Ethereum Contract Interface (ABI) Utility Documentation

Release 6.0.0-beta.1

The Ethereum Foundation

Jan 13, 2026

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The `eth-abi` library provides low level utilities for converting python values to and from solidity's binary ABI format. For detailed information on ABI types and their encodings, refer to the solidity ABI specification.

CHAPTER

ONE

CREDIT

Though much of the code has been revised, the `eth-abi` library was originally extracted from the `pyethereum` library which was authored by Vitalik Buterin.

CHAPTER

TWO

INSTALLATION

```
python -m pip install eth-abi
```

CHAPTER

THREE

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3.1 Encoding

3.1.1 Encoding Python Values

Python values can be encoded into binary values for a given ABI type as follows:

```
>>> from eth_abi import encode

>>> # encode a single ABI type
>>> encode(['uint256'], [12345])
b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x0009'

>>> # encode multiple ABI types
>>> encode(['bytes32', 'bytes32'], [b'a', b'b'])
b'a\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00b\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00'

>>> # encode a single tuple type with two `bytes32` types
>>> encode(['(bytes32,bytes32)'], [(b'a', b'b')])
b'a\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00b\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00'
```

The *eth_abi.encoding.BaseEncoder.encode()* function provides an API for encoding python values into binary values for ABI types. It accepts a sequence of ABI type strings as the first argument and a sequence of python values to be encoded into the respective ABI types as the second argument.

3.1.2 Checking for Encodability

It is also possible to check whether or not a certain python value is encodable for a given ABI type using *is_encodable*:

```
>>> from eth_abi import is_encodable

>>> is_encodable('int', 2)
True
```

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```
>>> is_encodable('int', 'foo')
False

>>> is_encodable('(int,bool)', (0, True))
True

>>> is_encodable('(int,bool)', (0, 0))
False
```

3.1.3 Non-Standard Packed Mode Encoding

> **Warning**
>
> Non-standard packed mode encoding is an experimental feature in the eth-abi library. Use at your own risk and please report any problems at https://github.com/ethereum/eth-abi/issues.

In certain cases, the Solidity programming language uses a non-standard packed encoding. You can encode values in this format like so:

```
>>> from eth_abi.packed import encode_packed

>>> # encode_packed for a single ABI type
>>> encode_packed(['uint32'], [12345])
b'\x00\x0009'

>>> # encode_packed for multiple ABI types
>>> encode_packed(['int8[]', 'uint32'], ([1, 2, 3, 4], 12345))
b'\x01\x02\x03\x04\x00\x0009'

>>> # encode_packed for a tuple with `uint8[]` and `uint32` types
>>> encode_packed(['(int8[],uint32)'], [([1, 2, 3, 4], 12345)])
b'\x01\x02\x03\x04\x00\x0009'
```

More information about this encoding format is available at https://solidity.readthedocs.io/en/develop/abi-spec.html#non-standard-packed-mode.

3.2 Decoding

3.2.1 Decoding ABI Values

Binary values for a given ABI type can be decoded into python values as follows:

```
>>> from eth_abi import decode

>>> # decode a single ABI type
>>> decode(['uint256'], b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x0009')
(12345,)

>>> # decode multiple ABI types
```

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```
>>> decode(['bytes1', 'bytes1'], b'a\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00b\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00')
(b'a', b'b')

>>> # decode a single tuple type with two `bytes1` types
>>> decode(['(bytes1,bytes1)'], b'a\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00b\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00')
((b'a', b'b'),)
```

The *eth_abi.decoding.BaseDecoder.decode()* function provides an API for decoding binary values for ABI types into python values. It accepts a sequence of ABI type strings as the first argument and the binary data to be decoded, as a python `bytes` or `bytearray` value, as the second argument.

3.2.2 Strict Mode

By default, the decoder will raise an exception if the binary data to be decoded is not padded to the next 32-byte boundary. This behavior can be disabled for the `ByteStringDecoder` (the default decoder for `bytes` and `string` types) by passing `strict=False` to the `eth_abi.abi.decode()` method. Turning off strict mode will also ignore any trailing bytes beyond the data size specified. This means that if there is any padding, the validation for only empty bytes in the padding area is also ignored.

```
>>> from eth_abi import abi

>>> # decode a bytes value without strict mode
>>> hex_val = (
...     # offset to data is 32 bytes:
...     "0000000000000000000000000000000000000000000000000000000000000020"
...     # length of data is 1 byte:
...     "0000000000000000000000000000000000000000000000000000000000000001"
...     # b"\x01" with less than 32 bytes of padding
...     # and not strictly padded with only zero bytes:
...     "0100000000000001020300"
... )
>>> (decoded,) = abi.decode(['bytes'], bytes.fromhex(hex_val), strict=False)
>>> decoded
b'\x01'
```

3.3 Registry

The `eth-abi` library uses a central registry to route encoding/decoding operations for different ABI types to an appropriate encoder/decoder callable or class. Using the registry, the coding behavior of any ABI type can be customized and additional coding behavior for new ABI types can be added.

3.3.1 Adding Simple Types

Here's an example of how you might add support for a simple "null" type using callables:

```
from eth_abi.exceptions import EncodingError, DecodingError
from eth_abi.registry import registry

# Define and register the coders
NULL_ENCODING = b'\x00' * 32

def encode_null(x):
    if x is not None:
        raise EncodingError('Unsupported value')

    return NULL_ENCODING

def decode_null(stream):
    if stream.read(32) != NULL_ENCODING:
        raise DecodingError('Not enough data or wrong data')

    return None

registry.register('null', encode_null, decode_null)

# Try them out
from eth_abi import encode, decode

assert encode(['null'], [None]) == NULL_ENCODING

(decoded_null_val,) = decode(['null'], NULL_ENCODING)
assert decoded_null_val is None

encoded_tuple = encode(['(int,null)'], [(1, None)])
assert encoded_tuple == b'\x00' * 31 + b'\x01' + NULL_ENCODING

(decoded_tuple,) = decode(['(int,null)'], encoded_tuple)
assert decoded_tuple == (1, None)
```

In the above example, we define two coder callables and register them to handle exact matches against the `'null'` type string. We do this by calling *`register`* on the *registry* object.

When a call is made to one of the coding functions (such as *`encode()`* or *`decode()`*), the type string which is provided (which we'll call `query`) is sent to the registry. This `query` will be checked against every registration in the registry. Since we created a registration for the exact type string `'null'`, coding operations for that type string will be routed to the encoder and decoder which were provided by the call to *`register`*. This also works when the registered type string appears in a compound type as with the tuple type in the example.

> **Note**
>
> As a safety measure, the registry will raise an exception if more than one registration matches a query. Take care to ensure that your custom registrations don't conflict with existing ones.

3.3.2 Adding More Complex Types

Sometimes, it's convenient to register a single class to handle encodings or decodings for a range of types. For example, we shouldn't have to make separate registrations for the `'uint256'` and `'uint8'` types or for the `'(int,bool)'` and `'(int,int)'` types. For cases like this, we can make registrations for custom subclasses of *BaseEncoder* and *BaseDecoder*.

Let's say we want to modify our "null" type above so that we can specify the number of 32-byte words that the encoded null value will occupy in the data stream. We could do that in the following way:

```
from eth_abi.decoding import BaseDecoder
from eth_abi.encoding import BaseEncoder
from eth_abi.exceptions import EncodingError, DecodingError
from eth_abi.registry import registry

# Define and register the coders
NULL_ENCODING = b'\x00' * 32

class EncodeNull(BaseEncoder):
    word_width = None

    @classmethod
    def from_type_str(cls, type_str, registry):
        word_width = int(type_str[4:])
        return cls(word_width=word_width)

    def encode(self, value):
        self.validate_value(value)
        return NULL_ENCODING * self.word_width

    def validate_value(self, value):
        if value is not None:
            raise EncodingError('Unsupported value')

class DecodeNull(BaseDecoder):
    word_width = None

    @classmethod
    def from_type_str(cls, type_str, registry):
        word_width = int(type_str[4:])
        return cls(word_width=word_width)

    def decode(self, stream):
        byts = stream.read(32 * self.word_width)
        if byts != NULL_ENCODING * self.word_width:
            raise DecodingError('Not enough data or wrong data')

        return None

registry.register(
    lambda x: x.startswith('null'),
    EncodeNull,
    DecodeNull,
    label='null',
```

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```
)

# Try them out
from eth_abi import encode, decode

assert encode(['null2'], [None]) == NULL_ENCODING * 2

(decoded_null_val,) = decode(['null2'], NULL_ENCODING * 2)
assert decoded_null_val is None

encoded_tuple = encode(['(int,null2)'], [(1, None)])
assert encoded_tuple == b'\x00' * 31 + b'\x01' + NULL_ENCODING * 2

(decoded_tuple,) = decode(['(int,null2)'], encoded_tuple)
assert decoded_tuple == (1, None)
```

There are a few differences here from our first example. Now, we are providing a type string matcher function instead of a literal type string with our call to *register*. Also, we are not using simple callables for our coding functions. We have created two custom coder classes which inherit from *BaseEncoder* and *BaseDecoder* respectively. Additionally, we have given a label to this registration in case we want to easily delete the registration later.

The matcher function `lambda x: x.startswith('null')` accepts a query type string and returns `True` or `False` to indicate if the query should be matched with our registration. If a query is *uniquely* matched with our registration in this way, the registry then calls *from_type_str* on our `EncodeNull` or `DecodeNull` class to obtain an appropriate instance of the class based on any additional information contained in the type string. In this example, that additional information is the number that appears at the end of the type string (e.g. `'2'` in `'null2'`). Through this process, the registry can determine an encoder or decoder for any type string of the form `'null<M>'`.

There are a few more details here that are worth explaining.

Both of our coder subclasses have some similar aspects. They both have a class property `word_width`. They also have the same implementation for the *from_type_str* method. The *BaseEncoder* and *BaseDecoder* classes both inherit from *BaseCoder* which causes any keyword arguments passed to `__init__` to be used to set the value of properties on an instance if a class property with the same name is found. This is why our implementations of *from_type_str* instantiate our coder classes with the keyword argument `word_width`. Using this pattern, coder classes can describe what "settings" they support while providing an easy way to assign values to those settings. Both of our coder classes use the same settings. The settings are initialized from the type string in the same way. Therefore, they have the same implementation for *from_type_str*. For clarity, the same `word_width` property and *from_type_str* implementation appear in both classes but they could also have been extracted out into a mixin class.

Our coder classes also implement the *BaseEncoder.encode* and *BaseDecoder.decode* methods. These methods work in the same way as the simple callable coders in our first example except that they have access to the settings which were extracted from the type string when the class was instantiated via the *from_type_str* method by the registry. This allows them to handle null values of an arbitrary width in the data stream. As with the callable coders, the *BaseEncoder.encode* and *BaseDecoder.decode* implementations are polite and raise an appropriate exception when anything goes wrong. `EncodeNull` does this via an implementation of *BaseEncoder.validate_value*. For encoder classes, it is necessary to implement this method since it is used by the *is_encodable* function to determine if a value is encodable without doing the extra work of encoding it. For certain data types, this can be more efficient than simply attempting to encode a value.

3.3.3 Handling Malformed Strings

Sometimes a `string` we receive is malformed, i.e. not utf-8 decodeable. This will throw an error by default, but we can adjust how it is handled by registering a new decoder with our preferred handler.

The `StringDecoder` class uses the Python `bytes.decode()` method at its core, which accepts an `errors` argument to define how un-decodeable bytes are handled. `StringDecoder` uses `errors=strict` by default, but can also accept `surrogateescape`, `ignore`, `replace`, or `backslashreplace`. You can read more about each of these options in the Python docs.

The ability to handle malformed strings is only available for decoding. It is assumed that attempting to encode a malformed string indicates user error.

```
from eth_abi import decode, encode
from eth_abi.decoding import StringDecoder
from eth_abi.encoding import TextStringEncoder
from eth_abi.registry import registry

# encode a string
test_string = encode(["string"], ["cat"])
assert (test_string == b"\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00 \x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x03cat\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
↪x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00"
)

# insert an un-decodeable byte
bad_string = test_string[:65] + b"\xff" + test_string[66:]

# verify the original test_string decodes properly
assert decode(["string"], test_string) == ("cat",)

# default `StringDecoder` will throw an error
try:
    decode(["string"], bad_string)

except UnicodeDecodeError as e:
    assert "'utf-8' codec can't decode byte 0xff" in str(e)

# If we want to handle un-decodeable strings, we can register multiple string
# decoders, each with its own `handle_string_errors` option

registry.register(
    "surrogateescape_string",
    TextStringEncoder,
    StringDecoder(handle_string_errors="surrogateescape")
)
registry.register(
    "backslashreplace_string",
    TextStringEncoder,
    StringDecoder(handle_string_errors="backslashreplace"),
)

assert decode(["surrogateescape_string"], bad_string) == ("c\udcfft",)
```

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```
assert decode(["backslashreplace_string"], bad_string) == ("c\\xfft",)
```

3.4 Codecs

Though the default registry can be customized by making additional coder registrations or by unregistering existing coders (see *Registry*), sometimes a user might wish to create their own registry entirely. In that case, they can still use the usual API for encoding and decoding values (see *Encoding* and *Decoding*) with their own registry by using the `ABICodec` or `ABIEncoder` class.

3.4.1 Using a Custom Registry

Here's an example of how you might add support for a simple "null" type using a custom registry while continuing to use the porcelain encoding and decoding API:

```
from eth_abi.codec import ABICodec
from eth_abi.exceptions import EncodingError, DecodingError
from eth_abi.registry import ABIRegistry

# Define and register the coders
NULL_ENCODING = b'\x00' * 32

def encode_null(x):
    if x is not None:
        raise EncodingError('Unsupported value')

    return NULL_ENCODING

def decode_null(stream):
    if stream.read(32) != NULL_ENCODING:
        raise DecodingError('Not enough data or wrong data')

    return None

registry = ABIRegistry()
registry.register('null', encode_null, decode_null)

# Try them out
codec = ABICodec(registry)

assert codec.encode(['null'], [None]) == NULL_ENCODING

(decoded_null_val,) = codec.decode(['null'], NULL_ENCODING)
assert decoded_null_val is None
```

In the above example, we define two coder callables and register them to handle exact matches against the `'null'` type string in a custom registry. For more information about coder registrations, see *Adding Simple Types*.

We then create a custom codec object with our custom registry and use this to encode and decode byte sequences. This allows us to continue using the porcelain API (described in the *Encoding* and *Decoding* sections) with our custom registry.

3.4.2 Copying an Existing Registry

Sometimes, it's more convenient to use an existing registry but with only one or two small modifications. This can be done via a registry's copying or cloning capability coupled with the use of a custom codec:

```
from eth_abi.codec import ABICodec
from eth_abi.registry import registry as default_registry

registry = default_registry.copy()
registry.unregister('address')

codec = ABICodec(registry)

try:
    codec.encode(['address'], [None])
except ValueError:
    pass
else:
    # We shouldn't reach this since the above code will cause an exception
    raise Exception('unreachable')

default_codec = ABICodec(default_registry)

# The default registry is unaffected since a copy was made
assert (
    default_codec.encode(['address'], ['0x' + 'ff' * 20]) ==
    b'\x00' * 12 + b'\xff' * 20
)
```

3.4.3 Using a Custom Stream Class

If a user wishes to customize the behavior of the internal stream class used for decoding, they can do the following:

```
from eth_abi.codec import ABIEncoder, ABIDecoder
from eth_abi.registry import registry

class MyStream:
    # Custom behavior...
    pass

class MyDecoder(ABIDecoder):
    stream_class = MyStream

class MyCodec(ABIEncoder, MyDecoder):
    pass

codec = MyCodec(registry)
```

3.5 Nested Dynamic Arrays

The `eth-abi` library supports the Solidity ABIv2 encoding format for nested dynamic arrays. This means that values for data types such as the following are legal and encodable/decodable: `int[][]`, `string[]`, `string[2]`, etc.

3.6 Grammar

The `eth-abi` library exposes its type string parsing and normalization facilities as part of its public API.

3.6.1 Parsing a Type String

Here are some examples of how you might parse a type string into a simple AST and do various operations with the results:

```
>>> from eth_abi.grammar import ABIType, BasicType, TupleType, parse

>>> tuple_type = parse('(int256,bytes,ufixed128x18,bool[])[2]')

>>> # Checking if a type is a tuple or a basic type
>>> isinstance(tuple_type, ABIType)
True
>>> isinstance(tuple_type, TupleType)
True
>>> [isinstance(i, ABIType) for i in tuple_type.components]
[True, True, True, True]
>>> [isinstance(i, BasicType) for i in tuple_type.components]
[True, True, True, True]

>>> int_type, bytes_type, ufixed_type, bool_type = tuple_type.components

>>> # Inspecting parts of types
>>> len(tuple_type.components)
4
>>> tuple_type.arrlist
((2,),)
>>> int_type.base, int_type.sub, int_type.arrlist
('int', 256, None)
>>> bytes_type.base, bytes_type.sub, bytes_type.arrlist
('bytes', None, None)
>>> ufixed_type.base, ufixed_type.sub, ufixed_type.arrlist
('ufixed', (128, 18), None)
>>> bool_type.base, bool_type.sub, bool_type.arrlist
('bool', None, ((),))

>>> # Checking for arrays or dynamicism
>>> tuple_type.is_array, tuple_type.is_dynamic
(True, True)
>>> int_type.is_array, int_type.is_dynamic
(False, False)
>>> bytes_type.is_array, bytes_type.is_dynamic
(False, True)
>>> ufixed_type.is_array, ufixed_type.is_dynamic
(False, False)
>>> bool_type.is_array, bool_type.is_dynamic
(True, True)
```

3.6.2 Checking Types for Validity

Types can be checked for validity. For example, `uint9` is not a valid type because the bit-width of `int` types must be a multiple of `8`:

```
>>> from eth_abi.grammar import parse

>>> basic_type = parse('uint9')
>>> # The basic type is not valid because the int type's bit-width is not valid
>>> basic_type.validate()
Traceback (most recent call last):
    ...
eth_abi.exceptions.ABITypeError: For 'uint9' type at column 1 in 'uint9': integer␣
↪size must be multiple of 8

>>> tuple_type = parse('(bool,uint9)')
>>> # The tuple type is not valid because it contains an int type with an invalid bit-
↪width
>>> tuple_type.validate()
Traceback (most recent call last):
    ...
eth_abi.exceptions.ABITypeError: For 'uint9' type at column 7 in '(bool,uint9)':␣
↪integer size must be multiple of 8
```

3.6.3 Normalizing Type Strings

Type strings can be normalized to their canonical form. This amounts to converting type aliases like `uint` to `uint256` and so forth:

```
>>> from eth_abi.grammar import normalize
>>> normalize('uint')
'uint256'
>>> normalize('(uint,(ufixed,function))')
'(uint256,(ufixed128x18,bytes24))'
```

Internally, `eth-abi` will only normalize type strings just before creating coders for a type. This is done automatically such that type strings passed to `eth-abi` do not need to be normalized before hand.

3.7 Tools

The `eth_abi.tools` module provides extra resources to users of `eth-abi` that are not required for typical use. It can be installed with `pip` as an extra requirement:

```
python -m pip install "eth-abi[tools]"
```

3.7.1 ABI Type Strategies

The `tools` module provides the *`get_abi_strategy()`* function. This function returns a hypothesis strategy (value generator) for any given ABI type specified by its canonical string representation:

```
>>> from eth_abi.tools import get_abi_strategy

>>> uint_st = get_abi_strategy('uint8')
```

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```
>>> uint_st
integers(min_value=0, max_value=255)

>>> uint_list_st = get_abi_strategy('uint8[2]')
>>> uint_list_st
lists(integers(min_value=0, max_value=255), min_size=2, max_size=2)

>>> fixed_st = get_abi_strategy('fixed8x1')
>>> fixed_st
decimals(min_value=-128, max_value=127, places=0).map(scale_by_Eneg1)

>>> tuple_st = get_abi_strategy('(bool,string)')
>>> tuple_st
tuples(booleans(), text())
```

Hypothesis strategies can be used to conduct property testing on contract code. For more information on property testing, visit the Hypothesis homepage or the Hypothesis readthedocs site.

3.8 API

3.8.1 eth_abi.abi module

3.8.2 eth_abi.base module

class eth_abi.base.**BaseCoder**(***kwargs*)

Bases: object

Base class for all encoder and decoder classes.

classmethod from_type_str(*type_str*, *registry*)

Used by *ABIRegistry* to get an appropriate encoder or decoder instance for the given type string and type registry.

3.8.3 eth_abi.codec module

class eth_abi.codec.**ABICodec**(*registry:* ABIRegistry)

Bases: *ABIEncoder*, *ABIDecoder*

class eth_abi.codec.**ABIDecoder**(*registry:* ABIRegistry)

Bases: *BaseABICoder*

Wraps a registry to provide last-mile decoding functionality.

decode(*types: Iterable[str]*, *data: bytes | bytearray*, *strict: bool = True*) → tuple[Any, ...]

Decodes the binary value `data` as a sequence of values of the ABI types in `types` via the head-tail mechanism into a tuple of equivalent python values.

Parameters

- **types** – A list or tuple of string representations of the ABI types that will be used for decoding e.g. `('uint256', 'bytes[]', '(int,int)')`
- **data** – The binary value to be decoded.

- **strict** – If `False`, dynamic-type decoders will ignore validations such as making sure the data is padded to a multiple of 32 bytes or checking that padding bytes are zero / empty. `False` is how the Solidity ABI decoder currently works. However, `True` is the default for the eth-abi library.

Returns
A tuple of equivalent python values for the ABI values represented in `data`.

stream_class
alias of `ContextFramesBytesIO`

class `eth_abi.codec.`**ABIEncoder**(*registry:* ABIRegistry)

Bases: *BaseABICoder*

Wraps a registry to provide last-mile encoding functionality.

encode(*types: Iterable[str]*, *args: Iterable[Any]*) → bytes

Encodes the python values in `args` as a sequence of binary values of the ABI types in `types` via the head-tail mechanism.

Parameters

- **types** – A list or tuple of string representations of the ABI types that will be used for encoding e.g. `('uint256', 'bytes[]', '(int,int)')`
- **args** – A list or tuple of python values to be encoded.

Returns
The head-tail encoded binary representation of the python values in `args` as values of the ABI types in `types`.

is_encodable(*typ: str*, *arg: Any*) → bool

Determines if the python value `arg` is encodable as a value of the ABI type `typ`.

Parameters

- **typ** – A string representation for the ABI type against which the python value `arg` will be checked e.g. `'uint256'`, `'bytes[]'`, `'(int,int)'`, etc.
- **arg** – The python value whose encodability should be checked.

Returns
`True` if `arg` is encodable as a value of the ABI type `typ`. Otherwise, `False`.

is_encodable_type(*typ: str*) → bool

Returns `True` if values for the ABI type `typ` can be encoded by this codec.

Parameters
typ – A string representation for the ABI type that will be checked for encodability e.g. `'uint256'`, `'bytes[]'`, `'(int,int)'`, etc.

Returns
`True` if values for `typ` can be encoded by this codec. Otherwise, `False`.

class `eth_abi.codec.`**BaseABICoder**(*registry:* ABIRegistry)

Bases: `object`

Base class for porcelain coding APIs. These are classes which wrap instances of *ABIRegistry* to provide last-mile coding functionality.

3.8.4 eth_abi.decoding module

class eth_abi.decoding.**BaseDecoder**(***kwargs*)

Bases: *BaseCoder*

Base class for all decoder classes. Subclass this if you want to define a custom decoder class. Subclasses must also implement *BaseCoder.from_type_str*.

abstract decode(*stream: ContextFramesBytesIO*) → Any

Decodes the given stream of bytes into a python value. Should raise *exceptions.DecodingError* if a python value cannot be decoded from the given byte stream.

3.8.5 eth_abi.encoding module

class eth_abi.encoding.**BaseEncoder**(***kwargs*)

Bases: *BaseCoder*

Base class for all encoder classes. Subclass this if you want to define a custom encoder class. Subclasses must also implement *BaseCoder.from_type_str*.

abstract encode(*value: Any*) → bytes

Encodes the given value as a sequence of bytes. Should raise *exceptions.EncodingError* if `value` cannot be encoded.

classmethod invalidate_value(*value: ~typing.Any*, *exc: type[Exception] = <class 'eth_abi.exceptions.EncodingTypeError'>*, *msg: str | None = None*) → None

Throws a standard exception for when a value is not encodable by an encoder.

abstract validate_value(*value: Any*) → None

Checks whether or not the given value can be encoded by this encoder. If the given value cannot be encoded, must raise *exceptions.EncodingError*.

3.8.6 eth_abi.exceptions module

exception eth_abi.exceptions.**ABITypeError**

Bases: `ValueError`

Raised when a parsed ABI type has inconsistent properties; for example, when trying to parse the type string `'uint7'` (which has a bit-width that is not congruent with zero modulo eight).

exception eth_abi.exceptions.**DecodingError**

Bases: `Exception`

Base exception for any error that occurs during decoding.

exception eth_abi.exceptions.**EncodingError**

Bases: `Exception`

Base exception for any error that occurs during encoding.

exception eth_abi.exceptions.**EncodingTypeError**

Bases: *EncodingError*

Raised when trying to encode a python value whose type is not supported for the output ABI type.

exception eth_abi.exceptions.**IllegalValue**

Bases: *EncodingError*

Raised when trying to encode a python value with the correct type but with a value that is not considered legal for the output ABI type.

```
fixed128x19_encoder(Decimal('NaN'))  # cannot encode NaN
```

exception eth_abi.exceptions.**InsufficientDataBytes**

Bases: *DecodingError*

Raised when there are insufficient data to decode a value for a given ABI type.

exception eth_abi.exceptions.**InvalidPointer**

Bases: *DecodingError*

Raised when the pointer to a value in the ABI encoding is invalid.

exception eth_abi.exceptions.**MultipleEntriesFound**

Bases: `ValueError`, *PredicateMappingError*

Raised when multiple registrations are found for a type string in a registry's internal mapping. This error is non-recoverable and indicates that a registry was configured incorrectly. Registrations are expected to cover completely distinct ranges of type strings.

> **Warning**
>
> In a future version of `eth-abi`, this error class will no longer inherit from `ValueError`.

exception eth_abi.exceptions.**NoEntriesFound**

Bases: `ValueError`, *PredicateMappingError*

Raised when no registration is found for a type string in a registry's internal mapping.

> **Warning**
>
> In a future version of `eth-abi`, this error class will no longer inherit from `ValueError`.

exception eth_abi.exceptions.**NonEmptyPaddingBytes**

Bases: *DecodingError*

Raised when the padding bytes of an ABI value are malformed.

exception eth_abi.exceptions.**ParseError**(*text*, *pos=-1*, *expr=None*)

Bases: `ParseError`

Raised when an ABI type string cannot be parsed.

exception eth_abi.exceptions.**PredicateMappingError**

Bases: `Exception`

Raised when an error occurs in a registry's internal mapping.

exception eth_abi.exceptions.**ValueOutOfBounds**

Bases: *IllegalValue*

Raised when trying to encode a python value with the correct type but with a value that appears outside the range of valid values for the output ABI type.

```
ufixed8x1_encoder(Decimal('25.6'))  # out of bounds
```

3.8.7 eth_abi.registry module

class eth_abi.registry.**ABIRegistry**

copy()

Copies a registry such that new registrations can be made or existing registrations can be unregistered without affecting any instance from which a copy was obtained. This is useful if an existing registry fulfills most of a user's needs but requires one or two modifications. In that case, a copy of that registry can be obtained and the necessary changes made without affecting the original registry.

has_encoder(*type_str: str*) → bool

Returns `True` if an encoder is found for the given type string `type_str`. Otherwise, returns `False`. Raises *MultipleEntriesFound* if multiple encoders are found.

register(*lookup: str | Callable[[str], bool]*, *encoder: Callable[[Any], bytes] | type[*BaseEncoder*]*, *decoder: Callable[[ContextFramesBytesIO], Any] | type[*BaseDecoder*]*, *label: str | None = None*) → None

Registers the given `encoder` and `decoder` under the given `lookup`. A unique string label may be optionally provided that can be used to refer to the registration by name.

Parameters

- **lookup** – A type string or type string matcher function (predicate). When the registry is queried with a type string `query` to determine which encoder or decoder to use, `query` will be checked against every registration in the registry. If a registration was created with a type string for `lookup`, it will be considered a match if `lookup == query`. If a registration was created with a matcher function for `lookup`, it will be considered a match if `lookup(query) is True`. If more than one registration is found to be a match, then an exception is raised.
- **encoder** – An encoder callable or class to use if `lookup` matches a query. If `encoder` is a callable, it must accept a python value and return a `bytes` value. If `encoder` is a class, it must be a valid subclass of *encoding.BaseEncoder* and must also implement the *from_type_str* method on *base.BaseCoder*.
- **decoder** – A decoder callable or class to use if `lookup` matches a query. If `decoder` is a callable, it must accept a stream-like object of bytes and return a python value. If `decoder` is a class, it must be a valid subclass of *decoding.BaseDecoder* and must also implement the *from_type_str* method on *base.BaseCoder*.
- **label** – An optional label that can be used to refer to this registration by name. This label can be used to unregister an entry in the registry via the *unregister* method and its variants.

register_decoder(*lookup: str | Callable[[str], bool]*, *decoder: Callable[[ContextFramesBytesIO], Any] | type[*BaseDecoder*]*, *label: str | None = None*) → None

Registers the given `decoder` under the given `lookup`. A unique string label may be optionally provided that can be used to refer to the registration by name. For more information about arguments, refer to *register*.

register_encoder(*lookup: str | Callable[[str], bool]*, *encoder: Callable[[Any], bytes] | type[*BaseEncoder*]*, *label: str | None = None*) → None

Registers the given `encoder` under the given `lookup`. A unique string label may be optionally provided that can be used to refer to the registration by name. For more information about arguments, refer to *register*.

unregister(*label: str | None*) → None

Unregisters the entries in the encoder and decoder registries which have the label `label`.

unregister_decoder(*lookup_or_label: str | Callable[[str], bool]*) → None

Unregisters a decoder in the registry with the given lookup or label. If `lookup_or_label` is a string, the decoder with the label `lookup_or_label` will be unregistered. If it is an function, the decoder with the lookup function `lookup_or_label` will be unregistered.

unregister_encoder(*lookup_or_label: str | Callable[[str], bool]*) → None

Unregisters an encoder in the registry with the given lookup or label. If `lookup_or_label` is a string, the encoder with the label `lookup_or_label` will be unregistered. If it is an function, the encoder with the lookup function `lookup_or_label` will be unregistered.

3.8.8 eth_abi.grammar module

class eth_abi.grammar.**ABIType**(*arrlist=None*, *node=None*)

Base class for results of type string parsing operations.

arrlist

The list of array dimensions for a parsed type. Equal to `None` if type string has no array dimensions.

property is_array

Equal to `True` if a type is an array type (i.e. if it has an array dimension list). Otherwise, equal to `False`.

property is_dynamic

Equal to `True` if a type has a dynamically sized encoding. Otherwise, equal to `False`.

property item_type

If this type is an array type, equal to an appropriate *ABIType* instance for the array's items.

node

The parsimonious `Node` instance associated with this parsed type. Used to generate error messages for invalid types.

to_type_str()

Returns the string representation of an ABI type. This will be equal to the type string from which it was created.

validate()

Validates the properties of an ABI type against the solidity ABI spec:

https://solidity.readthedocs.io/en/develop/abi-spec.html

Raises *ABITypeError* if validation fails.

class eth_abi.grammar.**TupleType**(*components*, *arrlist=None*, ***, *node=None*)

Represents the result of parsing a tuple type string e.g. "(int,bool)".

components

A tuple of *ABIType* instances for each of the tuple type's components.

property is_dynamic

Equal to `True` if a type has a dynamically sized encoding. Otherwise, equal to `False`.

property item_type

If this type is an array type, equal to an appropriate *ABIType* instance for the array's items.

to_type_str()

Returns the string representation of an ABI type. This will be equal to the type string from which it was created.

validate()

Validates the properties of an ABI type against the solidity ABI spec:

https://solidity.readthedocs.io/en/develop/abi-spec.html

Raises *ABITypeError* if validation fails.

class eth_abi.grammar.**BasicType**(*base*, *sub=None*, *arrlist=None*, *, *node=None*)

Represents the result of parsing a basic type string e.g. "uint", "address", "ufixed128x19[][2]".

base

The base of a basic type e.g. "uint" for "uint256" etc.

property is_dynamic

Equal to `True` if a type has a dynamically sized encoding. Otherwise, equal to `False`.

property item_type

If this type is an array type, equal to an appropriate *ABIType* instance for the array's items.

sub

The sub type of a basic type e.g. `256` for "uint256" or `(128, 18)` for "ufixed128x18" etc. Equal to `None` if type string has no sub type.

to_type_str()

Returns the string representation of an ABI type. This will be equal to the type string from which it was created.

validate()

Validates the properties of an ABI type against the solidity ABI spec:

https://solidity.readthedocs.io/en/develop/abi-spec.html

Raises *ABITypeError* if validation fails.

eth_abi.grammar.**normalize**(*type_str*)

Normalizes a type string into its canonical version e.g. the type string 'int' becomes 'int256', etc.

Parameters
type_str – The type string to be normalized.

Returns
The canonical version of the input type string.

eth_abi.grammar.**parse**(*type_str*)

Parses a type string into an appropriate instance of *ABIType*. If a type string cannot be parsed, throws *ParseError*.

Parameters
type_str – The type string to be parsed.

Returns
An instance of *ABIType* containing information about the parsed type string.

3.8.9 eth_abi.tools module

eth_abi.tools.**get_abi_strategy**(*type_str: str*) → SearchStrategy

Returns a hypothesis strategy for the given ABI type.

Parameters

type_str – The canonical string representation of the ABI type for which a hypothesis strategy should be returned.

Returns

A hypothesis strategy for generating Python values that are encodable as values of the given ABI type.

3.9 Release Notes

3.9.1 eth-abi v6.0.0-beta.1 (2025-12-17)

Breaking Changes

- Drop support for Python 3.8 & 3.9 (#250)

Improved Documentation

- Fix typo in index (#243)

Features

- Add support for Python 3.14 (#250)

3.9.2 eth-abi v5.2.0 (2025-01-14)

Features

- Merge template, adding `py313` support, replace `bumpversion` with `bump-my-version`, raise required `hypothesis` versions. (#241)

Internal Changes - for eth-abi Contributors

- Merge template, fixing docs CI and other various updates (#236)

3.9.3 eth-abi v5.1.0 (2024-04-01)

Internal Changes - for eth-abi Contributors

- Upgrade parsimonious from `0.9` to `0.10`, which is 15% faster (#231)
- Add `python 3.12` support, add all-format docs tests and nightly CI runs, reorg tests file structure to match CI grouping (#232)

3.9.4 eth-abi v5.0.1 (2024-03-04)

Bugfixes

- During decoding, verify all pointers in arrays and tuples point to a valid location in the payload (#226)
- Fix memory leak warning in NodeVisitor and ABIRegistry (#230)

Internal Changes - for eth-abi Contributors

- Clear mypy `misc`-type errors and add top-level `py.typed` file back (#221)

3.9.5 eth-abi v5.0.0 (2024-01-09)

Breaking Changes

- Drop python 3.7 support (#217)

Internal Changes - for eth-abi Contributors

- Merge updates from the project template, notably, use `pre-commit` for linting and change the name of the `master` branch to `main` (#217)
- Corrected format of booleans in `pyproject.toml` and added a test for the presence of the `eth_abi.__version__` attribute (#219)

3.9.6 eth-abi v4.2.1 (2023-09-13)

Internal Changes - for eth-abi contributors

- Add `build.os` section to readthedocs build settings (#213)

Miscellaneous changes

- #214

3.9.7 eth-abi v4.2.0 (2023-08-28)

Features

- Allow turning off abi decoder "strict mode" when calling `abi.decode()`. (#198)

Bugfixes

- Validate against zero-sized `tuple` types / empty Solidity structs. (#212)

3.9.8 eth-abi v4.1.0 (2023-06-08)

Features

- updated *StringDecoder* class to allow user-defined handling of malformed strings, handle with *strict* by default (#187)

Internal Changes - for eth-abi contributors

- remove unused docs deps, bump version of remaining (#203)
- Moved requirements-docs.txt info into .readthedocs.yml (#204)
- pull in updates from the python project template (#205)
- Updated CI process to handle tox issue caused by *virtualenv* update (#208)

3.9.9 eth-abi v4.0.0 (2023-03-22)

No significant changes.

3.9.10 eth-abi v4.0.0-beta.3 (2023-03-20)

Breaking Changes

- Upgrade Parsimonious dependency to allow >=0.9,<0.10 (#201)

3.9.11 eth-abi v4.0.0-beta.2 (2022-11-21)

Features

- Add support for Python 3.11 (#194)

Miscellaneous changes

- #196

3.9.12 eth-abi v4.0.0-beta.1 (2022-09-27)

Bugfixes

- Reconcile differences in 32-byte padding between eth-abi encoders for dynamic types and Solidity's abi.encode() for 0 or empty values (#158)

Breaking Changes

- Remove `encode_abi_single()`, `encode_packed_single()`, and `decode_abi_single()`. Rename `encode_abi()`, `encode_abi_packed()`, and `decode_abi()` to `encode()`, `encode_packed()`, and `decode()`, respectively. (#161)

Miscellaneous changes

- #161, #166, #167, #168, #177, #183, #186

3.9.13 eth-abi v3.0.1 (2022-07-18)

Deprecations

- Add `DeprecationWarning` for `encode_abi()`, `encode_single()`, `decode_abi()`, and `decode_single()` and add temporary versions of `abi.encode()` and `abi.decode()` so users can start making these changes early. (#165)

Miscellaneous changes

- #165, #166, #172, #177, #178

3.9.14 eth_abi 3.0.0 (2022-01-19)

Features

- Add support for python 3.8 (#145)
- Add support for Python 3.8. Includes updating mypy and flake8 version requirements (#155)
- Drop Python 3.6 support, add Python 3.9 and 3.10 support. Update any dependencies accordingly (#156)

Bugfixes

- Catch ABITypeError exceptions when checking `has_encoder` (#148)

Improved Documentation

- Fix broken badges in README (#144)

Miscellaneous changes

- #123, #154

3.9.15 eth-abi v2.1.1 (2020-02-27)

Bugfixes

- If subclassing `eth_abi.decoding.ContextFramesBytesIO.seek()`, the new method was not being used by `seek_in_frame()`. Now it will be. (#139)

Internal Changes - for eth_abi contributors

- Merged in project template, for changes in release scripts, docs, release notes, etc. (#140)

3.9.16 v2.1.0

- Added support for "byte" alias for "bytes1" type.
- Added support for custom stream class in *`ABIDecoder`*. See *Using a Custom Stream Class*.

3.9.17 v2.0.0

- Includes all changes from v2.0.0 beta and alpha versions.

3.9.18 v2.0.0-beta.9

- Added `eth_abi.tools` submodule with extra requirements installable with `pip install eth-abi[tools]`. See *Tools*.

3.9.19 v2.0.0-beta.8

- Added *`has_encoder()`* and *`is_encodable_type()`* to facilitate checking for type validity against coder registrations.

3.9.20 v2.0.0-beta.7

Released March 24, 2019

- Fixed an issue that caused custom types containing capital letters to be unparseable.
- Removed PyPy support.
- Added Python 3.7 support.

3.9.21 v2.0.0-beta.6

- Added the grammar module to the public API. See *Grammar*.
- Updated string API for the *ABIType*. Type strings for *ABIType* instances are now obtained via the *to_type_str()* method instead of by invoking the builtin Python `str` function with an instance of *ABIType*.

3.9.22 v2.0.0-beta.5

- Added registry copying functionality to facilitate modification of the default registry. See *Copying an Existing Registry*.

3.9.23 v2.0.0-beta.4

- Update eth-typing requirement to `>=2.0.0,<3.0.0`.

3.9.24 v2.0.0-beta.3

- Added codec API to facilitate use of custom registries. See *Codecs*.

3.9.25 v2.0.0-beta.2

Released October 16, 2018

- Bugfixes
  - Was accidentally allowing eth-typing v2. Now it requires eth-typing v1 only.

3.9.26 v2.0.0-beta.1

- New Features
  - Added support for nested dynamic arrays from the Solidity version 2 ABI
  - Added support for non-standard packed mode encoding
  - Added support for tuple array types e.g. `(int,int)[]`
- Backwards Incompatible Changes
  - The `encode_single()` and `decode_single()` functions no longer accept type tuples to identify ABI types. Only type strings are accepted.
  - The `collapse_type()` function has been removed. People who still wish to use this function should replicate its logic locally and where needed.
  - The `process_type()` function has been removed in favor of the *parse()* function. This should make the parsing API more consistent with the new parsimonious parser.

3.9.27 v2.0.0-alpha.1

Released July 19, 2018

- Backwards Incompatible Changes
  - `decode_single()` called with ABI type 'string' will now return a python `str` instead of `bytes`.
  - Support for the legacy `real` and `ureal` types has been removed
- Bugfixes
  - Simple callable encoders work again

- Misc
  - Various documentation updates and type annotations

3.9.28 v1.3.0

Released December 6, 2018

- Bugfixes
  - Resolved an issue that was preventing discovery of type hints.
- Misc
  - Updated eth-typing dependency version to `>=2.0.0,<3.0.0`.

3.9.29 v1.2.2

Released October 18, 2018

- Bugfixes
  - Expand parsimonious dependency from v0.8.0 to v0.8.*

3.9.30 v1.2.1

Released October 16, 2018

- Bugfixes
  - Was accidentally allowing eth-typing v2. Now it requires eth-typing v1 only. (backport from v2)

3.9.31 v1.2.0

Released August 28, 2018

- New Features
  - Backported and added support for nested dynamic arrays from the Solidity version 2 ABI

3.9.32 v1.1.1

Released May 10, 2018

- Bugfixes
  - `is_encodable()` now returns `False` if a `Decimal` has too many digits to be encoded in the given `fixed<M>x<N>` type. (It was previously raising a `ValueError`)
  - Raise an *`EncodingTypeError`* instead of a `TypeError` when trying to encode a `float` into a `fixed<M>x<N>` type.

3.9.33 v1.1.0

Released May 8, 2018

- New Features
  - Added a Registry API (docs in progress) for looking up encoders by ABI type
  - Added support for types: tuple and fixedMxN
  - Added new is_encodable check for whether a value can be encoded with the given ABI type

- Bugfixes
  - Fix RealDecoder bug that allowed values other than 32 bytes
  - Fix bug that accepted `stringN` as a valid ABI type. Strings may not have a fixed length.
  - Stricter value checking when encoding a Decimal (Make sure it's not a NaN)
  - Fix typos in "missing property" exceptions
- Misc
  - Precompile regexes, for performance & clarity
  - Test fixups and switch to CircleCI
  - Readme improvements
  - Performance improvements
  - Drop Python 2 support cruft

3.9.34 v1.0.0

Released Feb 28, 2018

- Confirmed pypy3 compatibility
- Add support for eth-utils v1.0.0-beta2 and v1.0.1 stable
- Testing improvements

3.9.35 v1.0.0-beta.0

Released Feb 5, 2018

- Drop py2 support
- Add support for eth-utils v1-beta1

3.9.36 v0.5.0

- Rename to `eth-abi` for consistency across github/pypi/python-module

3.9.37 v0.4.4

- Better error messages for decoder errors.

3.9.38 v0.4.3

- Bugfix for `process_type` to support byte string type arrguments

3.9.39 v0.4.2

- `process_type` now auto-expands all types which have omittied their sizes.

3.9.40 v0.4.1

- Support for `function` types.

3.9.41 v0.3.1

- Bugfix for small signed integer and real encoding/decoding

3.9.42 v0.3.1

- Bugfix for faulty release.

3.9.43 v0.3.0

- Depart from the original pyethereum encoding/decoding logic.
- Fully rewritten encoder and decoder functionality.

3.9.44 v0.2.2

- Fix a handful of bytes encoding issues.

3.9.45 v0.2.1

- Use pyrlp utility functions for big_endian int operations

3.9.46 v0.2.0

- Bugfixes from upstream pyethereum repository for encoding/decoding
- Python 3 Support

3.9.47 v0.1.0

- Initial release

3.10 Contributing

Thank you for your interest in contributing! We welcome all contributions no matter their size. Please read along to learn how to get started. If you get stuck, feel free to ask for help in Ethereum Python Discord server.

3.10.1 Setting the stage

To get started, fork the repository to your own github account, then clone it to your development machine:

```
git clone git@github.com:your-github-username/eth-abi.git
```

Next, install the development dependencies. We recommend using a virtual environment, such as virtualenv.

```
cd eth-abi
virtualenv -p python venv
. venv/bin/activate
python -m pip install -e ".[dev]"
pre-commit install
```

3.10.2 Running the tests

A great way to explore the code base is to run the tests.

We can run all tests with:

```
pytest tests
```

3.10.3 Code Style

We use pre-commit to enforce a consistent code style across the library. This tool runs automatically with every commit, but you can also run it manually with:

```
make lint
```

If you need to make a commit that skips the `pre-commit` checks, you can do so with `git commit --no-verify`.

This library uses type hints, which are enforced by the `mypy` tool (part of the `pre-commit` checks). All new code is required to land with type hints, with the exception of code within the `tests` directory.

3.10.4 Documentation

Good documentation will lead to quicker adoption and happier users. Please check out our guide on how to create documentation for the Python Ethereum ecosystem.

3.10.5 Pull Requests

It's a good idea to make pull requests early on. A pull request represents the start of a discussion, and doesn't necessarily need to be the final, finished submission.

GitHub's documentation for working on pull requests is available here.

Once you've made a pull request, take a look at the Circle CI build status in the GitHub interface and make sure all tests are passing. In general pull requests that do not pass the CI build yet won't get reviewed unless explicitly requested.

If the pull request introduces changes that should be reflected in the release notes, please add a newsfragment file as explained here.

If possible, the change to the release notes file should be included in the commit that introduces the feature or bugfix.

3.10.6 Releasing

Releases are typically done from the `main` branch, except when releasing a beta (in which case the beta is released from `main`, and the previous stable branch is released from said branch).

Final review before each release

Before releasing a new version, build and test the package that will be released:

```
git checkout main && git pull
make package-test
```

This will build the package and install it in a temporary virtual environment. Follow the instructions to activate the venv and test whatever you think is important.

Review the documentation that will get published:

```
make docs
```

Validate and preview the release notes:

```
make validate-newsfragments
```

Build the release notes

Before bumping the version number, build the release notes. You must include the part of the version to bump (see below), which changes how the version number will show in the release notes.

```
make notes bump=$$VERSION_PART_TO_BUMP$$
```

If there are any errors, be sure to re-run make notes until it works.

Push the release to github & pypi

After confirming that the release package looks okay, release a new version:

```
make release bump=$$VERSION_PART_TO_BUMP$$
```

This command will:

- Bump the version number as specified in `.pyproject.toml` and `setup.py`.
- Create a git commit and tag for the new version.
- Build the package.
- Push the commit and tag to github.
- Push the new package files to pypi.

Which version part to bump

`$$VERSION_PART_TO_BUMP$$` must be one of: `major`, `minor`, `patch`, `stage`, or `devnum`.

The version format for this repo is `{major}.{minor}.{patch}` for stable, and `{major}.{minor}.{patch}-{stage}.{devnum}` for unstable (`stage` can be alpha or beta).

If you are in a beta version, `make release bump=stage` will switch to a stable.

To issue an unstable version when the current version is stable, specify the new version explicitly, like `make release bump="--new-version 4.0.0-alpha.1"`

You can see what the result of bumping any particular version part would be with `bump-my-version show-bump`

3.11 Code of Conduct

3.11.1 Our Pledge

In the interest of fostering an open and welcoming environment, we as contributors and maintainers pledge to make participation in our project and our community a harassment-free experience for everyone, regardless of age, body size, disability, ethnicity, gender identity and expression, level of experience, education, socio-economic status, nationality, personal appearance, race, religion, or sexual identity and orientation.

3.11.2 Our Standards

Examples of behavior that contributes to creating a positive environment include:

- Using welcoming and inclusive language
- Being respectful of differing viewpoints and experiences
- Gracefully accepting constructive criticism
- Focusing on what is best for the community
- Showing empathy towards other community members

Examples of unacceptable behavior by participants include:

- The use of sexualized language or imagery and unwelcome sexual attention or advances
- Trolling, insulting/derogatory comments, and personal or political attacks
- Public or private harassment
- Publishing others' private information, such as a physical or electronic address, without explicit permission
- Other conduct which could reasonably be considered inappropriate in a professional setting

3.11.3 Our Responsibilities

Project maintainers are responsible for clarifying the standards of acceptable behavior and are expected to take appropriate and fair corrective action in response to any instances of unacceptable behavior.

Project maintainers have the right and responsibility to remove, edit, or reject comments, commits, code, wiki edits, issues, and other contributions that are not aligned to this Code of Conduct, or to ban temporarily or permanently any contributor for other behaviors that they deem inappropriate, threatening, offensive, or harmful.

3.11.4 Scope

This Code of Conduct applies both within project spaces and in public spaces when an individual is representing the project or its community. Examples of representing a project or community include using an official project e-mail address, posting via an official social media account, or acting as an appointed representative at an online or offline event. Representation of a project may be further defined and clarified by project maintainers.

3.11.5 Enforcement

Instances of abusive, harassing, or otherwise unacceptable behavior may be reported by contacting the project team at snakecharmers@ethereum.org. All complaints will be reviewed and investigated and will result in a response that is deemed necessary and appropriate to the circumstances. The project team is obligated to maintain confidentiality with regard to the reporter of an incident. Further details of specific enforcement policies may be posted separately.

Project maintainers who do not follow or enforce the Code of Conduct in good faith may face temporary or permanent repercussions as determined by other members of the project's leadership.

3.11.6 Attribution

This Code of Conduct is adapted from the Contributor Covenant, version 1.4, available at https://www.contributor-covenant.org/version/1/4/code-of-conduct.html

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