

## Generell

Die numerischen Datentypen sind gleichermaßen zu behandeln wie in den bekannten Programmiersprachen.

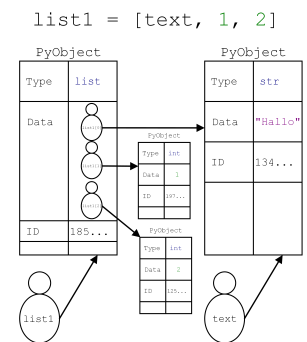
### Datentypen

Datentyp	Beschreibung	False-Wert
<b>NoneType</b>	Indikator für nichts	None
<b>Numerische Datentypen</b>		
<b>int</b>	Ganze Zahlen	0
<b>float</b>	Gleitkommazahlen	0.0
<b>bool</b>	Boolesche Werte	False
<b>complex</b>	Komplexe Zahlen	0 + 0j
<b>Sequenzielle Datentypen</b>		
<b>str</b>	Zeichenketten oder Strings(unveränderlich)	' '
<b>list</b>	Listen(veränderlich)	[]
<b>tuple</b>	Tupel(unveränderlich)	()
<b>bytes</b>	Sequenz von Bytes(unveränderlich)	b' '
<b>bytearray</b>	Sequenz von Bytes(veränderlich)	bytearray(b' ')
<b>Mengen</b>		
<b>set</b>	Einmalig vorkommende Objekte	set()
<b>frozenset</b>	Wie set jedoch unveränderlich	frozenset()
<b>Assoziative Datentypen</b>		
<b>dict</b>	Dictionary(veränderlich)	

### Operatoren

Operator	Beschreibung
x // y	Ganzzahliger Quotient
x ** y	Potenzieren, $x^y$
+, -, ...	Übliche Operation

### Variablen



### Casting

Datentyp	Klasse	Direkt	Datentyp	Klasse	Direkt
Ganzzahl	int()	3	Gleitkommazahl	float()	3.1415
Boolescher Wert	bool()	True,False	Komplexe Zahl	complex()	2 + 4j
String	str()	"HSR", 'OST'	Liste	list()	[1,2,3]
Menge	set()	1,2,3	Tupel	tuple()	(1,2,3)
Unver. Menge	frozenset()	frozenset(1,2,3)	Dictionary	dict()	, "Key": 1

### Eingabe und Ausgabe

```
name = input("type your name:")
print("Hello", name)
strList = ["YES", "WE", "CAN"]
for w in strList:
    print(w, end="--")
```

**In:**

type your name:MFG GG OG

**Out:**

Hello MFG GG OG

YES-WE-CAN-

Parameter	Beschreibung	Default
object(s)	Alle Objekte werden in String konvertiert	
sep='separator'	Separierung der Objekte	' '
end='end'	Letztes Zeichen des print-Befehl	'\n'
file	Objekt mit einer Write-Methode	sys.stdout
flush	Boolescher Wert für die Output-Überprüfung	False

### Listen

list.append(x)	list.extend(iterable)	list.remove(x)
list.clear()	list.index(x[, start[, end]]) → int	list.reverse()
list.copy() → list	list.insert(i, x)	list.sort(key=None, reverse=False)
list.count(x) → int	list.pop([i]) → object	

### Erzeugen von Listen

```
mylist = [1, 2, 3]
alist = list([4, 5, 6])
blist = alist.copy() # deep copy
print(f'mylist = {mylist}, alist = {alist}')
print(f'blist = {blist}')
```

**Out:**

mylist = [1, 2, 3], alist = [4, 5, 6]

## Hinzufügen/Entfernen von Elementen

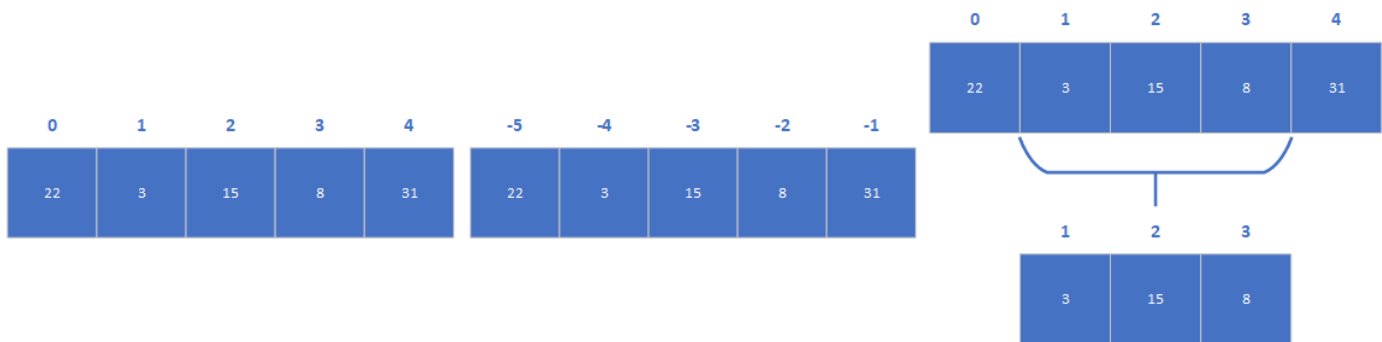
```
mylist = [1, 2]
mylist.append(33)
mylist.extend([11, 22])
print(f'#1 mylist = {mylist}')
mylist.pop()
mylist.pop(2)
mylist.remove(11)
print(f'#2 mylist = {mylist}')
mylist.clear()
print(f'#3 mylist = {mylist}')
```

### Out:

```
#1 mylist = [1, 2, 33, 11, 22]
#2 mylist = [1, 2]
#3 mylist = []
```

## Indexierung/Slicing

slice = lst[start:end:step] 'inklusive' start bis 'exklusiv' end



```
mylist = [22, 3, 15, 8, 31]
print(f'mylist[:] = {mylist[:]}')
print(f'mylist[1:4] = {mylist[1:4]}')
print(f'mylist[::2] = {mylist[::2]}')
print(f'mylist.index(3) = {mylist.index(3)}')
```

### Out:

```
mylist[:] = [22, 3, 15, 8, 31]
mylist[1:4] = [3, 15, 8]
mylist[::2] = [22, 15, 31]
mylist.index(3) = 1
```

## Sortieren

```
def myfunc(e):
    return len(e)

mylist = [4, 3, 5, 7, 3, 2]
strlist = ['BMW', 'Tesla', 'GM']
mylist.sort()
print('#1', mylist)
mylist.sort(reverse=True)
print('#2', mylist)
print('#3', mylist.count(2))
strlist.sort(key=myfunc)
print('#4', strlist)
```

### Out:

```
#1 [2, 3, 3, 4, 5, 7]
#2 [7, 5, 4, 3, 3, 2]
#3 1
#4 ['GM', 'BMW', 'Tesla']
```

## Tuple

Tuples sind ähnlich zu behandeln wie die Listen, nur dass sie nicht veränderbar sind.

`tuple.index(x)` `tuple.count(x)`

```
mytuplel = (1, "one", [0, 1])
print(mytuplel)
```

### Out:

```
(1, 'one', [0, 1])
```

## Set

set.add(elem)	set.intersection(*others) → set	set.remove(elem)
set.clear()	set.intersection_update(*others)	set.symmetric_difference(other) → set
set.copy() → set	set.isdisjoint(other) → bool	set.symmetric_difference_update(other)
set.difference(*others) → set	set.issubset(other) → bool	set.union(*others) → set
set.difference_update(*others)	set.issuperset(other) → bool	set.update(*others)
set.discard(elem)	set.pop() → object	

Ein set kann ebenfalls wie eine Liste behandelt werden, wobei die Werte nur einmalig vorkommen können und sie nicht veränderbar sind. Weitere Werte können hinzugefügt oder entfernt werden. Sets sind ungeordnet, heisst, **die Reihenfolge der Elemente kann nicht vorhergesagt werden.**

### Erzeugen

```
myset = {'I', 'love', 'swiss', 'cheese'}
aset = {'one', 'two', 'one', 'six'}
print(f'myset = {myset}')
print(f'aset = {aset}')
```

#### Out:

```
myset = 'I', 'cheese', 'love', 'swiss'
aset = 'six', 'two', 'one'
```

### Basics

```
myset = {4, 12, 77, 120}
myset.add('elem')
myset.remove(120)
myset.pop()
myset.discard('nothing')
print(f'myset = {myset}')
aset = myset.copy()
myset.clear()
print(f'myset = {myset}')
print(f'aset = {aset}')
```

#### Out:

```
myset = 12, 77, 'elem'
myset = set()
aset = 'elem', 12, 77
```

## Dictionary

dict.clear()	dict.pop(key[, default]) → object
dict.copy() → dict	dict.popitem() → tuple
dict.fromkeys(iterable[, value]) → object	dict.setdefault(key[, default]) → object
dict.get(key[, default]) → object	dict.update([other])
dict.items() → dict_items	dict.values() → dict_values
dict.keys() → dict_keys	

Ein Dictionary ist ein geordneter Datentyp um Wertepaare zu speichern. Dieser Datentyp erlaubt keine Duplikate!

### Basics

```
cb300 = {
    'brand': 'honda',
    'color': 'red',
    'power': (31, 'hp')
}
update = {'category': 'naked'}
cb300['mileage[km]'] = 3148
cb300['mileage[km]'] = 4399
cb300.update(update)
cb500 = cb300.copy()
cb500['power'] = (48, 'hp')
cb500['color'] = 'grey'
print(cb300)
print(cb500)
```

#### Out:

```
{'brand': 'honda', 'color': 'red', 'power': (31, 'hp'),
'mileage[km]': 4399, 'category': 'naked'}
{'brand': 'honda', 'color': 'red', 'power': (48, 'hp'),
'mileage[km]': 4399, 'category': 'naked'}
```

**Entfernen/Löschen**

```
cb300 = {
    'brand':    'honda',
    'color':    'red',
    'power':    (31, 'hp')
}
print(cb300.pop('color', 'raw'))
print(cb300.pop('color', 'raw'))
print(cb300.popitem()) #removes last added
                        item
cb300.clear()
print(cb300)
```

**Out:**

```
red
raw
('power', (31, 'hp'))
{}
```

**Abfragen/Hinzufügen**

```
cb300 = {
    'brand':    'honda',
    'color':    'red',
    'power':    (31, 'hp')
}
keys = ('year', 'weight')
values = 0
print(cb300.items())
print(cb300.keys())
print(cb300.values())
print(cb300.get('color', 'raw'))
print(cb300.get('mileage', 0))
print(cb300.setdefault('color', 'black'))
cb300.update(dict.fromkeys(keys, values))
print(cb300)
```

**Out:**

```
dict.items([('brand', 'honda'), ('color', 'red'),
('power', (31, 'hp'))])
dict.keys(['brand', 'color', 'power'])
dict.values(['honda', 'red', (31, 'hp')])
red
0
red
{'brand': 'honda', 'color': 'red', 'power': (31, 'hp'),
'year': 0, 'weight': 0}
```

**Strings**

<pre>string1 = "python" string2 = """Mehrzeiliger String""" t = string1[2] t = string1[-4]</pre>	<pre># F-String example fruit = 'apple' color = 'red' print(f'The fruit {fruit} has       the color {color}')</pre>
--	---

**Dateien****Dateien lesen**

```
with open("mytextfile.txt", encoding="
utf-8") as f:
    text = f.readlines()
    print(text)
```

**Dateien schreiben**

```
bundesraete=['Ueli Maurer', '
Ehrenglatze Berset']
with open('mytextfile.txt', 'w',
encoding='utf-8') as f:
    f.writelines(bundesraete)
```

## Matrix

<code>np.array(object, dtype=None, *, copy=True, order="K", subok=False, ndmin=0) ndarray</code>
<code>np.arange([start,] stop[, step,] dtype=None) ndarray</code>
<code>np.asarray(a, dtype=None, order=None, *, like=None) ndarray</code>
<code>np.copy(a, order="K", subok=False) ndarray</code>
<code>np.empty(shape, dtype=float, order="C") int ndarray</code>
<code>np.empty_like(prototype, dtype=None, order="K", subok=True, shape=None) ndarray</code>
<code>np.eye(N, M=None, k=0, dtype=class "float", order="C") ndarray</code>
<code>np.full(shape, fill value, dtype=None, order="C") ndarray</code>
<code>np.full like(a, fill value, dtype=None, order="K", subok=True, shape=None) ndarray</code>
<code>np.fromfile(file, dtype=float, count=-1, sep=, offset=0) ndarray</code>
<code>np.fromstring(string, dtype=float, count=-1, sep=) ndarray</code>
<code>np.identity(n, dtype=None) ndarray</code>
<code>np.linspace(start, stop, num=50, endpoint=True, retstep=False, dtype=None, axis=0) ndarray</code>
<code>np.loadtxt(fname, dtype= &lt; class "float" &gt; , comments="#", delimiter=None, converters=None, skiprows=0, usecols=None, unpack=False, ndmin=0, encoding="bytes", max rows=None) ndarray</code>
<code>np.logspace(start, stop, num=50, endpoint=True, base=10.0, dtype=None, axis=0) ndarray</code>
<code>np.meshgrid(*xi, copy=True, sparse=False, indexing="xy") ndarray</code>
<code>np.ones(shape, dtype=None, order="C") ndarray</code>
<code>np.ones like(a, dtype=None, order="K", subok=True, shape=None) ndarray</code>
<code>np.random.randn(d0, d1, ...,dn) ndarray</code>
<code>np.random.randint(low, high=None, size=None, dtype=int) ndarray</code>
<code>np.zeros(shape, dtype=float, order="C") ndarray</code>
<code>np.zeros like(a, dtype=None, order="K", subok=True, shape=None) ndarray</code>

### Basics

order='K', 'A', 'C', 'F', optional

K = lässt das Array wie es ist, A lässt es in F denn rest aber geht in C

F bedeutet zuerst Spalten lesen, oder vom äussern zum innern.

C bedeutet zuerst zeilen lesen , vom innersten zum äussern.

ndmin bestimmt mindest anzahl an Dimensionen.

```
import numpy as np

arr1 = np.array([[1, 2, 3],[ 4, 5, 6]])
print(arr1)
arr2 = np.arange(1,2,0.3)
print(arr2)
arr3 = np.asarray(arr1, dtype= float)
print(arr3)
arr4 = np.copy(arr1)
print(arr4 is arr1)
arr5 =np.empty((2, 3))
print(arr5)
arr6 =np.linspace(1,50)
print(arr6)
```

### Out:

arr1= [[1 2 3][4 5 6]]

arr2 [1. 1.3 1.6 1.9]

arr3 [[1. 2. 3][4. 5. 6.]]

arr4 False (die Objekte sind nicht gleich)

arr5 = Ein Array mit leeren zufälligen Floatzahlen  
meist sehr klein.

arr6 = [1 2 3 ... 49 50]

## Array Manipulation

<code>numpy.append(arr, values, axis=None)</code> ndarray	<code>np.ravel(a, order="C")</code> ndarray array like
<code>np.array split(ary, indices or sections, axis=0)</code> list	<code>np.repeat(a, repeats, axis=None)</code> ndarray
<code>np.atleast 1d(*args)</code> ndarray	<code>np.reshape(a, newshape, order="C")</code> ndarray
<code>np.atleast 2d(*args)</code> ndarray	<code>np.resize(a, newshape)</code> ndarray
<code>np.atleast 3d(*args)</code> ndarray	<code>np.roll(a, shift, axis=None)</code> ndarray
<code>np.c [...]</code> ndarray	<code>np.row stack(tup)</code> ndarray
<code>np.column stack(tup)</code> ndarray	<code>np.split(ary, indices or sections, axis=0)</code> list
<code>np.concatenate((a1, a2, ...), axis=0, out=None)</code> ndarray	<code>np.stack(arrays, axis=0, out=None)</code> ndarray
<code>np.dstack(tup)</code> ndarray	<code>np.tile(A, reps)</code> ndarray
<code>np.expand dims(a, axis)</code> ndarray	<code>np.transpose(a, axes=None)</code> ndarray
<code>np.ndarray.flatten([order])</code> ndarray	<code>ndarray.T</code> ndarray
<code>np.hstack(tup)</code> ndarray	<code>np.unravel index(indices, shape, order="C")</code> tup
<code>np.r [...]</code> ndarray	<code>np.vstack(tup)</code> ndarray

```
import numpy as np

np.append()
```

**Out:**

## Matplotlib

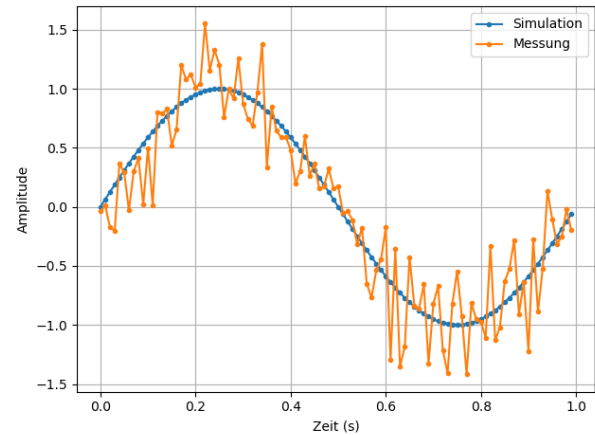
<b>Creation</b>	
<code>plt.figure(num=None, dpi=None, facecolor=None, edgecolor=None, frameon=True, FigureClass=plt.figure.Figure, clear=False, **kwargs)</code>	<code>→ Figure</code>
<code>plt.subplot(*args, **kwargs)</code>	<code>→ AxesSubplot</code>
<code>plt.subplots(nrows=1, ncols=1, *, sharex=False, sharey=False, squeeze=True, subplot_kw=None, gridspec_kw=None, **fig_kw)</code>	<code>Figure, → axes.Axes</code>
<code>plt.twinx(ax=None)</code>	<code>→ AxesSubplot</code>
<code>plt.twiny(ax=None)</code>	<code>→ AxesSubplot</code>
<code>plt.tight_layout(*, pad=1.08, h_pad=None, w_pad=None, rect=None)</code>	
<code>plt.savefig(*args, **kwargs)</code>	
<code>plt.show(*, block=None)</code>	
<b>Drawing</b>	
<code>plt.annotate(text, xy, *args, **kwargs)</code>	<code>→ Annotation</code>
<code>plt.arrow(x, y, dx, dy, **kwargs)</code>	<code>→ FancyArrow</code>
<code>plt.contour(*args, data=None, **kwargs)</code>	<code>→ QuadContourSet</code>
<code>plt.contourf(*args, data=None, **kwargs)</code>	<code>→ QuadContourSet</code>
<code>plt.loglog(*args, **kwargs)</code>	<code>→ list of Line2D objects</code>
<code>plt.plot(*args, scalex=True, scaley=True, data=None, **kwargs)</code>	<code>→ list of Line2D objects</code>
<code>plt.scatter(x, y, s=None, c=None, marker=None, cmap=None, norm=None, vmin=None, vmax=None, alpha=None, linewidths=None, verts=deprecated parameter, edgecolors=None, *, plotnonfinite=False, data=None, **kwargs)</code>	<code>→ PathCollection</code>
<code>plt.semilogx(*args, **kwargs)</code>	<code>→ list of Line2D objects</code>
<code>plt.semilogy(*args, **kwargs)</code>	<code>→ list of Line2D objects</code>
<code>plt.stem(*args, linefmt=None, markerfmt=None, basefmt=None, bottom=0, label=None, use_line_collection=True, data=None)</code>	<code>→ StemContainer</code>
<code>plt.step(x, y, *args, where="pre", data=None, **kwargs)</code>	<code>→ list of Line2D objects</code>
<code>plt.streamplot(x, y, u, v, density=1, linewidth=None, color=None, cmap=None, norm=None, arrowsize=1, arrowstyle="— ", minlength=0.1, transform=None, zorder=None, start_points=None, maxlength=4.0, integration_direction="both", *, data=None)</code>	<code>→ StreamplotSet</code>
<code>plt.text(x, y, s, fontdict=None, **kwargs)</code>	<code>→ Text</code>
<b>Decoration</b>	
<code>plt.axis(*args, emit=True, **kwargs)</code>	<code>→ Annotation</code>
<code>plt.axhline(y=0, xmin=0, xmax=1, **kwargs)</code>	<code>→ Line2D</code>
<code>plt.axvline(x=0, ymin=0, ymax=1, **kwargs)</code>	<code>→ Line2D</code>
<code>plt.colorbar(mappable=None, cax=None, ax=None, **kw)</code>	<code>→ Colorbar</code>
<code>plt.grid(b=None, which="major", axis="both", **kwargs)</code>	
<code>plt.legend(*args, **kwargs)</code>	
<code>plt.margins(*margins, x=None, y=None, tight=True)</code>	<code>→ tuple</code>
<code>plt.suptitle(t, **kwargs)</code>	<code>Text</code>
<code>plt.title(label, fontdict=None, loc=None, pad=None, *, y=None, **kwargs)</code>	<code>→ Text</code>
<code>plt.xlabel(xlabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)</code>	
<code>plt.xlim(*args, **kwargs)</code>	<code>→ tuple</code>
<code>plt.xticks(ticks=None, labels=None, **kwargs)</code>	<code>→ tuple</code>
<code>plt.ylabel(ylabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)</code>	
<code>plt.ylim(*args, **kwargs)</code>	<code>→ tuple</code>
<code>plt.yticks(ticks=None, labels=None, **kwargs)</code>	<code>→ tuple</code>
<b>Decoration OOP</b>	
<code>Axes.set_title(self, label, fontdict=None, loc=None, pad=None, *, y=None, **kwargs)</code>	<code>→ Text</code>
<code>Axes.set_xlabel(self, xlabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)</code>	
<code>Axes.set_xlim(self, left=None, right=None, emit=True, auto=False, *, xmin=None, xmax=None)</code>	<code>→ tuple</code>
<code>Axes.set_xticks(self, ticks, *, minor=False)</code>	<code>→ tuple</code>
<code>Axes.set_ylabel(self, ylabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)</code>	
<code>Axes.set_ylim(self, bottom=None, top=None, emit=True, auto=False, *, ymin=None, ymax=None)</code>	<code>→ tuple</code>
<code>Axes.set_yticks(self, ticks, *, minor=False)</code>	<code>→ tuple</code>

Linestyle	Marker	Color
'-', 'solid'	'o'=point	'v'=triangle_down
':', 'dotted'	's'=square	'p'=pentagon
'--', 'dashed'	'*' =star	'd','D'=diamond
'-.', 'dashdot'	'x','X'=x	'+' , 'P'=plus

### Einfaches Beispiel

```
import numpy as np
import matplotlib.pyplot as plt

# signale definieren
t = np.arange(100)/100
s1 = np.sin(2*np.pi*t)
s2 = s1 + np.random.randn(*s1.shape)/4
# Figure und Axis erstellen
plt.figure()
# Signale plotten
plt.plot(t, s1, '-.', label='Simulation')
plt.plot(t, s2, '-.', label='Messung')
# Achsen beschriften
plt.xlabel('Zeit (s)')
plt.ylabel('Amplitude')
# Hilfslinien aktivieren
plt.grid(True)
# Legende hinzufuegen
plt.legend()
# Weisser Rand minimieren
plt.tight_layout()
# Diagramm abspeichern
plt.savefig('diagramm.svg')
```

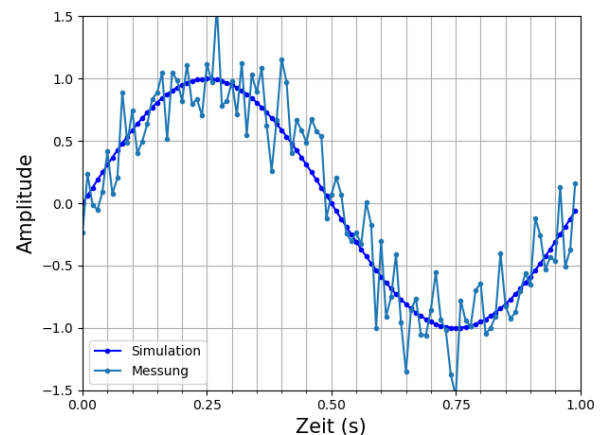


### OOP Beispiel

```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.ticker import (
    MultipleLocator, AutoMinorLocator)

t = np.arange(100)/100
s1 = np.sin(2*np.pi*t)
s2 = s1 + np.random.randn(*s1.shape)/4
# Figure und Axis erstellen
fig, ax = plt.subplots()
# Signale plotten
ax.plot(t, s1, linestyle='-', marker='.',
        color="blue", label='Simulation')
# ax.plot(t, s1, '-.', label='Simulation')
ax.plot(t, s2, '-.', label='Messung')
# Achsen beschriften
ax.set_xlabel('Zeit (s)', fontsize=15)
ax.set_ylabel('Amplitude', fontsize=15)
# Achsen limitieren
ax.set_ylim(-1.5, 1.5)
# ax.set_xticks(np.arange(0, 1.1, step=0.1))
ax.set_xlim(0, 1)

ax.xaxis.set_major_locator(MultipleLocator(
    0.25))
ax.xaxis.set_minor_locator(MultipleLocator(
    0.05))
# Hilfslinien aktivieren
# ax.grid(True)
ax.grid(which="both")
# Legende hinzufuegen
ax.legend(loc="lower left")
# Weisser Rand minimieren
fig.tight_layout()
```





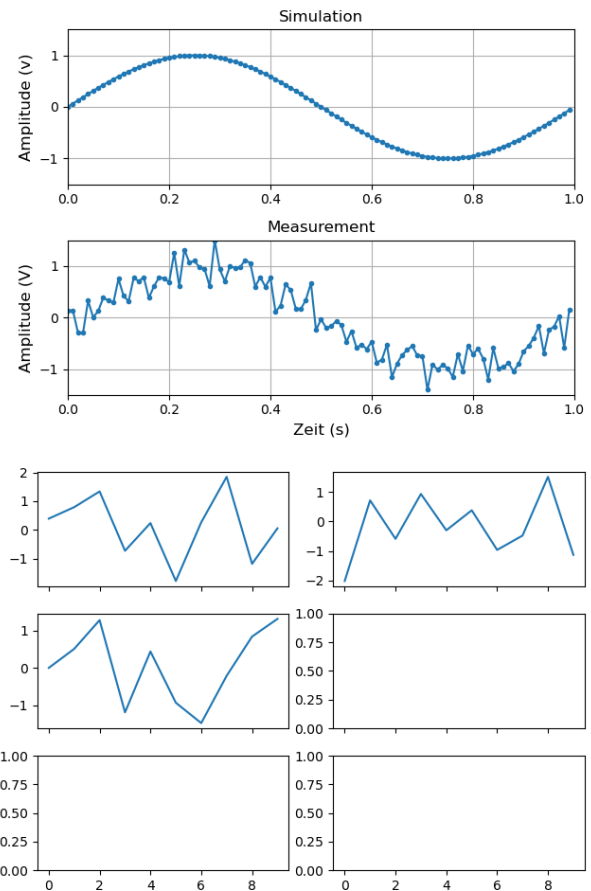
## Subplots

```

import numpy as np
import matplotlib.pyplot as plt

t = np.arange(100)/100
s1 = np.sin(2*np.pi*t)
s2 = s1 + np.random.randn(*s1.shape)/4
# Figure und Axis erstellen
fig = plt.figure()
ax1 = plt.subplot(2, 1, 1)
ax2 = plt.subplot(2, 1, 2, sharex=ax1)
# Signale plotten
ax1.plot(t, s1, '.-', label='Simulation')
ax2.plot(t, s2, '.-', label='Simulation')
# Achsen beschriften
# ax1.set_xlabel('Zeit (s)', fontsize=12)
ax1.set_ylabel('Amplitude (v)', fontsize=12)
ax2.set_xlabel('Zeit (s)', fontsize=12)
ax2.set_ylabel('Amplitude (V)', fontsize=12)
# Achsen limitieren
ax1.set_ylim(-1.5, 1.5)
ax2.set_ylim(-1.5, 1.5)
ax1.set_xlim(0, 1)
# Subplots beschriften
ax1.set_title("Simulation")
ax2.set_title("Measurement")
# Hilfslinien aktivieren
ax1.grid(True)
ax2.grid(True)
# Weisser Rand minimieren
fig.tight_layout()
#####
# Multiple subplots
fig, axes = plt.subplots(3, 2, sharex=True)
axes[0][0].plot(np.random.randn(10))
axes[0][1].plot(np.random.randn(10))
axes[1][0].plot(np.random.randn(10))
fig.tight_layout()

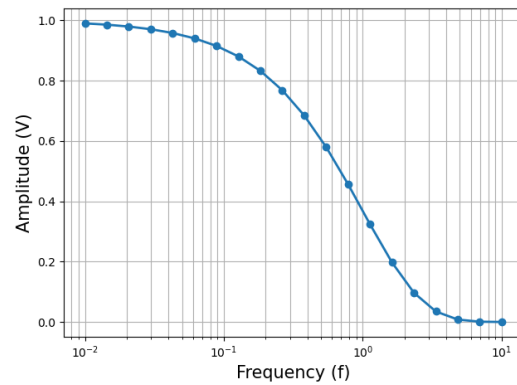
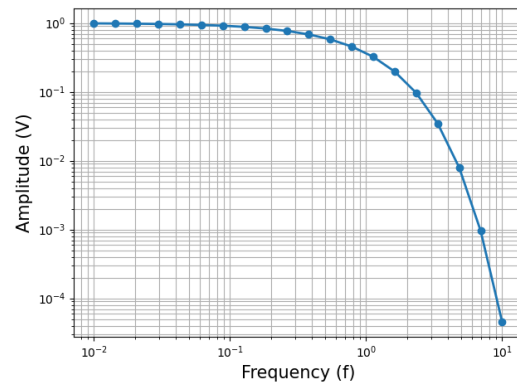
```



## logarithmische Darstellung

```
import numpy as np
import matplotlib.pyplot as plt

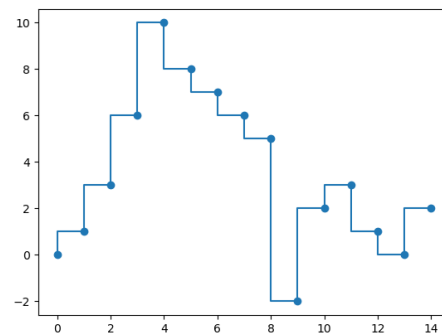
x = np.logspace(-2, 1, 20)
s = np.exp(-x)
# loglog-----
fig, ax = plt.subplots()
ax.loglog(x, s, '-o', linewidth=2)
ax.grid(which='major')
ax.grid(which='minor')
ax.set_xlabel('Frequency (f)', fontsize=15)
ax.set_ylabel('Amplitude (V)', fontsize=15)
fig.tight_layout()
# semilogx-----
fig, ax = plt.subplots()
ax.semilogx(x, s, '-o', linewidth=2)
ax.grid(which='major')
ax.grid(which='minor')
ax.set_xlabel('Frequency (f)', fontsize=15)
ax.set_ylabel('Amplitude (V)', fontsize=15)
fig.tight_layout()
# semilogy-----
```



## step

```
import numpy as np
import matplotlib.pyplot as plt

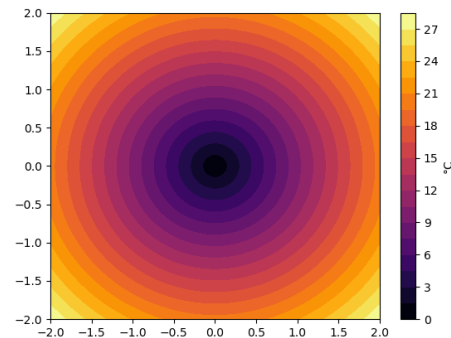
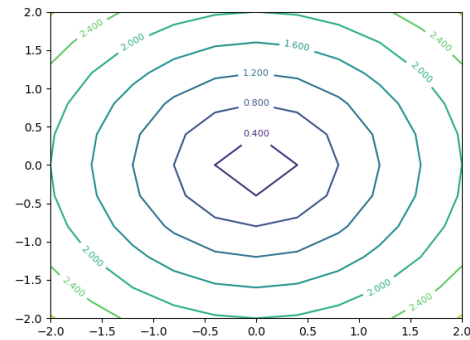
x = np.logspace(-2, 1, 20)
s = np.exp(-x)
fig, ax = plt.subplots()
x = np.arange(15)
y = np.array([0, 1, 3, 6, 10, 8, 7, 6, 5, -2,
              2, 3, 1, 0, 2])
ax.step(x, y, '-o', where='pre');
```



**contour/contourf**

```
import numpy as np
import matplotlib.pyplot as plt
# contour-----
x = y = np.linspace(-2, 2, 11)
X, Y = np.meshgrid(x, y)
Z = np.sqrt(X**2 + Y**2)
fig, ax = plt.subplots()
cont = ax.contour(X, Y, Z);
ax.clabel(cont, inline=True, fontsize=8);
# contourf-----
x = y = np.linspace(-2, 2, 100)
X, Y = np.meshgrid(x, y)
Z = np.sqrt(X**2 + Y**2)*10

fig, ax = plt.subplots()
cont = ax.contourf(X, Y, Z, 20, cmap='inferno');
cbar = fig.colorbar(cont);
cbar.ax.set_ylabel('C');
```

**hist**

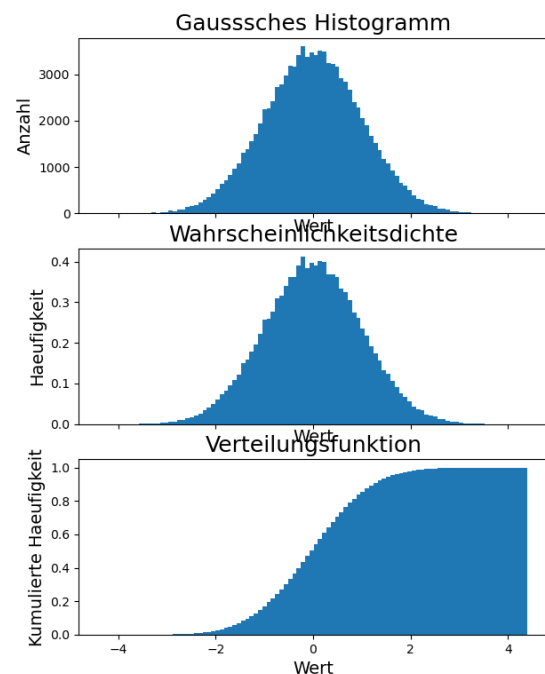
```
import numpy as np
import matplotlib.pyplot as plt

N = 100000
data = np.random.randn(N)

fig, axes = plt.subplots(3, sharex=True)
axes[0].hist(data, bins=100)
axes[0].set_title('Gausssches Histogramm',
    fontsize=18)
axes[0].set_xlabel('Wert', fontsize=14)
axes[0].set_ylabel('Anzahl', fontsize=14);

axes[1].hist(data, bins=100, density = True)
axes[1].set_title('Wahrscheinlichkeitsdichte',
    fontsize=18)
axes[1].set_xlabel('Wert', fontsize=14)
axes[1].set_ylabel('Haeufigkeit', fontsize=14);

axes[2].hist(data, bins=100, density = True,
    cumulative=True)
axes[2].set_title('Verteilungsfunktion',
    fontsize=18)
axes[2].set_xlabel('Wert', fontsize=14)
axes[2].set_ylabel('Kumulierte Haeufigkeit',
    fontsize=14);
```



## scatter

```

import numpy as np
import matplotlib.pyplot as plt

x = [160, 162, 180, 182, 172, 172, 160, 178,
     175, 190, 175, 168, 165]
y = [50, 58, 80, 85, 57, 65, 45, 80, 78, 100,
     60, 55, 55]
# test = np.loadtxt("body_dimensions_data.txt",
#                   usecols=(0))
data = np.loadtxt("body_dimensions_data.txt")
height = data[:, -2]
weight = data[:, -3]
s = data[:, -1]
male = s == 1
female = s == 0

fig, axes = plt.subplots(nrows=2)
scat_male = axes[0].scatter(height[male],
                             weight[male], color='b')
scat_female = axes[0].scatter(height[female],
                               weight[female], color='r')
axes[0].set_xlabel('Groesse (cm)', fontsize=14)
axes[0].set_ylabel('Gewicht (kg)', fontsize=14)
axes[0].legend((scat_male, scat_female), ('Male', 'Female'),
               fontsize=8)
# other example of scatter-----
from sklearn.datasets import load_iris
iris = load_iris()
features = iris.data.T
scat = axes[1].scatter(features[0], features[1],
                       alpha=0.2, s=100*features[3],
                       c=iris.target, cmap='viridis')
axes[1].set_xlabel(iris.feature_names[0],
                   fontsize='16')
axes[1].set_ylabel(iris.feature_names[1],
                   fontsize='16')
axes[1].legend(handles=scat.legend_elements()[0],
               labels=list(iris.target_names),
               loc='upper left')

```

