Indicium Health Data Agent - Project Documentation

Project Overview

This project implements an autonomous AI system designed to monitor public health data from **DATASUS (OpenDataSUS)** and correlate it with recent news articles. The system uses a multi-agent architecture powered by **LangGraph** to automate the process of data collection, validation, curation, and report generation.

High-Level Architecture

The system is organized into three main pipelines that execute in parallel and join for the final report creation.

1. Data Pipeline (Data Specialist Agent)

Responsible for handling epidemiological data from the SRAG (Severe Acute Respiratory Syndrome) database.

- **Fetch**: Automatically identifies the most recent CSV file from the OpenDataSUS portal based on year and metadata.
- **LLM Mapping**: Uses an LLM to map inconsistent or changing CSV column names to a standardized schema using the official data dictionary PDF as context.
- **Transformation**: Filters data by date range (last 12 months) and cleans fields for analysis.

2. News Pipeline (News Curator Agent)

Responsible for fetching and summarizing relevant public health news.

- **LLM Topic Expansion**: Uses an LLM to generate synonyms and related search terms to ensure comprehensive coverage.
- **Search**: Scrapes DuckDuckGo News for the expanded topics.
- **LLM Curation**: For each article found, an LLM checks for relevance to the specific health topic and generates a concise summary in Portuguese.

3. Report Generation (Report Designer Agent)

Synthesizes data and news into a visual report.

- **Metrics**: Calculates key performance indicators (KPIs) such as mortality rates, hospitalization rates, ICU occupancy, and case growth percentages using Pandas.
- **Rendering**: Generates a professional HTML report using Jinja2 templates, incorporating interactive charts (via Chart.js) and curated news cards.

Agent Tools & Functionalities

Each agent is equipped with specific tools to perform its tasks effectively.

1. Data Specialist Agent Tools

Tool	Functionality
`download_dataset`	Scrapes the OpenDataSUS portal to identify the most recent SRAG dataset, follows download links, and saves the CSV locally with a progress bar.

Tool	Functionality
`validate_columns`	**(LLM-Powered)** Reads the data dictionary PDF and the raw CSV header to intelligently map field names to the system schema.
`clean_dataset`	Loads raw data into Pandas, applies column mappings, filters by date (last 12 months), and saves a "refined" version for analysis.
`find_latest_dataset`	Scans the local `data/` directory to reuse existing files and avoid redundant downloads.

2. News Curator Agent Tools

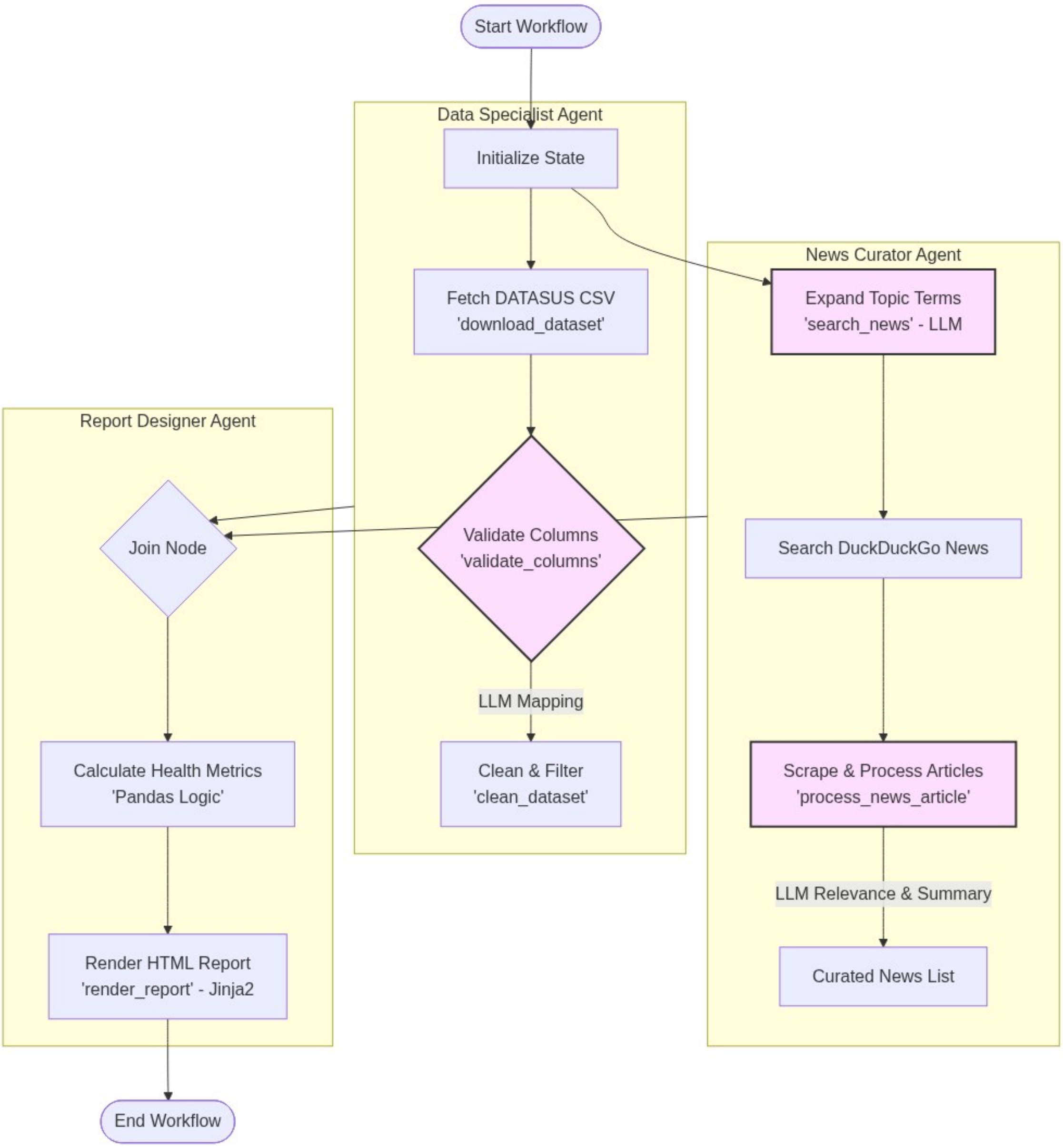
Tool	Functionality
`search_news`	**(LLM-Powered)** First expands the main topic into semantic synonyms, then performs targeted searches on DuckDuckGo News.
`process_news_article`	**(LLM-Powered)** Scrapes full article text from URLs and uses an LLM to evaluate relevance and generate a Portuguese summary.

3. Report Designer Agent Tools

Tool	Functionality
`render_report`	Uses Jinja2 templates to combine calculated metrics and news articles into a professional, responsive HTML report.
`cleanup_old_reports`	Maintains the `output/` directory by keeping only the 3 most recent reports.
Calculation Logic	

Tool	Functionality
	Executes complex Pandas aggregations for mortality, hospitalization, and growth rate calculations.

Conceptual Diagram


Start Workflow
Data Specialist Agent
Initialize State
Fetch DATASUS CSV 'download_dataset'
Validate Columns 'validate_columns'
LLM Mapping
Clean & Filter 'clean_dataset'
News Curator Agent
Expand Topic Terms 'search_news' - LLM
Search DuckDuckGo News
Scrape & Process Articles 'process_news_article'
LLM Relevance & Summary
Curated News List
Report Designer Agent
Join Node
Calculate Health Metrics 'Pandas Logic'
Render HTML Report 'render_report' - Jinja2
End Workflow

Explicit LLM Usage

The system leverages LLMs (specifically `gemini-2.5-flash`) at critical decision points where structured logic is insufficient:

Step	Tool/Function	Purpose of LLM
Column Mapping	`validate_columns`	Analyzes raw CSV headers and compares them to the Data Dictionary PDF text to find correct field mappings despite naming variations.
Topic Expansion	`search_news`	Generates 5+ semantic variations of the search topic (e.g., "Dengue" -> "Aedes aegypti", "epidemia de arboviroses") to improve search recall.
News Curation	`process_news_article`	Acts as a filter to reject "noise" (off-topic articles) and generates the summaries used in the final report.

Metric Calculation Logic

1. **Confirmed Cases**: Count of records where the classification field (`CLASSI_FIN`) is not null in the current month.
2. **Mortality Rate**: Percentage of deaths among confirmed cases (`EVOLUCAO = 2` and `CLASSI_FIN` present).
3. **Hospitalization Rate**: Percentage of total notifications that required hospital admission (`HOSPITAL = 1`).
4. **Growth Rates**: Month-over-month percentage change in total notifications and confirmed cases.

5. **State Rankings**: Aggregation of notifications by Federation Unit (`SG_UF_NOT`).