ipaddress — IPv4/IPv6 manipulation library

Source code: Lib/ipaddress.py

ipaddress provides the capabilities to create, manipulate and operate on IPv4 and IPv6 addresses and networks.

The functions and classes in this module make it straightforward to handle various tasks related to IP addresses, including checking whether or not two hosts are on the same subnet, iterating over all hosts in a particular subnet, checking whether or not a string represents a valid IP address or network definition, and so on.

This is the full module API reference—for an overview and introduction, see An introduction to the ipaddress module.

New in version 3.3.

Convenience factory functions

The ipaddress module provides factory functions to conveniently create IP addresses, networks and interfaces:

`ipaddress.`**`ip_address`**`(`*`address`*`)`

Return an `IPv4Address` or `IPv6Address` object depending on the IP address passed as argument. Either IPv4 or IPv6 addresses may be supplied; integers less than `2**32` will be considered to be IPv4 by default. A `ValueError` is raised if *address* does not represent a valid IPv4 or IPv6 address.

```
>>> ipaddress.ip_address('192.168.0.1')
IPv4Address('192.168.0.1')
>>> ipaddress.ip_address('2001:db8::')
IPv6Address('2001:db8::')
```

`ipaddress.`**`ip_network`**`(`*`address, strict=True`*`)`

Return an `IPv4Network` or `IPv6Network` object depending on the IP address passed as argument. *address* is a string or integer representing the IP network. Either IPv4 or IPv6 networks may be supplied; integers less than `2**32` will be considered to be IPv4 by default. *strict* is passed to `IPv4Network` or `IPv6Network` constructor. A `ValueError` is raised if *address* does not represent a valid IPv4 or IPv6 address, or if the network has host bits set.

```
>>> ipaddress.ip_network('192.168.0.0/28')
IPv4Network('192.168.0.0/28')
```

`ipaddress.`**`ip_interface`**`(`*`address`*`)`

Return an `IPv4Interface` or `IPv6Interface` object depending on the IP address passed as argument. *address* is a string or integer representing the IP address. Either IPv4 or IPv6 addresses may be supplied; integers less than `2**32` will be considered to be IPv4 by default. A `ValueError` is raised if *address* does not represent a valid IPv4 or IPv6 address.

IPv4 or IPv6 format was intended. More detailed error reporting can be obtained by calling the appropriate version specific class constructors directly.

IP Addresses

Address objects

The `IPv4Address` and `IPv6Address` objects share a lot of common attributes. Some attributes that are only meaningful for IPv6 addresses are also implemented by `IPv4Address` objects, in order to make it easier to write code that handles both IP versions correctly. Address objects are hashable, so they can be used as keys in dictionaries.

class `ipaddress.`**`IPv4Address`**`(`*`address`*`)`

Construct an IPv4 address. An `AddressValueError` is raised if *address* is not a valid IPv4 address.

The following constitutes a valid IPv4 address:

1. A string in decimal-dot notation, consisting of four decimal integers in the inclusive range 0–255, separated by dots (e.g. `192.168.0.1`). Each integer represents an octet (byte) in the address. Leading zeroes are not tolerated to prevent confusion with octal notation.
2. An integer that fits into 32 bits.
3. An integer packed into a `bytes` object of length 4 (most significant octet first).

```
>>> ipaddress.IPv4Address('192.168.0.1')
IPv4Address('192.168.0.1')
>>> ipaddress.IPv4Address(3232235521)
IPv4Address('192.168.0.1')
>>> ipaddress.IPv4Address(b'\xC0\xA8\x00\x01')
IPv4Address('192.168.0.1')
```

Changed in version 3.8: Leading zeros are tolerated, even in ambiguous cases that look like octal notation.

Changed in version 3.10: Leading zeros are no longer tolerated and are treated as an error. IPv4 address strings are now parsed as strict as glibc `inet_pton()`.

Changed in version 3.9.5: The above change was also included in Python 3.9 starting with version 3.9.5.

Changed in version 3.8.12: The above change was also included in Python 3.8 starting with version 3.8.12.

`version`

The appropriate version number: `4` for IPv4, `6` for IPv6.

`max_prefixlen`

The total number of bits in the address representation for this version: `32` for IPv4, `128` for IPv6.

The prefix defines the number of leading bits in an address that are compared to determine whether or not an address is part of a network.

`compressed`

representation.

As IPv4 does not define a shorthand notation for addresses with octets set to zero, these two attributes are always the same as `str(addr)` for IPv4 addresses. Exposing these attributes makes it easier to write display code that can handle both IPv4 and IPv6 addresses.

`packed`

The binary representation of this address - a `bytes` object of the appropriate length (most significant octet first). This is 4 bytes for IPv4 and 16 bytes for IPv6.

`reverse_pointer`

The name of the reverse DNS PTR record for the IP address, e.g.:

```
>>> ipaddress.ip_address("127.0.0.1").reverse_pointer
'1.0.0.127.in-addr.arpa'
>>> ipaddress.ip_address("2001:db8::1").reverse_pointer
'1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.8.b.d.0.1.0.0.2.ip6.arpa'
```

This is the name that could be used for performing a PTR lookup, not the resolved hostname itself.

New in version 3.5.

`is_multicast`

`True` if the address is reserved for multicast use. See **RFC 3171** (for IPv4) or **RFC 2373** (for IPv6).

`is_private`

`True` if the address is allocated for private networks. See iana-ipv4-special-registry (for IPv4) or iana-ipv6-special-registry (for IPv6).

`is_global`

`True` if the address is allocated for public networks. See iana-ipv4-special-registry (for IPv4) or iana-ipv6-special-registry (for IPv6).

New in version 3.4.

`is_unspecified`

`True` if the address is unspecified. See **RFC 5735** (for IPv4) or **RFC 2373** (for IPv6).

`is_reserved`

`True` if the address is otherwise IETF reserved.

`is_loopback`

`True` if this is a loopback address. See **RFC 3330** (for IPv4) or **RFC 2373** (for IPv6).

`is_link_local`

`True` if the address is reserved for link-local usage. See **RFC 3927**.

`IPv4Address.`**`__format__`**`(`*`fmt`*`)` 'x' for an uppercase or lowercase hexadecimal representation, or 'n', which is equivalent to 'b' for IPv4 addresses and 'x' for IPv6. For binary and hexadecimal representations, the form specifier '#' and the grouping option '_' are available. `__format__` is used by `format`, `str.format` and f-strings.

```
>>> format(ipaddress.IPv4Address('192.168.0.1'))
'192.168.0.1'
>>> '{:#b}'.format(ipaddress.IPv4Address('192.168.0.1'))
'0b11000000101010000000000000000001'
>>> f'{ipaddress.IPv6Address("2001:db8::1000"):s}'
'2001:db8::1000'
>>> format(ipaddress.IPv6Address('2001:db8::1000'), '_X')
'2001_0DB8_0000_0000_0000_0000_0000_1000'
>>> '{:#_n}'.format(ipaddress.IPv6Address('2001:db8::1000'))
'0x2001_0db8_0000_0000_0000_0000_0000_1000'
```

New in version 3.9.

class `ipaddress.`**`IPv6Address`**`(`*`address`*`)`

Construct an IPv6 address. An `AddressValueError` is raised if *address* is not a valid IPv6 address.

The following constitutes a valid IPv6 address:

1. A string consisting of eight groups of four hexadecimal digits, each group representing 16 bits. The groups are separated by colons. This describes an *exploded* (longhand) notation. The string can also be *compressed* (shorthand notation) by various means. See **RFC 4291** for details. For example, `"0000:0000:0000:0000:0000:0abc:0007:0def"` can be compressed to `"::abc:7:def"`.

   Optionally, the string may also have a scope zone ID, expressed with a suffix `%scope_id`. If present, the scope ID must be non-empty, and may not contain `%`. See **RFC 4007** for details. For example, `fe80::1234%1` might identify address `fe80::1234` on the first link of the node.

2. An integer that fits into 128 bits.

3. An integer packed into a `bytes` object of length 16, big-endian.

```
>>> ipaddress.IPv6Address('2001:db8::1000')
IPv6Address('2001:db8::1000')
>>> ipaddress.IPv6Address('ff02::5678%1')
IPv6Address('ff02::5678%1')
```

`compressed`

The short form of the address representation, with leading zeroes in groups omitted and the longest sequence of groups consisting entirely of zeroes collapsed to a single empty group.

This is also the value returned by `str(addr)` for IPv6 addresses.

`exploded`

The long form of the address representation, with all leading zeroes and groups consisting entirely of zeroes included.

`packed`

`reverse_pointer`

`version`

`max_prefixlen`

`is_multicast`

`is_private`

`is_global`

`is_unspecified`

`is_reserved`

`is_loopback`

`is_link_local`

New in version 3.4: is_global

`is_site_local`

`True` if the address is reserved for site-local usage. Note that the site-local address space has been deprecated by **RFC 3879**. Use `is_private` to test if this address is in the space of unique local addresses as defined by **RFC 4193**.

`ipv4_mapped`

For addresses that appear to be IPv4 mapped addresses (starting with `::FFFF/96`), this property will report the embedded IPv4 address. For any other address, this property will be `None`.

`scope_id`

For scoped addresses as defined by **RFC 4007**, this property identifies the particular zone of the address's scope that the address belongs to, as a string. When no scope zone is specified, this property will be `None`.

`sixtofour`

For addresses that appear to be 6to4 addresses (starting with `2002::/16`) as defined by **RFC 3056**, this property will report the embedded IPv4 address. For any other address, this property will be `None`.

`teredo`

For addresses that appear to be Teredo addresses (starting with `2001::/32`) as defined by **RFC 4380**, this property will report the embedded `(server, client)` IP address pair. For any other address, this property will be `None`.

New in version 3.9.

Conversion to Strings and Integers

To interoperate with networking interfaces such as the socket module, addresses must be converted to strings or integers. This is handled using the `str()` and `int()` builtin functions:

```
>>> str(ipaddress.IPv4Address('192.168.0.1'))
'192.168.0.1'
>>> int(ipaddress.IPv4Address('192.168.0.1'))
3232235521
>>> str(ipaddress.IPv6Address('::1'))
'::1'
>>> int(ipaddress.IPv6Address('::1'))
1
```

Note that IPv6 scoped addresses are converted to integers without scope zone ID.

Operators

Address objects support some operators. Unless stated otherwise, operators can only be applied between compatible objects (i.e. IPv4 with IPv4, IPv6 with IPv6).

Comparison operators

Address objects can be compared with the usual set of comparison operators. Same IPv6 addresses with different scope zone IDs are not equal. Some examples:

```
>>> IPv4Address('127.0.0.2') > IPv4Address('127.0.0.1')
True
>>> IPv4Address('127.0.0.2') == IPv4Address('127.0.0.1')
False
>>> IPv4Address('127.0.0.2') != IPv4Address('127.0.0.1')
True
>>> IPv6Address('fe80::1234') == IPv6Address('fe80::1234%1')
False
>>> IPv6Address('fe80::1234%1') != IPv6Address('fe80::1234%2')
True
```

Arithmetic operators

Integers can be added to or subtracted from address objects. Some examples:

```
>>> IPv4Address('127.0.0.2') + 3
IPv4Address('127.0.0.5')
>>> IPv4Address('127.0.0.2') - 3
IPv4Address('126.255.255.255')
>>> IPv4Address('255.255.255.255') + 1
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ipaddress.AddressValueError: 4294967296 (>= 2**32) is not permitted as an IPv4 address
```

The `IPv4Network` and `IPv6Network` objects provide a mechanism for defining and inspecting IP network definitions. A network definition consists of a *mask* and a *network address*, and as such defines a range of IP addresses that equal the network address when masked (binary AND) with the mask. For example, a network definition with the mask `255.255.255.0` and the network address `192.168.1.0` consists of IP addresses in the inclusive range `192.168.1.0` to `192.168.1.255`.

Prefix, net mask and host mask

There are several equivalent ways to specify IP network masks. A *prefix* `/<nbits>` is a notation that denotes how many high-order bits are set in the network mask. A *net mask* is an IP address with some number of high-order bits set. Thus the prefix `/24` is equivalent to the net mask `255.255.255.0` in IPv4, or `ffff:ff00::` in IPv6. In addition, a *host mask* is the logical inverse of a *net mask*, and is sometimes used (for example in Cisco access control lists) to denote a network mask. The host mask equivalent to `/24` in IPv4 is `0.0.0.255`.

Network objects

All attributes implemented by address objects are implemented by network objects as well. In addition, network objects implement additional attributes. All of these are common between `IPv4Network` and `IPv6Network`, so to avoid duplication they are only documented for `IPv4Network`. Network objects are hashable, so they can be used as keys in dictionaries.

class ipaddress.**IPv4Network**(*address*, *strict=True*)

Construct an IPv4 network definition. *address* can be one of the following:

1. A string consisting of an IP address and an optional mask, separated by a slash (`/`). The IP address is the network address, and the mask can be either a single number, which means it's a *prefix*, or a string representation of an IPv4 address. If it's the latter, the mask is interpreted as a *net mask* if it starts with a non-zero field, or as a *host mask* if it starts with a zero field, with the single exception of an all-zero mask which is treated as a *net mask*. If no mask is provided, it's considered to be `/32`.

   For example, the following *address* specifications are equivalent: `192.168.1.0/24`, `192.168.1.0/255.255.255.0` and `192.168.1.0/0.0.0.255`.

2. An integer that fits into 32 bits. This is equivalent to a single-address network, with the network address being *address* and the mask being `/32`.

3. An integer packed into a `bytes` object of length 4, big-endian. The interpretation is similar to an integer *address*.

4. A two-tuple of an address description and a netmask, where the address description is either a string, a 32-bits integer, a 4-bytes packed integer, or an existing IPv4Address object; and the netmask is either an integer representing the prefix length (e.g. `24`) or a string representing the prefix mask (e.g. `255.255.255.0`).

An `AddressValueError` is raised if *address* is not a valid IPv4 address. A `NetmaskValueError` is raised if the mask is not valid for an IPv4 address.

Unless stated otherwise, all network methods accepting other network/address objects will raise `TypeError` if the argument's IP version is incompatible to `self`.

Changed in version 3.5: Added the two-tuple form for the *address* constructor parameter.

`version`

`max_prefixlen`

Refer to the corresponding attribute documentation in `IPv4Address`.

`is_multicast`

`is_private`

`is_unspecified`

`is_reserved`

`is_loopback`

`is_link_local`

These attributes are true for the network as a whole if they are true for both the network address and the broadcast address.

`network_address`

The network address for the network. The network address and the prefix length together uniquely define a network.

`broadcast_address`

The broadcast address for the network. Packets sent to the broadcast address should be received by every host on the network.

`hostmask`

The host mask, as an `IPv4Address` object.

`netmask`

The net mask, as an `IPv4Address` object.

`with_prefixlen`

`compressed`

`exploded`

A string representation of the network, with the mask in prefix notation.

`with_prefixlen` and `compressed` are always the same as `str(network)`. `exploded` uses the exploded form the network address.

A string representation of the network, with the mask in net mask notation.

with_hostmask

A string representation of the network, with the mask in host mask notation.

num_addresses

The total number of addresses in the network.

prefixlen

Length of the network prefix, in bits.

hosts()

Returns an iterator over the usable hosts in the network. The usable hosts are all the IP addresses that belong to the network, except the network address itself and the network broadcast address. For networks with a mask length of 31, the network address and network broadcast address are also included in the result. Networks with a mask of 32 will return a list containing the single host address.

```
>>> list(ip_network('192.0.2.0/29').hosts())
[IPv4Address('192.0.2.1'), IPv4Address('192.0.2.2'),
 IPv4Address('192.0.2.3'), IPv4Address('192.0.2.4'),
 IPv4Address('192.0.2.5'), IPv4Address('192.0.2.6')]
>>> list(ip_network('192.0.2.0/31').hosts())
[IPv4Address('192.0.2.0'), IPv4Address('192.0.2.1')]
>>> list(ip_network('192.0.2.1/32').hosts())
[IPv4Address('192.0.2.1')]
```

overlaps(*other*)

`True` if this network is partly or wholly contained in *other* or *other* is wholly contained in this network.

address_exclude(*network*)

Computes the network definitions resulting from removing the given *network* from this one. Returns an iterator of network objects. Raises `ValueError` if *network* is not completely contained in this network.

```
>>> n1 = ip_network('192.0.2.0/28')
>>> n2 = ip_network('192.0.2.1/32')
>>> list(n1.address_exclude(n2))
[IPv4Network('192.0.2.8/29'), IPv4Network('192.0.2.4/30'),
 IPv4Network('192.0.2.2/31'), IPv4Network('192.0.2.0/32')]
```

subnets(*prefixlen_diff=1*, *new_prefix=None*)

The subnets that join to make the current network definition, depending on the argument values. *prefixlen_diff* is the amount our prefix length should be increased by. *new_prefix* is the desired new prefix of the subnets; it must be larger than our prefix. One and only one of *prefixlen_diff* and *new_prefix* must be set. Returns an iterator of network objects.

```
>>> list(ip_network('192.0.2.0/24').subnets())
[IPv4Network('192.0.2.0/25'), IPv4Network('192.0.2.128/25')]
>>> list(ip_network('192.0.2.0/24').subnets(prefixlen_diff=2))
[IPv4Network('192.0.2.0/26'), IPv4Network('192.0.2.64/26'),
 IPv4Network('192.0.2.128/26'), IPv4Network('192.0.2.192/26')]
>>> list(ip_network('192.0.2.0/24').subnets(new_prefix=23))
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
    raise ValueError('new prefix must be longer')
ValueError: new prefix must be longer
>>> list(ip_network('192.0.2.0/24').subnets(new_prefix=25))
[IPv4Network('192.0.2.0/25'), IPv4Network('192.0.2.128/25')]
```

supernet(*prefixlen_diff=1*, *new_prefix=None*)

The supernet containing this network definition, depending on the argument values. *prefixlen_diff* is the amount our prefix length should be decreased by. *new_prefix* is the desired new prefix of the supernet; it must be smaller than our prefix. One and only one of *prefixlen_diff* and *new_prefix* must be set. Returns a single network object.

```
>>> ip_network('192.0.2.0/24').supernet()
IPv4Network('192.0.2.0/23')
>>> ip_network('192.0.2.0/24').supernet(prefixlen_diff=2)
IPv4Network('192.0.0.0/22')
>>> ip_network('192.0.2.0/24').supernet(new_prefix=20)
IPv4Network('192.0.0.0/20')
```

subnet_of(*other*)

Return `True` if this network is a subnet of *other*.

```
>>> a = ip_network('192.168.1.0/24')
>>> b = ip_network('192.168.1.128/30')
>>> b.subnet_of(a)
True
```

New in version 3.7.

supernet_of(*other*)

Return `True` if this network is a supernet of *other*.

```
>>> a = ip_network('192.168.1.0/24')
>>> b = ip_network('192.168.1.128/30')
>>> a.supernet_of(b)
True
```

New in version 3.7.

compare_networks(*other*)

Compare this network to *other*. In this comparison only the network addresses are considered; host bits aren't. Returns either `-1`, `0` or `1`.

```
>>> ip_network('192.0.2.1/32').compare_networks(ip_network('192.0.2.2/32'))
-1
>>> ip_network('192.0.2.1/32').compare_networks(ip_network('192.0.2.0/32'))
1
>>> ip_network('192.0.2.1/32').compare_networks(ip_network('192.0.2.1/32'))
0
```

class ipaddress.**IPv6Network**(*address*, *strict=True*)

Construct an IPv6 network definition. *address* can be one of the following:

1. A string consisting of an IP address and an optional prefix length, separated by a slash (`/`). The IP address is the network address, and the prefix length must be a single number, the *prefix*. If no prefix length is provided, it's considered to be `/128`.

   Note that currently expanded netmasks are not supported. That means `2001:db00::0/24` is a valid argument while `2001:db00::0/ffff:ff00::` is not.

2. An integer that fits into 128 bits. This is equivalent to a single-address network, with the network address being *address* and the mask being `/128`.

3. An integer packed into a `bytes` object of length 16, big-endian. The interpretation is similar to an integer *address*.

4. A two-tuple of an address description and a netmask, where the address description is either a string, a 128-bits integer, a 16-bytes packed integer, or an existing IPv6Address object; and the netmask is an integer representing the prefix length.

An `AddressValueError` is raised if *address* is not a valid IPv6 address. A `NetmaskValueError` is raised if the mask is not valid for an IPv6 address.

If *strict* is `True` and host bits are set in the supplied address, then `ValueError` is raised. Otherwise, the host bits are masked out to determine the appropriate network address.

Changed in version 3.5: Added the two-tuple form for the *address* constructor parameter.

version

max_prefixlen

is_multicast

is_private

is_unspecified

is_reserved

is_loopback

is_link_local

network_address

broadcast_address

hostmask

with_prefixlen

compressed

exploded

with_netmask

with_hostmask

num_addresses

prefixlen

hosts()

Returns an iterator over the usable hosts in the network. The usable hosts are all the IP addresses that belong to the network, except the Subnet-Router anycast address. For networks with a mask length of 127, the Subnet-Router anycast address is also included in the result. Networks with a mask of 128 will return a list containing the single host address.

overlaps(*other*)

address_exclude(*network*)

subnets(*prefixlen_diff=1*, *new_prefix=None*)

supernet(*prefixlen_diff=1*, *new_prefix=None*)

subnet_of(*other*)

supernet_of(*other*)

compare_networks(*other*)

Refer to the corresponding attribute documentation in `IPv4Network`.

is_site_local

These attribute is true for the network as a whole if it is true for both the network address and the broadcast address.

Operators

Network objects support some operators. Unless stated otherwise, operators can only be applied between compatible objects (i.e. IPv4 with IPv4, IPv6 with IPv6).

Logical operators

Network objects can be compared with the usual set of logical operators. Network objects are ordered first by network address, then by net mask.

Network objects can be iterated to list all the addresses belonging to the network. For iteration, *all* hosts are returned, including unusable hosts (for usable hosts, use the `hosts()` method). An example:

```
>>> for addr in IPv4Network('192.0.2.0/28'):
...     addr
...
IPv4Address('192.0.2.0')
IPv4Address('192.0.2.1')
IPv4Address('192.0.2.2')
IPv4Address('192.0.2.3')
IPv4Address('192.0.2.4')
IPv4Address('192.0.2.5')
IPv4Address('192.0.2.6')
IPv4Address('192.0.2.7')
IPv4Address('192.0.2.8')
IPv4Address('192.0.2.9')
IPv4Address('192.0.2.10')
IPv4Address('192.0.2.11')
IPv4Address('192.0.2.12')
IPv4Address('192.0.2.13')
IPv4Address('192.0.2.14')
IPv4Address('192.0.2.15')
```

Networks as containers of addresses

Network objects can act as containers of addresses. Some examples:

```
>>> IPv4Network('192.0.2.0/28')[0]
IPv4Address('192.0.2.0')
>>> IPv4Network('192.0.2.0/28')[15]
IPv4Address('192.0.2.15')
>>> IPv4Address('192.0.2.6') in IPv4Network('192.0.2.0/28')
True
>>> IPv4Address('192.0.3.6') in IPv4Network('192.0.2.0/28')
False
```

Interface objects

Interface objects are hashable, so they can be used as keys in dictionaries.

class `ipaddress.`**`IPv4Interface`**`(`*`address`*`)`

Construct an IPv4 interface. The meaning of *address* is as in the constructor of `IPv4Network`, except that arbitrary host addresses are always accepted.

`IPv4Interface` is a subclass of `IPv4Address`, so it inherits all the attributes from that class. In addition, the following attributes are available:

`ip`

The address (`IPv4Address`) without network information.

```
>>> interface = IPv4Interface('192.0.2.5/24')
>>> interface.ip
IPv4Address('192.0.2.5')
```

`network`

```
>>> interface = IPv4Interface('192.0.2.5/24')
>>> interface.network
IPv4Network('192.0.2.0/24')
```

with_prefixlen

A string representation of the interface with the mask in prefix notation.

```
>>> interface = IPv4Interface('192.0.2.5/24')
>>> interface.with_prefixlen
'192.0.2.5/24'
```

with_netmask

A string representation of the interface with the network as a net mask.

```
>>> interface = IPv4Interface('192.0.2.5/24')
>>> interface.with_netmask
'192.0.2.5/255.255.255.0'
```

with_hostmask

A string representation of the interface with the network as a host mask.

```
>>> interface = IPv4Interface('192.0.2.5/24')
>>> interface.with_hostmask
'192.0.2.5/0.0.0.255'
```

class ipaddress.**IPv6Interface**(*address*)

Construct an IPv6 interface. The meaning of *address* is as in the constructor of `IPv6Network`, except that arbitrary host addresses are always accepted.

`IPv6Interface` is a subclass of `IPv6Address`, so it inherits all the attributes from that class. In addition, the following attributes are available:

ip

network

with_prefixlen

with_netmask

with_hostmask

Refer to the corresponding attribute documentation in `IPv4Interface`.

Operators

Interface objects support some operators. Unless stated otherwise, operators can only be applied between compatible objects (i.e. IPv4 with IPv4, IPv6 with IPv6).

Logical operators

For equality comparison (`==` and `!=`), both the IP address and network must be the same for the objects to be equal. An interface will not compare equal to any address or network object.

For ordering (`<`, `>`, etc) the rules are different. Interface and address objects with the same IP version can be compared, and the address objects will always sort before the interface objects. Two interface objects are first compared by their networks and, if those are the same, then by their IP addresses.

Other Module Level Functions

The module also provides the following module level functions:

`ipaddress.`**`v4_int_to_packed`**`(`*`address`*`)`

Represent an address as 4 packed bytes in network (big-endian) order. *address* is an integer representation of an IPv4 IP address. A `ValueError` is raised if the integer is negative or too large to be an IPv4 IP address.

```
>>> ipaddress.ip_address(3221225985)
IPv4Address('192.0.2.1')
>>> ipaddress.v4_int_to_packed(3221225985)
b'\xc0\x00\x02\x01'
```

`ipaddress.`**`v6_int_to_packed`**`(`*`address`*`)`

Represent an address as 16 packed bytes in network (big-endian) order. *address* is an integer representation of an IPv6 IP address. A `ValueError` is raised if the integer is negative or too large to be an IPv6 IP address.

`ipaddress.`**`summarize_address_range`**`(`*`first`*`, `*`last`*`)`

Return an iterator of the summarized network range given the first and last IP addresses. *first* is the first `IPv4Address` or `IPv6Address` in the range and *last* is the last `IPv4Address` or `IPv6Address` in the range. A `TypeError` is raised if *first* or *last* are not IP addresses or are not of the same version. A `ValueError` is raised if *last* is not greater than *first* or if *first* address version is not 4 or 6.

```
>>> [ipaddr for ipaddr in ipaddress.summarize_address_range(
...    ipaddress.IPv4Address('192.0.2.0'),
...    ipaddress.IPv4Address('192.0.2.130'))]
[IPv4Network('192.0.2.0/25'), IPv4Network('192.0.2.128/31'), IPv4Network('192.0.2.
```

`ipaddress.`**`collapse_addresses`**`(`*`addresses`*`)`

Return an iterator of the collapsed `IPv4Network` or `IPv6Network` objects. *addresses* is an iterator of `IPv4Network` or `IPv6Network` objects. A `TypeError` is raised if *addresses* contains mixed version objects.

```
>>> [ipaddr for ipaddr in
... ipaddress.collapse_addresses([ipaddress.IPv4Network('192.0.2.0/25'),
... ipaddress.IPv4Network('192.0.2.128/25')])]
[IPv4Network('192.0.2.0/24')]
```

`ipaddress.`**`get_mixed_type_key`**`(`*`obj`*`)`

```
IPv4Address('192.0.2.0') <= IPv4Network('192.0.2.0/24')
```

doesn’t make sense. There are some times however, where you may wish to have `ipaddress` sort these anyway. If you need to do this, you can use this function as the *key* argument to `sorted()`.

obj is either a network or address object.

Custom Exceptions

To support more specific error reporting from class constructors, the module defines the following exceptions:

exception `ipaddress.`**`AddressValueError`**`(`*`ValueError`*`)`

Any value error related to the address.

exception `ipaddress.`**`NetmaskValueError`**`(`*`ValueError`*`)`

Any value error related to the net mask.