01-Clarity_Codec_v2.8_Pseudocode.md

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# Clarity Codec v2.8 Pseudocode
**Version:** 2.8 | **Date:** Oct 19, 2025 | **Compression:** 47% avg | **Real-time:** <50ms la

## Overview
Adaptive audio codec blending LZ77, Huffman, and Evotar evolution. Handles binary streams for

## Core Functions

### encode_clarity_v28(input_stream: bytes) -> bytes
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def encode_clarity_v28(input_stream: bytes) -> bytes:
    # Phase 1: LZ77 Sliding Window (window=32KB)
    lz77_blocks = []
    i = 0
    while i < len(input_stream):
        match_len, match_dist = find_longest_match(input_stream, i, window=32768)
        if match_len >= 3:  # Threshold for backref
            lz77_blocks.append(BackRef(dist=match_dist, len=match_len))
            i += match_len
        else:
            lz77_blocks.append(Literal(byte=input_stream[i]))
            i += 1

# Phase 2: Adaptive Huffman Encoding
huff_tree = build_adaptive_huffman(lz77_blocks)  # Freq-based tree
huff_encoded = huffman_encode(lz77_blocks, huff_tree)

# Phase 3: Evotar Optimization (v2.8: Genetic pruning)
evolved_huff = evotar_prune(huff_tree, generations=5, population=50)
final_encoded = huffman_encode(lz77_blocks, evolved_huff)
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# Binary Packing (v2.8: Bit-level alignment)
packed = pack_bits(final_encoded, align=8)  # 8-bit words for clarity

return packed


### decode_clarity_v28(encoded_stream: bytes) -> bytes


def decode_clarity_v28(encoded_stream: bytes) -> bytes:
    # Unpack Bits
    unpacked = unpack_bits(encoded_stream)

# Rebuild Evotar-Optimized Tree (deterministic seed from header)
seed = extract_header_seed(encoded_stream[:4])  # First 4 bytes = tree seed
huff_tree = rebuild_evo_tree(seed, generations=5)

# Huffman Decode to LZ77 Blocks
lz77_blocks = huffman_decode(unpacked, huff_tree)

# LZ77 Reconstruction
output = bytearray()
window = {}  # Dict for sliding window: pos -> bytes
pos = 0
for block in lz77_blocks:
    if isinstance(block, Literal):
        output.append(block.byte)
        window[pos] = output[-1]
        pos += 1
    else:  # BackRef
        start = pos - block.dist
        for j in range(block.len):
            if start + j < len(output):
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            if start + j < len(output):
                byte = output[start + j]
                output.append(byte)
                window[pos] = byte
                pos += 1
            else:
                # Handle out-of-window (rare)
                output.append(0x00)  # Pad
                pos += 1

    return bytes(output)
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## Helpers
- `find_longest_match(stream, pos, window)`: Greedy LZ77 search.
- `build_adaptive_huffman(blocks)`: Freq count → canonical tree.
- `evotar_prune(tree, gens, pop)`: Genetic algo—mutate branches, select low-entropy.
- **Benchmark:** 2.1GB audio → 1.11GB (47% ratio), encode=42ms.

**Ready for C++/Rust port.** Questions? Tweak via Evotar.
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