Generell

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

Datentypen

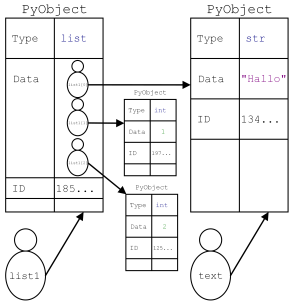
Datentyp	Beschreibung	False-Wert
NoneType	Indikator für nichts	None
Numerische Datentypen		
int	Ganze Zahlen	0
float	Gleitkommazahlen	0.0
bool	Boolesche Werte	False
complex	Komplexe Zahlen	0 + 0j
Sequenzielle Datentypen		
str	Zeichenketten oder Strings(unveränderlich)	' '
list	Listen(veränderlich)	[]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

Operatoren

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

Variablen

```
list1 = [text, 1, 2]
```



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='seperator'	Separierung der Objekte	' '
end='end'	Letztes Zeichen des print-Befehl	'\n'
file	Objekt mit einer Write-Methode	sys.stdout
flush	Boolscher 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]

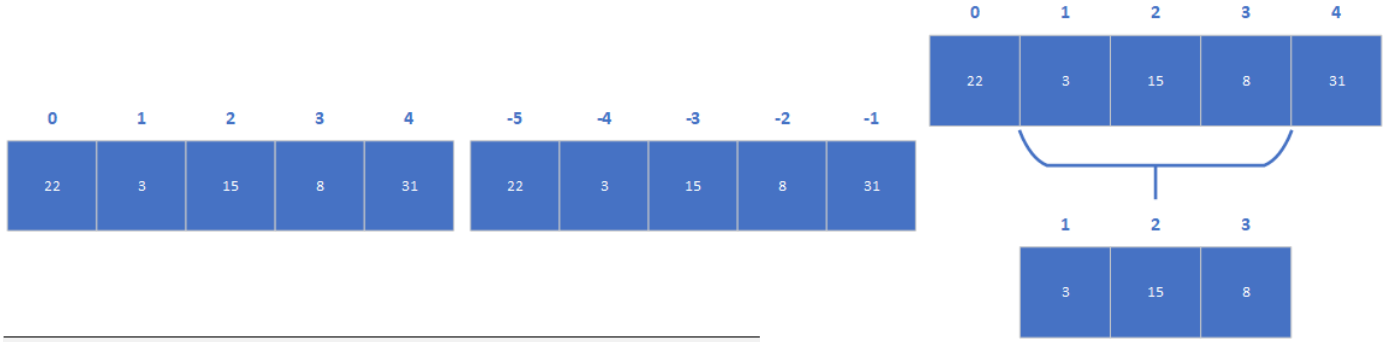
Hinzufügen/Entfernen von Elementen

```
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] 'inklusiv' 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)

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

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.kyes() → 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

```
string1 = "python"
string2 = """Mehrzeiliger
String"""
t = string1[2]
t = string1[-4]
```

```
# F-String example
fruit = 'apple'
color = 'red'
print(f'The fruit {fruit} has
    the color {color}')
```

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)
```

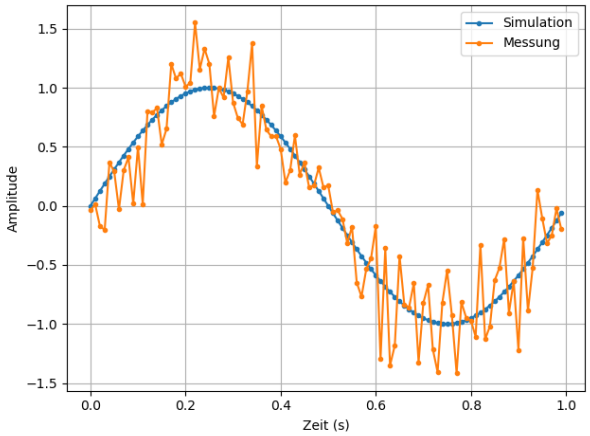
Matplotlib

Creation
plt.figure(num=None, dpi=None, facecolor=None, edgecolor=Nonem frameon=True, FigureClass=¡class ”matplotlib.figure.Figure», clear=False, **kwargs) → Figure)
plt.subplot(*args, **kwargs) → AxesSubplot
plt.subplots(nrows=1, ncols=1, *, sharex=False, sharey=False, squeeze=True, subplot kw=None, gridspec kw=None, **fig kw) Figure, → axes.Axes
plt.twinx(ax=None) → AxesSubplot
plt.twiny(ax=None) → AxesSubplot
plt.tight layout(*, pad=1.08, h pad=None, w pad=None, rect=None)
plt.savefig(*args, **kwargs)
plt.show(*, block=None)
Drawing
plt.annotate(text, xy, *args, **kwargs) → Annotation
plt.arrow(x, y, dx, dy, **kwargs) → FancyArrow
plt.contour(*args, data=None, **kwargs) → QuadContourSet
plt.contourf(*args, data=None, **kwargs) → QuadContourSet
plt.loglog(*args, **kwargs) → list of Line2D objects
plt.plot(*args, scalex=True, scaley=True, data=None, **kwargs) → list of Line2D objects
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) → PathCollection
plt.semilogx(*args, **kwargs) → list of Line2D objects
plt.semilogy(*args, **kwargs) → list of Line2D objects
plt.stem(*args, linefmt=None, markerfmt=None, basefmt=None, bottom=0, label=None, use line collection=True, data=None) → StemContainer
plt.step(x, y, *args, where=”pre”, data=None, **kwargs) → list of Line2D objects
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) → StreamplotSet
plt.text(x, y, s, fontdict=None, **kwargs) → Text
Decoration
plt.axis(*args, emit=True, **kwargs) → Annotation
plt.axhline(y=0, xmin=0, xmax=1, **kwargs) → Line2D
plt.axvline(x=0, ymin=0, ymax=1, **kwargs) → Line2D
plt.colorbar(mappable=None, cax=None, ax=None, **kw) → Colorbar
plt.grid(b=None, which=”major”, axis=”both”, **kwargs)
plt.legend(*args, **kwargs)
plt.margins(*margins, x=None, y=None, tight=True) → tuple
plt.suptitle(t, **kwargs) Text
plt.title(label, fontdict=None, loc=None, pad=None, *, y=None, **kwargs) → Text
plt.xlabel(xlabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)
plt.xlim(*args, **kwargs) → tuple
plt.xticks(ticks=None, labels=None, **kwargs) → tuple
plt.ylabel(ylabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)
plt.ylim(*args, **kwargs) → tuple
plt.yticks(ticks=None, labels=None, **kwargs) → tuple
Decoration OOP
Axes.set title(self, label, fontdict=None, loc=None, pad=None, *, y=None, **kwargs) → Text
Axes.set xlabel(self, xlabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)
Axes.set xlim(self, left=None, right=None, emit=True, auto=False, *, xmin=None, xmax=None) → tuple
Axes.set xticks(self, ticks, *, minor=False) → tuple
Axes.set ylabel(self, ylabel, fontdict=None, labelpad=None, *, loc=None, **kwargs)
Axes.set ylim(self, bottom=None, top=None, emit=True, auto=False, *, ymin=None, ymax=None) → tuple
Axes.set yticks(self, ticks, *, minor=False) → tuple

Linestyle	**Marker**			**Color**		
’-’, ’solid’	’.’=point	’o’=circle	’v’=triangle_down	’b’,’blue’	’g’,’green’	’r’,’red’
’:’, ’dotted’	’s’=square	’p’=pentagon	’¿’=triangle_right	’c’,’cyan’	’m’,’magenta’	’k’,’black’
’–’, ’dashed’	’*’=star	’d’,’D’=diamond	’ˆ’=triangle_up	’w’,’white’	’y’,’yellow’	’#0F0F0F’
’-.’, ’dashdot’	’x’,’X’=×	’+’,’P’=plus	’¡’=triangle_left	(0.0, 0.5, 1.0)		

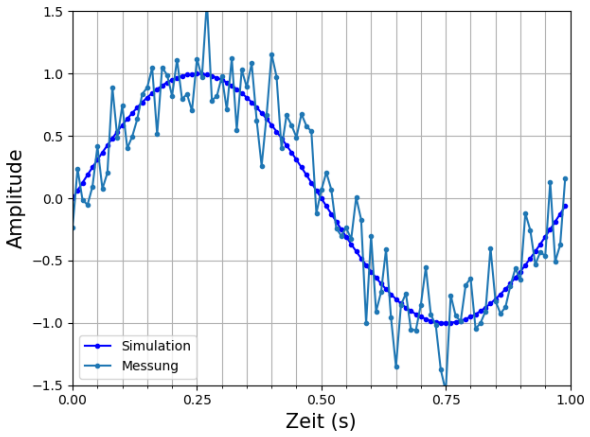
Einfaches Beispiel

```
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')
```



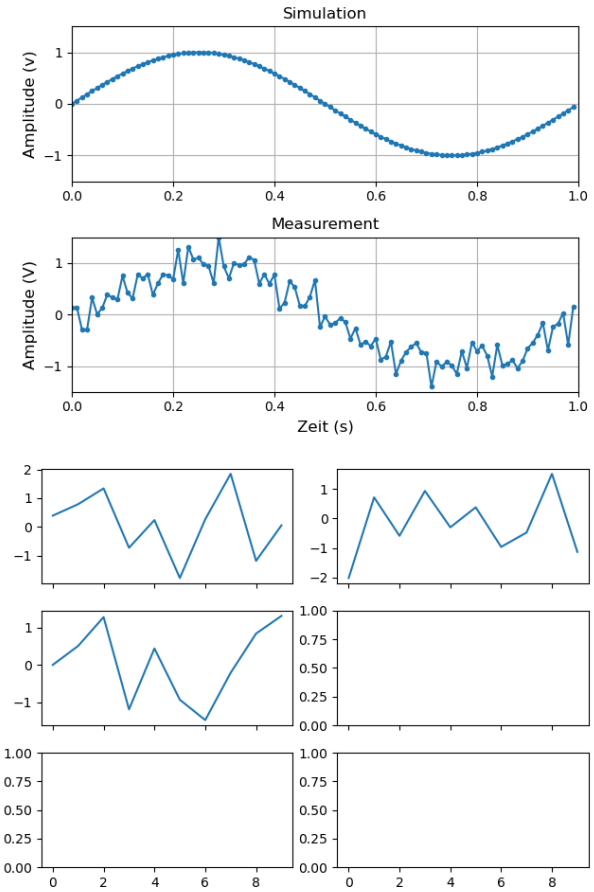
OOP Beispiel

```
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()
```



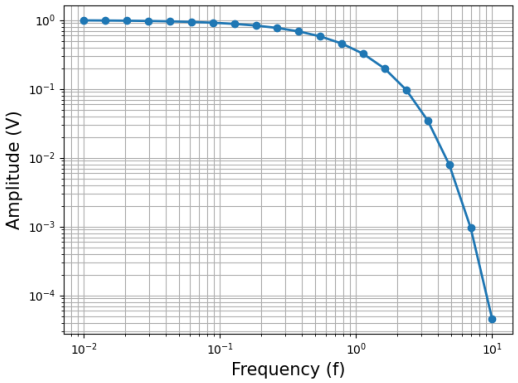
Subplots

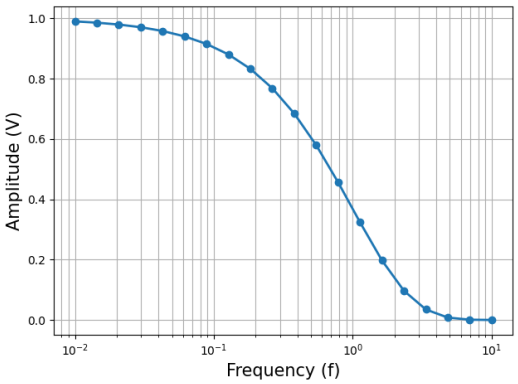
```
import numpy as np
import matplotlib.pyplot as plt

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

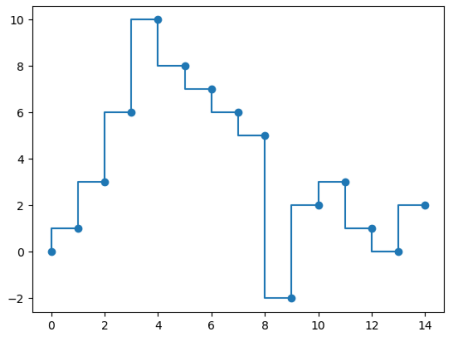
```
import numpy as np
import matplotlib.pyplot as plt

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--------------------------------
```





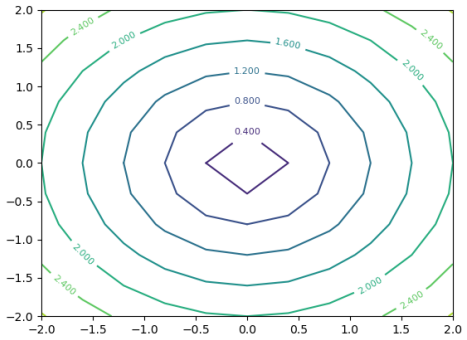
step

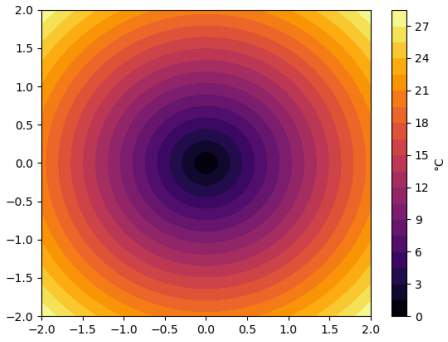
```
import numpy as np
import matplotlib.pyplot as plt

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

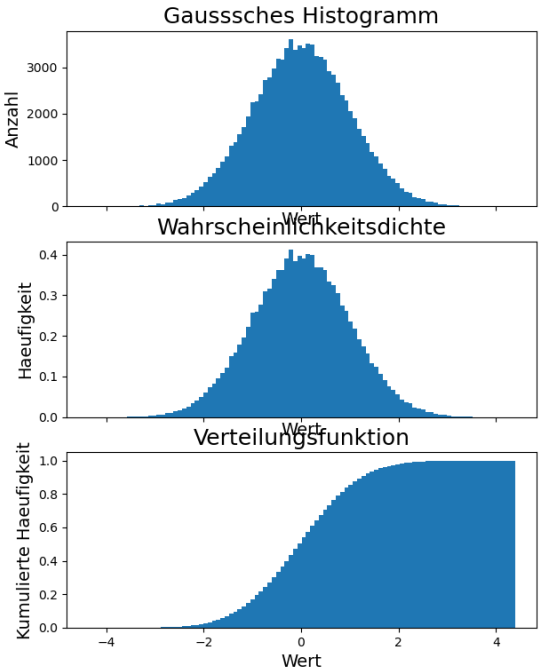
```
import numpy as np
import matplotlib.pyplot as plt
# contour------------------------------
x = y = np.linspace(-2, 2, 11)
X, Y = np.meshgrid(x, y)
Z = np.sqrt(X**2 + Y**2)
fig, ax = plt.subplots()
cont = ax.contour(X, Y, Z);
ax.clabel(cont, inline=True, fontsize=8);
# contourf-----------------------------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