
mpu Documentation

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This package contains various small functions and classes. All of the functionality is not offered by any mayor package.

Core design principles are:

- **Lightweight:** mpu does not bring unexpected dependencies. You have fine-grained control via extras.
- **Documentation:** Every parameter is properly documented. For each opened issue or question I will think about adding the information to the docs
- **Testing:** >90% test coverage. For each issue found I will think about creating a test which could have shown the issue.

Please note that this is not in version 1.0 yet. So there will likely be breaking changes.

Contents:

mpu: Martins Python Utilities.

class `mpu.Location` (*latitude: float, longitude: float*)

Bases: `object`

Define a single point.

Parameters

- **latitude** (*float*) – in [-90, 90] - from North to South
- **longitude** (*float*) – in [-180, 180] - from West to East

MAX_LATITUDE = 90

MAX_LONGITUDE = 180

MIN_LATITUDE = -90

MIN_LONGITUDE = -180

distance (*there: mpu.Location*) → `float`

Calculate the distance from this location to there.

Parameters *there* (`Location`) –

Returns `distance_in_m`

Return type `float`

get_google_maps_link () → `str`

Get a Google Maps link to this location.

property latitude

Getter for latitude.

property longitude

Getter for longitude.

`mpu.clip` (*number: Union[int, float], lowest: Union[None, int, float] = None, highest: Union[None, int, float] = None*) → `Union[int, float]`

Clip a number to a given lowest / highest value.

Parameters

- **number** (*number*) –
- **lowest** (*number, optional*) –
- **highest** (*number, optional*) –

Returns `clipped_number`

Return type number

Examples

```
>>> clip(42, lowest=0, highest=10)
10
```

`mpu.consistent_shuffle` (**lists: List[List[Any]]*) → Tuple[List[Any], ...]
Shuffle lists consistently.

Parameters **lists* – Variable length number of lists

Returns *shuffled_lists* – All of the lists are shuffled consistently

Return type tuple of lists

Examples

```
>>> import mpu, random; random.seed(8)
>>> mpu.consistent_shuffle([1,2,3], ['a', 'b', 'c'], ['A', 'B', 'C'])
([3, 2, 1], ['c', 'b', 'a'], ['C', 'B', 'A'])
```

`mpu.exception_logging` (*exctype: Any, value: Any, tb: Optional[traceback]*) → None
Log exception by using the root logger.

Use it as `sys.excepthook = exception_logging`.

Parameters

- **exctype** (*type*) –
- **value** (*NameError*) –
- **tb** (*traceback*) –

`mpu.haversine_distance` (*origin: Tuple[float, float], destination: Tuple[float, float]*) → float
Calculate the Haversine distance.

Parameters

- **origin** (*Tuple[float, float]*) – (lat, long)
- **destination** (*Tuple[float, float]*) – (lat, long)

Returns *distance_in_km*

Return type float

Examples

```
>>> munich = (48.1372, 11.5756)
>>> berlin = (52.5186, 13.4083)
>>> round(haversine_distance(munich, berlin), 1)
504.2
```

```
>>> new_york_city = (40.712777777778, -74.005833333333) # NYC
>>> round(haversine_distance(berlin, new_york_city), 1)
6385.3
```


`mpu.is_in_intervall` (*value*: `mpu.type.Comparable`, *min_value*: `mpu.type.Comparable`, *max_value*: `mpu.type.Comparable`, *name*: *str* = 'variable') → None

Raise an exception if value is not in an interval.

Parameters

- **value** (`Comparable`) –
- **min_value** (`Comparable`) –
- **max_value** (`Comparable`) –
- **name** (*str*) – Name of the variable to print in exception.

`mpu.parallel_for` (*loop_function*: `Callable[[Any], Any]`, *parameters*: `List[Tuple[Any, ...]]`, *nb_threads*: `int` = 100) → `List[Any]`

Execute the loop body in parallel.

Note: Race-Conditions Executing code in parallel can cause an error class called “race-condition”.

Parameters

- **loop_function** (`Callable`) – Python function which takes a tuple as input
- **parameters** (`List[Tuple]`) – Each element here should be executed in parallel.

Returns return_values

Return type list of return values

MPU.AWS

Convenience functions for AWS interactions.

```
class mpu.aws.ExistsStrategy (value)
```

Bases: `enum.Enum`

Strategies what to do when a file already exists.

```
ABORT = 'abort'
```

```
RAISE = 'raise'
```

```
REPLACE = 'replace'
```

```
class mpu.aws.S3Path (bucket_name, key)
```

Bases: `tuple`

```
bucket_name
```

Alias for field number 0

```
key
```

Alias for field number 1

```
mpu.aws.list_files (bucket: str, prefix: str = "", profile_name: Optional[str] = None) → List[str]
```

List up to 1000 files in a bucket.

Parameters

- **bucket** (*str*) –
- **profile_name** (*str, optional*) – AWS profile

Returns s3_paths

Return type List[str]

```
mpu.aws.s3_download (source: str, destination: Optional[str] = None, exists_strategy: mpu.aws.ExistsStrategy = <ExistsStrategy.RAISE: 'raise'>, profile_name: Optional[str] = None) → Optional[str]
```

Copy a file from an S3 source to a local destination.

Parameters

- **source** (*str*) – Path starting with `s3://`, e.g. `'s3://bucket-name/key/foo.bar'`
- **destination** (*str, optional*) – If none is given, a temporary file is created
- **exists_strategy** (`{'raise', 'replace', 'abort'}`) – What is done when the destination already exists? * `ExistsStrategy.RAISE` means a `RuntimeError` is raised, * `ExistsStrategy.REPLACE` means the local file is replaced, * `ExistsStrategy.ABORT` means the download is not done.

- **profile_name** (*str*, *optional*) – AWS profile

Returns **download_path** – Path of the downloaded file, if any was downloaded.

Return type Optional[str]

Raises **botocore.exceptions.NoCredentialsError** – Botocore is not able to find your credentials. Either specify **profile_name** or add the environment variables **AWS_ACCESS_KEY_ID**, **AWS_SECRET_ACCESS_KEY** and **AWS_SESSION_TOKEN**. See <https://boto3.readthedocs.io/en/latest/guide/configuration.html>

`mpu.aws.s3_read` (*source: str*, *profile_name: Optional[str] = None*) → bytes
Read a file from an S3 source.

Parameters

- **source** (*str*) – Path starting with `s3://`, e.g. `'s3://bucket-name/key/foo.bar'`
- **profile_name** (*str*, *optional*) – AWS profile

Returns content

Return type bytes

Raises **botocore.exceptions.NoCredentialsError** – Botocore is not able to find your credentials. Either specify **profile_name** or add the environment variables **AWS_ACCESS_KEY_ID**, **AWS_SECRET_ACCESS_KEY** and **AWS_SESSION_TOKEN**. See <https://boto3.readthedocs.io/en/latest/guide/configuration.html>

`mpu.aws.s3_upload` (*source: str*, *destination: str*, *profile_name: Optional[str] = None*) → None
Copy a file from a local source to an S3 destination.

Parameters

- **source** (*str*) –
- **destination** (*str*) – Path starting with `s3://`, e.g. `'s3://bucket-name/key/foo.bar'`
- **profile_name** (*str*, *optional*) – AWS profile

MPU.DATASTRUCTURES

Utility datastructures.

```
class mpu.datastructures.EList (*args: Iterable[T])  
    Bases: list, typing.Generic
```

Enhanced List.

This class supports every operation a normal list supports. Additionally, you can call it with a list as an argument.

Examples

```
>>> l = EList([2, 1, 0])  
>>> l[2]  
0  
>>> l[[2, 0]]  
[0, 2]  
>>> l[1]  
[0, 1, 2]
```

```
remove_indices (indices: List[int]) → mpu.datastructures.EList
```

Remove rows by which have the given indices.

Parameters *indices* (List[int]) –

Returns *filtered_list*

Return type *EList*

```
class mpu.datastructures.Interval (left: Optional[Any] = None, right: Optional[Any] = None)
```

Bases: *mpu.datastructures.IntervalLike*

Representation of an interval.

The empty interval is represented as left=None, right=None. Left and right have to be comparable. Typically, it would be numbers or dates.

Parameters

- **left** (*Optional[Any]*) –
- **right** (*Optional[Any]*) –

```
intersection (other: 'Interval') → 'Interval'
```

```
intersection (other: 'IntervalUnion') → IntervalLike
```

Intersect two IntervalLike objects.

Parameters *other* (IntervalLike) –

Returns intersected

Return type *IntervalLike*

is_empty () → bool
Return if the interval is empty.

issubset (*other*: *mpu.datastructures.IntervalLike*) → bool
Check if the interval “self” is completely inside of other.

Parameters *other* (*IntervalLike*) –

Returns *is_inside*

Return type bool

union (*other*: *mpu.datastructures.IntervalLike*) → *mpu.datastructures.IntervalLike*
Combine two Intervals.

Parameters *other* (*IntervalLike*) –

Returns *interval_union*

Return type *IntervalLike*

class *mpu.datastructures.IntervalLike*

Bases: object

Anything like an interval or a union of an interval.

As mpu supports Python 2.7 until 2020 and does not want to include extra dependencies, ABC cannot be used.

intersection (*other*: *mpu.datastructures.IntervalLike*) → *mpu.datastructures.IntervalLike*
Intersect two *IntervalLike* objects.

Parameters *other* (*IntervalLike*) –

Returns *intersected*

Return type *IntervalLike*

is_empty () → bool
Return if the *IntervalLike* is empty.

issubset (*other*: *mpu.datastructures.IntervalLike*) → bool
Check if the interval “self” is completely inside of other.

Parameters *other* (*IntervalLike*) –

Returns *is_inside*

Return type bool

union (*other*: *mpu.datastructures.IntervalLike*) → *mpu.datastructures.IntervalLike*
Combine two Intervals.

Parameters *other* (*IntervalLike*) –

Returns *interval_union*

Return type *IntervalLike*

class *mpu.datastructures.IntervalUnion* (*intervals*)

Bases: *mpu.datastructures.IntervalLike*

A union of Intervals.

intersection (*other*: `mpu.datastructures.IntervalLike`) → `mpu.datastructures.IntervalLike`
 Return the intersection between this `IntervalUnion` and another object.

This changes the object itself!

Parameters *other* (`Interval` or `IntervalUnion`)–

Returns `intersection`

Return type `Interval` or `IntervalUnion`

is_empty () → `bool`

Return if the `IntervalUnion` is empty.

issubset (*other*: `mpu.datastructures.IntervalLike`) → `bool`

Check if this `IntervalUnion` is completely inside of *other*.

Parameters *other* (`Interval` or `IntervalUnion`)–

Returns `is_inside`

Return type `bool`

union (*other*: `mpu.datastructures.IntervalLike`) → `mpu.datastructures.IntervalLike`

Return the union between this `IntervalUnion` and another object.

Parameters *other* (`Interval` or `IntervalUnion`)–

Returns `union`

Return type `Interval` or `IntervalUnion`

`mpu.datastructures.dict_merge` (*dict_left*: `Dict`, *dict_right*: `Dict`, *merge_method*: `str` = `'take_left_shallow'`) → `Dict`

Merge two dictionaries.

This method does NOT modify `dict_left` or `dict_right`!

Apply this method multiple times if the dictionary is nested.

Parameters

- **dict_left** (`Dict`)–
- **dict_right** (`Dict`)–
- **merge_method** (`{'take_left_shallow', 'take_left_deep', 'take_right_shallow', 'take_right_deep', 'sum'}`)–
 - `take_left_shallow`: Use both dictionaries. If both have the same key, take the value of `dict_left`
 - `take_left_deep`: If both dictionaries have the same key and the value is a dict for both again, then merge those sub-dictionaries
 - `take_right_shallow`: See `take_left_shallow`
 - `take_right_deep`: See `take_left_deep`
 - `sum`: sum up both dictionaries. If one does not have a value for a key of the other, assume the missing value to be zero.

Returns `merged_dict`

Return type `Dict`

Examples

```
>>> dict_merge({'a': 1, 'b': 2}, {'c': 3}) == {'a': 1, 'b': 2, 'c': 3}
True
```

```
>>> out = dict_merge({'a': {'A': 1}},
...                 {'a': {'A': 2, 'B': 3}}, 'take_left_deep')
>>> expected = {'a': {'A': 1, 'B': 3}}
>>> out == expected
True
```

```
>>> out = dict_merge({'a': {'A': 1}},
...                 {'a': {'A': 2, 'B': 3}}, 'take_left_shallow')
>>> expected = {'a': {'A': 1}}
>>> out == expected
True
```

```
>>> out = dict_merge({'a': 1, 'b': {'c': 2}},
...                 {'b': {'c': 3, 'd': 4}},
...                 'sum')
>>> expected = {'a': 1, 'b': {'c': 5, 'd': 4}}
>>> out == expected
True
```

`mpu.datastructures.does_keychain_exist` (*dict_*: *Dict*, *list_*: *List*) → *bool*
Check if a sequence of keys exist in a nested dictionary.

Parameters

- **dict** (*Dict*[*str/int/tuple*, *Any*]) –
- **list** (*List*[*str/int/tuple*]) –

Returns `keychain_exists`

Return type *bool*

Examples

```
>>> d = {'a': {'b': {'c': 'd'}}}
>>> l_exists = ['a', 'b']
>>> does_keychain_exist(d, l_exists)
True
```

```
>>> l_no_existant = ['a', 'c']
>>> does_keychain_exist(d, l_no_existant)
False
```

`mpu.datastructures.flatten` (*iterable*: *Iterable*, *string_flattening*: *bool* = *False*) → *List*
Flatten an given iterable of iterables into one list.

Parameters

- **iterable** (*Iterable*) –
- **string_flattening** (*bool*) – If this is *False*, then strings are NOT flattened

Returns `flat_list`

Return type List

Examples

```
>>> flatten([1, [2, [3]]])
[1, 2, 3]
```

```
>>> flatten(((1, 2), (3, 4), (5, 6)))
[1, 2, 3, 4, 5, 6]
```

```
>>> flatten(EList([EList([1, 2]), (3, [4, [[5]]])]))
[1, 2, 3, 4, 5]
```

`mpu.datastructures.set_dict_value` (*dictionary: Dict, keys: List[Any], value: Any*) → Dict
Set a value in a (nested) dictionary by defining a list of keys.

Note: Side-effects This function does not make a copy of dictionary, but directly edits it.

Parameters

- **dictionary** (*Dict*) –
- **keys** (*List[Any]*) –
- **value** (*Any*) –

Returns dictionary

Return type dict

Examples

```
>>> d = {'a': {'b': {'c': 'x', 'f': 'g'}, 'd': 'e'}}
>>> expected = {'a': {'b': {'c': 'foobar', 'f': 'g'}, 'd': 'e'}}
>>> set_dict_value(d, ['a', 'b', 'c'], 'foobar') == expected
True
```


MPU.DATETIME

Datetime related utility functions.

`mpu.datetime.add_time(datetime_obj, days=0, hours=0, minutes=0, seconds=0)`
Add time to a timezone-aware datetime object.

This keeps the timezone correct, even if it changes due to daylight saving time (DST).

Parameters

- **datetime_obj** (*datetime.datetime*) –
- **days** (*int*) –
- **hours** (*int*) –
- **minutes** (*int*) –
- **seconds** (*int*) –

Returns datetime

Return type `datetime.datetime`

`mpu.datetime.generate(minimum, maximum, local_random=<random.Random object>)`
Generate a random date.

The generated dates are uniformly distributed.

Parameters

- **minimum** (*datetime object*) –
- **maximum** (*datetime object*) –
- **local_random** (*random.Random*) –

Returns generated_date

Return type `datetime object`

Examples

```
>>> import random; r = random.Random(); r.seed(0)
>>> from datetime import datetime
```

```
>>> generate(datetime(2018, 1, 1), datetime(2018, 1, 2), local_random=r)
datetime.datetime(2018, 1, 1, 20, 15, 58, 47972)
```

```
>>> generate(datetime(2018, 1, 1), datetime(2018, 1, 2), local_random=r)
datetime.datetime(2018, 1, 1, 18, 11, 27, 260414)
```

MPU.DECORATORS

Decorators which are not in *functools*.

`mpu.decorators.deprecated` (*func: Callable*) → Callable

Mark functions as deprecated.

It will result in a warning being emitted when the function is used.

`mpu.decorators.timing` (*func: Callable*) → Callable

Measure the execution time of a function call and print the result.

MPU.GEOMETRY

Create and manipulate two-dimensional geometrical entities such as lines.

For more advanced use cases, see:

- [sympy.geometry](#)
- [Shapely](#)

```
class mpu.geometry.LineSegment (p1: mpu.geometry.Point, p2: mpu.geometry.Point, name: str =  
                                'LineSegment')
```

Bases: object

A line segment a a 2-dimensional Euclidean space.

Parameters

- **p1** (Point) –
- **p2** (Point) –

angle () → float

Get the angle of this line.

bounding_box () → Tuple[mpu.geometry.Point, mpu.geometry.Point]

Get the bounding box of this line represented by two points.

The p1 point is in the lower left corner, the p2 one at the upper right corner.

intersect (*other*: mpu.geometry.LineSegment) → Union[None, mpu.geometry.LineSegment,
mpu.geometry.Point]

Get the intersection between this LineSegment and another LineSegment.

Parameters other (LineSegment) –

Returns intersection

Return type Union[None, LineSegment, Point]

is_point () → bool

Check if this LineSegment is a point.

length () → float

Get the length of this line segment.

simplify () → Union[mpu.geometry.Point, mpu.geometry.LineSegment]

Simplify this line segment to a point, if possible.

```
class mpu.geometry.Point (x: float, y: float)
```

Bases: object

A point in a 2-dimensional Euclidean space.

Parameters

- **x** (*float*) –
- **y** (*float*) –

`mpu.geometry.crossproduct` (*a*: `mpu.geometry.Point`, *b*: `mpu.geometry.Point`) → `float`
 Get the cross product of two points.

`mpu.geometry.do_bounding_boxes_intersect` (*a*: `mpu.geometry.Point`, *b*: `mpu.geometry.Point`) → `bool`
 Check if bounding boxes do intersect.
 If one bounding box touches the other, they do intersect.

`mpu.geometry.do_lines_intersect` (*a*: `mpu.geometry.LineSegment`, *b*: `mpu.geometry.LineSegment`) → `bool`
 Check if LineSegments *a* and *b* intersect.

`mpu.geometry.get_all_intersecting_lines_by_brute_force` (*lines*: `List[mpu.geometry.LineSegment]`) → `Set[FrozenSet[mpu.geometry.LineSegment]]`
 Get all interectionLines by applying a brute force algorithm.

Parameters *lines* (*all lines you want to check, in no order*) –

Returns

Return type a list that contains all pairs of intersecting lines

`mpu.geometry.is_point_on_line` (*a*: `mpu.geometry.LineSegment`, *b*: `mpu.geometry.Point`) → `bool`
 Check if point *b* is on LineSegment *a*.

`mpu.geometry.is_point_right_of_line` (*a*: `mpu.geometry.LineSegment`, *b*: `mpu.geometry.Point`) → `bool`
 Check if point *b* is right of line *a*.

`mpu.geometry.line_segment_touches_or_crosses_line` (*a*: `mpu.geometry.LineSegment`, *b*: `mpu.geometry.LineSegment`) → `bool`
 Check if line segment *a* touches or crosses line segment *b*.

MPU.IMAGE

Image manipulation.

`mpu.image.get_meta(filepath: str) → Dict`
Get meta-information of an image.

Parameters `filepath` (*str*) –

Returns `meta`

Return type Dict

Reading and writing common file formats.

`mpu.io.download` (*source: str, sink: Optional[str] = None*) → *str*
Download a file.

Parameters

- **source** (*str*) – Where the file comes from. Some URL.
- **sink** (*str, optional (default: same filename in current directory)*) – Where the file gets stored. Some filepath in the local file system.

`mpu.io.get_access_datetime` (*filepath: str*) → *datetime.datetime*
Get the last time filepath was accessed.

Parameters `filepath` (*str*) –

Returns `access_datetime`

Return type *datetime*

`mpu.io.get_creation_datetime` (*filepath: str*) → *Optional[datetime.datetime]*
Get the date that a file was created.

Parameters `filepath` (*str*) –

Returns `creation_datetime`

Return type *Optional[datetime]*

`mpu.io.get_file_meta` (*filepath: str*) → *Dict[str, Any]*
Get meta-information about a file.

Parameters `filepath` (*str*) –

Returns `meta`

Return type *dict*

`mpu.io.get_modification_datetime` (*filepath: str*) → *datetime.datetime*
Get the datetime that a file was last modified.

Parameters `filepath` (*str*) –

Returns `modification_datetime`

Return type *datetime*

`mpu.io.gzip_file` (*source: str, sink: str*) → *None*
Create a GZIP file from a source file.

Parameters

- **source** (*str*) – Filepath
- **sink** (*str*) – Filepath

`mpu.io.hash` (*filepath: str, method: str = 'sha1', buffer_size: int = 65536*) → *str*
Calculate a hash of a local file.

Parameters

- **filepath** (*str*) –
- **method** (*{'sha1', 'md5'}*) –
- **buffer_size** (*int, optional (default: 65536 byte = 64 KiB)*) – in byte

Returns hash

Return type *str*

`mpu.io.read` (*filepath: str, **kwargs: Any*) → *Any*
Read a file.

Supported formats:

- CSV
- JSON, JSONL
- pickle

Parameters

- **filepath** (*str*) – Path to the file that should be read. This methods action depends mainly on the file extension.
- **kwargs** (*Dict*) – Any keywords for the specific file format. For CSV, this is ‘delimiter’, ‘quotechar’, ‘skiprows’, ‘format’

Returns data

Return type *Union[str, bytes]* or other (e.g. *format=dicts*)

`mpu.io.urlread` (*url: str, encoding: str = 'utf8'*) → *str*
Read the content of an URL.

Parameters *url* (*str*) –

Returns content

Return type *str*

`mpu.io.write` (*filepath: str, data: Union[Dict, List], **kwargs: Dict*) → *Any*
Write a file.

Supported formats:

- CSV
- JSON, JSONL
- pickle

Parameters

- **filepath** (*str*) – Path to the file that should be read. This methods action depends mainly on the file extension. Make sure that it ends in *.csv*, *.json*, *.jsonl*, or *.pickle*.

- **data** (*Union[Dict, List]*) – Content that should be written
- **kwargs** (*Dict*) – Any keywords for the specific file format.

Returns data

Return type str or bytes

Mathematical functions which are not adequately covered by standard libraries.

Standard libraries are:

- `math`
- `scipy`
- `sympy`

`mpu.math.argmax` (*iterable: Iterable*) → `Optional[int]`

Find the first index of the biggest value in the iterable.

Parameters `iterable` (*Iterable*) –

Returns `argmax`

Return type `Optional[int]`

Examples

```
>>> argmax([0, 0, 0])
0
>>> argmax([1, 0, 0])
0
>>> argmax([0, 1, 0])
1
>>> argmax([])
```

`mpu.math.factorize` (*number: int*) → `List[int]`

Get the prime factors of an integer except for 1.

Parameters `number` (*int*) –

Returns `primes`

Return type `List[int]`

Examples

```
>>> factorize(-17)
[-1, 17]
>>> factorize(8)
[2, 2, 2]
>>> factorize(3**25)
[3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3]
>>> factorize(1)
[1]
```

`mpu.math.gcd(a: int, b: int) → int`

Calculate the greatest common divisor.

Currently, this uses the Euclidean algorithm.

Parameters

- **a** (*int*) – Non-zero
- **b** (*int*) – Non-zero

Returns `greatest_common_divisor`

Return type `int`

Examples

```
>>> gcd(1, 7)
1
>>> gcd(-1, -1)
1
>>> gcd(1337, 42)
7
>>> gcd(-1337, -42)
7
>>> gcd(120, 364)
4
>>> gcd(273, 1870)
1
```

`mpu.math.generate_primes() → Iterator[int]`

Generate an infinite sequence of prime numbers.

The algorithm was originally written by David Eppstein, UC Irvine. See: <http://code.activestate.com/recipes/117119/>

Examples

```
>>> g = generate_primes()
>>> next(g)
2
>>> next(g)
3
>>> next(g)
5
```


`mpu.math.is_prime` (*number: int*) → bool

Check if a number is prime.

Parameters `number` (*int*) –

Returns `is_prime_number`

Return type bool

Examples

```
>>> is_prime(-17)
False
>>> is_prime(17)
True
>>> is_prime(47055833459)
True
```

`mpu.math.product` (*iterable: Iterable, start: int = 1*) → int

Calculate the product of the iterables.

Parameters

- **iterable** (*iterable*) – List, tuple or similar which contains numbers
- **start** (*number, optional (default: 1)*) –

Returns `product`

Return type number

Examples

```
>>> product([1, 2, 3, 4, 5])
120
>>> product([])
1
```

`mpu.math.round_down` (*x: float, decimal_places: int*) → float

Round a float down to `decimal_places`.

Parameters

- **x** (*float*) –
- **decimal_places** (*int*) –

Returns `rounded_float`

Return type float

Examples

```
>>> round_down(1.23456, 3)
1.234
>>> round_down(1.23456, 2)
1.23
```

`mpu.math.round_up(x: float, decimal_places: int) → float`
Round a float up to `decimal_places`.

Parameters

- **x** (*float*) –
- **decimal_places** (*int*) –

Returns `rounded_float`

Return type `float`

Examples

```
>>> round_up(1.2344, 3)
1.235
>>> round_up(1.234, 3)
1.234
>>> round_up(1.23456, 3)
1.235
>>> round_up(1.23456, 2)
1.24
```

Machine Learning functions.

`mpu.ml.indices2one_hot` (*indices: Iterable, nb_classes: int*) → List
Convert an iterable of indices to one-hot encoded list.

You might also be interested in `sklearn.preprocessing.OneHotEncoder`

Parameters

- **indices** (*Iterable*) – iterable of indices
- **nb_classes** (*int*) – Number of classes
- **dtype** (*type*) –

Returns `one_hot`

Return type List

Examples

```
>>> indices2one_hot([0, 1, 1], 3)
[[1, 0, 0], [0, 1, 0], [0, 1, 0]]
>>> indices2one_hot([0, 1, 1], 2)
[[1, 0], [0, 1], [0, 1]]
```

`mpu.ml.one_hot2indices` (*one_hots: List*) → List
Convert an iterable of one-hot encoded targets to a list of indices.

Parameters `one_hot` (*List*) –

Returns `indices`

Return type List

Examples

```
>>> one_hot2indices([[1, 0, 0], [0, 1, 0], [0, 0, 1]])
[0, 1, 2]
```

```
>>> one_hot2indices([[1, 0], [1, 0], [0, 1]])
[0, 0, 1]
```


MPU.PATH

Functions for path manipulation and retrieval of files.

`mpu.path.get_all_files` (*root: str, followlinks: bool = False*) → List
Get all files within the given root directory.

Note that this list is not ordered.

Parameters

- **root** (*str*) – Path to a directory
- **followlinks** (*bool, optional (default: False)*) –

Returns `filepath` – List of absolute paths to files

Return type List

`mpu.path.get_from_package` (*package_name: str, path: str*) → str
Get the absolute path to a file in a package.

Parameters

- **package_name** (*str*) – e.g. ‘mpu’
- **path** (*str*) – Path within a package

Returns `filepath`

Return type str

Pandas utility functions.

`mpu.pd.describe` (*df*: *pandas.core.frame.DataFrame*, *dtype*: *Optional[Dict] = None*) → Dict
Print a description of a Pandas dataframe.

Parameters

- **df** (*pd.DataFrame*) –
- **dtype** (*Optional[Dict]*) – Maps column names to types

`mpu.pd.example_df` () → *pandas.core.frame.DataFrame*
Create an example dataframe.

MPU.SHELL

Enhancing printed terminal output.

```
class mpu.shell.Codes
    Bases: object

    Escape sequences for enhanced shell output.

    BACKGROUND_BLACK = '\x1b[40m'
    BACKGROUND_BLUE = '\x1b[44m'
    BACKGROUND_CYAN = '\x1b[46m'
    BACKGROUND_DARK_GRAY = '\x1b[100m'
    BACKGROUND_DEFAULT = '\x1b[49m'
    BACKGROUND_GREEN = '\x1b[42m'
    BACKGROUND_LIGHT_BLUE = '\x1b[104m'
    BACKGROUND_LIGHT_CYAN = '\x1b[106m'
    BACKGROUND_LIGHT_GRAY = '\x1b[47m'
    BACKGROUND_LIGHT_GREEN = '\x1b[102m'
    BACKGROUND_LIGHT_MAGENTA = '\x1b[105m'
    BACKGROUND_LIGHT_RED = '\x1b[101m'
    BACKGROUND_LIGHT_YELLOW = '\x1b[103m'
    BACKGROUND_MAGENTA = '\x1b[45m'
    BACKGROUND_RED = '\x1b[41m'
    BACKGROUND_WHITE = '\x1b[107m'
    BACKGROUND_YELLOW = '\x1b[43m'
    BLACK = '\x1b[30m'
    BLINK = '\x1b[5m'
    BLUE = '\x1b[34m'
    BOLD = '\x1b[1m'
    CYAN = '\x1b[36m'
    DARK_GRAY = '\x1b[90m'
    DEFAULT = '\x1b[39m'
```

```
DIM = '\x1b[2m'  
GREEN = '\x1b[32m'  
HIDDEN = '\x1b[8m'  
LIGHT_BLUE = '\x1b[94m'  
LIGHT_CYAN = '\x1b[96m'  
LIGHT_GRAY = '\x1b[37m'  
LIGHT_GREEN = '\x1b[92m'  
LIGHT_MAGENTA = '\x1b[95m'  
LIGHT_RED = '\x1b[91m'  
LIGHT_YELLOW = '\x1b[93m'  
MAGENTA = '\x1b[35m'  
RED = '\x1b[31m'  
RESET_ALL = '\x1b[0m'  
RESET_BLINK = '\x1b[25m'  
RESET_BOLD = '\x1b[21m'  
RESET_DIM = '\x1b[22m'  
RESET_HIDDEN = '\x1b[28m'  
RESET_REVERSE = '\x1b[27m'  
RESET_UNDERLINED = '\x1b[24m'  
REVERSE = '\x1b[7m'  
UNDERLINED = '\x1b[4m'  
WHITE = '\x1b[97m'  
YELLOW = '\x1b[33m'
```

`mpu.shell.print_table` (*table: List*) → None
Print as a table.

I recommend looking at *[tabulate]*(<https://pypi.org/project/tabulate/>).

Parameters `table` (*List*) –

Examples

```
>>> print_table([[1, 2, 3], [41, 0, 1]])  
1 2 3  
41 0 1
```

`mpu.shell.text_input` (*text: str*) → str
Ask the user for textual input.

Parameters `text` (*str*) – What the user sees.

Returns `inputted_text` – What the user wrote.

Return type str

MPU.STRING

String manipulation, verification and formatting.

For more complex checks, you might want to use the [validators](<http://validators.readthedocs.io>) package.

`mpu.string.human_readable_bytes` (*nb_bytes: Union[int, float], suffix: str = 'B'*) → str
Convert a byte number into a human readable format.

Parameters

- **nb_bytes** (*Union[int, float]*) –
- **suffix** (*str, optional (default: "B")*) –

Returns `size_str`

Return type str

Examples

```
>>> human_readable_bytes(123)
'123.0 B'
```

```
>>> human_readable_bytes(1025)
'1.0 KiB'
```

```
>>> human_readable_bytes(9671406556917033397649423)
'8.0 YiB'
```

`mpu.string.is_email` (*potential_email_address: str*) → bool
Check if `potential_email_address` is a valid e-mail address.

Please note that this function has no false-negatives but many false-positives. So if it returns that the input is not a valid e-mail address, it certainly isn't. If it returns True, it might still be invalid. For example, the domain could not be registered.

Parameters `potential_email_address` (*str*) –

Returns `is_email`

Return type bool

Examples

```
>>> is_email('')
False
>>> is_email('info@martin-thoma.de')
True
>>> is_email('info@math.martin-thoma.de')
True
>>> is_email('Martin Thoma <info@martin-thoma.de>')
False
>>> is_email('info@martin-thoma')
False
>>> is_email('Martin <>')
False
```

`mpu.string.is_float` (*potential_float: str*) → bool
Check if `potential_float` is a valid float.

Returns `is_float`

Return type bool

Examples

```
>>> is_float('123')
True
>>> is_float('1234567890123456789')
True
>>> is_float('0')
True
>>> is_float('-123')
True
>>> is_float('123.45')
True
>>> is_float('a')
False
>>> is_float('0x8')
False
```

`mpu.string.is_iban` (*potential_iban: str*) → bool
Check if a string is a valid IBAN number.

IBAN is described in ISO 13616-1:2007 Part 1.

Spaces are ignored.

CODE 0 = always zero b = BIC or National Bank code c = Account number i = holder's kennitala (national identification number) k = IBAN check digits n = Branch number t = Account type x = National check digit or character

Examples

```
>>> is_iban('DE89 3704 0044 0532 0130 00')
True
>>> is_iban('DE89 3704 0044 0532 0130 01')
False
```

`mpu.string.is_int` (*potential_int: str*) → bool
Check if *potential_int* is a valid integer.

Parameters *potential_int* (*str*) –

Returns `is_int`

Return type bool

Examples

```
>>> is_int('123')
True
>>> is_int('1234567890123456789')
True
>>> is_int('0')
True
>>> is_int('-123')
True
>>> is_int('123.45')
False
>>> is_int('a')
False
>>> is_int('0x8')
False
```

`mpu.string.is_ipv4` (*potential_ipv4: str*, *allow_leading_zeros: bool = False*, *allow_shortened_addresses: bool = False*) → bool
Check if a string is a valid IPv4 address.

Parameters *potential_ipv4* (*str*) –

Returns `is_valid`

Return type bool

Examples

```
>>> is_ipv4("192.168.0.4")
True
>>> is_ipv4("192.168..4")
False
>>> is_ipv4("192.168.01.4", allow_leading_zeros=True)
True
>>> is_ipv4("192.168.01.4", allow_leading_zeros=False)
False
>>> is_ipv4("256.168.01.4")
False
>>> is_ipv4("4", allow_shortened_addresses=True)
```

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```
True
>>> is_ipv4("4", allow_shortened_addresses=False)
False
```

`mpu.string.is_none` (*string_*: *str*, *default*: *Union[str, bool]* = 'raise') → bool

Check if a string is equivalent to None.

Parameters

- **string** (*str*) –
- **default** (*{'raise', False}*) – Default behaviour if none of the “None” strings is detected.

Returns `is_none`

Return type bool

Examples

```
>>> is_none('2', default=False)
False
>>> is_none('undefined', default=False)
True
```

`mpu.string.str2bool` (*string_*: *str*, *default*: *Union[str, bool]* = 'raise') → bool

Convert a string to a bool.

Parameters

- **string** (*str*) –
- **default** (*{'raise', False}*) – Default behaviour if none of the “true” strings is detected.

Returns boolean

Return type bool

Examples

```
>>> str2bool('True')
True
>>> str2bool('1')
True
>>> str2bool('0')
False
```

`mpu.string.str2bool_or_none` (*string_*: *str*, *default*: *Union[str, bool]* = 'raise') → Optional[bool]

Convert a string to a bool or to None.

Parameters

- **string** (*str*) –
- **default** (*{'raise', False}*) – Default behaviour if none of the “true” or “none” strings is detected.

Returns `bool_or_none`

Return type bool or None

Examples

```
>>> str2bool_or_none('True')
True
>>> str2bool_or_none('1')
True
>>> str2bool_or_none('0')
False
>>> str2bool_or_none('undefined')
```

`mpu.string.str2float_or_none(string_: str) → Optional[float]`

Convert a string to a float or to None.

Parameters `string` (*str*) –

Returns `float_or_none`

Return type float or None

Examples

```
>>> str2float_or_none('1')
1.0
>>> str2float_or_none('1.2')
1.2
>>> str2float_or_none('undefined')
```

`mpu.string.str2int_or_none(string_: str) → Optional[int]`

Convert a string to a int or to None.

Parameters `string` (*str*) –

Returns `int_or_none`

Return type int or None

Examples

```
>>> str2int_or_none('2')
2
>>> str2int_or_none('undefined')
```

`mpu.string.str2str_or_none(string_: str) → Optional[str]`

Convert a string to a str or to None.

Parameters `string` (*str*) –

Returns `str_or_none`

Return type bool or None

Examples

```
>>> str2str_or_none('True')
'True'
>>> str2str_or_none('1')
'1'
>>> str2str_or_none('0')
'0'
>>> str2str_or_none('undefined')
```


MPU.TYPE

Helpers for type annotations.

```
class mpu.type.Comparable(*args, **kws)  
    Bases: typing.Protocol
```

Type for a function which is comparable to other instances.

16.1 Module contents

Handle units - currently only currencies.

class `mpu.units.Currency` (*name: str, code: str, numeric_code: str, symbol: str, exponent: Optional[int], entities: Optional[List], withdrawal_date: Optional[str], subunits: Optional[str]*)

Bases: `object`

Currency base class which contains information similar to ISO 4217.

for_json () → `Dict[str, Any]`
Return a JSON-serializable object.

classmethod from_json (*json: Dict*) → `mpu.units.Currency`
Create a Currency object from a JSON dump.

class `mpu.units.Money` (*value: Union[str, fractions.Fraction, int, Tuple], currency: Union[str, mpu.units.Currency]*)

Bases: `object`

Unit of account.

Parameters

- **value** (`Union[str, fractions.Fraction, int, Tuple]`)–
- **currency** (`Currency` or `str`)–

Examples

```
>>> rent = Money(500, 'USD')
>>> '{:.2f,shortcode}'.format(rent)
'USD 500.00'
>>> '{:.2f,postshortcode}'.format(rent)
'500.00 USD'
>>> '{:.2f,symbol}'.format(rent)
'$500.00'
>>> '{:.2f,postsymbol}'.format(rent)
'500.00$'
>>> '{:.2f}'.format(rent)
'500.00 USD'
```

for_json () → `Dict[str, Any]`
Return a JSON-serializable object.

classmethod `from_json` (*json: Dict[str, Any]*) → *mpu.units.Money*

Create a Money object from a JSON dump.

`mpu.units.get_currency` (*currency_str: str*) → *mpu.units.Currency*

Convert an identifier for a currency into a currency object.

Parameters `currency_str` (*str*) –

Returns `currency`

Return type *Currency*

16.2 Allowed operations with Money

Here you can see which operations are allowed by two Money objects of currencies (A and B):

Money A	Operator	Money A	Money B	int, Fraction
	+ , -	Money A	N/A	N/A
	*	N/A	N/A	Money A
	/	N/A	N/A	N/A
	//	Fraction	N/A	Money A
	>, >=, <, <=	Bool	N/A	N/A
	==	Bool	False	False

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