GABAC: AN ARITHMETIC CODING SOLUTION FOR GENOMIC DATA

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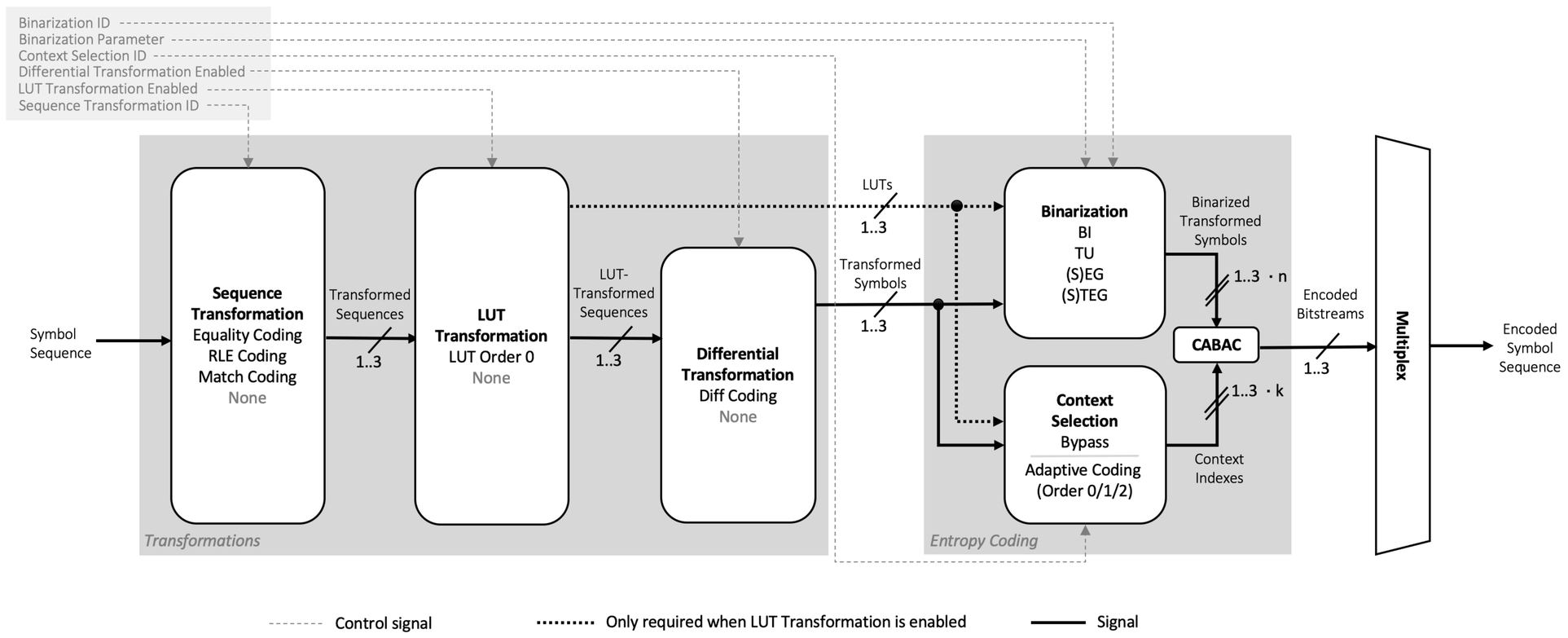
Introduction: In an effort to provide a response to the ever-expanding generation of genomic data, MPEG (Moving Picture Experts Group), under the auspices of ISO (International Organization for Standardization), is designing a new solution for the representation, compression and management of genomic sequencing data: the MPEG-G standard. Part 2 of the MPEG-G standard focuses on specifying the coding of the sequencing data. This work discusses the first implementation of an MPEG-G compliant entropy encoder/decoder: GABAC.

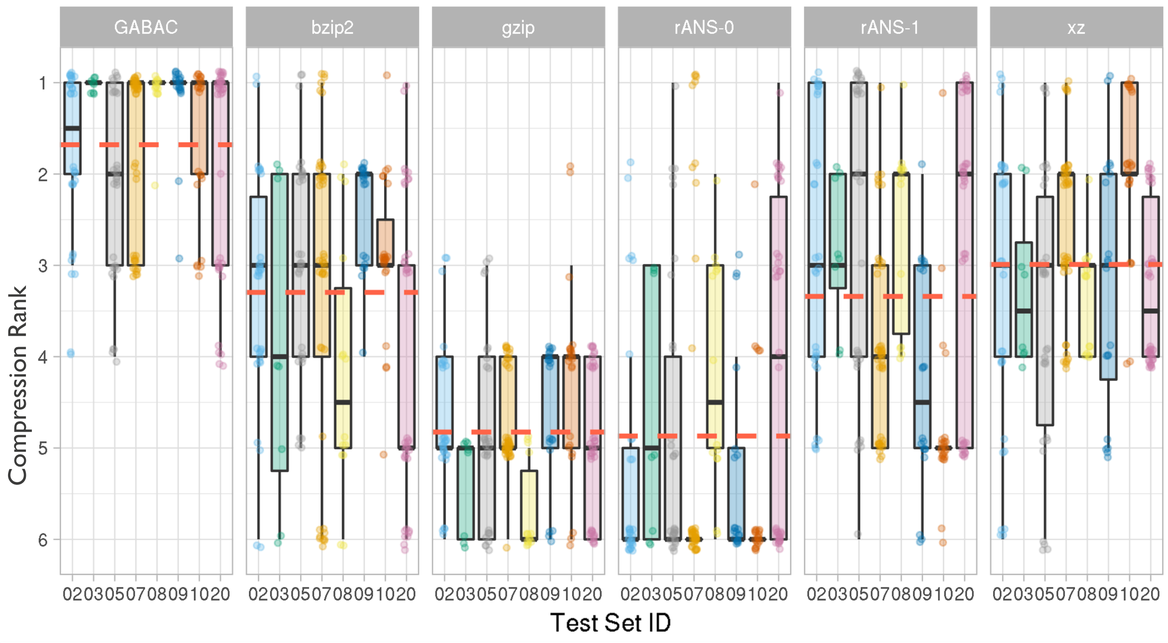
Methods: GABAC combines proven coding technologies, such as context-adaptive binary arithmetic coding (CABAC), binarization schemes, and transformations into one straight-forward solution for the compression of the sequencing data.

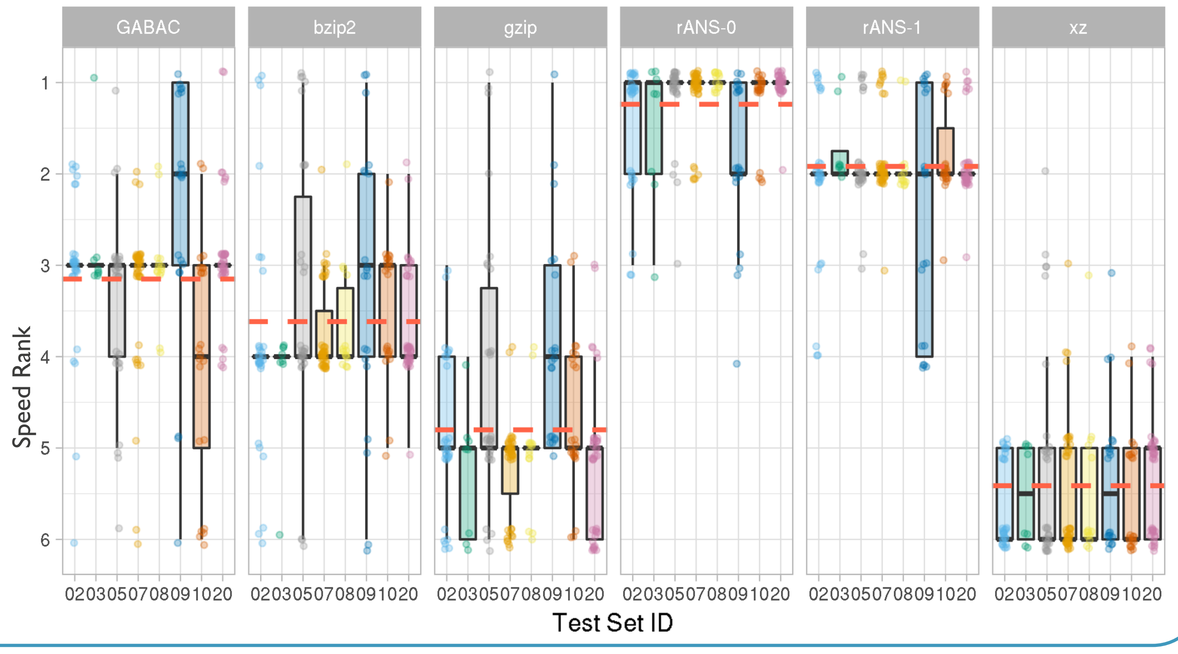


Results

- To analyze the performance of the GABAC encoder, a test set of 206 descriptor stream files has been selected. Files were extracted from the MPEG-G Genomic Information Database (total uncompressed size: 12.97 GiB).
- **Adding GABAC to the CRAM codec set offers a significant performance gain, both in compression ratio and in encoding speed.**

	Compressed Size	Encoding Time	Decoding Time
gzip	3,524 MiB	3h 25m 18s	**06m 02s**
bzip2	3,088 MiB	33m 55s	20m 00s
xz	2,944 MiB	4h 47m 38s	09m 25s
rANS-0	4,143 MiB	**06m 01s**	07m 08s
rANS-1	3,400 MiB	06m 54s	08m 20s
GABAC	**2,877 MiB**	45m 25s	20m 18s
CRAM	2,879 MiB	2h 25m 58s	**09m 32s**
CRAM + GABAC	**2,800 MiB**	**1h 01m 17s**	20m 08s





Conclusions

- We present the first implementation of an MPEG-G Part 2 compliant entropy codec.
- Our implementation already outperforms well established codecs and can serve as a reference for future implementations. The performance of new implementations of the specification is expected to improve over time.
- Adding GABAC to the CRAM codec set offers significant performance gains, both in compression ratio and in encoding speed.