
pepfrag

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Contents:

1	Installation	1
2	Usage	3
2.1	Peptide Construction	3
2.2	Fragment Generation	3
3	pepfrag package	7
3.1	Module contents	7
4	Indices and tables	11
	Python Module Index	13
	Index	15

CHAPTER 1

Installation

pepfrag can be installed via PyPI:

```
pip install pepfrag
```

pepfrag is compatible with `python > 3.7` and most operating systems. The package has been tested on

- Windows 10
- MacOS 10.15
- Ubuntu 18.04 LTS

Because *pepfrag* includes C/C++ extensions, installation requires the presence of a C++ 11 compatible compiler on your machine.

2.1 Peptide Construction

pepfrag provides one key public class: *Peptide*. This class includes public methods for calculating the mass of the peptide, including any configured modifications (*ModSite*s), and the peptide fragment ions, with configurable neutral losses.

A *Peptide* can be constructed from its amino acid sequence, charge state and modifications, for example:

```
from pepfrag import ModSite, Peptide

peptide = Peptide(
    "ABCMPPK",
    2,
    (ModSite(15.994915, 4, "Oxidation"), ModSite(304.20536, "nterm", "iTRAQ8plex"))
)
```

Peptide modifications are defined using a sequence of *ModSite* instances.

Additional keyword arguments are available, allowing the use of average masses instead of monoisotopic masses and introducing radical peptide fragment generation.

2.2 Fragment Generation

Fragment ions can be generated using the *fragment()* method.

The generated fragment ions can be customized using the *ion_types* argument to *fragment()*, which takes a dictionary mapping the desired *IonType*s to their planned neutral losses. The default is:

```
from pepfrag import IonType

DEFAULT_IONS = {
    IonType.precursor: ['H2O', 'NH3', 'CO2'],
```

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```

IonType.imm: [],
IonType.b: ['H2O', 'NH3', 'CO'],
IonType.y: ['NH3', 'H2O'],
IonType.a: [],
IonType.c: [],
IonType.z: []
}

```

The generated ions can be changed by providing a custom `ion_types` dictionary when calling `fragment()`, for example:

```

from pepfrag import IonType, Peptide

peptide = Peptide('AMYK', 2, [])
peptide.fragment(ion_types={
    IonType.precursor: [],
    IonType.b: ['NH3'],
    IonType.y: ['H2O']
})

```

outputs the following fragment ions, including precursor ions, *b* ions with *NH3* losses and *y* ions with *H2O* losses:

```

[
    (72.044390252029, 'b1[+]', 1),
    (55.01784115090901, '[b1-NH3][+]', 1),
    (147.11280416609898, 'y1[+]', 1),
    (129.10223948206897, '[y1-H2O][+]', 1),
    (203.084875340499, 'b2[+]', 2),
    (186.058326239379, '[b2-NH3][+]', 2),
    (310.17613269973896, 'y2[+]', 2),
    (292.16556801570897, '[y2-H2O][+]', 2),
    (366.14820387413897, 'b3[+]', 3),
    (349.121654773019, '[b3-NH3][+]', 3),
    (183.57774017050897, 'b3[2+]', 3),
    (175.06446561994898, '[b3-NH3][2+]', 3),
    (441.21661778820896, 'y3[+]', 3),
    (423.206053104179, '[y3-H2O][+]', 3),
    (221.11194712754397, 'y3[2+]', 3),
    (212.10666478552898, '[y3-H2O][2+]', 3),
    (512.253731573359, '[M+H][+]', 4),
    (256.63050402011896, '[M+H][2+]', 4)
]

```

2.2.1 Customizing Neutral Losses

`pepfrag` includes a number of common neutral losses available using only their string names. These are: *NH3*, *H2O*, *CO2* and *CO*.

Additional neutral losses can be specified using a tuple of (*label*, *mass*). For example:

```

from pepfrag import IonType

ion_types = {
    IonType.b: [('testLoss1', 17.04), 'NH3']
}

```

This would generate b ions, along with $b\text{-testLoss1}$ and $b\text{-NH3}$ fragment ions.

3.1 Module contents

class pepfrag.**Mass** (*mono: float, avg: float*)

Bases: object

Represents a mass pair of monoisotopic and average masses.

Parameters

- **mono** – Monoisotopic mass.
- **avg** – Average mass.

class pepfrag.**MassType**

Bases: enum.Enum

An enumeration representing the possible mass types.

Note that the values of these enumerations correspond to their index in *Mass*, and similarly in the C++ code underneath methods such as *calculate_mass*.

mono = 0

Monoisotopic mass

avg = 1

Average mass

class pepfrag.**IonType**

Bases: enum.Enum

Enumeration of possible fragment ion types.

precursor = 1

Precursor ions

imm = 2

Immonium ions

```

b = 3
    b-type ions
y = 4
    y-type ions
a = 5
    a-type ions
c = 6
    c-type ions
z = 7
    z-type ions
x = 8
    x-type ions

```

```

class pepfrag.ModSite (mass: float, site: Union[int, str], mod: str)
    Bases: object

```

Class representing an instance of *mod_name* at position *site*.

Parameters

- **mass** – Mass of the modification.
- **site** – Position of the modification. Integer for sequence position, ‘nterm’ for N-terminus or ‘cterm’ for C-terminus.
- **mod** – Name of the modification.

```

class pepfrag.Peptide (sequence: str, charge: int, modifications: Sequence[pepfrag.pepfrag.ModSite], mass_type: pepfrag.constants.MassType = <MassType.mono: 0>, radical: bool = False)

```

Bases: object

A class to represent a peptide, including its charge state and any modifications, including PTMs and quantitative tags. The class should be used to fragment the peptides for mass spectrum annotation.

mass_type

Type of masses used in calculations (see [MassType](#)).

radical

Flag indicating whether the peptide is a radical peptide.

peptide_mass

The mass of the peptide along the sequence, with each position calculated separately.

Note: In the returned list, index 0 is the N-terminus mass, while index -1 is the C-terminus mass.

mass

Total mass of the peptide, including modifications.

mz

Calculates the mass-to-charge ratio of the peptide.

calculate_mass () → List[float]

Calculates the theoretical mass of the peptide along the sequence, including any modifications.

Returns Masses along the peptide sequence. Index 0 is the N-terminus mass, while index -1 is the C-terminus mass.

fragment (*ion_types*: *Optional[Dict[pepfrag.pepfrag.IonType, List[Union[str, Tuple[str, float]]]]] = None*) → List[Tuple[float, str, int]]

Fragments the peptide to generate the ion types specified.

Parameters *ion_types* – Dictionary of *IonType* s to list of configured neutral losses. Only fragments for *IonType* s specified here will be generated.

Returns List of generated ions, as tuples of (*fragment mass*, *ion label*, *sequence position*).

CHAPTER 4

Indices and tables

- `genindex`
- `modindex`
- `search`

p

pepfrag, [7](#)

A

a (*pepfrag.IonType* attribute), 8
avg (*pepfrag.MassType* attribute), 7

B

b (*pepfrag.IonType* attribute), 7

C

c (*pepfrag.IonType* attribute), 8
calculate_mass() (*pepfrag.Peptide* method), 8

F

fragment() (*pepfrag.Peptide* method), 8

I

imm (*pepfrag.IonType* attribute), 7
IonType (class in *pepfrag*), 7

M

Mass (class in *pepfrag*), 7
mass (*pepfrag.Peptide* attribute), 8
mass_type (*pepfrag.Peptide* attribute), 8
MassType (class in *pepfrag*), 7
ModSite (class in *pepfrag*), 8
mono (*pepfrag.MassType* attribute), 7
mz (*pepfrag.Peptide* attribute), 8

P

pepfrag (module), 7
Peptide (class in *pepfrag*), 8
peptide_mass (*pepfrag.Peptide* attribute), 8
precursor (*pepfrag.IonType* attribute), 7

R

radical (*pepfrag.Peptide* attribute), 8

X

x (*pepfrag.IonType* attribute), 8

Y

y (*pepfrag.IonType* attribute), 8

Z

z (*pepfrag.IonType* attribute), 8