
Python Audio Tools Documentation

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Contents:

AUDIOTOOLS — THE BASE PYTHON AUDIO TOOLS MODULE

The `audiotools` module contains a number of useful base classes and functions upon which all of the other modules depend.

`audiotools.VERSION`

The current Python Audio Tools version as a plain string.

`audiotools.AVAILABLE_TYPES`

A tuple of `AudioFile`-compatible classes of available audio types. Note these are types available to `audiotools`, not necessarily available to the user - depending on whether the required binaries are installed or not.

Class	Format
<code>AACAudio</code>	AAC in ADTS container
<code>AiffAudio</code>	Audio Interchange File Format
<code>ALACAudio</code>	Apple Lossless
<code>AuAudio</code>	Sun Au
<code>FlacAudio</code>	Native Free Lossless Audio Codec
<code>M4AAudio</code>	AAC in M4A container
<code>MP3Audio</code>	MPEG-1 Layer 3
<code>MP2Audio</code>	MPEG-1 Layer 2
<code>OggFlacAudio</code>	Ogg Free Lossless Audio Codec
<code>ShortenAudio</code>	Shorten
<code>SpeexAudio</code>	Ogg Speex
<code>VorbisAudio</code>	Ogg Vorbis
<code>WaveAudio</code>	Waveform Audio File Format
<code>WavPackAudio</code>	WavPack

`audiotools.TYPE_MAP`

A dictionary of `type_name` strings -> `AudioFile` values containing only types which have all required binaries installed.

`audiotools.BIN`

A dictionary-like class for performing lookups of system binaries. This checks the system and user's config files and ensures that any redirected binaries are called from their proper location. For example, if the user has configured `flac(1)` to be run from `/opt/flac/bin/flac`

```
>>> BIN["flac"]  
"/opt/flac/bin/flac"
```

This class also has a `can_execute()` method which returns `True` if the given binary is executable.

```
>>> BIN.can_execute(BIN["flac"])
True
```

`audiotools.open(filename)`

Opens the given filename string and returns an `AudioFile`-compatible object. Raises `UnsupportedFile` if the file cannot be identified or is not supported. Raises `IOError` if the file cannot be opened at all.

`audiotools.open_files(filenamees[, sorted[, messenger]])`

Given a list of filename strings, returns a list of `AudioFile`-compatible objects which can be successfully opened. By default, they are returned sorted by album number and track number. If `sorted` is `False`, they are returned in the same order as they appear in the `filenamees` list. If `messenger` is given, use that `Messenger` object to for warnings if files cannot be opened. Otherwise, such warnings are sent to `stdout`.

`audiotools.open_directory(directory[, sorted[, messenger]])`

Given a root directory, returns an iterator of all the `AudioFile`-compatible objects found via a recursive search of that directory. `sorted`, and `messenger` work as in `open_files()`.

`audiotools.group_tracks(audiofiles)`

Given an iterable collection of `AudioFile`-compatible objects, returns an iterator of objects grouped into lists by album. That is, all objects with the same `album_name` and `album_number` metadata fields will be returned in the same list on each pass.

`audiotools.filename_to_type(path)`

Given a path, try to guess its `AudioFile` class based on its filename suffix. Raises `UnknownAudioType` if the suffix is unrecognized. Raises `AmbiguousAudioType` if more than one type of audio shares the same suffix.

`audiotools.transfer_data(from_function, to_function)`

This function takes two functions, presumably analogous to `write()` and `read()` functions, respectively. It calls `to_function` on the object returned by calling `from_function` with an integer argument (presumably a string) until that object's length is 0.

```
>>> infile = open("input.txt", "r")
>>> outfile = open("output.txt", "w")
>>> transfer_data(infile.read, outfile.write)
>>> infile.close()
>>> outfile.close()
```

`audiotools.transfer_framelist_data(pcmreader, to_function[, signed[, big_endian]])`

A natural progression of `transfer_data()`, this function takes a `PCMReader` object and transfers the `pcm.FrameList` objects returned by its `PCMReader.read()` method to `to_function` after converting them to plain strings.

```
>>> pcm_data = audiotools.open("file.wav").to_pcm()
>>> outfile = open("output.pcm", "wb")
>>> transfer_framelist_data(pcm_data, outfile)
>>> pcm_data.close()
>>> outfile.close()
```

`audiotools.pcm_cmp(pcmreader1, pcmreader2)`

This function takes two `PCMReader` objects and compares their PCM output. Returns `True` if that output matches exactly, `False` if not.

`audiotools.striped_pcm_cmp(pcmreader1, pcmreader2)`

This function takes two `PCMReader` objects and compares their PCM output after stripping any 0 samples from the beginning and end of each. Returns `True` if the remaining output matches exactly, `False` if not.

`audiotools.pcm_frame_cmp(pcmreader1, pcmreader2)`

This function takes two `PCMReader` objects and compares their PCM frame output. It returns the frame number

of the first mismatch as an integer which begins at frame number 0. If the two streams match completely, it returns `None`. May raise `IOError` or `ValueError` if problems occur during reading.

`audiotools.pcm_split` (*pcmreader*, *pcm_lengths*)

Takes a `PCMReader` object and list of PCM sample length integers. Returns an iterator of new `PCMReader` objects, each limited to the given lengths. The original `pcmreader` is closed upon the iterator's completion.

`audiotools.applicable_replay_gain` (*audiofiles*)

Takes a list of `AudioFile`-compatible objects. Returns `True` if `ReplayGain` can be applied to those files based on their sample rate, number of channels, and so forth. Returns `False` if not.

`audiotools.calculate_replay_gain` (*audiofiles*)

Takes a list of `AudioFile`-compatible objects. Returns an iterator of (`audiofile`, `track_gain`, `track_peak`, `album_gain`, `album_peak`) tuples or raises `ValueError` if a problem occurs during calculation.

`audiotools.read_metadata_file` (*path*)

Given a path to a FreeDB XMCD file or MusicBrainz XML file, returns an `AlbumMetaDataFile`-compatible object or raises a `MetaDataFileException` if the file cannot be read or parsed correctly.

`audiotools.read_sheet` (*filename*)

Reads a Cuesheet-compatible file such as `toc.TOCFile` or `cue.Cuesheet` or raises `SheetException` if the file cannot be opened, identified or parsed correctly.

`audiotools.to_pcm_progress` (*audiofile*, *progress*)

Given an `AudioFile`-compatible object and `progress` function, returns a `PCMReaderProgress` object of that object's PCM stream.

If `progress` is `None`, the `audiofile`'s PCM stream is returned as-is.

1.1 AudioFile Objects

class `audiotools.AudioFile`

The `AudioFile` class represents an audio file on disk, such as a FLAC file, MP3 file, WAVE file and so forth. It is not meant to be instantiated directly. Instead, functions such as `open()` will return `AudioFile`-compatible objects with the following attributes and methods.

`AudioFile.NAME`

The name of the format as a string. This is how the format is referenced by utilities via the `-t` option, and must be unique among all formats.

`AudioFile.SUFFIX`

The default file suffix as a string. This is used by the `%(suffix)s` format field in the `track_name()` class-method, and by the `filename_to_type()` function for inferring the file format from its name. However, it need not be unique among all formats.

`AudioFile.COMPRESSION_MODES`

A tuple of valid compression level strings, for use with the `from_pcm()` and `convert()` methods. If the format has no compression levels, this tuple will be empty.

`AudioFile.DEFAULT_COMPRESSION`

A string of the default compression level to use with `from_pcm()` and `convert()`, if none is given. This is *not* the default compression indicated in the user's configuration file; it is a hard-coded value of last resort.

`AudioFile.COMPRESSION_DESCRIPTIONS`

A dict of compression descriptions, as unicode strings. The key is a valid compression mode string. Not all compression modes need have a description; some may be left blank.

`AudioFile.BINARIES`

A tuple of binary strings required by the format. For example, the Vorbis format may require "oggenc" and "oggdec" in order to be available for the user.

`AudioFile.REPLAYGAIN_BINARIES`

A tuple of binary strings required for ReplayGain application. For example, the Vorbis format may require "vorbisgain" in order to use the `add_replay_gain()` classmethod. This tuple may be empty if the format requires no binaries or has no ReplayGain support.

classmethod `AudioFile.is_type(file)`

Takes a file-like object with `read()` and `seek()` methods that's reset to the beginning of the stream. Returns True if the file is determined to be of the same type as this particular `AudioFile` implementation. Returns False if not.

`AudioFile.bits_per_sample()`

Returns the number of bits-per-sample in this audio file as a positive integer.

`AudioFile.channels()`

Returns the number of channels in this audio file as a positive integer.

`AudioFile.channel_mask()`

Returns a `ChannelMask` object representing the channel assignment of this audio file. If the channel assignment is unknown or undefined, that `ChannelMask` object may have an undefined value.

`AudioFile.sample_rate()`

Returns the sample rate of this audio file, in Hz, as a positive integer.

`AudioFile.total_frames()`

Returns the total number of PCM frames in this audio file, as a non-negative integer.

`AudioFile.cd_frames()`

Returns the total number of CD frames in this audio file, as a non-negative integer. Each CD frame is 1/75th of a second.

`AudioFile.seconds_length()`

Returns the length of this audio file as a `decimal.Decimal` number of seconds.

`AudioFile.lossless()`

Returns True if the data in the audio file has been stored losslessly. Returns False if not.

`AudioFile.set_metadata(metadata)`

Takes a `MetaData`-compatible object and sets this audio file's metadata to that value, if possible. Raises `IOError` if a problem occurs when writing the file.

`AudioFile.get_metadata()`

Returns a `MetaData`-compatible object representing this audio file's metadata, or None if this file contains no metadata. Raises `IOError` if a problem occurs when reading the file.

`AudioFile.delete_metadata()`

Deletes the audio file's metadata, removing or unsetting tags as necessary. Raises `IOError` if a problem occurs when writing the file.

`AudioFile.to_pcm()`

Returns this audio file's PCM data as a `PCMReader`-compatible object. May return a `PCMReaderError` if an error occurs initializing the decoder.

classmethod `AudioFile.from_pcm(filename, pcmreader[, compression])`

Takes a filename string, `PCMReader`-compatible object and optional compression level string. Creates a new audio file as the same format as this audio class and returns a new `AudioFile`-compatible object. Raises `EncodingError` if a problem occurs during encoding.

In this example, we'll transcode `track.flac` to `track.mp3` at the default compression level:

```
>>> audiotools.MP3Audio.from_pcm("track.mp3",
...                               audiotools.open("track.flac").to_pcm())
```

`AudioFile.convert` (*filename*, *target_class* [, *compression* [, *progress*]])

Takes a filename string, `AudioFile` subclass and optional compression level string. Creates a new audio file and returns an object of the same class. Raises `EncodingError` if a problem occurs during encoding.

In this example, we'll transcode `track.flac` to `track.mp3` at the default compression level:

```
>>> audiotools.open("track.flac").convert("track.mp3",
...                                       audiotools.MP3Audio)
```

Why have both a `convert` method as well as `to_pcm/from_pcm` methods? Although the former is often implemented using the latter, the `pcm` methods alone contain only raw audio data. By comparison, the `convert` method has information about what the file is being converted to and can transfer other side data if necessary.

For example, if a `.wav` file with non-audio RIFF chunks is converted to `WavPack`, this method will preserve those chunks:

```
>>> audiotools.open("chunks.wav").convert("chunks.wv",
...                                       audiotools.WavPackAudio)
```

whereas the `to_pcm/from_pcm` method alone will not.

The optional `progress` argument is a function which takes two integer arguments: `amount_processed` and `total_amount`. If supplied, this function is called at regular intervals during the conversion process and may be used to indicate the current status to the user. Note that these numbers are only meaningful when compared to one another; `amount` may represent PCM frames, bytes or anything else. The only restriction is that `total_amount` will remain static during processing and `amount_processed` will progress from 0 to `total_amount`.

```
>>> def print_progress(x, y):
...     print "%d%%" % (x * 100 / y)
...
>>> audiotools.open("track.flac").convert("track.wv",
...                                       audiotools.WavPackAudio,
...                                       progress=print_progress)
```

`AudioFile.verify` ([*progress*])

Verifies the track for correctness. Returns `True` if verification is successful. Raises an `InvalidFile` subclass if some problem is detected. If the file has built-in checksums or other error detection capabilities, this method checks those values to ensure it has not been damaged in some way.

The optional `progress` argument functions identically to the one provided to `convert()`. That is, it takes a two integer argument function which is called at regular intervals to indicate the status of verification.

`AudioFile.track_number` ()

Returns this audio file's track number as a non-negative integer. This method first checks the file's metadata values. If unable to find one, it then tries to determine a track number from the track's filename. If that method is also unsuccessful, it returns 0.

`AudioFile.album_number` ()

Returns this audio file's album number as a non-negative integer. This method first checks the file's metadata values. If unable to find one, it then tries to determine an album number from the track's filename. If that method is also unsuccessful, it returns 0.

classmethod `AudioFile.track_name` (*file_path* [, *track_metadata* [, *format* [, *suffix*]]])

Given a file path string and optional `MetaData`-compatible object a UTF-8 encoded Python format string, and an ASCII-encoded suffix string, returns a filename string with the format string fields filled-in. If not provided by

metadata, track_number and album_number will be determined from file_path, if possible. Raises UnsupportedTracknameField if the format string contains unsupported fields.

Currently supported fields are:

Field	Value
% (album_name) s	track_metadata.album_name
% (album_number) s	track_metadata.album_number
% (album_total) s	track_metadata.album_total
% (album_track_number) s	album_number combined with track_number
% (artist_name) s	track_metadata.artist_name
% (catalog) s	track_metadata.catalog
% (comment) s	track_metadata.comment
% (composer_name) s	track_metadata.composer_name
% (conductor_name) s	track_metadata.conductor_name
% (copyright) s	track_metadata.copyright
% (date) s	track_metadata.date
% (ISRC) s	track_metadata.ISRC
% (media) s	track_metadata.year
% (performer_name) s	track_metadata.performer_name
% (publisher) s	track_metadata.publisher
% (suffix) s	the <code>AudioFile</code> suffix
% (track_name) s	track_metadata.track_name
% (track_number) 2.2d	track_metadata.track_number
% (track_total) s	track_metadata.track_total
% (year) s	track_metadata.year
% (basename) s	file_path basename without suffix

classmethod `AudioFile.add_replay_gain` (*filenames* [, *progress*])

Given a list of filename strings of the same class as this `AudioFile` class, calculates and adds ReplayGain metadata to those files. Raises `ValueError` if some problem occurs during ReplayGain calculation or application. *progress*, if indicated, is a function which takes two arguments that is called as needed during ReplayGain application to indicate progress - identical to the argument used by `convert()`.

classmethod `AudioFile.can_add_replay_gain` ()

Returns `True` if this audio class supports ReplayGain and we have the necessary binaries to apply it. Returns `False` if not.

classmethod `AudioFile.lossless_replay_gain` ()

Returns `True` if this audio class applies ReplayGain via a lossless process - such as by adding a metadata tag of some sort. Returns `False` if applying metadata modifies the audio file data itself.

`AudioFile.replay_gain` ()

Returns this audio file's ReplayGain values as a `ReplayGain` object, or `None` if this audio file has no values.

`AudioFile.set_cuesheet` (*cuesheet*)

Takes a cuesheet-compatible object with `catalog()`, `IRSCs()`, `indexes()` and `pcm_lengths()` methods and sets this audio file's embedded cuesheet to those values, if possible. Raises `IOError` if this `AudioFile` supports embedded cuesheets but some error occurred when writing the file.

`AudioFile.get_cuesheet` ()

Returns a cuesheet-compatible object with `catalog()`, `IRSCs()`, `indexes()` and `pcm_lengths()` methods or `None` if no cuesheet is embedded. Raises `IOError` if some error occurs when reading the file.

classmethod `AudioFile.has_binaries` (*system_binaries*)

Takes the `audiotools.BIN` object of system binaries. Returns `True` if all the binaries necessary to implement this `AudioFile`-compatible class are present and executable. Returns `False` if not.

actual `MetaData` objects. Modifying fields within a `MetaData`-compatible object will modify its underlying representation and those changes will take effect should `set_metadata()` be called with that updated object.

The `images` argument, if given, should be an iterable collection of `Image`-compatible objects.

`MetaData.track_name`

This individual track's name as a Unicode string.

`MetaData.track_number`

This track's number within the album as an integer.

`MetaData.track_total`

The total number of tracks on the album as an integer.

`MetaData.album_name`

The name of this track's album as a Unicode string.

`MetaData.artist_name`

The name of this track's original creator/composer as a Unicode string.

`MetaData.performer_name`

The name of this track's performing artist as a Unicode string.

`MetaData.composer_name`

The name of this track's composer as a Unicode string.

`MetaData.conductor_name`

The name of this track's conductor as a Unicode string.

`MetaData.media`

The album's media type, such as `u"CD"`, `u"tape"`, `u"LP"`, etc. as a Unicode string.

`MetaData.ISRC`

This track's ISRC value as a Unicode string.

`MetaData.catalog`

This track's album catalog number as a Unicode string.

`MetaData.year`

This track's album release year as a Unicode string.

`MetaData.date`

This track's album recording date as a Unicode string.

`MetaData.album_number`

This track's album number if it is one of a series of albums, as an integer.

`MetaData.album_total`

The total number of albums within the set, as an integer.

`MetaData.comment`

This track's comment as a Unicode string.

classmethod `MetaData.converted` (*metadata*)

Takes a `MetaData`-compatible object (or `None`) and returns a new `MetaData` object of the same class, or `None`. For instance, `VorbisComment.converted()` returns `VorbisComment` objects. The purpose of this classmethod is to offload metadata conversion to the metadata classes themselves. Therefore, by using the `VorbisComment.converted()` classmethod, the `VorbisAudio` class only needs to know how to handle `VorbisComment` metadata.

Why not simply handle all metadata using this high-level representation and avoid conversion altogether? The reason is that `MetaData` is often only a subset of what the low-level implementation can support. For example, a `VorbisComment` may contain the `'FOO'` tag which has no analogue in `MetaData`'s list of fields. But

when passed through the `VorbisComment.converted()` classmethod, that 'FOO' tag will be preserved as one would expect.

The key is that performing:

```
>>> track.set_metadata(track.get_metadata())
```

should always round-trip properly and not lose any metadata values.

classmethod `MetaData.supports_images()`

Returns True if this `MetaData` implementation supports images. Returns False if not.

`MetaData.images()`

Returns a list of `Image`-compatible objects this metadata contains.

`MetaData.front_covers()`

Returns a subset of `images()` which are marked as front covers.

`MetaData.back_covers()`

Returns a subset of `images()` which are marked as back covers.

`MetaData.leaflet_pages()`

Returns a subset of `images()` which are marked as leaflet pages.

`MetaData.media_images()`

Returns a subset of `images()` which are marked as media.

`MetaData.other_images()`

Returns a subset of `images()` which are marked as other.

`MetaData.add_image(image)`

Takes a `Image`-compatible object and adds it to this metadata's list of images.

`MetaData.delete_image(image)`

Takes an `Image` from this class, as returned by `images()`, and removes it from this metadata's list of images.

`MetaData.merge(new_metadata)`

Updates this metadata by replacing empty fields with those from `new_metadata`. Non-empty fields are left as-is.

1.3 AlbumMetaData Objects

class `audiotools.AlbumMetaData(metadata_iter)`

This is a dictionary-like object of `track_number` -> `MetaData` values. It is designed to represent metadata returned by CD lookup services such as FreeDB or MusicBrainz.

`AlbumMetaData.metadata()`

Returns a single `MetaData` object containing all the fields that are consistent across this object's collection of `MetaData`.

1.4 AlbumMetaDataFile Objects

class `audiotools.AlbumMetaDataFile(album_name, artist_name, year, catalog, extra, track_metadata)`

This is an abstract parent class to `audiotools.XMCD` and `audiotools.MusicBrainzReleaseXML`. It represents a collection of album metadata as generated by the FreeDB or MusicBrainz services. Modifying fields within an `AlbumMetaDataFile`-compatible object will modify its underlying representation and those

changes will be present when `to_string()` is called on the updated object. Note that `audiotools.XMCD` doesn't support the `catalog` field while `audiotools.MusicBrainzReleaseXML` doesn't support the `extra` fields.

`AlbumMetaDataFile.album_name`

The album's name as a Unicode string.

`AlbumMetaDataFile.artist_name`

The album's artist's name as a Unicode string.

`AlbumMetaDataFile.year`

The album's release year as a Unicode string.

`AlbumMetaDataFile.catalog`

The album's catalog number as a Unicode string.

`AlbumMetaDataFile.extra`

The album's extra information as a Unicode string.

`AlbumMetaDataFile.__len__()`

The total number of tracks on the album.

`AlbumMetaDataFile.to_string()`

Returns the on-disk representation of the file as a binary string.

classmethod `AlbumMetaDataFile.from_string(string)`

Given a binary string, returns an `AlbumMetaDataFile` object of the same class. Raises `MetaDataFileException` if a parsing error occurs.

`AlbumMetaDataFile.get_track(index)`

Given a track index (starting from 0), returns a `(track_name, track_artist, track_extra)` tuple of Unicode strings. Raises `IndexError` if the requested track is out-of-bounds.

`AlbumMetaDataFile.set_track(index, track_name, track_artist, track_extra)`

Given a track index (starting from 0) and a set of Unicode strings, sets the appropriate track information. Raises `IndexError` if the requested track is out-of-bounds.

classmethod `AlbumMetaDataFile.from_tracks(tracks)`

Given a set of `AudioFile` objects, returns an `AlbumMetaDataFile` object of the same class. All files are presumed to be from the same album.

classmethod `AlbumMetaDataFile.from_cuesheet(cuesheet, total_frames, sample_rate[, metadata])`

Given a Cuesheet-compatible object with `catalog()`, `IRSCs()`, `indexes()` and `pcm_lengths()` methods; `total_frames` and `sample_rate` integers; and an optional `MetaData` object of the entire album's metadata, returns an `AlbumMetaDataFile` object of the same class constructed from that data.

`AlbumMetaDataFile.track_metadata(track_number)`

Given a `track_number` (starting from 1), returns a `MetaData` object of that track's metadata.

Raises `IndexError` if the track is out-of-bounds.

`AlbumMetaDataFile.get(track_number, default)`

Given a `track_number` (starting from 1), returns a `MetaData` object of that track's metadata, or returns `default` if that track is not present.

`AlbumMetaDataFile.track_metadatas()`

Returns an iterator over all the `MetaData` objects in this file.

`AlbumMetaDataFile.metadata()`

Returns a single `MetaData` object of all consistent fields in this file. For example, if `album_name` is the same in all `MetaData` objects, the returned object will have that `album_name` value. If `track_name` differs, the returned object have a blank `track_name` field.

1.5 Image Objects

class `audiotools.Image` (*data, mime_type, width, height, color_depth, color_count, description, type*)
 This class is a container for image data.

`Image.data`

A plain string of raw image bytes.

`Image.mime_type`

A Unicode string of this image's MIME type, such as `u'image/jpeg'`

`Image.width`

This image's width in pixels as an integer.

`Image.height`

This image's height in pixels as an integer

`Image.color_depth`

This image's color depth in bits as an integer. 24 for JPEG, 8 for GIF, etc.

`Image.color_count`

For palette-based images, this is the number of colors the image contains as an integer. For non-palette images, this value is 0.

`Image.description`

A Unicode string of this image's description.

`Image.type`

An integer representing this image's type.

Value	Type
0	front cover
1	back cover
2	leaflet page
3	media
4	other

`Image.suffix()`

Returns this image's typical filename suffix as a plain string. For example, JPEGs return `"jpg"`

`Image.type_string()`

Returns this image's type as a plain string. For example, an image of type 0 returns `"Front Cover"`

classmethod `Image.new` (*image_data, description, type*)

Given a string of raw image bytes, a Unicode description string and image type integer, returns an `Image`-compatible object. Raises `InvalidImage` if unable to determine the image type from the data string.

`Image.thumbnail` (*width, height, format*)

Given width and height integers and a format string (such as `"JPEG"`) returns a new `Image` object resized to those dimensions while retaining its original aspect ratio.

1.6 ReplayGain Objects

class `audiotools.ReplayGain` (*track_gain, track_peak, album_gain, album_peak*)

This is a simple container for ReplayGain values.

`ReplayGain.track_gain`

A float of a track's ReplayGain value.

ReplayGain.**track_peak**

A float of a track's peak value, from 0.0 to 1.0

ReplayGain.**album_gain**

A float of an album's ReplayGain value.

ReplayGain.**album_peak**

A float of an album's peak value, from 0.0 to 1.0

1.7 PCMReader Objects

class `audiotools.PCMReader` (*file*, *sample_rate*, *channels*, *channel_mask*, *bits_per_sample*[, *process*[, *signed*[, *big_endian*]]])

This class wraps around file-like objects and generates `pcm.FrameList` objects on each call to `read()`. `sample_rate`, `channels`, `channel_mask` and `bits_per_sample` should be integers. `process` is a subprocess helper object which generates PCM data. `signed` is `True` if the generated PCM data is signed. `big_endian` is `True` if the generated PCM data is big-endian.

Note that `PCMReader`-compatible objects need only implement the `sample_rate`, `channels`, `channel_mask` and `bits_per_sample` fields. The rest are helpers for converting raw strings into `pcm.FrameList` objects.

`PCMReader.sample_rate`

The sample rate of this audio stream, in Hz, as a positive integer.

`PCMReader.channels`

The number of channels in this audio stream as a positive integer.

`PCMReader.channel_mask`

The channel mask of this audio stream as a non-negative integer.

`PCMReader.bits_per_sample`

The number of bits-per-sample in this audio stream as a positive integer.

`PCMReader.read` (*bytes*)

Try to read a `pcm.FrameList` object of size `bytes`, if possible. This method is *not* guaranteed to read that amount of bytes. It may return less, particularly at the end of an audio stream. It may even return `FrameLists` larger than requested. However, it must always return a non-empty `FrameList` until the end of the PCM stream is reached. May raise `IOError` if there is a problem reading the source file, or `ValueError` if the source file has some sort of error.

`PCMReader.close` ()

Closes the audio stream. If any subprocesses were used for audio decoding, they will also be closed and waited for their process to finish. May raise a `DecodingError`, typically indicating that a helper subprocess used for decoding has exited with an error.

1.7.1 PCMReaderError Objects

class `audiotools.PCMReaderError` (*error_message*, *sample_rate*, *channels*, *channel_mask*, *bits_per_sample*)

This is a subclass of `PCMReader` which always returns empty `pcm.FrameList` objects and always raises a `DecodingError` with the given `error_message` when closed. The purpose of this is to postpone error generation so that all encoding errors, even those caused by unsuccessful decoding, are restricted to the `from_pcm()` classmethod which can then propagate the `DecodingError` error message to the user.

1.7.2 PCMConverter Objects

class `audiotools.PCMConverter` (*pcmreader*, *sample_rate*, *channels*, *channel_mask*, *bits_per_sample*)

This class takes an existing `PCMReader`-compatible object along with a new set of `sample_rate`, `channels`, `channel_mask` and `bits_per_sample` values. Data from `pcmreader` is then automatically converted to the same format as those values.

`PCMConverter.sample_rate`

If the new sample rate differs from `pcmreader`'s sample rate, audio data is automatically resampled on each call to `read()`.

`PCMConverter.channels`

If the new number of channels is smaller than `pcmreader`'s channel count, existing channels are removed or downmixed as necessary. If the new number of channels is larger, data from the first channel is duplicated as necessary to fill the rest.

`PCMConverter.channel_mask`

If the new channel mask differs from `pcmreader`'s channel mask, channels are removed as necessary such that the proper channel only outputs to the proper speaker.

`PCMConverter.bits_per_sample`

If the new bits-per-sample differs from `pcmreader`'s number of bits-per-sample, samples are shrunk or enlarged as necessary to cover the full amount of bits.

`PCMConverter.read()`

This method functions the same as the `PCMReader.read()` method.

`PCMConverter.close()`

This method functions the same as the `PCMReader.close()` method.

1.7.3 BufferedPCMReader Objects

class `audiotools.BufferedPCMReader` (*pcmreader*)

This class wraps around an existing `PCMReader` object. Its calls to `read()` are guaranteed to return `pcm.FrameList` objects as close to the requested amount of bytes as possible without going over by buffering data internally.

The reason such behavior is not required is that we often don't care about the size of the individual `FrameLists` being passed from one routine to another. But on occasions when we need `pcm.FrameList` objects to be of a particular size, this class can accomplish that.

1.7.4 ReorderedPCMReader Objects

class `audiotools.ReorderedPCMReader` (*pcmreader*, *channel_order*)

This class wraps around an existing `PCMReader` object. It takes a list of channel number integers (which should be the same as `pcmreader`'s channel count) and reorders channels upon each call to `read()`.

For example, to swap channels 0 and 1 in a stereo stream, one could do the following:

```
>>> reordered = ReorderedPCMReader(original, [1, 0])
```

Calls to `reordered.read()` will then have the left channel on the right side and vice versa.

1.7.5 PCMCat Objects

class `audiotools.PCMCat` (*pcmreaders*)

This class wraps around an iterable group of `PCMReader` objects and concatenates their output into a single output stream.

Warning: `PCMCat` does not check that its input `PCMReader` objects all have the same sample rate, channels, channel mask or bits-per-sample. Mixing incompatible readers is likely to trigger undesirable behavior from any sort of processing - which often assumes data will be in a consistent format.

1.7.6 PCMReaderWindow Objects

class `audiotools.PCMReaderWindow` (*pcmreader, initial_offset, total_pcm_frames*)

This class wraps around an existing `PCMReader` object and truncates or extends its samples as needed. `initial_offset`, if positive, indicates how many PCM frames to truncate from the beginning of the stream. If negative, the beginning of the stream is padded by that many PCM frames - all of which have a value of 0. `total_pcm_frames` indicates the total length of the stream as a non-negative number of PCM frames. If shorter than the actual length of the PCM reader's stream, the reader is truncated. If longer, the stream is extended by as many PCM frames as needed. Again, padding frames have a value of 0.

1.7.7 LimitedPCMReader Objects

class `audiotools.LimitedPCMReader` (*buffered_pcmreader, total_pcm_frames*)

This class wraps around an existing `BufferedPCMReader` and ensures that no more than `total_pcm_frames` will be read from that stream by limiting reads to it.

Note: `PCMReaderWindow` is designed primarily for handling sample offset values in a `CDTrackReader`, or for skipping a potentially large number of samples in a stream. `LimitedPCMReader` is designed for splitting a stream into several smaller streams without losing any PCM frames.

Which to use for a given situation depends on whether one cares about consuming the samples outside of the sub-reader or not.

1.7.8 PCMReaderProgress Objects

class `audiotools.PCMReaderProgress` (*pcmreader, total_frames, progress*)

This class wraps around an existing `PCMReader` object and generates periodic updates to a given progress function. `total_frames` indicates the total number of PCM frames in the PCM stream.

```
>>> progress_display = SingleProgressDisplay(Messenger("audiotools"), u"encoding file")
>>> pcmreader = source_audiofile.to_pcm()
>>> source_frames = source_audiofile.total_frames()
>>> target_audiofile = AudioType.from_pcm("target_filename",
...                                     PCMReaderProgress(pcmreader,
...                                                         source_frames,
...                                                         progress_display.update))
```

1.8 ChannelMask Objects

class `audiotools.ChannelMask` (*mask*)

This is an integer-like class that abstracts channel assignments into a set of bit fields.

Mask	Speaker
0x1	front_left
0x2	front_right
0x4	front_center
0x8	low_frequency
0x10	back_left
0x20	back_right
0x40	front_left_of_center
0x80	front_right_of_center
0x100	back_center
0x200	side_left
0x400	side_right
0x800	top_center
0x1000	top_front_left
0x2000	top_front_center
0x4000	top_front_right
0x8000	top_back_left
0x10000	top_back_center
0x20000	top_back_right

All channels in a `pcm.FrameList` will be in RIFF WAVE order as a sensible convention. But which channel corresponds to which speaker is decided by this mask. For example, a 4 channel `PCMReader` with the channel mask `0x33` corresponds to the bits `00110011`

Reading those bits from right to left (least significant first) the `front_left`, `front_right`, `back_left`, `back_right` speakers are set. Therefore, the `PCMReader`'s 4 channel `FrameLists` are laid out as follows:

```
0.front_left
1.front_right
2.back_left
3.back_right
```

Since the `front_center` and `low_frequency` bits are not set, those channels are skipped in the returned `FrameLists`.

Many formats store their channels internally in a different order. Their `PCMReader` objects will be expected to reorder channels and set a `ChannelMask` matching this convention. And, their `from_pcm()` classmethods will be expected to reverse the process.

A `ChannelMask` of 0 is “undefined”, which means that channels aren’t assigned to *any* speaker. This is an ugly last resort for handling formats where multi-channel assignments aren’t properly defined. In this case, a `from_pcm()` classmethod is free to assign the undefined channels any way it likes, and is under no obligation to keep them undefined when passing back out to `to_pcm()`

`ChannelMask.defined()`

Returns True if this mask is defined.

`ChannelMask.undefined()`

Returns True if this mask is undefined.

`ChannelMask.channels()`

Returns the speakers this mask contains as a list of strings in the order they appear in the PCM stream.

`ChannelMask.index(channel_name)`

Given a channel name string, returns the index of that channel within the PCM stream. For example:

```
>>> mask = ChannelMask(0xB)      #fL, fR, LFE, but no fC
>>> mask.index("low_frequency")
2
```

classmethod `ChannelMask.from_fields(**fields)`

Takes channel names as function arguments and returns a `ChannelMask` object.

```
>>> mask = ChannelMask.from_fields(front_right=True,
...                               front_left=True,
...                               front_center=True)
>>> int(mask)
7
```

classmethod `ChannelMask.from_channels(channel_count)`

Takes a channel count integer and returns a `ChannelMask` object.

Warning: `from_channels()` *only* works for 1 and 2 channel counts and is meant purely as a convenience method for mono or stereo streams. All other values will trigger a `ValueError`

1.9 CDDA Objects

class `audiotools.CDDA(device[, speed[, perform_logging]])`

This class is used to access a CD-ROM device. It functions as a list of `CDTrackReader` objects, each representing a CD track and starting from index 1.

```
>>> cd = CDDA("/dev/cdrom")
>>> len(cd)
17
>>> cd[1]
<audiotools.CDTrackReader instance at 0x170def0>
>>> cd[17]
<audiotools.CDTrackReader instance at 0x1341b00>
```

If `True`, `perform_logging` indicates that track reads should generate `CDTrackLog` entries. Otherwise, no logging is performed.

Warning: `perform_logging` also determines the level of multithreading allowed during CD reading. If logging is active, `CDTrackReader`'s `read` method will block all other threads until the read is complete. If logging is inactive, a read will not block other threads. This is an unfortunate necessity due to `libcdio`'s callback mechanism implementation.

`CDDA.length()`

The length of the entire CD, in sectors.

`CDDA.first_sector()`

The position of the first sector on the CD, typically 0.

`CDDA.last_sector()`

The position of the last sector on the CD.

1.9.1 CDTrackReader Objects

class `audiotools.CDTrackReader` (*cdda*, *track_number* [, *perform_logging*])

These objects are usually retrieved from `CDDA` objects rather than instantiated directly. Each is a `PCMReader`-compatible object with a few additional methods specific to CD reading.

`CDTrackReader.rip_log`

A `CDTrackLog` object indicating `cdparanoia`'s results from reading this track from the CD. This attribute should be checked only after the track has been fully read.

`CDTrackReader.offset` ()

Returns the offset of this track within the CD, in sectors.

`CDTrackReader.length` ()

Returns the total length of this track, in sectors.

1.9.2 CDTrackLog Objects

class `audiotools.CDTrackLog`

This is a dictionary-like object which should be retrieved from `CDTrackReader` rather than instantiated directly. Its `__str__` () method will return a human-readable collection of error statistics comparable to what's returned by the `cdda2wav` program.

1.10 DVDAudio Objects

class `audiotools.DVDAudio` (*audio_ts_path* [, *device*])

This class is used to access a DVD-Audio. It contains a collection of titlesets. Each titleset contains a list of `DVDATitle` objects, and each `DVDATitle` contains a list of `DVDATrack` objects. `audio_ts_path` is the path to the DVD-Audio's `AUDIO_TS` directory, such as `/media/cdrom/AUDIO_TS`. `device` is the path to the DVD-Audio's mount device, such as `/dev/cdrom`.

For example, to access the 3rd `DVDATrack` object of the 2nd `DVDATitle` of the first titleset, one can simply perform the following:

```
>>> track = DVDAudio(path) [0] [1] [2]
```

Note: If `device` is indicated *and* the `AUDIO_TS` directory contains a `DVDAUDIO.MKB` file, unprotection will be performed automatically if supported on the user's platform. Otherwise, the files are assumed to be unprotected.

1.10.1 DVDATitle Objects

class `audiotools.DVDATitle` (*dvdaudio*, *titleset*, *title*, *pts_length*, *tracks*)

This class represents a single DVD-Audio title. `dvdaudio` is a `DVDAudio` object. `titleset` and `title` are integers indicating this title's position in the DVD-Audio - both offset from 0. `pts_length` is the the total length of the title in PTS ticks (there are 90000 PTS ticks per second). `tracks` is a list of `DVDATrack` objects.

It is rarely instantiated directly; one usually retrieves titles from the parent `DVDAudio` object.

`DVDATitle.dvdaudio`

The parent `DVDAudio` object.

`DVDATitle.titleset`

An integer of this title's titleset, offset from 0.

DVDATitle.title

An integer of this title's position within the titleset, offset from 0.

DVDATitle.pts_length

The length of this title in PTS ticks.

DVDATitle.tracks

A list of `DVDATrack` objects.

DVDATitle.info()

Returns a (sample_rate, channels, channel_mask, bits_per_sample, type) tuple of integers. type is 0xA0 if the title is a PCM stream, or 0xA1 if the title is an MLP stream.

DVDATitle.stream()

Returns an `AOBStream` object of this title's data.

DVDATitle.to_pcm()

Returns a `PCMReader`-compatible object of this title's entire data stream.

1.10.2 DVDATrack Objects

class `audiotools.DVDATrack` (*dvdaudio*, *titleset*, *title*, *track*, *first_pts*, *pts_length*, *first_sector*, *last_sector*)

This class represents a single DVD-Audio track. `dvdaudio` is a `DVDAudio` object. `titleset`, `title` and `track` are integers indicating this track's position in the DVD-Audio - all offset from 0. `first_pts` is the track's first PTS value. `pts_length` is the the total length of the track in PTS ticks. `first_sector` and `last_sector` indicate the range of sectors this track occupies.

It is also rarely instantiated directly; one usually retrieves tracks from the parent `DVDATitle` object.

DVDATrack.dvdaudio

The parent `DVDAudio` object.

DVDATrack.titleset

An integer of this tracks's titleset, offset from 0.

DVDATrack.title

An integer of this track's position within the titleset, offset from 0.

DVDATrack.track

An integer of this track's position within the title, offset from 0.

DVDATrack.first_pts

The track's first PTS index.

DVDATrack.pts_length

The length of this track in PTS ticks.

DVDATrack.first_sector

The first sector this track occupies.

<p>Warning: The track is <i>not</i> guaranteed to start at the beginning of its first sector. Although it begins within that sector, the track's start may be offset some arbitrary number of bytes from the sector's start.</p>

DVDATrack.last_sector

The last sector this track occupies.

1.10.3 AOBStream Objects

class `audiotools.AOBStream` (*aob_files*, *first_sector*, *last_sector*[, *unprotector*])

This is a stream of DVD-Audio AOB data. It contains several convenience methods to make unpacking that data easier. *aob_files* is a list of complete AOB file path strings. *first_sector* and *last_sector* are integers indicating the stream's range of sectors. *unprotector* is a function which takes a string of binary sector data and returns an unprotected binary string.

`AOBStream.sectors` ()

Iterates over a series of 2048 byte, binary strings of sector data for the entire AOB stream. If *unprotector* is present, those sectors are returned unprotected.

`AOBStream.packets` ()

Iterates over a series of packets by wrapping around the sectors iterator. Each sector contains one or more packets. Packets containing audio data (that is, those with a stream ID of 0xBD) are returned while non-audio packets are discarded.

`AOBStream.packet_payloads` ()

Iterates over a series of packet data by wrapping around the packets iterator. The payload is the packet with its ID, CRC and padding removed. Concatenating all of a stream's payloads results in a complete MLP or PCM stream suitable for passing to a decoder.

1.11 ExecQueue Objects

class `audiotools.ExecQueue`

This is a class for executing multiple Python functions in parallel across multiple CPUs.

`ExecQueue.execute` (*function*, *args*[, *kwargs*])

Queues a Python function, list of arguments and optional dictionary of keyword arguments.

`ExecQueue.run` ([*max_processes*])

Executes all queued Python functions, running *max_processes* number of functions at a time until the entire queue is empty. This operates by forking a new subprocess per function, executing that function and then, regardless of the function's result, the child job performs an unconditional exit.

This means that any side effects of executed functions have no effect on `ExecQueue`'s caller besides those which modify files on disk (encoding an audio file, for example).

class `audiotools.ExecQueue2`

This is a class for executing multiple Python functions in parallel across multiple CPUs and receiving results from those functions.

`ExecQueue2.execute` (*function*, *args*[, *kwargs*])

Queues a Python function, list of arguments and optional dictionary of keyword arguments.

`ExecQueue2.run` ([*max_processes*])

Executes all queued Python functions, running *max_processes* number of functions at a time until the entire queue is empty. Returns an iterator of the returned values of those functions. This operates by forking a new subprocess per function with a pipe between them, executing that function in the child process and then transferring the resulting pickled object back to the parent before performing an unconditional exit.

Queued functions that raise an exception or otherwise exit uncleanly yield `None`. Likewise, any side effects of the called function have no effect on `ExecQueue`'s caller.

1.12 ExecProgressQueue Objects

class `audiotools.ExecProgressQueue` (*progress_display*)

This class runs multiple jobs in parallel and displays their progress output to the given `ProgressDisplay` object.

`ExecProgressQueue.results`

A dict of results returned by the queued functions once executed. The key is an integer starting from 0.

Note: Why not a list? Since jobs may finish in an arbitrary order, a dict is used so that results can be accumulated out-of-order. Even using placeholder values such as `None` may not be appropriate if queued functions return `None` as a significant value.

`ExecProgressQueue.execute` (*function* [, *progress_text* [, *completion_output* [, **args* [, ***kwargs*]]]])

Queues a Python function for execution. This function is passed the optional `args` and `kwargs` arguments upon execution. However, this function is also passed an *additional* `progress` keyword argument which is a function that takes `current` and `total` integer arguments. The executed function can then call that `progress` function at regular intervals to indicate its progress.

If given, `progress_text` is a unicode string to be displayed while the function is being executed.

`completion_output` is displayed once the executed function is completed. It can be either a unicode string or a function whose argument is the returned result of the executed function and which must output a unicode string.

`ExecProgressQueue.run` (*[max_processes]*)

Executes all the queued functions, running `max_processes` number of functions at a time until the entire queue is empty. This operates by forking a new subprocess per function in which the running progress and function output are piped to the parent for display to the screen or accumulation in the `ExecProgressQueue.results` dict.

If an exception occurs in one of the subprocesses, that exception will be raised by `ExecProgressQueue.run()` and all the running jobs will be terminated.

```
>>> def progress_function(progress, filename):
...     # perform work here
...     progress(current, total)
...     # more work
...     result.a = a
...     result.b = b
...     result.c = c
...     return result
...
>>> def format_result(result):
...     return u"%s %s %s" % (result.a, result.b, result.c)
...
>>> queue = ExecProgressQueue(ProgressDisplay(Messenger("executable")))
>>> queue.execute(function=progress_function,
...               progress_text=u"%s progress" % (filename1),
...               completion_output=format_result,
...               filename=filename1)
...
>>> queue.execute(function=progress_function,
...               progress_text=u"%s progress" % (filename2),
...               completion_output=format_result,
...               filename=filename2)
```

```

...
>>> queue.run()
>>> queue.results

```

1.13 Messenger Objects

class `audiotools.Messenger` (*executable_name, options*)

This is a helper class for displaying program data, analogous to a primitive logging facility. It takes a raw `executable_name` string and `optparse.OptionParser` object. Its behavior changes depending on whether the options object's `verbosity` attribute is "normal", "debug" or "silent".

`Messenger.output` (*string*)

Outputs Unicode *string* to stdout and adds a newline, unless `verbosity` level is "silent".

`Messenger.partial_output` (*string*)

Output Unicode *string* to stdout and flushes output so it is displayed, but does not add a newline. Does nothing if `verbosity` level is "silent".

`Messenger.info` (*string*)

Outputs Unicode *string* to stdout and adds a newline, unless `verbosity` level is "silent".

`Messenger.partial_info` (*string*)

Output Unicode *string* to stdout and flushes output so it is displayed, but does not add a newline. Does nothing if `verbosity` level is "silent".

Note: What's the difference between `Messenger.output()` and `Messenger.info()`? `Messenger.output()` is for a program's primary data. `Messenger.info()` is for incidental information. For example, `trackinfo` uses `Messenger.output()` for what it displays since that output is its primary function. But `track2track` uses `Messenger.info()` for its lines of progress since its primary function is converting audio and tty output is purely incidental.

`Messenger.warning` (*string*)

Outputs warning text, Unicode *string* and a newline to stderr, unless `verbosity` level is "silent".

```

>>> m = audiotools.Messenger("audiotools", options)
>>> m.warning(u"Watch Out!")
*** Warning: Watch Out!

```

`Messenger.error` (*string*)

Outputs error text, Unicode *string* and a newline to stderr.

```

>>> m.error(u"Fatal Error!")
*** Error: Fatal Error!

```

`Messenger.os_error` (*oserror*)

Given an `OSError` object, displays it as a properly formatted error message with an appended newline.

Note: This is necessary because of the way `OSError` handles its embedded filename string. Using this method ensures that filename is properly encoded when displayed. Otherwise, there's a good chance that non-ASCII filenames will be garbled.

`Messenger.usage` (*string*)

Outputs usage text, Unicode *string* and a newline to stderr.

```
>>> m.usage(u"<arg1> <arg2> <arg3>")
*** Usage: audiotools <arg1> <arg2> <arg3>
```

`Messenger.filename` (*string*)

Takes a raw filename string and converts it to a Unicode string.

`Messenger.new_row` ()

This method begins the process of creating aligned table data output. It sets up a new row in our output table to which we can add columns of text which will be aligned automatically upon completion.

`Messenger.output_column` (*string* [, *right_aligned*])

This method adds a new Unicode string to the currently open row. If *right_aligned* is `True`, its text will be right-aligned when it is displayed. When you've finished with one row and wish to start on another, call `Messenger.new_row()` again.

`Messenger.blank_row` ()

This method adds a completely blank row to its table data. Note that the first row within an output table cannot be blank.

`Messenger.output_rows` ()

Formats and displays the entire table data through the `Messenger.output()` method (which will do nothing if verbosity level is "silent").

```
>>> m.new_row()
>>> m.output_column(u"a", True)
>>> m.output_column(u" : ", True)
>>> m.output_column(u"This is some test data")
>>> m.new_row()
>>> m.output_column(u"ab", True)
>>> m.output_column(u" : ", True)
>>> m.output_column(u"Another row of test data")
>>> m.new_row()
>>> m.output_column(u"abc", True)
>>> m.output_column(u" : ", True)
>>> m.output_column(u"The final row of test data")
>>> m.output_rows()
  a : This is some test data
 ab : Another row of test data
abc : The final row of test data
```

`Messenger.info_rows` ()

Functions like `Messenger.output_rows()`, but displays output via `Messenger.info()` rather than `Messenger.output()`.

`Messenger.divider_row` (*dividers*)

This method takes a list of vertical divider Unicode characters, one per output column, and multiplies those characters by their column width when displayed.

```
>>> m.new_row()
>>> m.output_column(u"foo")
>>> m.output_column(u" ")
>>> m.output_column(u"bar")
>>> m.divider_row([u"-", u" ", u"-"])
>>> m.new_row()
>>> m.output_column(u"test")
>>> m.output_column(u" ")
>>> m.output_column(u"column")
>>> m.output_rows()
foo  bar
```

```
-----
test column
```

`Messenger.ansi` (*string, codes*)

Takes a Unicode string and list of ANSI SGR code integers. If `stdout` is to a TTY, returns a Unicode string formatted with those codes. If not, the string is returned as is. Codes can be taken from the many predefined values in the `Messenger` class. Note that not all output terminals are guaranteed to support all ANSI escape codes.

`Messenger.ansi_err` (*string, codes*)

This is identical to `Messenger.ansi`, but it checks whether `stderr` is a TTY instead of `stdout`.

Code	Effect
<code>Messenger.RESET</code>	resets current codes
<code>Messenger.BOLD</code>	bold font
<code>Messenger.FAINT</code>	faint font
<code>Messenger.ITALIC</code>	italic font
<code>Messenger.UNDERLINE</code>	underline text
<code>Messenger.BLINK_SLOW</code>	blink slowly
<code>Messenger.BLINK_FAST</code>	blink quickly
<code>Messenger.REVERSE</code>	reverse text
<code>Messenger.STRIKEOUT</code>	strikeout text
<code>Messenger.FG_BLACK</code>	foreground black
<code>Messenger.FG_RED</code>	foreground red
<code>Messenger.FG_GREEN</code>	foreground green
<code>Messenger.FG_YELLOW</code>	foreground yellow
<code>Messenger.FG_BLUE</code>	foreground blue
<code>Messenger.FG_MAGENTA</code>	foreground magenta
<code>Messenger.FG_CYAN</code>	foreground cyan
<code>Messenger.FG_WHITE</code>	foreground white
<code>Messenger.BG_BLACK</code>	background black
<code>Messenger.BG_RED</code>	background red
<code>Messenger.BG_GREEN</code>	background green
<code>Messenger.BG_YELLOW</code>	background yellow
<code>Messenger.BG_BLUE</code>	background blue
<code>Messenger.BG_MAGENTA</code>	background magenta
<code>Messenger.BG_CYAN</code>	background cyan
<code>Messenger.BG_WHITE</code>	background white

`Messenger.ansi_clearline` ()

Generates a ANSI escape codes to clear the current line.

This works only if `stdout` is a TTY, otherwise it does nothing.

```
>>> msg = Messenger("audiotools", None)
>>> msg.partial_output(u"working")
>>> time.sleep(1)
>>> msg.ansi_clearline()
>>> msg.output(u"done")
```

`Messenger.ansi_uplines` (*self, lines*)

Moves the cursor upwards by the given number of lines.

`Messenger.ansi_cleardown` (*self*)

Clears all the output below the current line. This is typically used in conjunction with `Messenger.ansi_uplines` ().

```
>>> msg = Messenger("audiotools", None)
>>> msg.output(u"line 1")
>>> msg.output(u"line 2")
>>> msg.output(u"line 3")
>>> msg.output(u"line 4")
>>> time.sleep(2)
>>> msg.ansi_uplines(4)
>>> msg.ansi_cleardown()
>>> msg.output(u"done")
```

`Messenger.terminal_size` (*fd*)

Given a file descriptor integer, or file object with a `fileno()` method, returns the size of the current terminal as a (height, width) tuple of integers.

1.14 ProgressDisplay Objects

class `audiotools.ProgressDisplay` (*messenger*)

This is a class for displaying incremental progress updates to the screen. It takes a `Messenger` object which is used for generating output. Whether or not `sys.stdout` is a TTY determines how this class operates. If a TTY is detected, screen updates are performed incrementally with individual rows generated and refreshed as needed using ANSI escape sequences such that the user's screen need not scroll. If a TTY is not detected, most progress output is omitted.

`ProgressDisplay.add_row` (*row_id*, *output_line*)

Adds a row of output to be displayed with progress indicated. *row_id* should be a unique identifier, typically an int. *output_line* should be a unicode string indicating what we're displaying the progress of.

`ProgressDisplay.update_row` (*row_id*, *current*, *total*)

Updates the progress of the given row. *current* and *total* are integers such that *current* / *total* indicates the percentage of progress performed.

`ProgressDisplay.refresh` ()

Refreshes the screen output, clearing and displaying a fresh progress rows as needed. This is called automatically by `update_row()`.

`ProgressDisplay.clear` ()

Clears the screen output. Although `refresh()` will call this method as needed, one may need to call it manually when generating output independently for the progress monitor so that partial updates aren't left on the user's screen.

`ProgressDisplay.delete_row` (*row_id*)

Removes the row with the given ID from the current list of progress monitors.

class `audiotools.SingleProgressDisplay` (*messenger*, *progress_text*)

This is a subclass of `ProgressDisplay` used for generating only a single line of progress output. As such, one only specifies a single row of unicode *progress_text* at initialization time and can avoid the row management functions entirely.

`SingleProgressDisplay.update` (*current*, *total*)

Updates the status of our output row with *current* and *total* integers, which function identically to those of `ProgressDisplay.update_row()`.

class `audiotools.ReplayGainProgressDisplay` (*messenger*, *lossless_replay_gain*)

This is another `ProgressDisplay` subclass optimized for the display of ReplayGain application progress. *messenger* is a `Messenger` object and *lossless_replay_gain* is a boolean indicating whether ReplayGain is being applied losslessly or not (which can be determined from the

`AudioFile.lossless_replay_gain()` classmethod). Whether or not `sys.stdout` is a TTY determines how this class behaves.

`ReplayGainProgressDisplay.initial_message()`

If operating on a TTY, this does nothing since progress output will be displayed. Otherwise, this indicates that ReplayGain application has begun.

`ReplayGainProgressDisplay.update(current, total)`

Updates the status of ReplayGain application.

`ReplayGainProgressDisplay.final_message()`

If operating on a TTY, this indicates that ReplayGain application is complete. Otherwise, this does nothing.

```
>>> rg_progress = ReplayGainProgressDisplay(messenger, AudioType.lossless_replay_gain())
>>> rg_progress.initial_message()
>>> AudioType.add_replay_gain(filename_list, rg_progress.update)
>>> rg_progress.final_message()
```

class `audiotools.ProgressRow(row_id, output_line)`

This is used by `ProgressDisplay` and its subclasses for actual output generation. `row_id` is a unique identifier and `output_line` is a unicode string. It is not typically instantiated directly.

`ProgressRow.update(current, total)`

Updates the current progress with `current` and `total` integer values.

`ProgressRow.unicode(width)`

Returns the output line and its current progress as a unicode string, formatted to the given width in onscreen characters. Screen width can be determined from the `Messenger.terminal_size()` method.

1.14.1 display_unicode Objects

This class is for displaying portions of a unicode string to the screen. The reason this is needed is because not all Unicode characters are the same width. So, for example, if one wishes to display a portion of a unicode string to a screen that's 80 ASCII characters wide, one can't simply perform:

```
>>> messenger.output(unicode_string[0:80])
```

since some of those Unicode characters might be double width, which would cause the string to wrap.

class `audiotools.display_unicode(unicode_string)`

`display_unicode.head(display_characters)`

Returns a new `display_unicode` object that's been truncated to the given number of display characters.

```
>>> s = u"".join(map(unichr, range(0x30a1, 0x30a1+25)))
>>> len(s)
25
>>> u = unicode(display_unicode(s).head(40))
>>> len(u)
20
>>> print repr(u)
u'\u30a1\u30a2\u30a3\u30a4\u30a5\u30a6\u30a7\u30a8\u30a9\u30aa\u30ab\u30ac\u30ad\u30ae\u30af\u30
```

`display_unicode.tail(display_characters)`

Returns a new `display_unicode` object that's been truncated to the given number of display characters.

```
>>> s = u"".join(map(unichr, range(0x30a1, 0x30a1+25)))
>>> len(s)
25
>>> u = unicode(display_unicode(s).tail(40))
```

```
>>> len(u)
20
>>> print repr(u)
u'\u30a6\u30a7\u30a8\u30a9\u30aa\u30ab\u30ac\u30ad\u30ae\u30af\u30b0\u30b1\u30b2\u30b3\u30b4\u30b5\u30b6\u30b7\u30b8\u30b9'
```

`display_unicode.split` (*display_characters*)

Returns a tuple of `display_unicode` objects. The first is up to `display_characters` wide, while the second contains the remainder.

```
>>> s = u"".join(map(unichr, range(0x30a1, 0x30a1+25)))
>>> (head, tail) = display_unicode(s).split(40)
>>> print repr(unicode(head))
u'\u30a1\u30a2\u30a3\u30a4\u30a5\u30a6\u30a7\u30a8\u30a9\u30aa\u30ab\u30ac\u30ad\u30ae\u30af\u30b0\u30b1\u30b2\u30b3\u30b4\u30b5\u30b6\u30b7\u30b8\u30b9'
```

AUDIOTOOLS . PCM — THE PCM FRAMELIST MODULE

The `audiotools.pcm` module contains the `FrameList` and `FloatFrameList` classes for handling blobs of raw data. These classes are immutable and list-like, but provide several additional methods and attributes to aid in processing PCM data.

`audiotools.pcm.from_list` (*list, channels, bits_per_sample, is_signed*)

Given a list of integer values, a number of channels, the amount of bits-per-sample and whether the samples are signed, returns a new `FrameList` object with those values. Raises `ValueError` if a `FrameList` cannot be built from those values.

```
>>> f = from_list([-1,0,1,2],2,16,True)
>>> list(f)
[-1, 0, 1, 2]
```

`audiotools.pcm.from_frames` (*frame_list*)

Given a list of `FrameList` objects, returns a new `FrameList` whose values are built from those objects. Raises `ValueError` if any of the objects are longer than 1 PCM frame, their number of channels are not consistent or their `bits_per_sample` are not consistent.

```
>>> l = [from_list([-1,0],2,16,True),
...      from_list([ 1,2],2,16,True)]
>>> f = from_frames(l)
>>> list(f)
[-1, 0, 1, 2]
```

`audiotools.pcm.from_channels` (*frame_list*)

Given a list of `FrameList` objects, returns a new `FrameList` whose values are built from those objects. Raises `ValueError` if any of the objects are wider than 1 channel, their number of frames are not consistent or their `bits_per_sample` are not consistent.

```
>>> l = [from_list([-1,1],1,16,True),
...      from_list([ 0,2],1,16,True)]
>>> f = from_channels(l)
>>> list(f)
[-1, 0, 1, 2]
```

`audiotools.pcm.from_float_frames` (*float_frame_list*)

Given a list of `FloatFrameList` objects, returns a new `FloatFrameList` whose values are built from those objects. Raises `ValueError` if any of the objects are longer than 1 PCM frame or their number of channels are not consistent.

```
>>> l = [FloatFrameList([-1.0,0.0],2),
...      FloatFrameList([ 0.5,1.0],2)]
>>> f = from_float_frames(l)
>>> list(f)
[-1.0, 0.0, 0.5, 1.0]
```

`audiotools.pcm.from_float_channels` (*float_frame_list*)

Given a list of `FloatFrameList` objects, returns a new `FloatFrameList` whose values are built from those objects. Raises `ValueError` if any of the objects are wider than 1 channel or their number of frames are not consistent.

```
>>> l = [FloatFrameList([-1.0,0.5],1),
...      FloatFrameList([ 0.0,1.0],1)]
>>> f = from_float_channels(l)
>>> list(f)
[-1.0, 0.0, 0.5, 1.0]
```

2.1 FrameList Objects

class `audiotools.pcm.FrameList` (*string, channels, bits_per_sample, is_big_endian, is_signed*)

This class implements a PCM `FrameList`, which can be envisioned as a 2D array of signed integers where each row represents a PCM frame of samples and each column represents a channel.

During initialization, `string` is a collection of raw bytes, `bits_per_sample` is an integer and `is_big_endian` and `is_signed` are booleans. This provides a convenient way to transforming raw data from file-like objects into `FrameList` objects. Once instantiated, a `FrameList` object is immutable.

`FrameList.frames`

The amount of PCM frames within this object, as a non-negative integer.

`FrameList.channels`

The amount of channels within this object, as a positive integer.

`FrameList.bits_per_sample`

The size of each sample in bits, as a positive integer.

`FrameList.frame` (*frame_number*)

Given a non-negative `frame_number` integer, returns the samples at the given frame as a new `FrameList` object. This new `FrameList` will be a single frame long, but have the same number of channels and `bits_per_sample` as the original. Raises `IndexError` if one tries to get a frame number outside this `FrameList`'s boundaries.

`FrameList.channel` (*channel_number*)

Given a non-negative `channel_number` integer, returns the samples at the given channel as a new `FrameList` object. This new `FrameList` will be a single channel wide, but have the same number of frames and `bits_per_sample` as the original. Raises `IndexError` if one tries to get a channel number outside this `FrameList`'s boundaries.

`FrameList.split` (*frame_count*)

Returns a pair of `FrameList` objects. The first contains up to `frame_count` number of PCM frames. The second contains the remainder. If `frame_count` is larger than the number of frames in the `FrameList`, the first will contain all of the frames and the second will be empty.

`FrameList.to_float` ()

Converts this object's values to a new `FloatFrameList` object by transforming all samples to the range -1.0 to 1.0.

`FrameList.to_bytes` (*is_big_endian, is_signed*)

Given `is_big_endian` and `is_signed` booleans, returns a plain string of raw PCM data. This is much like the inverse of `FrameList`'s initialization routine.

`FrameList.frame_count` (*bytes*)

A convenience method which converts a given byte count to the maximum number of frames those bytes could contain, or a minimum of 1.

```
>>> FrameList("", 2, 16, False, True).frame_count(8)
2
```

2.2 FloatFrameList Objects

class `audiotools.pcm.FloatFrameList` (*floats, channels*)

This class implements a `FrameList` of floating point samples, which can be envisioned as a 2D array of signed floats where each row represents a PCM frame of samples, each column represents a channel and each value is within the range of -1.0 to 1.0.

During initialization, `floats` is a list of float values and `channels` is an integer number of channels.

`FloatFrameList.frames`

The amount of PCM frames within this object, as a non-negative integer.

`FloatFrameList.channels`

The amount of channels within this object, as a positive integer.

`FloatFrameList.frame` (*frame_number*)

Given a non-negative `frame_number` integer, returns the samples at the given frame as a new `FloatFrameList` object. This new `FloatFrameList` will be a single frame long, but have the same number of channels as the original. Raises `IndexError` if one tries to get a frame number outside this `FloatFrameList`'s boundaries.

`FloatFrameList.channel` (*channel_number*)

Given a non-negative `channel_number` integer, returns the samples at the given channel as a new `FloatFrameList` object. This new `FloatFrameList` will be a single channel wide, but have the same number of frames as the original. Raises `IndexError` if one tries to get a channel number outside this `FloatFrameList`'s boundaries.

`FloatFrameList.split` (*frame_count*)

Returns a pair of `FloatFrameList` objects. The first contains up to `frame_count` number of PCM frames. The second contains the remainder. If `frame_count` is larger than the number of frames in the `FloatFrameList`, the first will contain all of the frames and the second will be empty.

`FloatFrameList.to_int` (*bits_per_sample*)

Given a `bits_per_sample` integer, converts this object's floating point values to a new `FrameList` object.

AUDIOTOOLS . RESAMPLE — THE RESAMPLER MODULE

The `audiotools.resample` module contains a resampler for modifying the sample rate of PCM data. This class is not usually instantiated directly; instead, one can use `audiotools.PCMConverter` which calculates the resampling ratio and handles unprocessed samples automatically.

3.1 Resampler Objects

class `audiotools.resample.Resampler` (*channels, ratio, quality*)

This class performs the actual resampling and maintains the resampler's state. `channels` is the number of channels in the stream being resampled. `ratio` is the new sample rate divided by the current sample rate. `quality` is an integer value between 0 and 4, where 0 is the best quality.

For example, to convert a 2 channel, 88200Hz audio stream to 44100Hz, one starts by building a resampler as follows:

```
>>> resampler = Resampler(2, float(44100) / float(88200), 0)
```

`Resampler.process` (*float_frame_list, last*)

Given a `FloatFrameList` object and whether this is the last chunk of PCM data from the stream, returns a pair of new `FloatFrameList` objects. The first is the processed samples at the new rate. The second is a set of unprocessed samples which must be pushed through again on the next call to `process()`.

AUDIOTOOLS . REPLAYGAIN — THE REPLAYGAIN CALCULATION MODULE

The `audiotools.replaygain` module contains the `ReplayGain` class for calculating the `ReplayGain` gain and peak values for a set of PCM data, and the `ReplayGainReader` class for applying those gains to a `audiotools.PCMReader` stream.

4.1 ReplayGain Objects

class `audiotools.replaygain.ReplayGain` (*sample_rate*)

This class performs `ReplayGain` calculation for a stream of the given `sample_rate`. Raises `ValueError` if the sample rate is not supported.

`Replaygain.update` (*frame_list*)

Takes a `pcm.FrameList` object and updates our ongoing `ReplayGain` calculation. Raises `ValueError` if some error occurs during calculation.

`ReplayGain.title_gain` ()

Returns a pair of floats. The first is the calculated gain value since our last call to `title_gain` (). The second is the calculated peak value since our last call to `title_gain` ().

`ReplayGain.album_gain` ()

Returns a pair of floats. The first is the calculated gain value of the entire stream. The first is the calculated peak value of the entire stream.

4.2 ReplayGainReader Objects

class `audiotools.replaygain.ReplayGainReader` (*pcmreader, gain, peak*)

This class wraps around an existing `PCMReader` object. It takes floating point `gain` and `peak` values and modifies the `pcmreader`'s output as necessary to match those values. This has the effect of raising or lowering a stream's sound volume to `ReplayGain`'s reference value.

AUDIOTOOLS.CDIO — THE CD INPUT/OUTPUT MODULE

The `audiotools.cdio` module contains the `CDDA` class for accessing raw CDDA data. One does not typically use this module directly. Instead, the `audiotools.CDDA` class provides encapsulation to hide many of these low-level details.

5.1 CDDA Objects

class `audiotools.cdio.CDDA` (*device*)

This class is used to access a specific CD-ROM device, which should be given as a string such as `"/dev/cdrom"` during instantiation.

Note that audio CDs are accessed by sectors, each 1/75th of a second long - or 588 PCM frames. Thus, many of this object's methods take and return sector integer values.

`CDDA.total_tracks` ()

Returns the total number of tracks on the CD as an integer.

```
>>> cd = CDDA("/dev/cdrom")
>>> cd.total_tracks()
17
```

`CDDA.track_offsets` (*track_number*)

Given a `track_number` integer (starting from 1), returns a pair of sector values. The first is the track's first sector on the CD. The second is the track's last sector on the CD.

```
>>> cd.track_offsets(1)
(0, 15774)
>>> cd.track_offsets(2)
(15775, 31836)
```

`CDDA.first_sector` ()

Returns the first sector of the entire CD as an integer, typically 0.

```
>>> cd.first_sector()
0
```

`CDDA.last_sector` ()

Returns the last sector of the entire CD as an integer.

```
>>> cd.last_sector()
240449
```

`CDDA.length_in_seconds()`

Returns the length of the entire CD in seconds as an integer.

```
>>> cd.length_in_seconds()
3206
```

`CDDA.track_type(track_number)`

Given a `track_number` integer (starting from 1), returns the type of track it is as an integer.

`CDDA.set_speed(speed)`

Sets the CD-ROM's reading speed to the new integer value.

`CDDA.seek(sector)`

Sets our current position on the CD to the given sector. For example, to begin reading audio data from the second track:

```
>>> cd.track_offsets(2)[0]
15775
>>> cd.seek(15775)
```

`CDDA.read_sector()`

Reads a single sector from the CD as a `pcm.FrameList` object and moves our current read position ahead by 1.

```
>>> f = cd.read_sector()
>>> f
<pcm.FrameList object at 0x2ca16f0>
>>> len(f)
1176
```

`CDDA.read_sectors(sectors)`

Given a number of sectors, reads as many as possible from the CD as a `pcm.FrameList` object and moves our current read position ahead by that many sectors.

```
>>> f = cd.read_sectors(10)
>>> f
<pcm.FrameList object at 0x7f022e0d6c60>
>>> len(f)
11760
```

`audiotools.cdio.set_read_callback(function)`

Sets a global callback function which takes two integer values as arguments. The second argument is a `cdparanoia` value corresponding to errors fixed, if any:

Value	CDParanoia Value	Meaning
0	PARANOIA_CB_READ	Read off adjust ???
1	PARANOIA_CB_VERIFY	Verifying jitter
2	PARANOIA_CB_FIXUP_EDGE	Fixed edge jitter
3	PARANOIA_CB_FIXUP_ATOM	Fixed atom jitter
4	PARANOIA_CB_SCRATCH	Unsupported
5	PARANOIA_CB_REPAIR	Unsupported
6	PARANOIA_CB_SKIP	Skip exhausted retry
7	PARANOIA_CB_DRIFT	Skip exhausted retry
8	PARANOIA_CB_BACKOFF	Unsupported
9	PARANOIA_CB_OVERLAP	Dynamic overlap adjust
10	PARANOIA_CB_FIXUP_DROPPED	Fixed dropped bytes
11	PARANOIA_CB_FIXUP_DUPED	Fixed duplicate bytes
12	PARANOIA_CB_READERR	Hard read error

AUDIOTOOLS . CUE — THE CUESHEET PARSING MODULE

The `audiotools.cue` module contains the `Cuesheet` class used for parsing and building cuesheet files representing CD images.

`audiotools.cue.read_cuesheet(filename)`

Takes a filename string and returns a new `Cuesheet` object. Raises `CueException` if some error occurs when reading the file.

exception `audiotools.cue.CueException`

A subclass of `audiotools.SheetException` raised when some parsing or reading error occurs when reading a cuesheet file.

6.1 Cuesheet Objects

class `audiotools.cue.Cuesheet`

This class is used to represent a `.cue` file. It is not meant to be instantiated directly but returned from the `read_cuesheet()` function. The `__str__()` value of a `Cuesheet` corresponds to a formatted file on disk.

`Cuesheet.catalog()`

Returns the cuesheet's catalog number as a plain string, or `None` if the cuesheet contains no catalog number.

`Cuesheet.single_file_type()`

Returns `True` if the cuesheet is formatted for a single input file. Returns `False` if the cuesheet is formatted for several individual tracks.

`Cuesheet.indexes()`

Returns an iterator of index lists. Each index is a tuple of CD sectors corresponding to a track's offset on disk.

`Cuesheet.pcm_lengths(total_length)`

Takes the total length of the entire CD in PCM frames. Returns a list of PCM frame lengths for all audio tracks within the cuesheet. This list of lengths can be used to split a single CD image file into several individual tracks.

`Cuesheet.ISRCs()`

Returns a dictionary of `track_number -> ISRC` values for all tracks whose ISRC value is not empty.

classmethod `Cuesheet.file(sheet, filename)`

Takes a `Cuesheet`-compatible object with `catalog()`, `indexes()`, `ISRCs()` methods along with a filename string. Returns a new `Cuesheet` object. This is used to convert other sort of `Cuesheet`-like objects into actual `Cuesheets`.

AUDIOTOOLS . TOC — THE TOC FILE PARSING MODULE

The `audiotools.toc` module contains the `TOCFile` class used for parsing and building TOC files representing CD images.

`audiotools.toc.read_tocfile(filename)`

Takes a filename string and returns a new `TOCFile` object. Raises `TOCException` if some error occurs when reading the file.

exception `audiotools.toc.TOCException`

A subclass of `audiotools.SheetException` raised when some parsing or reading error occurs when reading a TOC file.

7.1 TOCFile Objects

class `audiotools.toc.TOCFile`

This class is used to represent a `.toc` file. It is not meant to be instantiated directly but returned from the `read_tocfile()` function.

`TOCFile.catalog()`

Returns the TOC file's catalog number as a plain string, or `None` if the TOC file contains no catalog number.

`TOCFile.indexes()`

Returns an iterator of index lists. Each index is a tuple of CD sectors corresponding to a track's offset on disk.

`TOCFile.pcm_lengths(total_length)`

Takes the total length of the entire CD in PCM frames. Returns a list of PCM frame lengths for all audio tracks within the TOC file. This list of lengths can be used to split a single CD image file into several individual tracks.

`TOCFile.ISRCs()`

Returns a dictionary of `track_number` -> ISRC values for all tracks whose ISRC value is not empty.

classmethod `TOCFile.file(sheet, filename)`

Takes a `cue.Cuesheet`-compatible object with `catalog()`, `indexes()`, `ISRCs()` methods along with a filename string. Returns a new `TOCFile` object. This is used to convert other sort of Cuesheet-like objects into actual TOC files.

AUDIOTOOLS . PLAYER — THE AUDIO PLAYER MODULE

The `audiotools.player` module contains the `Player` and `AudioOutput` classes for playing `AudioFiles`.

`audiotools.player.AUDIO_OUTPUT`

A tuple of `AudioOutput`-compatible classes of available output types. As with `AVAILABLE_TYPES`, these are classes that are available to `audiotools`, not necessarily available to the user.

Class	Output System
<code>PulseAudioOutput</code>	<code>PulseAudio</code>
<code>OSSAudioOutput</code>	<code>OSS</code>
<code>PortAudioOutput</code>	<code>PortAudio</code>
<code>NULLAudioOutput</code>	No output

8.1 Player Objects

This class is an audio player which plays audio data from an opened audio file object to a given output sink.

class `audiotools.player.Player` (`audio_output` [, `replay_gain` [, `next_track_callback`]])
`audio_output` is a `AudioOutput` object subclass which audio data will be played to. `replay_gain` is either `RG_NO_REPLAYGAIN`, `RG_TRACK_GAIN` or `RG_ALBUM_GAIN`, indicating the level of `ReplayGain` to apply to tracks being played back. `next_track_callback` is a function which takes no arguments, to be called when the currently playing track is completed.

`Player.open` (`audiofile`)

Opens the given `audiotools.AudioFile` object for playing. Any currently playing file is stopped.

`Player.play` ()

Begins or resumes playing the currently opened `audiotools.AudioFile` object, if any.

`Player.set_replay_gain` (`replay_gain`)

Sets the given `ReplayGain` level to apply during playback. Choose from `RG_NO_REPLAYGAIN`, `RG_TRACK_GAIN` or `RG_ALBUM_GAIN`. `ReplayGain` cannot be applied mid-playback. One must `stop` () and `play` () a file for it to take effect.

`Player.pause` ()

Pauses playback of the current file. Playback may be resumed with `play` () or `toggle_play_pause` ()

`Player.toggle_play_pause` ()

Pauses the file if playing, play the file if paused.

`Player.stop()`

Stops playback of the current file. If `play()` is called, playback will start from the beginning.

`Player.close()`

Closes the player for playback. The player thread is halted and the `AudioOutput` object is closed.

`Player.progress()`

Returns a `(pcm_frames_played, pcm_frames_total)` tuple. This indicates the current playback status in terms of PCM frames.

8.2 CDPlayer Objects

This class is an audio player which plays audio data from a CDDA disc to a given output sink.

class `audiotools.player.CDPlayer(cdda, audio_output[, next_track_callback])`

`cdda` is a `audiotools.CDDA` object. `audio_output` is a `AudioOutput` object subclass which audio data will be played to. `next_track_callback` is a function which takes no arguments, to be called when the currently playing track is completed.

`CDPlayer.open(track_number)`

Opens the given track number for reading, where `track_number` starts from 1.

`CDPlayer.play()`

Begins or resumes playing the currently opened track, if any.

`CDPlayer.pause()`

Pauses playback of the current track. Playback may be resumed with `play()` or `toggle_play_pause()`

`CDPlayer.toggle_play_pause()`

Pauses the track if playing, play the track if paused.

`CDPlayer.stop()`

Stops playback of the current track. If `play()` is called, playback will start from the beginning.

`CDPlayer.close()`

Closes the player for playback. The player thread is halted and the `AudioOutput` object is closed.

`CDPlayer.progress()`

Returns a `(pcm_frames_played, pcm_frames_total)` tuple. This indicates the current playback status in terms of PCM frames.

8.3 AudioOutput Objects

This is an abstract class used to implement audio output sinks.

class `audiotools.player.AudioOutput()`

`AudioOutput.NAME`

The name of the `AudioOutput` subclass as a string.

`AudioOutput.compatible(pcmreader)`

Returns True if the given `audiotools.PCMReader` is compatible with the currently opened output stream. If False, one should call `init()` in order to reinitialize the output stream to play the given reader.

`AudioOutput.init(sample_rate, channels, channel_mask, bits_per_sample)`

Initializes the output stream for playing audio with the given parameters. This *must* be called prior to `play()` and `close()`.

`AudioOutput.framelist_converter()`

Returns a function which converts `audiotools.pcm.FrameList` objects to objects which are compatible with our `play()` method, for the currently initialized stream.

`AudioOutput.play(data)`

Plays the converted data object to our output stream.

Note: Why not simply have the `play()` method perform PCM conversion itself instead of shifting it to `framelist_converter()`? The reason is that conversion may be a relatively time-consuming task. By shifting that process into a subthread, there's less chance that performing that work will cause playing to stutter while it completes.

`AudioOutput.close()`

Closes the output stream for further playback.

classmethod `AudioOutput.available()`

Returns True if the `AudioOutput` implementation is available on the system.

META DATA FORMATS

Although it's more convenient to manipulate the high-level `audiotools.MetaData` base class, one sometimes needs to be able to view and modify the low-level implementation also.

9.1 ApeTag

class `ApeTag` (`tags`[, `tag_length`])

This is an APEv2 tag used by the WavPack, Monkey's Audio and Musepack formats, among others. During initialization, it takes a list of `ApeTagItem` objects and an optional length integer (typically set only by `get_metadata()` methods which already know the tag's total length). It can then be manipulated like a regular Python dict with keys as strings and values as `ApeTagItem` objects. Note that this is also a `audiotools.MetaData` subclass with all of the same methods.

For example:

```
>>> tag = ApeTag([ApeTagItem(0, False, 'Title', u'Track Title'.encode('utf-8'))])
>>> tag.track_name
u'Track Title'
>>> tag['Title']
ApeTagItem(0, False, 'Title', 'Track Title')
>>> tag['Title'] = ApeTagItem(0, False, 'Title', u'New Title'.encode('utf-8'))
>>> tag.track_name
u'New Title'
>>> tag.track_name = u'Yet Another Title'
>>> tag['Title']
ApeTagItem(0, False, 'Title', 'Yet Another Title')
```

The fields are mapped between `ApeTag` and `audiotools.MetaData` as follows:

APEv2	Metadata
Title	track_name
Track	track_number/track_total
Media	album_number/album_total
Album	album_name
Artist	artist_name
Performer	performer_name
Composer	composer_name
Conductor	conductor_name
ISRC	ISRC
Catalog	catalog
Copyright	copyright
Publisher	publisher
Year	year
Record Date	date
Comment	comment

Note that Track and Media may be “/”-separated integer values where the first is the current number and the second is the total number.

```
>>> tag = ApeTag([ApeTagItem(0, False, 'Track', u'1'.encode('utf-8'))])
>>> tag.track_number
1
>>> tag.track_total
0
>>> tag = ApeTag([ApeTagItem(0, False, 'Track', u'2/3'.encode('utf-8'))])
>>> tag.track_number
2
>>> tag.track_total
3
```

classmethod `ApeTag.read(file)`

Takes an open file object and returns an `ApeTag` object of that file’s APEv2 data, or None if the tag cannot be found.

`ApeTag.build()`

Returns this tag’s complete APEv2 data as a string.

class `ApeTagItem(item_type, read_only, key, data)`

This is the container for `ApeTag` data. `item_type` is an integer with one of the following values:

1	UTF-8 data
2	binary data
3	external data
4	reserved

`read_only` is a boolean set to True if the tag-item is read-only. `key` is an ASCII string. `data` is a regular Python string (not unicode).

`ApeTagItem.build()`

Returns this tag item’s data as a string.

classmethod `ApeTagItem.binary(key, data)`

A convenience classmethod which takes strings of key and value data and returns a populated `ApeTagItem` object of the appropriate type.

classmethod `ApeTagItem.external(key, data)`

A convenience classmethod which takes strings of key and value data and returns a populated `ApeTagItem` object of the appropriate type.

classmethod `ApeTagItem.string` (*key, unicode*)

A convenience classmethod which takes a key string and value unicode and returns a populated `ApeTagItem` object of the appropriate type.

9.2 FLAC

class `FlacMetaData` (*blocks*)

This is a **FLAC** tag which is prepended to FLAC and Ogg FLAC files. It is initialized with a list of `FlacMetaDataBlock` objects which it stores internally in one of several fields. It also supports all `audiotools.MetaData` methods.

For example:

```
>>> tag = FlacMetaData([FlacMetaDataBlock(
...     type=4,
...     data=FlacVorbisComment({u'TITLE': [u'Track Title']}).build())])
>>> tag.track_name
u'Track Title'
>>> tag.vorbis_comment[u'TITLE']
[u'Track Title']
>>> tag.vorbis_comment = a.FlacVorbisComment({u'TITLE': [u'New Track Title']})
>>> tag.track_name
u'New Track Title'
```

Its fields are as follows:

`FlacMetaData.streaminfo`

A `FlacMetaDataBlock` object containing raw STREAMINFO data. Since `FLAC`'s `set_metadata()` method will override this attribute as necessary, one will rarely need to parse it or set it.

`FlacMetaData.vorbis_comment`

A `FlacVorbisComment` object containing text data such as track name and artist name. If the `FLAC` file doesn't have a VORBISCOMMENT block, `FlacMetaData` will set an empty one at initialization time which will then be written out by a call to `set_metadata()`.

`FlacMetaData.cuesheet`

A `FlacCueSheet` object containing CUESHEET data, or `None`.

`FlacMetaData.image_blocks`

A list of `FlacPictureComment` objects, each representing a PICTURE block. The list may be empty.

`FlacMetaData.extra_blocks`

A list of raw `FlacMetaDataBlock` objects containing any unknown or unsupported `FLAC` metadata blocks. Note that padding is not stored here. PADDING blocks are discarded at initialization time and then re-created as needed by calls to `set_metadata()`.

`FlacMetaData.metadata_blocks` ()

Returns an iterator over all the current blocks as `FlacMetaDataBlock`-compatible objects and without any padding block at the end.

`FlacMetaData.build` (*[padding_size]*)

Returns a string of this `FlacMetaData` object's contents.

class `FlacMetaDataBlock` (*type, data*)

This is a simple container for `FLAC` metadata block data. `type` is one of the following block type integers:

0	STREAMINFO
1	PADDING
2	APPLICATION
3	SEEKTABLE
4	VORBIS_COMMENT
5	CUESHEET
6	PICTURE

`data` is a string.

`FlacMetaDataBlock.build_block([last])`

Returns the entire metadata block as a string, including the header. Set `last` to 1 to indicate this is the final metadata block in the stream.

class `FlacVorbisComment` (*vorbis_data* [, *vendor_string*])

This is a subclass of `VorbisComment` modified to be FLAC-compatible. It utilizes the same initialization information and field mappings.

`FlacVorbisComment.build_block([last])`

Returns the entire metadata block as a string, including the header. Set `last` to 1 to indicate this is the final metadata block in the stream.

class `FlacPictureComment` (*type*, *mime_type*, *description*, *width*, *height*, *color_depth*, *color_count*, *data*)

This is a subclass of `audiotools.Image` with additional methods to make it FLAC-compatible.

`FlacPictureComment.build()`

Returns this picture data as a block data string, without the metadata block headers. Raises `FlacMetaDataBlockTooLarge` if the size of its picture data exceeds 16777216 bytes.

`FlacPictureComment.build_block([last])`

Returns the entire metadata block as a string, including the header. Set `last` to 1 to indicate this is the final metadata block in the stream.

class `FlacCueSheet` (*container* [, *sample_rate*])

This is a `audiotools.cue.Cuesheet`-compatible object with `catalog()`, `ISRCs()`, `indexes()` and `pcm_lengths()` methods, in addition to those needed to make it FLAC metadata block compatible. Its `container` argument is an `audiotools.Con.Container` object which is returned by calling `FlacCueSheet.CUESHEET.parse()` on a raw input data string.

`FlacCueSheet.build_block([last])`

Returns the entire metadata block as a string, including the header. Set `last` to 1 to indicate this is the final metadata block in the stream.

classmethod `FlacCueSheet.converted` (*sheet*, *total_frames* [, *sample_rate*])

Takes another `audiotools.cue.Cuesheet`-compatible object and returns a new `FlacCueSheet` object.

9.3 ID3v1

class `ID3v1Comment` (*metadata*)

This is an ID3v1 tag which is often appended to MP3 files. During initialization, it takes a tuple of 6 values - in the same order as returned by `ID3v1Comment.read_id3v1_comment()`. It can then be manipulated like a regular Python list, in addition to the regular `audiotools.MetaData` methods. However, since ID3v1 is a nearly complete subset of `audiotools.MetaData` (the genre integer is the only field not represented), there's little need to reference its items by index directly.

For example:

```
>>> tag = ID3v1Comment((u'Track Title',u'',u'',u'',u'',1))
>>> tag.track_name
u'Track Title'
>>> tag[0] = u'New Track Name'
>>> tag.track_name
u'New Track Name'
```

Fields are mapped between `ID3v1Comment` and `audiotools.MetaData` as follows:

Index	Metadata
0	track_name
1	artist_name
2	album_name
3	year
4	comment
5	track_number

`ID3v1Comment.build_tag()`

Returns this tag as a string.

classmethod `ID3v1Comment.build_id3v1(song_title, artist, album, year, comment, track_number)`

A convenience method which takes several unicode strings (except for `track_number`, an integer) and returns a complete ID3v1 tag as a string.

classmethod `ID3v1Comment.read_id3v1_comment(filename)`

Takes an MP3 filename string and returns a tuple of that file's ID3v1 tag data, or tag data with empty fields if no ID3v1 tag is found.

9.4 ID3v2.2

class `ID3v22Comment` (*frames*)

This is an ID3v2.2 tag, one of the three ID3v2 variants used by MP3 files. During initialization, it takes a list of `ID3v22Frame`-compatible objects. It can then be manipulated like a regular Python dict with keys as 3 character frame identifiers and values as lists of `ID3v22Frame` objects - since each frame identifier may occur multiple times.

For example:

```
>>> tag = ID3v22Comment([ID3v22TextFrame('TT2',0,u'Track Title')])
>>> tag.track_name
u'Track Title'
>>> tag['TT2']
[<audiotools.__id3__.ID3v22TextFrame instance at 0x1004c17a0>]
>>> tag['TT2'] = [ID3v22TextFrame('TT2',0,u'New Track Title')]
>>> tag.track_name
u'New Track Title'
```

Fields are mapped between ID3v2.2 frame identifiers, `audiotools.MetaData` and `ID3v22Frame` objects as follows:

Identifier	MetaData	Object
TT2	track_name	ID3v22TextFrame
TRK	track_number/track_total	ID3v22TextFrame
TPA	album_number/album_total	ID3v22TextFrame
TAL	album_name	ID3v22TextFrame
TP1	artist_name	ID3v22TextFrame
TP2	performer_name	ID3v22TextFrame
TP3	conductor_name	ID3v22TextFrame
TCM	composer_name	ID3v22TextFrame
TMT	media	ID3v22TextFrame
TRC	ISRC	ID3v22TextFrame
TCR	copyright	ID3v22TextFrame
TPB	publisher	ID3v22TextFrame
TYE	year	ID3v22TextFrame
TRD	date	ID3v22TextFrame
COM	comment	ID3v22ComFrame
PIC	images ()	ID3v22PicFrame

class ID3v22Frame (*frame_id, data*)

This is the base class for the various ID3v2.2 frames. *frame_id* is a 3 character string and *data* is the frame's contents as a string.

ID3v22Frame.**build** ()

Returns the frame's contents as a string of binary data.

classmethod ID3v22Frame.**parse** (*container*)

Given a `audiotools.Con.Container` object with data parsed from `audiotools.ID3v22Frame.FRAME`, returns an `ID3v22Frame` or one of its subclasses, depending on the frame identifier.

class ID3v22TextFrame (*frame_id, encoding, string*)

This is a container for textual data. *frame_id* is a 3 character string, *string* is a unicode string and *encoding* is one of the following integers representing a text encoding:

0	Latin-1
1	UCS-2

ID3v22TextFrame.**__int__** ()

Returns the first integer portion of the frame data as an int.

ID3v22TextFrame.**total** ()

Returns the integer portion of the frame data after the first slash as an int. For example:

```
>>> tag['TRK'] = [ID3v22TextFrame('TRK', 0, u'1/2')]
>>> tag['TRK']
[<audiotools.__id3__.ID3v22TextFrame instance at 0x1004c6830>]
>>> int(tag['TRK'][0])
1
>>> tag['TRK'][0].total()
2
```

classmethod ID3v22TextFrame.**from_unicode** (*frame_id, s*)

A convenience method for building `ID3v22TextFrame` objects from a frame identifier and unicode string. Note that if *frame_id* is "COM", this will build an `ID3v22ComFrame` object instead.

class ID3v22ComFrame (*encoding, language, short_description, content*)

This frame is for holding a potentially large block of comment data. *encoding* is the same as in text frames:

0	Latin-1
1	UCS-2

language is a 3 character string, such as "eng" for English. `short_description` and `content` are unicode strings.

classmethod `ID3v22ComFrame.from_unicode(s)`

A convenience method for building `ID3v22ComFrame` objects from a unicode string.

class `ID3v22PicFrame(data, format, description, pic_type)`

This is a subclass of `audiotools.Image`, in addition to being an ID3v2.2 frame. `data` is a string of binary image data. `format` is a 3 character unicode string identifying the image type:

u"PNG"	PNG
u"JPG"	JPEG
u"BMP"	Bitmap
u"GIF"	GIF
u"TIF"	TIFF

`description` is a unicode string. `pic_type` is an integer representing one of the following:

0	Other
1	32x32 pixels 'file icon' (PNG only)
2	Other file icon
3	Cover (front)
4	Cover (back)
5	Leaflet page
6	Media (e.g. label side of CD)
7	Lead artist / Lead performer / Soloist
8	Artist / Performer
9	Conductor
10	Band / Orchestra
11	Composer
12	Lyricist / Text writer
13	Recording Location
14	During recording
15	During performance
16	Movie / Video screen capture
17	A bright colored fish
18	Illustration
19	Band / Artist logotype
20	Publisher / Studio logotype

`ID3v22PicFrame.type_string()`

Returns the `pic_type` as a plain string.

classmethod `ID3v22PicFrame.converted(image)`

Given an `audiotools.Image` object, returns a new `ID3v22PicFrame` object.

9.5 ID3v2.3

class `ID3v23Comment(frames)`

This is an ID3v2.3 tag, one of the three ID3v2 variants used by MP3 files. During initialization, it takes a list of `ID3v23Frame`-compatible objects. It can then be manipulated like a regular Python dict with keys as 4 character frame identifiers and values as lists of `ID3v23Frame` objects - since each frame identifier may occur multiple times.

For example:

```
>>> tag = ID3v23Comment([ID3v23TextFrame('TIT2',0,u'Track Title')])
>>> tag.track_name
u'Track Title'
>>> tag['TIT2']
[<audiotools.__id3__.ID3v23TextFrame instance at 0x1004c6680>]
>>> tag['TIT2'] = [ID3v23TextFrame('TIT2',0,u'New Track Title')]
>>> tag.track_name
u'New Track Title'
```

Fields are mapped between ID3v2.3 frame identifiers, `audiotools.MetaData` and `ID3v23Frame` objects as follows:

Identifier	MetaData	Object
TIT2	track_name	ID3v23TextFrame
TRCK	track_number/track_total	ID3v23TextFrame
TPOS	album_number/album_total	ID3v23TextFrame
TALB	album_name	ID3v23TextFrame
TPE1	artist_name	ID3v23TextFrame
TPE2	performer_name	ID3v23TextFrame
TPE3	conductor_name	ID3v23TextFrame
TCOM	composer_name	ID3v23TextFrame
TMED	media	ID3v23TextFrame
TSRC	ISRC	ID3v23TextFrame
TCOP	copyright	ID3v23TextFrame
TPUB	publisher	ID3v23TextFrame
TYER	year	ID3v23TextFrame
TRDA	date	ID3v23TextFrame
COMM	comment	ID3v23ComFrame
APIC	images()	ID3v23PicFrame

class ID3v23Frame (*frame_id, data*)

This is the base class for the various ID3v2.3 frames. `frame_id` is a 4 character string and `data` is the frame's contents as a string.

`ID3v23Frame.build()`

Returns the frame's contents as a string of binary data.

classmethod ID3v23Frame.parse (*container*)

Given a `audiotools.Con.Container` object with data parsed from `audiotools.ID3v23Frame.FRAME`, returns an `ID3v23Frame` or one of its subclasses, depending on the frame identifier.

class ID3v23TextFrame (*frame_id, encoding, string*)

This is a container for textual data. `frame_id` is a 4 character string, `string` is a unicode string and `encoding` is one of the following integers representing a text encoding:

0	Latin-1
1	UCS-2

`ID3v23TextFrame.__int__()`

Returns the first integer portion of the frame data as an int.

`ID3v23TextFrame.total()`

Returns the integer portion of the frame data after the first slash as an int. For example:

```
>>> tag['TRAK'] = [ID3v23TextFrame('TRAK',0,u'3/4')]
>>> tag['TRAK']
[<audiotools.__id3__.ID3v23TextFrame instance at 0x1004c17a0>]
>>> int(tag['TRAK'][0])
```

```

3
>>> tag['TRAK'][0].total()
4

```

classmethod `ID3v23TextFrame.from_unicode(frame_id, s)`

A convenience method for building `ID3v23TextFrame` objects from a frame identifier and unicode string. Note that if `frame_id` is "COMM", this will build an `ID3v23ComFrame` object instead.

class `ID3v23ComFrame(encoding, language, short_description, content)`

This frame is for holding a potentially large block of comment data. `encoding` is the same as in text frames:

0	Latin-1
1	UCS-2

`language` is a 3 character string, such as "eng" for english. `short_description` and `content` are unicode strings.

classmethod `ID3v23ComFrame.from_unicode(s)`

A convenience method for building `ID3v23ComFrame` objects from a unicode string.

class `ID3v23PicFrame(data, mime_type, description, pic_type)`

This is a subclass of `audiotools.Image`, in addition to being an ID3v2.3 frame. `data` is a string of binary image data. `mime_type` is a string of the image's MIME type, such as "image/jpeg".

`description` is a unicode string. `pic_type` is an integer representing one of the following:

0	Other
1	32x32 pixels 'file icon' (PNG only)
2	Other file icon
3	Cover (front)
4	Cover (back)
5	Leaflet page
6	Media (e.g. label side of CD)
7	Lead artist / Lead performer / Soloist
8	Artist / Performer
9	Conductor
10	Band / Orchestra
11	Composer
12	Lyricist / Text writer
13	Recording Location
14	During recording
15	During performance
16	Movie / Video screen capture
17	A bright colored fish
18	Illustration
19	Band / Artist logotype
20	Publisher / Studio logotype

classmethod `ID3v23PicFrame.converted(image)`

Given an `audiotools.Image` object, returns a new `ID3v23PicFrame` object.

9.6 ID3v2.4

class `ID3v24Comment(frames)`

This is an ID3v2.4 tag, one of the three ID3v2 variants used by MP3 files. During initialization, it takes a list of `ID3v24Frame`-compatible objects. It can then be manipulated like a regular Python dict with keys as 4

character frame identifiers and values as lists of `ID3v24Frame` objects - since each frame identifier may occur multiple times.

For example:

```
>>> import audiotools as a
>>> tag = ID3v24Comment([ID3v24TextFrame('TIT2',0,u'Track Title')])
>>> tag.track_name
u'Track Title'
>>> tag['TIT2']
[<audiotools.__id3__.ID3v24TextFrame instance at 0x1004c17a0>]
>>> tag['TIT2'] = [ID3v24TextFrame('TIT2',0,'New Track Title')]
>>> tag.track_name
u'New Track Title'
```

Fields are mapped between ID3v2.4 frame identifiers, `audiotools.Metadata` and `ID3v24Frame` objects as follows:

Identifier	MetaData	Object
TIT2	track_name	ID3v24TextFrame
TRCK	track_number/track_total	ID3v24TextFrame
TPOS	album_number/album_total	ID3v24TextFrame
TALB	album_name	ID3v24TextFrame
TPE1	artist_name	ID3v24TextFrame
TPE2	performer_name	ID3v24TextFrame
TPE3	conductor_name	ID3v24TextFrame
TCOM	composer_name	ID3v24TextFrame
TMED	media	ID3v24TextFrame
TSRC	ISRC	ID3v24TextFrame
TCOP	copyright	ID3v24TextFrame
TPUB	publisher	ID3v24TextFrame
TYER	year	ID3v24TextFrame
TRDA	date	ID3v24TextFrame
COMM	comment	ID3v24ComFrame
APIC	images()	ID3v24PicFrame

class ID3v24Frame (*frame_id, data*)

This is the base class for the various ID3v2.3 frames. `frame_id` is a 4 character string and `data` is the frame's contents as a string.

`ID3v24Frame.build()`

Returns the frame's contents as a string of binary data.

classmethod ID3v24Frame.parse (*container*)

Given a `audiotools.Con.Container` object with data parsed from `audiotools.ID3v24Frame.FRAME`, returns an `ID3v24Frame` or one of its subclasses, depending on the frame identifier.

class ID3v24TextFrame (*frame_id, encoding, string*)

This is a container for textual data. `frame_id` is a 4 character string, `string` is a unicode string and `encoding` is one of the following integers representing a text encoding:

0	Latin-1
1	UTF-16
2	UTF-16BE
3	UTF-8

`ID3v24TextFrame.__int__()`

Returns the first integer portion of the frame data as an int.

`ID3v24TextFrame.total()`

Returns the integer portion of the frame data after the first slash as an int. For example:

```
>>> tag['TRAK'] = [ID3v24TextFrame('TRAK', 0, u'5/6')]
>>> tag['TRAK']
[<audiotools.__id3__.ID3v24TextFrame instance at 0x1004c17a0>]
>>> int(tag['TRAK'][0])
5
>>> tag['TRAK'][0].total()
6
```

classmethod `ID3v24TextFrame.from_unicode(frame_id, s)`

A convenience method for building `ID3v24TextFrame` objects from a frame identifier and unicode string. Note that if `frame_id` is "COMM", this will build an `ID3v24ComFrame` object instead.

class `ID3v24ComFrame(encoding, language, short_description, content)`

This frame is for holding a potentially large block of comment data. `encoding` is the same as in text frames:

0	Latin-1
1	UTF-16
2	UTF-16BE
3	UTF-8

`language` is a 3 character string, such as "eng" for english. `short_description` and `content` are unicode strings.

classmethod `ID3v24ComFrame.from_unicode(s)`

A convenience method for building `ID3v24ComFrame` objects from a unicode string.

class `ID3v24PicFrame(data, mime_type, description, pic_type)`

This is a subclass of `audiotools.Image`, in addition to being an ID3v2.4 frame. `data` is a string of binary image data. `mime_type` is a string of the image's MIME type, such as "image/jpeg".

`description` is a unicode string. `pic_type` is an integer representing one of the following:

0	Other
1	32x32 pixels 'file icon' (PNG only)
2	Other file icon
3	Cover (front)
4	Cover (back)
5	Leaflet page
6	Media (e.g. label side of CD)
7	Lead artist / Lead performer / Soloist
8	Artist / Performer
9	Conductor
10	Band / Orchestra
11	Composer
12	Lyricist / Text writer
13	Recording Location
14	During recording
15	During performance
16	Movie / Video screen capture
17	A bright colored fish
18	Illustration
19	Band / Artist logotype
20	Publisher / Studio logotype

classmethod `ID3v23PicFrame.converted(image)`

Given an `audiotools.Image` object, returns a new `ID3v24PicFrame` object.

9.7 ID3 Comment Pair

Often, MP3 files are tagged with both an ID3v2 comment and an ID3v1 comment for maximum compatibility. This class encapsulates both comments into a single class.

class ID3CommentPair (*id3v2_comment*, *id3v1_comment*)

id3v2_comment is an `ID3v22Comment`, `ID3v23Comment` or `ID3v24Comment`. *id3v1_comment* is an `ID3v1Comment`. When getting `audiotools.MetaData` attributes, the ID3v2 comment is used by default. Set attributes are propagated to both. For example:

```
>>> tag = ID3CommentPair(ID3v23Comment([ID3v23TextFrame('TIT2',0,u'Title 1')]),
...                       ID3v1Comment((u'Title 2',u'',u'',u'',u'',1)))
>>> tag.track_name
u'Title 1'
>>> tag.track_name = u'New Track Title'
>>> unicode(tag.id3v2['TIT2'][0])
u'New Track Title'
>>> tag.id3v1[0]
u'New Track Title'
```

`ID3CommentPair.id3v2`

The embedded `ID3v22Comment`, `ID3v23Comment` or `ID3v24Comment`

`ID3CommentPair.id3v1`

The embedded `ID3v1Comment`

9.8 M4A

class M4AMetaData (*ilst_atoms*)

This is the metadata format used by QuickTime-compatible formats such as M4A and Apple Lossless. Due to its relative complexity, `M4AMetaData`'s implementation is more low-level than others. During initialization, it takes a list of `ILST_Atom`-compatible objects. It can then be manipulated like a regular Python dict with keys as 4 character atom name strings and values as a list of `ILST_Atom` objects. It is also a `audiotools.MetaData` subclass. Note that `ilst` atom objects are relatively opaque and easier to handle via convenience builders.

As an example:

```
>>> tag = M4AMetaData(M4AMetaData.text_atom(chr(0xA9) + 'nam', u'Track Name'))
>>> tag.track_name
u'Track Name'
>>> tag[chr(0xA9) + 'nam']
[ILST_Atom('\xa9nam', [__Qt_Atom__('data', '\x00\x00\x00\x01\x00\x00\x00\x00Track Name', 0)]]
>>> tag[chr(0xA9) + 'nam'] = M4AMetaData.text_atom(chr(0xA9) + 'nam', u'New Track Name')
>>> tag.track_name
u'New Track Name'
```

Fields are mapped between `M4AMetaData`, `audiotools.MetaData` and iTunes as follows:

M4AMetaData	MetaData	iTunes
"\xA9nam"	track_name	Name
"\xA9ART"	artist_name	Artist
"\xA9day"	year	Year
"trkn"	track_number/track_total	Track Number
"disk"	album_number/album_total	Album Number
"\xA9alb"	album_name	Album
"\xA9wrt"	composer_name	Composer
"\xA9cmt"	comment	Comment
"cp rt"	copyright	

Note that several of the 4 character keys are prefixed by the non-ASCII byte 0xA9.

`M4AMetaData.to_atom(previous_meta)`

This takes the previous M4A meta atom as a string and returns a new `__Qt_Atom__` object of our new meta atom with any non-ilst atoms ported from the old atom to the new atom.

classmethod `M4AMetaData.binary_atom(key, value)`

Takes a 4 character atom name key and binary string value. Returns a 1 element `ILST_Atom` list suitable for adding to our internal dictionary.

classmethod `M4AMetaData.text_atom(key, value)`

Takes a 4 character atom name key and unicode value. Returns a 1 element `ILST_Atom` list suitable for adding to our internal dictionary.

classmethod `M4AMetaData.trkn_atom(track_number, track_total)`

Takes track number and track total integers (the `trkn` key is assumed). Returns a 1 element `ILST_Atom` list suitable for adding to our internal dictionary.

classmethod `M4AMetaData.disk_atom(disk_number, disk_total)`

Takes album number and album total integers (the `disk` key is assumed). Returns a 1 element `ILST_Atom` list suitable for adding to our internal dictionary.

classmethod `M4AMetaData.covr_atom(image_data)`

Takes a binary string of cover art data (the `covr` key is assumed). Returns a 1 element `ILST_Atom` list suitable for adding to our internal dictionary.

class `ILST_Atom(type, sub_atoms)`

This is initialized with a 4 character atom type string and a list of `__Qt_Atom__`-compatible sub-atom objects (typically a single data atom containing the metadata field's value). It's less error-prone to use `M4AMetaData`'s convenience classmethods rather than building `ILST_Atom` objects by hand.

Its `__unicode__()` method is particularly useful because it parses its sub-atoms and returns a human-readable value depending on whether it contains textual data or not.

9.9 Vorbis Comment

class `VorbisComment(vorbis_data[, vendor_string])`

This is a `VorbisComment` tag used by FLAC, Ogg FLAC, Ogg Vorbis, Ogg Speex and other formats in the Ogg family. During initialization `vorbis_data` is a dictionary whose keys are unicode strings and whose values are lists of unicode strings - since each key in a Vorbis Comment may occur multiple times with different values. The optional `vendor_string` unicode string is typically handled by `get_metadata()` and `set_metadata()` methods, but it can also be accessed via the `vendor_string` attribute. Once initialized, `VorbisComment` can be manipulated like a regular Python dict in addition to its standard `audiotools.Metadata` methods.

For example:

```
>>> tag = VorbisComment({u'TITLE':[u'Track Title']})
>>> tag.track_name
u'Track Title'
>>> tag[u'TITLE']
[u'New Title']
>>> tag[u'TITLE'] = [u'New Title']
>>> tag.track_name
u'New Title'
```

Fields are mapped between `VorbisComment` and `audiotools.MetaData` as follows:

VorbisComment	Metadata
TITLE	track_name
TRACKNUMBER	track_number
TRACKTOTAL	track_total
DISCNUMBER	album_number
DISCTOTAL	album_total
ALBUM	album_name
ARTIST	artist_name
PERFORMER	performer_name
COMPOSER	composer_name
CONDUCTOR	conductor_name
SOURCE MEDIUM	media
ISRC	ISRC
CATALOG	catalog
COPYRIGHT	copyright
PUBLISHER	publisher
DATE	year
COMMENT	comment

Note that if the same key is used multiple times, the metadata attribute only indicates the first one:

```
>>> tag = VorbisComment({u'TITLE':[u'Title1',u'Title2']})
>>> tag.track_name
u'Title1'
```

`VorbisComment.build()`

Returns this object's complete Vorbis Comment data as a string.

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