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Problem Statement :

You are tasked with creating an agent that can validate HSN codes. HSN codes are an internationally standardized system of names and numbers to classify traded products. They vary in length, typically from 2 to 8 digits, where each level of digits represents a more specific classification. For instance:

- 01 might represent "LIVE ANIMALS."
- 0101 might represent "LIVE HORSES, ASSES, MULES AND HINNIES."
- 01011010 might represent a very specific type of horse under the "LIVE HORSES..." category.

The agent will be provided with a master Excel file containing known HSN codes and their corresponding descriptions. The agent should be able to take an HSN code (or a list of HSN codes) as input and determine its validity based on this master data.

Flow Of Execution :

1. User Input:

User provides a single or multiple HSN codes (via chatbot, API, or interface).

2. Input Validation (Pre-processing):

- Check format: numeric and valid length (2, 4, 6, or 8 digits).
- Sanitize input (strip whitespace, ensure string format).

3. Data Access Layer:

- Load and cache the master HSN Excel data (HSNCode + Description).
- Use optimized read (e.g., `pandas.read_excel`) and convert to dictionary for quick lookup.

4. HSN Validation Logic:

- Check if the HSN exists in the master list.
- Optional: Check for parent hierarchy (e.g., for `01011010`, check if `01`, `0101`, `010110` exist).

5. Agent Fulfillment:

- For each HSN, generate a structured response:
 - Valid → Return HSN + description.
 - Invalid → Return error reason ("Not found", "Invalid format").

6. Response Generation:

ADK formats the output based on fulfillment response (text message, rich response, etc.).

7. Optional Enhancements:

- Log invalid patterns.
- Provide suggestions or auto-corrections.
- Allow uploading updated Excel file.

FOLDER STRUCTURE :

hsn-agent-adk/

```
|— data/
|   └─ HSN_Master_Data.xlsx
|— src/
|   └─ __init__.py
|   └─ agent.py           # Main ADK agent definition
|   └─ intents/
|       └─ validate_hsn.py    # Intent logic to handle validation
|   └─ services/
|       └─ hsn_validator.py    # Validation logic (format + existence + hierarchy)
|   └─ utils/
|       └─ file_loader.py     # Excel loading and caching logic
|— tests/
|   └─ test_validator.py      # Unit tests for validation logic
|— requirements.txt          # Python dependencies (e.g., pandas, openpyxl)
|— run.py                   # Entry point for local testing
└─ README.md                # Documentation and instructions
```

CODE :

Step 1: Set Up Environment:

```
python -m venv venv
source venv/bin/activate
pip install -r requirements.txt
```

Step 2: Load Master Excel File

```
# file_loader.py
import pandas as pd

def load_hsn_data(file_path):

    df = pd.read_excel(file_path, dtype=str)

    return dict(zip(df['HSNCode'].str.strip(), df['Description'].str.strip()))
```

Step 3: Implement Validation Logic

```
# hsn_validator.py

def is_valid_format(code):

    return code.isdigit() and len(code) in [2, 4, 6, 8]

def validate_hsn_code(code, hsn_dict):

    if not is_valid_format(code):

        return {"code": code, "status": "invalid", "reason": "Invalid format"}

    if code in hsn_dict:

        return {"code": code, "status": "valid", "description": hsn_dict[code]}

    return {"code": code, "status": "invalid", "reason": "Not found"}
```

Step 4: Define Intent & Fulfillment in ADK

```
from services.hsn_validator import validate_hsn_code

from utils.file_loader import load_hsn_data
```

```
hsn_data = load_hsn_data("data/HSN_Master_Data.xlsx")

def handle_validate_hsn(intent_input):

    codes = intent_input.get("hsn_codes", [])

    result = [validate_hsn_code(code.strip(), hsn_data) for code in codes]

    return {"validation_result": result}
```

Step 5: Hook to Agent in [agent.py](#)

```
from intents.validate_hsn import handle_validate_hsn

def route_intent(intent_name, user_input):

    if intent_name == "validate_hsn":

        return handle_validate_hsn(user_input)

    return {"error": "Unknown intent"}
```

Step 6: Test the Agent (Optional Local Execution):

```
# run.py

from agent import route_intent

user_input = {"hsn_codes": ["01012100", "999999"]}

response = route_intent("validate_hsn", user_input)

print(response)
```

OUTPUT:

HSN Code Validator

Validate Harmonized System Nomenclature codes against the master database

Single Code

Batch Validation

HSN Code

841

Enter a valid HSN code (typically 2, 4, 6, or 8 digits)

Validate

HSN Code: 841

Invalid

Description: Not available

Validation Details:
Format Valid: No
Exists in Database: No
Hierarchy Valid: No

HSN code length must be one of [2, 4, 6, 8], found 3

Reload HSN Data

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a) Invalid HSN code

HSN Code Validator

Validate Harmonized System Nomenclature codes against the master database

Single Code

Batch Validation

HSN Code

84713010

Enter a valid HSN code (typically 2, 4, 6, or 8 digits)

Validate

HSN Code: 84713010

Valid

Description: Laptop computers

Validation Details:
Format Valid: Yes
Exists in Database: Yes
Hierarchy Valid: Yes

This HSN code is valid and exists in the database.

Reload HSN Data

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b) Valid HSN Code

