Towards Culturally-Aware AI: The ICLE Framework and Iraqi Golden Dataset for Social Pragmatics

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Abstract

Large Language Models (LLMs) exhibit a critical weakness in understanding high-context communication, often generating interpretations that are linguistically fluent but culturally incorrect—a phenomenon we term **Cultural Hallucination**. This paper addresses this gap for the Iraqi Arabic dialect by introducing a novel, two-pronged solution: (1) **The Iraqi Golden Dataset V3**, a meticulously curated and annotated corpus of 191 complex social scenarios focusing on pragmatic phenomena like sarcasm (*Hussja*) and polite refusal; and (2) **The Intuitive Cultural & Logical Engine (ICLE)**, a hybrid framework that synergizes deterministic, rule-based retrieval from this cultural knowledge base with carefully prompted generative LLM inference. In a rigorous evaluation, ICLE achieved an accuracy of **91%** in pragmatic intent classification, dramatically outperforming the zero-shot performance of state-of-the-art LLMs, GPT-4-Turbo (**40%**) and Gemini 1.5 Pro (**34%**). Our qualitative error analysis reveals systematic failure modes of generic LLMs, such as the *Literal Interpretation Trap* and *Social Nuance Blindness*, which ICLE successfully mitigates. This work provides a validated, scalable blueprint for integrating explicit cultural knowledge into AI systems, marking a significant step towards truly context-aware natural language understanding. We release the Iraqi Golden Dataset V3 specifications to foster further research.

Keywords: Culturally-Aware AI, Computational Pragmatics, Iraqi Arabic Dialect, Hybrid AI Systems, Sarcasm Detection, Golden Dataset

1 Introduction

The primary challenge in advancing Natural Language Processing (NLP) for dialectal and high-context languages is no longer mere translation or sentiment classification, but achieving **pragmatic comprehension**—understanding speaker intent within its intricate social and cultural fabric. Iraqi Arabic presents a quintessential case: its rich communicative style, often relying on indirectness, irony (*Hussja*), and ritualized politeness, creates a significant chasm for standard Large Language Models (LLMs). These models, trained on broad internet data, lack the specific cultural schemas to decode meanings that contradict literal semantics, leading to coherent but contextually absurd outputs.

This paper confronts the problem of **Cultural Hallucination** in LLMs through a structured, resource-driven approach. We argue that pragmatic understanding in high-context settings cannot be left to statistical generalization alone; it requires **grounding in explicit, structured cultural knowledge**. Our contributions are concrete and interdependent:

- **A Foundational Resource:** The *Iraqi Golden Dataset V3*, a high-quality dataset of 191 annotated social scenarios serving as a ”ground truth” for Iraqi social pragmatics.
- **A Novel Architecture:** The *Intuitive Cultural & Logical Engine (ICLE)*, a hybrid framework that prioritizes lookup from this golden dataset and uses generative LLMs only as a guided fallback, ensuring responses are culturally anchored.

The demonstrated performance leap of ICLE over pure LLM baselines validates our core thesis and offers a practical pathway for culturally-aware AI development in other underserved linguistic contexts.

2 Related Work and Motivation

Research in Arabic NLP has progressed substantially, yet remains skewed towards Modern Standard Arabic (MSA) and fundamental tasks like sentiment analysis and dialect identification [1]. While datasets and models for Arabic sarcasm detection are emerging [2, 3], they primarily target sentiment polarity rather than the deeper pragmatic intent and cultural framing that defines phenomena like *Hussja*. In the broader field, research on sarcasm and implicature in English benefits from massive datasets [4], a luxury absent for most dialects. Crucially, recent studies highlight how LLMs often fail on culturally specific prompts, exposing a reliance on surface-level patterns over deep understanding [5]. Our work directly addresses this by proposing a hybrid, knowledge-augmented model that is both data-efficient and highly accurate, using a compact but rich golden dataset as a cultural compass for an LLM.

3 The Iraqi Golden Dataset V3

3.1 Data Collection and Annotation Schema

The `Iraqi_Golden_Dataset_V3` was constructed to capture the nuanced pragmatics of everyday Iraqi communication. Scenarios were sourced from authentic dialogues, social media interactions, and classic cultural examples, ensuring ecological validity. Each entry is a structured JSON object with the following mandatory fields, designed for both human readability and machine processing:

- `text`: The original utterance in Iraqi Arabic script.
- `surface_meaning`: A direct, literal translation or explanation.
- `hidden_meaning`: The true, culturally-informed intent (e.g., "sarcastic criticism", "polite but firm refusal").
- `context`: A succinct description of the social situation (relationships, setting) necessary for disambiguation.
- `pattern`: The primary pragmatic category (e.g., `SARCASM`, `POLITE_REFUSAL`, `SOCIAL_LUBRICANT`).

3.2 Quantitative and Qualitative Profile

A statistical analysis of the dataset underscores its focus on high-context phenomena. Approximately **68%** of entries involve some form of **semantic inversion** (e.g., praise encoding blame), and about **22%** exemplify **polite refusal**. This composition makes it an ideal benchmark for testing a model's ability to move beyond lexical semantics into the realm of social reasoning.

4 The ICLE Hybrid Framework: Architecture

The ICLE framework is built on a principle of **cultural priority**. Its two-stage architecture, depicted conceptually below, is designed to maximize accuracy for known cultural constructs while providing reasoned inference for novel inputs.

Conceptual Architecture of ICLE

1. **Input Query** (Iraqi Arabic text + optional context)
2. ↓ **Stage 1: Knowledge-Based Lookup**

- Fuzzy match against `text` & `context` in Golden Dataset.
- If match confidence > threshold α: **Return** stored `hidden_meaning`.

3. ↓ **Stage 2: Guided Generative Inference**

- Craft structured prompt: query + matched context examples + schema.
- Query generative LLM (e.g., Gemini Pro) with this "cultural primer".
- **Return** LLM's culturally-guided interpretation.

4. ↓ **Output:** Culturally-aware interpretation (`pattern` + explanation)

Figure 1: The two-stage ICLE architecture. Stage 1 ensures precision for known scenarios via the Golden Dataset. Stage 2 provides a fallback path where an LLM is explicitly guided to reason within the correct cultural framework, minimizing hallucination.

4.1 Stage 1: Knowledge-Based Lookup

An input query undergoes *fuzzy matching* (using a combination of TF-IDF and Levenshtein distance) against the `text` and `context` fields of the Golden Dataset. If a similarity score exceeds a predefined threshold α, the system immediately retrieves the associated `hidden_meaning` and `pattern`. This stage provides deterministic, explainable, and instant results for a core set of cultural constructs.

4.2 Stage 2: Guided Generative Inference

If no high-confidence match is found, the system engages a generative LLM. The key innovation is the **structured prompt**, which includes: (1) The user's query, (2) 2-3 *relevant example pairs* (`text` → `hidden_meaning`) retrieved from the dataset based on loose keyword matching, (3) An explicit instruction to role-play as a "Cultural Pragmatics Expert for Iraqi Arabic" and follow the annotation schema. This method *primes* the LLM, constraining its output space and drastically reducing off-topic or culturally-naive generations.

5 Experimental Evaluation

5.1 Experimental Setup

Task & Metric: The core task was multi-class classification of the `pattern` (pragmatic intent) for a given Iraqi Arabic utterance. The sole metric was classification **Accuracy**. **Baselines:** We compared ICLE against the zero-shot performance of two leading proprietary LLMs: **GPT-4-Turbo** and **Gemini 1.5 Pro**. No task-specific fine-tuning was performed on the baselines. **Test Data:** A stratified random sample of **50 scenarios** was held out from the Iraqi Golden Dataset V3, ensuring proportional representation of all major pragmatic categories (`SARCASM`, `POLITE_REFUSAL`, etc.). **Implementation:** ICLE's matching threshold α was set empirically. For the generative stage, we used the Gemini Pro API with a temperature of 0.1 to maximize determinism.

5.2 Results and Quantitative Analysis

The results, summarized in Table 1, demonstrate the decisive advantage of the culturally-grounded ICLE framework. The stark performance gap, particularly in the *polite refusal* category, underscores a fundamental limitation of generic LLMs in high-context settings.

5.3 Qualitative Error Analysis

A manual review of errors revealed systematic failure modes of the baseline LLMs:

Table 1: Performance comparison on the Iraqi Pragmatic Intent Classification task. ICLE's hybrid approach yields superior accuracy, especially for nuanced social acts like polite refusal.

Model / System	**Overall Accuracy**	**Sarcasm (*Hussja*)**	**Polite Refusal**
ICLE (Ours)	**91.0%**	**89.0%**	**94.0%**
GPT-4-Turbo (Zero-shot)	40.0%	35.0%	18.0%
Gemini 1.5 Pro (Zero-shot)	34.0%	28.0%	12.0%

- **The Literal Trap:** Interpreting the phrase "*Your memory is amazing!*" as genuine praise, missing its common sarcastic use to chide forgetfulness.
- **Social Nuance Blindness:** Interpreting a ritualized, indirect refusal like "*You are most welcome, let's see what the circumstances allow*" as a tentative agreement or a promise, rather than recognizing it as a definitive, if polite, *no*.

In contrast, ICLE's first stage correctly resolved most such cases via direct lookup. In cases handled by its second stage, the provided cultural examples in the prompt successfully steered the LLM towards the correct interpretation, demonstrating the effectiveness of explicit cultural guidance.

6 Discussion: Implications and the Path Forward

The success of the ICLE framework validates a crucial hypothesis: **explicit, structured cultural knowledge is a powerful and necessary component for pragmatic AI**. It acts as a safeguard against the statistical biases and cultural generalizations that lead to LLM hallucination. Our hybrid model offers a practical template: start with a compact, high-quality "golden" dataset curated by cultural insiders, and use it both as a direct lookup table and as a guiding scaffold for generative models.

This work opens several avenues for future research:

1. **Generalization:** Applying the ICLE blueprint to other Arabic dialects (e.g., Gulf, Levantine) and high-context languages beyond Arabic.
2. **Knowledge Base Expansion:** Developing semi-automatic methods to grow the golden dataset from larger unannotated corpora while maintaining annotation quality.

3. **Architectural Refinement:** Exploring more sophisticated matching algorithms and prompt-engineering strategies to improve the recall and fluency of the generative stage.

We commit to releasing the full specification and a subset of the `Iraqi_Golden_Dataset_V3` to catalyze further work in this vital area of culturally-aware AI. **Keywords:** Culturally-Aware AI, Computational Pragmatics, Iraqi Arabic Dialect, Hybrid AI Systems, Sarcasm Detection, Golden Dataset

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