", df.shape)
        return df
```

```
df_catalog = load_dataset()
```

Downloaded dataset to assignment2dataset.csv

Loaded dataset: (25, 3)

```
In [6]: df_catalog.head()
```

```
Out[6]:
```

	course_id	title	description
0	C001	Foundations of Machine Learning	Understand foundational machine learning algor...
1	C002	Deep Learning with TensorFlow and Keras	Explore neural network architectures using Ten...
2	C003	Natural Language Processing Fundamentals	Dive into NLP techniques for processing and un...
3	C004	Computer Vision and Image Processing	Learn the principles of computer vision and im...
4	C005	Reinforcement Learning Basics	Get introduced to reinforcement learning parad...

```
In [7]: # Prepare Text for Embedding
def build_text(row):
    title = str(row.get("title", "")) or ""
    desc = str(row.get("description", "")) or ""
    return title.strip() + ". " + desc.strip()

df_catalog["text"] = df_catalog.apply(build_text, axis=1)
df_catalog = df_catalog.reset_index(drop=True)
```

```
In [8]: df_catalog
```

Out [8]:		course_id	title	description		text
0	C001	Foundations of Machine Learning		Understand foundational machine learning algor...	Foundations of Machine Learning. Understand fo...	
1	C002	Deep Learning with TensorFlow and Keras		Explore neural network architectures using Ten...	Deep Learning with TensorFlow and Keras. Explo...	
2	C003	Natural Language Processing Fundamentals		Dive into NLP techniques for processing and un...	Natural Language Processing Fundamentals. Dive...	
3	C004	Computer Vision and Image Processing		Learn the principles of computer vision and im...	Computer Vision and Image Processing. Learn th...	
4	C005	Reinforcement Learning Basics		Get introduced to reinforcement learning parad...	Reinforcement Learning Basics. Get introduced ...	
5	C006	Data Engineering on AWS		Build scalable data pipelines using AWS servic...	Data Engineering on AWS. Build scalable data p...	
6	C007	Cloud Computing with Azure		Master Microsoft Azure's core services: virtua...	Cloud Computing with Azure. Master Microsoft A...	
7	C008	DevOps Practices and CI/CD		Adopt DevOps methodologies to accelerate softw...	DevOps Practices and CI/CD. Adopt DevOps metho...	
8	C009	Containerization with Docker and Kubernetes		Learn container fundamentals with Docker: imag...	Containerization with Docker and Kubernetes. L...	
9	C010	APIs and Microservices Architecture		Design and implement RESTful and GraphQL APIs ...	APIs and Microservices Architecture. Design an...	
10	C011	Big Data Analytics with Spark		Process and analyze large datasets using Apach...	Big Data Analytics with Spark. Process and ana...	
11	C012	SQL for Data Analysis		Master SQL querying for data analysis and repo...	SQL for Data Analysis. Master SQL querying for...	
12	C013	NoSQL Databases and MongoDB		Explore NoSQL paradigms: key-value, document, ...	NoSQL Databases and MongoDB. Explore NoSQL par...	
13	C014	Data Visualization with Tableau		Transform raw data into compelling visual stor...	Data Visualization with Tableau. Transform raw...	
14	C015	Business Intelligence with Power BI		Leverage Microsoft Power BI to build dynamic b...	Business Intelligence with Power BI. Leverage ...	
15	C016	Python Programming for Data Science		Learn Python fundamentals for data science: va...	Python Programming for Data Science. Learn Pyt...	
16	C017	R Programming and Statistical Analysis		Get introduced to R for statistical computing ...	R Programming and Statistical Analysis. Get in...	
17	C018	Product Management Essentials		Understand the product lifecycle from ideation...	Product Management Essentials. Understand the ...	
18	C019	Agile and Scrum Mastery		Adopt Agile frameworks to enhance team product...	Agile and Scrum Mastery. Adopt Agile framework...	

	course_id	title	description	text
19	C020	User Experience (UX) Design Principles	Learn UX design fundamentals: user research, p...	User Experience (UX) Design Principles. Learn ...
20	C021	Cybersecurity Fundamentals	Get introduced to cybersecurity principles: th...	Cybersecurity Fundamentals. Get introduced to ...
21	C022	Internet of Things (IoT) Development	Explore IoT architecture, sensors, and edge co...	Internet of Things (IoT) Development. Explore ...
22	C023	Blockchain Technology and Smart Contracts	Understand blockchain fundamentals: cryptograp...	Blockchain Technology and Smart Contracts. Und...
23	C024	Augmented and Virtual Reality Development	Dive into AR/VR concepts, device ecosystems, a...	Augmented and Virtual Reality Development. Div...
24	C025	MLOps: Productionizing Machine Learning	Master the practices needed to deploy and main...	MLOps: Productionizing Machine Learning. Maste...

```
In [9]: # Embed Courses
def embed_texts(texts: List[str]) -> np.ndarray:
    vectors = embeddings.embed_documents(texts) # list of lists
    arr = np.array(vectors, dtype="float32")
    arr = normalize(arr, norm="l2", axis=1) # normalize for cosine similarity
    return arr

course_texts = df_catalog["text"].tolist()
course_embs = embed_texts(course_texts)
print("Course embeddings shape:", course_embs.shape)
```

Course embeddings shape: (25, 768)

```
In [10]: # Build FAISS Index
def build_faiss_index(embs: np.ndarray):
    d = embs.shape[1]
    index = faiss.IndexFlatIP(d) # cosine similarity
    index.add(embs)
    return index

index = build_faiss_index(course_embs)
metadata = df_catalog.to_dict(orient="index")
```

```
In [11]: # Recommendation Function
def recommend_courses(profile: str, completed_ids: List[str]) -> List[Tuple[str, float]]:
    topn = 5 # Top 5 recommendations

    # Build query string
    completed_titles = []
    for cid in completed_ids:
        match = df_catalog[df_catalog["course_id"].astype(str) == str(cid)]
        if len(match) > 0:
            completed_titles.append(match.iloc[0]["title"])
    query_text = "Completed: " + "; ".join(completed_titles) + ". Interests: " + prof

    # Embed query
    q_emb = np.array(embeddings.embed_query(query_text), dtype="float32").reshape(1, 768)
    q_emb = normalize(q_emb, norm="l2", axis=1)

    # Search FAISS
    distances, indices = index.search(q_emb, 20)
```

```

# Filter results
results = []
seen = set()
for idx, score in zip(indices[0], distances[0]):
    cid = str(metadata[idx]["course_id"])
    if cid in completed_ids or cid in seen:
        continue
    seen.add(cid)
    results.append((cid, float(score)))
    if len(results) >= topn:
        break
return results

```

```

In [12]: # Helper to Get Course Info
def get_course_info(course_id):
    row = df_catalog[df_catalog["course_id"].astype(str) == str(course_id)]
    if len(row) == 0:
        return None
    r = row.iloc[0]
    return {"course_id": r["course_id"], "title": r["title"], "description": r["descr

```

```

In [15]: # Test with Sample Profiles
sample_profiles = [
    {"query": "I've completed the 'Python Programming for Data Science' course and en",
     "completed_ids": ["C016"]},
    {"query": "I know Azure basics and want to manage containers and build CI/CD pipe",
     "completed_ids": []},
    {"query": "My background is in ML fundamentals; I'd like to specialize in neural",
     "completed_ids": []},
    {"query": "I want to learn to build and deploy microservices with Kubernetes—what",
     "completed_ids": []},
    {"query": "I'm interested in blockchain and smart contracts but have no prior exp",
     "completed_ids": []}
]

for i, profile in enumerate(sample_profiles, 1):
    print(f"\n=== Profile {i}: {profile['query']}")
    recs = recommend_courses(profile["query"], profile["completed_ids"])
    for cid, score in recs:
        info = get_course_info(cid)
        print(f" -> {cid} | {info['title']} | Score: {score:.4f}")

```


=== Profile 1: I've completed the 'Python Programming for Data Science' course and enjoy data visualization. What should I take next?

- > C017 | R Programming and Statistical Analysis | Score: 0.8230
- > C001 | Foundations of Machine Learning | Score: 0.8162
- > C002 | Deep Learning with TensorFlow and Keras | Score: 0.8127
- > C011 | Big Data Analytics with Spark | Score: 0.8118
- > C014 | Data Visualization with Tableau | Score: 0.8100

=== Profile 2: I know Azure basics and want to manage containers and build CI/CD pipelines. Recommend courses.

- > C009 | Containerization with Docker and Kubernetes | Score: 0.8192
- > C007 | Cloud Computing with Azure | Score: 0.8190
- > C008 | DevOps Practices and CI/CD | Score: 0.8123
- > C010 | APIs and Microservices Architecture | Score: 0.7806
- > C002 | Deep Learning with TensorFlow and Keras | Score: 0.7706

=== Profile 3: My background is in ML fundamentals; I'd like to specialize in neural networks and production workflows.

- > C002 | Deep Learning with TensorFlow and Keras | Score: 0.8219
- > C001 | Foundations of Machine Learning | Score: 0.7982
- > C004 | Computer Vision and Image Processing | Score: 0.7754
- > C016 | Python Programming for Data Science | Score: 0.7742
- > C025 | MLOps: Productionizing Machine Learning | Score: 0.7694

=== Profile 4: I want to learn to build and deploy microservices with Kubernetes—what courses fit best?

- > C009 | Containerization with Docker and Kubernetes | Score: 0.8650
- > C010 | APIs and Microservices Architecture | Score: 0.8571
- > C002 | Deep Learning with TensorFlow and Keras | Score: 0.8221
- > C008 | DevOps Practices and CI/CD | Score: 0.8077
- > C025 | MLOps: Productionizing Machine Learning | Score: 0.7993

=== Profile 5: I'm interested in blockchain and smart contracts but have no prior experience. Which courses do you suggest?

- > C023 | Blockchain Technology and Smart Contracts | Score: 0.8562
- > C002 | Deep Learning with TensorFlow and Keras | Score: 0.7944
- > C022 | Internet of Things (IoT) Development | Score: 0.7855
- > C013 | NoSQL Databases and MongoDB | Score: 0.7833
- > C010 | APIs and Microservices Architecture | Score: 0.7795