Title: Lyra (codec)

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Categories: Category:2021 software, Category:Google software, Category:Lossy compression algorithms, Category:Machine learning, Category:Software using the Apache license, Category:Speech codecs



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Lyra is a lossy audio codec developed by Google that is designed for compressing speech at very low bitrates. Unlike most other audio formats, it compresses data using a machine learning -based algorithm.

## Features

The Lyra codec is designed to transmit speech in real-time when bandwidth is severely restricted, such as over slow or unreliable network connections. [ 1 ] It runs at fixed bitrates of 3.2, 6, and 9 kbit/s and it is intended to provide better quality than codecs that use traditional waveform-based algorithms at similar bitrates. [ 2 ] [ 3 ] Instead, compression is achieved via a machine learning algorithm that encodes the input with feature extraction, and then reconstructs an approximation of the original using a generative model. [ 1 ] This model was trained on thousands of hours of speech recorded in over 70 languages to function with various speakers. [ 2 ] Because generative models are more computationally complex than traditional codecs, a simple model that processes different frequency ranges in parallel is used to obtain acceptable performance. [ 4 ] Lyra imposes 20 ms of latency due to its frame size. [ 3 ] Google's reference implementation is available for Android and Linux . [ 4 ]

## Quality

Lyra's initial version performed significantly better than traditional codecs at similar bitrates. [ 1 ] [ 4 ] [ 5 ] Ian Buckley at MakeUseOf said, "It succeeds in creating almost eerie levels of audio reproduction with bitrates as low as 3 kbps." Google claims that it reproduces natural-sounding speech, and that Lyra at 3 kbit/s beats Opus at 8 kbit/s. [ 2 ] Tsahi Levent-Levi writes that Satin , Microsoft's AI-based codec, outperforms it at higher bitrates. [ 5 ]

## History

In December 2017, Google researchers published a preprint paper on replacing the Codec 2 decoder with a WaveNet neural network. They found that a neural network is able to extrapolate features of the voice not described in the Codec 2 bitstream and give better audio quality, and that the use of conventional features makes the neural network calculation simpler compared to a purely waveform-based network. Lyra version 1 would reuse this overall framework of feature extraction, quantization, and neural synthesis. [ 6 ]

Lyra was first announced in February 2021, [ 2 ] and in April, Google released the source code of their reference implementation. [ 1 ] The initial version had a fixed bitrate of 3 kbit/s and around 90 ms latency. [ 1 ] [ 2 ] The encoder calculates a log mel spectrogram and performs vector quantization to store the spectrogram in a data stream. The decoder is a WaveNet neural network that takes the spectrogram and reconstructs the input audio. [ 2 ]

A second version (v2/1.2.0), released in September 2022, improved sound quality, latency, and performance, and permitted multiple bitrates. V2 uses a "SoundStream" structure where both the encoder and decoder are neural networks, a kind of autoencoder . A residual vector quantizer is used to turn the feature values into transferrable data. [ 3 ]

## Support

### Implementations

Google's implementation is available on GitHub under the Apache License. [ 1 ] [ 7 ] Written in C++ , it is optimized for 64-bit ARM but also runs on x86 , on either Android or Linux. [ 4 ]

Applications

Google Meet uses Lyra to transmit sound for video chats when bandwidth is limited. [ 1 ] [ 5 ]

References

External links

Lyra: A New Very Low-Bitrate Codec for Speech Compression Google blog post with a demonstration comparing codecs

See also

Satin (codec) , an AI-based codec developed by Microsoft

Comparison of audio coding formats

Speech coding

Videotelephony

v

t

e

DV

MJPEG

Motion JPEG 2000

MPEG-1

MPEG-2 Part 2

Part 2

MPEG-4 Part 2 / ASP Part 10 / AVC Part 33 / IVC

Part 2 / ASP

Part 10 / AVC

Part 33 / IVC

MPEG-H Part 2 / HEVC

Part 2 / HEVC

MPEG-I Part 3 / VVC

Part 3 / VVC

MPEG-5 Part 1 / EVC Part 2 / LCEVC

Part 1 / EVC

Part 2 / LCEVC

H.120

H.261

H.262

H.263

H.264 / AVC

H.265 / HEVC

H.266 / VVC
H.267 / Enhanced Compression Model
VC-1
VC-2
VC-3
VC-5
VC-6
TrueMotion S
VP3
VP6
VP7
VP8
VP9
AV1
AVS1 P2/AVS+ (GB/T 20090.2/16)
AVS2 P2 (GB/T 33475.2,GY/T 299.1) HDR Vivid(GY/T 358)
HDR Vivid(GY/T 358)
AVS3 P2(GY/T 368)
Apple Video
AVS
Bink
Cinepak
Daala
DVI
FFV1
Huffyuv
Indeo
Lagarith
Microsoft Video 1
MSU Lossless
OMS Video
Pixlet
ProRes 422 4444
422
4444
QuickTime Animation Graphics
Animation
Graphics

RealVideo
RTVideo
SheerVideo
Smacker
Sorenson Video/Spark
Theora
Thor
Ut
WMV
XEB
YULS
MPEG-1 Layer II Multichannel
Multichannel
MPEG-1 Layer I
MPEG-1 Layer III (MP3)
AAC HE-AAC AAC-LD
HE-AAC
AAC-LD
MPEG Surround
MPEG-4 ALS
MPEG-4 SLS
MPEG-4 DST
MPEG-4 HVXC
MPEG-4 CELP
MPEG-D USAC
MPEG-H 3D Audio
G.711 A-law μ-law
A-law
μ-law
G.718
G.719
G.722
G.722.1
G.722.2
G.723
G.723.1
G.726
G.728

G.729

G.729.1

Opus

iLBC

Speex

Vorbis

FLAC

AMR

AMR-WB

AMR-WB+

EVRC

EVRC-B

EVS

GSM-HR

GSM-FR

GSM-EFR

AC-3

AC-4

DTS

SBC

LC3

AVS1 P10 (GB/T 20090.10)

AVS2 P3 (GB/T 33475.3) Audio Vivid (GY/T 363)

Audio Vivid (GY/T 363)

DRA (GB/T 22726)

ExAC(SJ/T 11299.4)

ACELP

ALAC

Asao

ATRAC

CELT

Codec 2

iSAC

Lyra

MELP

Monkey's Audio

MT9

Musepack

OptimFROG
OSQ
QCELP
RCELP
RealAudio
SD2
SHN
SILK
Siren
SMV
SVOPC
TTA True Audio
True Audio
TwinVQ
VMR-WB
VSELP
WavPack
WMA
MQA
aptX
aptX HD
aptX Low Latency
aptX Adaptive
LDAC
LHDC
LLAC
CCITT Group 4
GIF
HEIC / HEIF
HEVC
JBIG
JBIG2
JPEG
JPEG 2000
JPEG-LS
JPEG XL
JPEG XR
JPEG XS

JPEG XT

PNG APNG

APNG

TIFF

TIFF/EP

TIFF/IT

AV1

AVIF

BPG

DjVu

EXR

FLIF

ICER

MNG

PGF

QOI

QTVR

WBMP

WebP

MPEG-ES MPEG-PES

MPEG-PES

MPEG-PS

MPEG-TS

ISO/IEC base media file format

MPEG-4 Part 14 (MP4)

Motion JPEG 2000

MPEG-21 Part 9

MPEG media transport

H.222.0

T.802

RTP

Ogg

Matroska

GXF

MXF

3GP and 3G2

AMV

ASF

AIFF

AVI

AU

BPG

Bink Smacker

Smacker

BMP

DivX Media Format

EVO

Flash Video

HEIF

IFF

M2TS

Matroska WebM

WebM

QuickTime File Format

RatDVD

RealMedia

RIFF WAV

WAV

MOD and TOD

VOB, IFO and BUP

NETVC

MPEG LA

Alliance for Open Media

Entropy Arithmetic Huffman Modified

Arithmetic

Huffman

Modified

LPC ACELP CELP LSP WLPC

ACELP

CELP

LSP

WLPC

Lossless

Lossy

LZ DEFLATE LZW

DEFLATE

LZW

PCM A-law μ-law ADPCM DPCM

A-law

μ-law

ADPCM

DPCM

Transforms DCT FFT MDCT Wavelet Daubechies DWT

DCT

FFT

MDCT

Wavelet Daubechies DWT

Daubechies

DWT

Comparison of audio coding formats

Comparison of video codecs

List of codecs