The scQOI compression algorithm

Specification 1.1, 6/30/2026 - Mari

Single-Channel QOI, or SCQ (stylized as “scQOI”) is a technically general purpose compression algorithm intended for monochrome images. scQOI is, as the name implies, based heavily on QOI. scQOI is a raw payload format and includes no termination or magic number semantics.

scQOI has 4 different opcodes. On a high level,

- SCQ_OP_BYTE — A literal byte, noted with byte FF.
- SCQ_OP_INDEX — A backreference, of up to 64 unique bytes backward.
- SCQ_OP_DIFF — A difference between the previous byte and the current one.
- SCQ_OP_RUN — A repeated byte

Each of the 4 opcodes matches to a uint2 value at the start of their byte (first 2 bits).
SCQ_OP_BYTE is 3 [11]
SCQ_OP_INDEX is 2 [10]
SCQ_OP_DIFF is 1 [01]
SCQ_OP_RUN is 0 [00]

SCQ_OP_BYTE

The Byte Opcode is the only 2-byte long opcode. It consists of a marker byte (`1111 1111`) and then the byte it represents. Once a byte is read, it is added to the byte cache. This is always the first opcode and its `FF` marker byte is the first in the bitstream.

SCQ_OP_INDEX

The Index Opcode is a backreference to a byte in the cache. It starts with `10`, then contains an unsigned 6-bit integer (values 0 to 63). The value represents how many cache entries backward the reference is (0 refers to the most recently cached byte, and 63 refers to the oldest cache entry). Indexes do not update the Cache, and position is not refreshed.

SCQ_OP_DIFF

The Difference Opcode is a predictor of the current byte by taking the difference between it and the previous one. Its signature is `01`. It contains a signed 6-bit integer (values -32 to 31). The difference wraps around modulo 256 (`FF` to `00` is just +1). Once a byte is read, it is added to the byte cache.

SCQ_OP_RUN

The Run Opcode is a run-length value. Its signature is `00`. It contains a uint6, counting the amount of repeats of the previous decompressed byte. Runs do not update the Cache, and position is not refreshed. Runs are not stored with a bias, so byte `00` (outside a Byte) is a no-op.

The Cache

The byte cache (related to LZ77’s sliding window and QOI’s index hash table) contains up to the 64 most recently encountered distinct byte values. A byte is only inserted if it is not already present in the cache, so duplicate entries never occur. When the cache is full, the oldest entries are removed.