3. Data Flow & System Behavior

3.1 Data Flow Diagram (DFD)

Context-Level DFD (Level 0)

This diagram represents the system at a high level, showing how data moves between external entities and the system.

Entities & Data Flow:

1. **User** uploads a CSV file.
2. **Data Preprocessing Module** cleans and prepares data.
3. **Neural Network Engine** processes data using domain-specific models.
4. **Supervising Neural Network** refines and combines outputs.
5. **Prediction Layer** generates final insights.
6. **API Integration Module** enhances results with semantic search, voice, and multimedia output.
7. **User** receives predictions via text, audio, or video.

Detailed-Level DFD (Level 1)

This expands the **Context-Level DFD** into more specific data flows between components.

Processes & Flow:

1. **User Interaction:**
    - Upload CSV → Passes through validation → Data moves to preprocessing.
2. **Preprocessing:**
    - Missing value handling, normalization, encoding → Processed data stored in a temporary buffer.
3. **Model Processing:**
    - Data sent to appropriate **Neural Network Engine** (LSTM for time-series, Transformer for tabular data).
4. **Supervising Network:**
    - Aggregates predictions → Refines insights → Routes results to output.
5. **Final Output:**
    - Predictions sent to APIs (Semantic Search, Text-to-Speech, Text-to-Video) → Enhanced insights delivered to the **User**.

3.2 Sequence Diagrams

Illustrates the sequence of interactions between the system components.

Prediction Request Sequence:

1. **User** → Uploads CSV.
2. **System** → Validates file format and structure.
3. **Preprocessing Module** → Cleans and transforms data.
4. **Neural Network Engine** → Selects model (LSTM/Transformer) and runs predictions.
5. **Supervising Neural Network** → Aggregates results.
6. **API Module** → Enhances results (e.g., generates text/audio/video insights).
7. **User** → Receives predictions.

3.3 Activity Diagram

Visualizes the workflow from CSV upload to final insight generation.

Steps:

1. **Start**
2. **User uploads CSV file**
3. **System validates format & structure**
    - If invalid → Show error & terminate.
    - If valid → Continue to preprocessing.
4. **Data Preprocessing Module cleans and encodes data**
5. **Neural Network Engine selects appropriate model (LSTM or Transformer)**
6. **Supervising Network aggregates outputs**
7. **API Integration Module enhances results**
8. **User receives final insights via text, speech, or video**
9. **End**

3.4 State Diagram

Represents different system states and how transitions occur.

States:

1. **Idle State** – System waits for user input.
2. **CSV Uploading State** – System receives and validates CSV.
3. **Preprocessing State** – Data cleaning and encoding happen.

4. **Model Processing State** – Neural network predictions are generated.
5. **Aggregation State** – Supervising network refines results.
6. **Output State** – Insights are formatted and delivered.
7. **Idle State** – System resets for the next request.

3.5 Class Diagram

Defines the structure, attributes, methods, and relationships between classes.

Main Classes & Relationships:

1. **User**
    - Attributes: userID, name, email
    - Methods: uploadCSV(), requestPrediction(), receiveOutput()
2. **Data Preprocessing**
    - Attributes: rawData, cleanedData
    - Methods: normalize(), encodeCategorical(), handleMissingValues()
3. **Neural Network Engine**
    - Attributes: modelType, parameters
    - Methods: trainModel(), predict()
4. **Supervising Network**
    - Attributes: aggregatedPredictions
    - Methods: combineOutputs(), refinePredictions()
5. **API Integration**
    - Attributes: apiType, responseFormat
    - Methods: generateText(), convertSpeech(), createVideo()
6. **Prediction Output**
    - Attributes: result, accuracy, timestamp
    - Methods: displayText(), playAudio(), renderVideo()

Conclusion

This section provides a structured **Data Flow & System Behavior** breakdown, ensuring clarity in system interactions. You can now visualize each component's function within the **Neural Network-Based Prediction Pipeline**.