Data Warehouse & Business Intelligence Project Report.

Collab Notebook Link: **DWH.ipynb**

Assignment Requirements

- Connect to at least two academic data sources (e.g., Semantic Scholar and Google Scholar).
- Write Python functions to fetch research papers using APIs.
- Design a data warehouse schema inside **Supabase** containing tables such as `papers`, `authors`, `paper_authors`, and `ingest_log`.
- Handle errors, API limits, and data quality issues.
- Implement deduplication logic so that the same paper appearing in both sources is stored only once.
- Log each ingestion with topic, counts, and timestamp.
- Submit a well-documented Jupyter Notebook and Report.

Proposed Solution and Architecture

The implemented solution was a modular, step-by-step ETL pipeline built in **Python (Jupyter Notebook)**. It follows the three classic stages of data warehousing:The overall flow is visualized as:

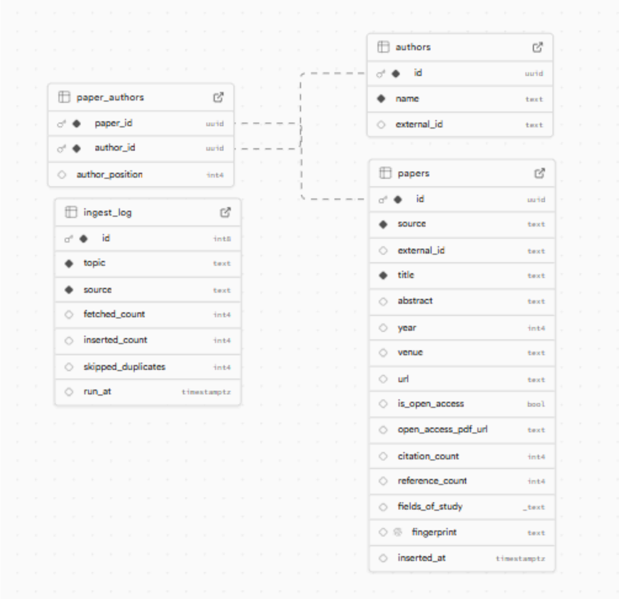
```
Semantic Scholar + Google Scholar
             ↓
       Fetch & Parse JSON
             ↓
  Normalize (title, authors, year)
             ↓
     Generate Fingerprints
             ↓
         Deduplicate
             ↓
        Insert → Supabase
             ↓
         Log Summary
```

Detailed Step-by-Step Implementation

Step 1 — Connecting to Supabase

A Supabase project was created and configured with the URL and Anon Key.
Tables were defined using SQL DDL:

The Python client was tested with a simple `.select("*")` query to confirm connection.



paper_authors	
paper_id	uuid
author_id	uuid
author_position	int4

ingest_log	
id	int8
topic	text
source	text
fetched_count	int4
inserted_count	int4
skipped_duplicates	int4
run_at	timestamptz

authors	
id	uuid
name	text
external_id	text

papers	
id	uuid
source	text
external_id	text
title	text
abstract	text
year	int4
venue	text
url	text
is_open_access	bool
open_access_pdf_url	text
citation_count	int4
reference_count	int4
fields_of_study	_text
fingerprint	text
inserted_at	timestamptz

Step 2 — Fetching from Semantic Scholar

A function `fetch_all_from_semantic_scholar(api_key, topic, max_pages, per_page)` used the Semantic Scholar REST API.

Step 3 — Fetching from Google Scholar via SerpApi

Because Google Scholar has no public API, the **SerpApi** REST endpoint was used.
The function `fetch_from_google_scholar_serpapi(topic, api_key, limit)` fetched 10 papers per page until the limit was reached.
It extracted titles, snippets, authors, links, and citation counts.
This ensured compliance with API rate limits and avoided blocking errors (`429 Too Many Requests`).

Step 4 — Data Merging

Instead of inserting data separately (as in earlier versions), both lists were concatenated:

```
all_papers = semantic_papers + google_papers
```

This produced one combined dataset representing all research results for the given topic.

Step 5 — Data Cleaning and Normalization

- Converted all titles to lowercase.
- Removed punctuation and extra spaces.
- Replaced missing values with empty strings.
- Ensured consistent author list format (e.g., `['A. Smith', 'B. Jones']`).

Step 6 — Fingerprint Deduplication

A custom function `make_fingerprint()` was defined:

```
def make_fingerprint(title, first_author, year):
```

By combining normalized title, first author, and year, each record became uniquely identifiable.
The helper `deduplicate_papers()` removed any repeated fingerprints, ensuring one unique record per paper across both sources.

Step 7 — Loading into Supabase

The function `populate_all_tables(topic, cleaned_papers, batch_size=50)` performed batch insertions:

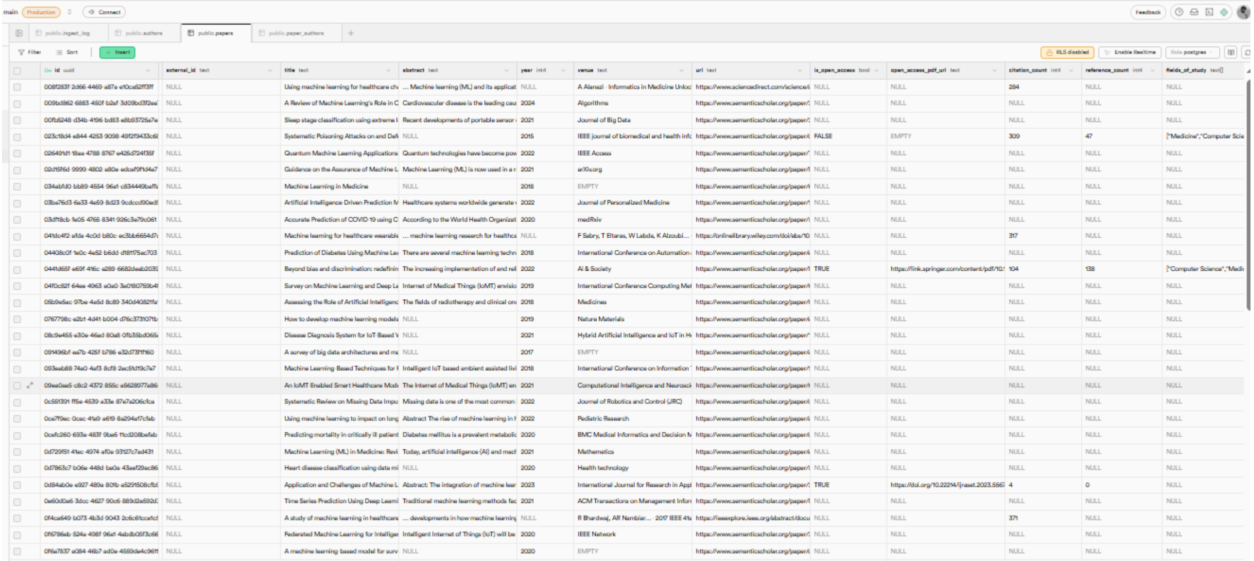
1. Inserted into `papers`.

2. Inserted unique authors into `authors`.

3. Created links in `paper_authors`.

4. Logged counts in `ingest_log`.

5. All database operations used Supabase's Python client for transactional safety.



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008f283f 2d66 4469 a87a e10ca52ff3ff	NULL	Using machine learning for healthcare ch	... Machine learning (ML) and its applicat	NULL	A Alanazi · Informatics in Medicine Unloc	https://www.sciencedirect.com/science/	NULL	NULL	284	NULL	NULL
009bd862 6883 450f b2af 3d09bd3f2ea	NULL	A Review of Machine Learning's Role in C	Cardiovascular disease is the leading cau	2024	Algorithms	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
00fb6248 d34b 4196 bd83 e8b93725a7e	NULL	Sleep stage classification using extreme l	Recent developments of portable sensor	2021	Journal of Big Data	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
023c18d4 e844 4253 9098 49f2f9433c6	NULL	Systematic Poisoning Attacks on and Def	NULL	2015	IEEE journal of biomedical and health info	https://www.semanticscholar.org/paper/	FALSE	EMPTY	309	47	["Medicine","Computer Scie
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03ba76d3 6a33 4e59 8d23 9cdccd90ed	NULL	Artificial Intelligence Driven Prediction M	Healthcare systems worldwide generate	2022	Journal of Personalized Medicine	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
03df18cb fe05 4765 8341 926c3e79c061	NULL	Accurate Prediction of COVID 19 using C	According to the World Health Organizat	2020	medRxiv	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
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04408c0f 1e0c 4e52 b6dd d181175ac703	NULL	Prediction of Diabetes Using Machine Le	There are several machine learning techn	2018	International Conference on Automation	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
0441d65f e69f 416c a289 6682deab203	NULL	Beyond bias and discrimination: redefinin	The increasing implementation of and rel	2022	AI & Society	https://www.semanticscholar.org/paper/	TRUE	https://link.springer.com/content/pdf/10.	104	138	["Computer Science","Medi
04f0c82f 64ee 4963 a0a0 3e0180759b4	NULL	Survey on Machine Learning and Deep Le	Internet of Medical Things (IoMT) envisio	2019	International Conference Computing Met	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
05b9e5ac 97be 4e5d 8c89 340d40821fe	NULL	Assessing the Role of Artificial Intelligenc	The fields of radiotherapy and clinical onc	2018	Medicines	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
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093eeb88 74e0 4af3 8cf8 2ec51d19c7e7	NULL	Machine Learning Based Techniques for F	Intelligent IoT based ambient assisted livi	2018	International Conference on Information	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
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0c561391 ff5e 4539 a33e 87e7a206cfca	NULL	Systematic Review on Missing Data Impu	Missing data is one of the most common	2022	Journal of Robotics and Control (JRC)	https://www.semanticscholar.org/paper/	NULL	NULL	NULL	NULL	NULL
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