# COMPROMISE Unified Taxonomy of Features

Plzeň, 29th June 2023

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# COMPROMISE methodoly

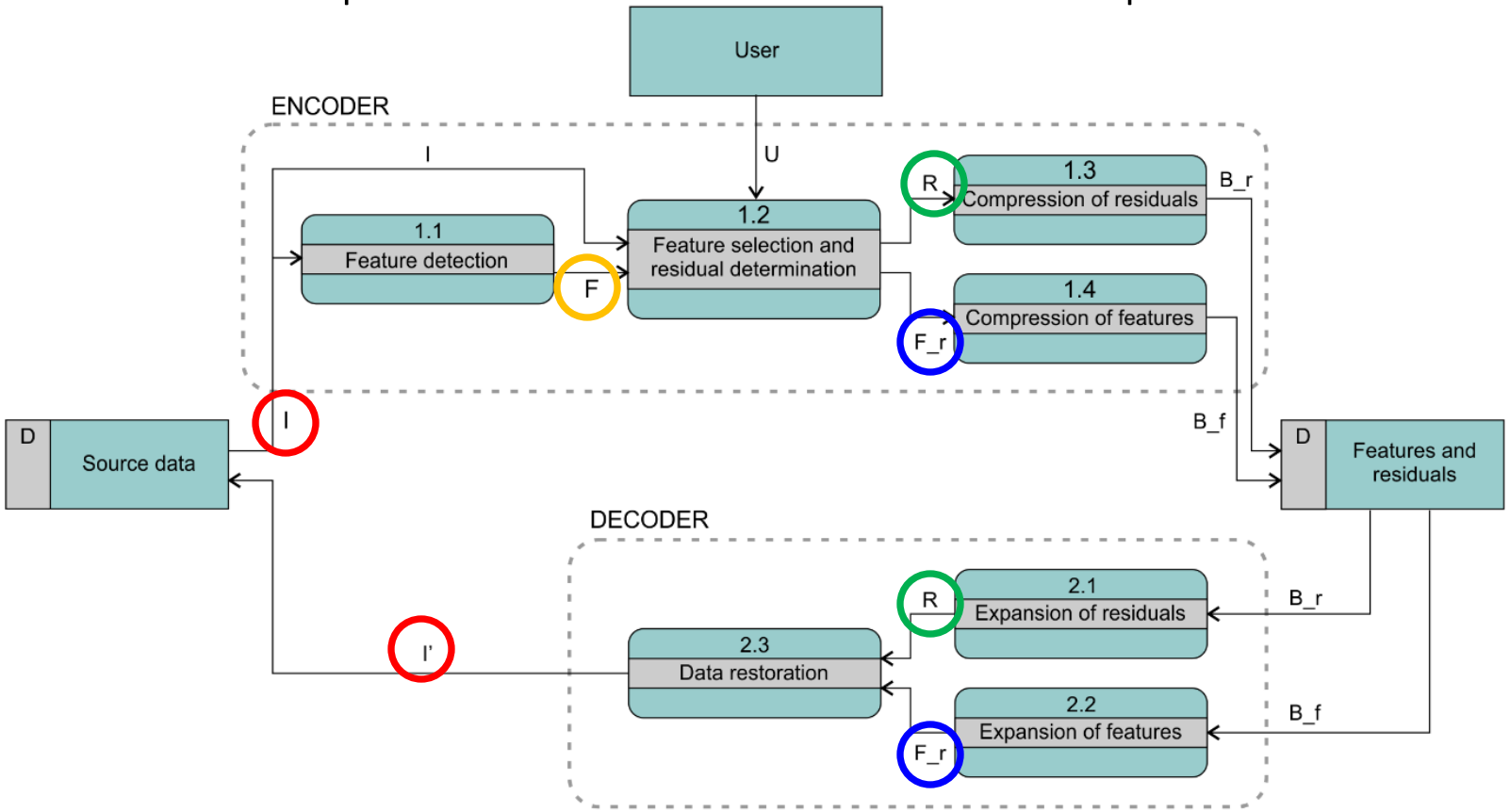
- Universal data compression methodology:
  - Unique (lossless) framework for lossless, near-lossless and lossy data compression.
- with a unified taxonomy of features:
  - Data representation suitable for the domain-independent data compression and decompression.
- Validation in 4 pilot domains was promised:
  - Audio (1-D),
  - Images (2-D),
  - Biomedical signals (1-D, more channels),
  - Sparse voxel grids (3-D).
  - … (e.g. Vector fields)

# COMPROMISE methodoly

- New data compression paradigm, based on:
  - Features: prediction functions for estimating the associated patterns of samples.
    - No overlaps between the patterns of different features!
    - Predicted values are subtracted from the input samples → residuals, expected to be better compressible.
  - and restoration methods.
    - generalization of data expansion (decompression).
    - Identification of data that may be omitted during the compression, and then still be restored with a sufficient quality (lossless, near-lossless, lossy) from the context.

# COMPROMISE methodoly

- 1.2 and 2.3 incorporate feature interpretation.
  - Domain-dependent features ↔ domain-independent.



# Uncompressed I/O Data Streams

- I and I' are streams of samples with clearly defined order.
- Sample: individual data item (primitive) of I or I':
  - Discrete point on a line in 1D, pixel in 2D, voxel in 3D.
  - Location: unique explicit or implicit identification in the stream.
  - Value: $s_{i,j,k}$ or $s'_{i,j,k}$
    - Integer (or transformed to integer)
    - Floating point number
    - Multiple attributes (RBG, stereo audio)
    - Samples without values
  - Non-numerical sample values not considered
    - Inability to simply derive residuals.
    - Usually limited to lossless compression.

# Uncompressed I/O Data Streams

- Complete regular grid:
  - $I \leftarrow \langle s_{i,j,k} \rangle,\ 0 \leq i < resX,\ 0 \leq j < resY,\ 0 \leq k < resZ$
  - Similar for I'.
- Sparsely aranged samples:
  - huge amount of samples with unknown, redundant, trivially predictable, or irrelevant values (samples without values)
  - $I \leftarrow \langle (i,j,k,s_{i,j,k}) \rangle,\quad \{(i,j,k)\} \subseteq [0, resX-1] \times [0, resY-1] \times [0, resZ-1]$

# Features and Residuals

- A **feature** is a piece of information that possesses high discriminative/predictive value for human interpretation or machine processing of I.
  - Header: definition of presence and structure of other data.
  - Pattern: sequence of samples from I, affected by the feature.
    - Each pattern sample: a) represented by residual in R, b) omitted (the context provides all info for restoration), c) coded directly within the feature.
  - Prediction: unambiguous rules together with control data, which determine how the feature affects samples from Pattern.
  - Each feature stores sufficient information to expand or restore all the samples in its pattern independently from other features.
  - Patterns of different features do not overlap.

# Feature.Pattern

- Segment: geometrically connected sequence of samples.
- Region: list of segments.
- Key samples: region of single-sample segments.
  - Depending on the feature type, key samples are written internally within *f*, while the others are encoded in R.
- Segments with two or more samples represented by:
  - Border: interval in 1D, chain codes in 2D or 3D.
  - Box: practical in a uniform grid or tree representation.
  - Key samples.
- Connectivity must be chosen to unambiguously define border and interior.
  - 4- and 8-connectivity in 2D,
  - 6-, 18- and 26- connectivity in 3D

# Feature.Prediction

- Classes of prediction functions:
  - Interpolation
  - Approximation
  - Extrapolation
- Catalogue needed for detailed specifications of class members.
- Meaningfully applied for:
  - Samples without values
  - Segment described with key samples
  - Segment described with border/box
  - Border/box + additional key samples in the interior
  - Region
- Additional functionalities provided by masks, topology of segments, and relation trees.

# Data headers

- Different layers
  - Default values (part of decoder/encoder, not I/O data)
  - Compressed file header
  - Header of the reduced stream of features $F_r$.
  - Feature header.
  - Header of the stream of residuals R (same level as $F_r$)
- Headers at lower layers overwrite settings from the higher ones.

# Restoration

- In the interior of segments with the setting Interior Included = NO, or
- Outside of any feature pattern.

- Restoration method defined in default configuration or in compressed file header.

- Lossless compression: without errors
- Near lossless compression: errors controlled locally
- Lossy compression: errors controlled globally.

# Digital audio example

- Simple feature hierchy
  - Blocks at higher level
  - Each block has its own $F_r$ and R.
- All feature patterns are intervals (1D segments) with border/box defined with pairs of local extrema.
- Four feature prediction functions
  - Line segment interpolation
  - Key values interpolation (no prediction or RLE)
  - Polyline approximation (uses the mask)
  - Average approximation.
- Basically lossless, but adaptable to other two modes by omitting or requantized.

# Conclusion

- Something MUST HAVE, not necessarily MUST USE.
- Suitable for publication after shown that few more examples suit into the methodology.