

# RASPBERRY PI - EINSATZMÖGLICHKEITEN EINES LOW BUDGET COMPUTERS

WISSENSCHAFTLICHES RECHNEN

RASPBERRY PI ALS WEB SERVER UND ACCESS POINT

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# ÜBERSICHT

- Wissenschaftliches Rechnen
  - mit Mathematica
  - mit Python und SciPy
- Raspberry Pi als Webserver und Access Point

# MATHEMATICA

# INSTALLATION (CA. 1GB DOWNLOAD)

- Raspberry Pi mit dem Internet verbinden
- Terminalfenster / Shell öffnen
- Folgenden Befehle ausführen

```
$ sudo apt-get update  
$ sudo apt-get install wolfram-engine  
  
# braucht ca. 20 - 30 Minuten
```

ODER KLONEN VORINSTALLIERTER PROGRAMME  
MATHEMATICA / SCIENTIFIC PYTHON / WEB SERVER /  
ACCESS-POINT

# MATHEMATICA IN KOMMANDEZEILE (TEXT-BASED INTERFACE)

```
$ wolfram
```

```
In[1]:= Solve[4x+x^3 == 0,x]
```

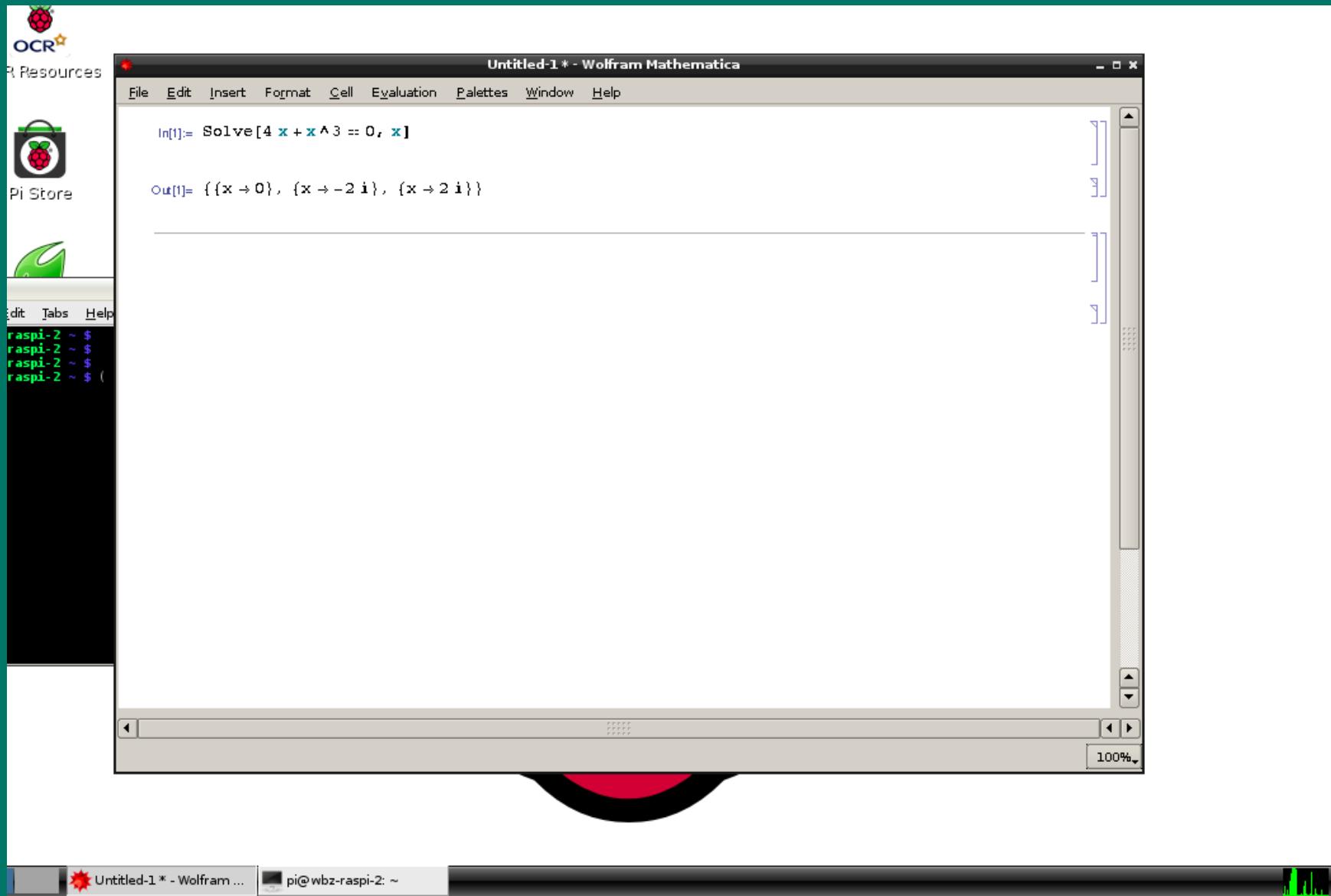
```
Out[1]= {{x -> 0}, {x -> -2 I}, {x -> 2 I}}
```

```
In[2]:= HilbertMatrix[4] // MatrixForm
```

```
Out[2]//MatrixForm=
```

	1	1	1
	-	-	-
1	2	3	4
1	1	1	1
-	-	-	-
2	3	4	5
1	1	1	1
-	-	-	-
3	4	5	6
1	1	1	1

# MATHEMATICA MIT GRAPHISCHER OBERFLÄCHE



# BEISPIEL: ERZEUGEN EINER LISTE GANZER ZAHLEN UND FILTERN VON PRIMZAHLEN

```
In[12]:= Range[1000000,1000050]
```

```
Out[12]= {1000000, 1000001, 1000002, 1000003, 1000004, 1000005,  
> 1000007, 1000008, 1000009, 1000010, 1000011, 1000012, 1000013,  
> 1000015, 1000016, 1000017, 1000018, 1000019, 1000020, 1000021,  
> 1000023, 1000024, 1000025, 1000026, 1000027, 1000028, 1000029,  
> 1000031, 1000032, 1000033, 1000034, 1000035, 1000036, 1000037,  
> 1000039, 1000040, 1000041, 1000042, 1000043, 1000044, 1000045,  
> 1000047, 1000048, 1000049, 1000050}
```

```
In[13]:= Select[% ,PrimeQ]
```

```
Out[13]= {1000003, 1000033, 1000037, 1000039}
```

# FUNKTIONALE PROGRAMMIERUNG

- Mathematica unterstützt funktionale Programmierung und ist dynamisch typisiert.
- In Mathematica gibt es nur Funktionen und fest verbaute Symbole, z. B. das Zeichen  $\infty$  für unendlich.
- Als weitere Abgrenzung zu anderen Sprachen ist eine nicht auswertbare Zeile in Mathematica kein Fehler, sondern eine Rückgabe.
- Version 10 seit 9. Juli 2014

# DEFINIEREN VON MATHEMATISCHEMEN FUNKTIONEN

$$f1(x) \mapsto x^2 + 1$$

```
In[6]:= f1[x_] := x^2+1
```

```
In[7]:= f1[3]
```

```
Out[7]= 10
```

```
In[9]:= f1[t^2]
```

```
4
```

```
Out[9]= 1 + t
```

# VEKTOREN UND MATRIZEN WERDEN ALS LISTEN REPRÄSENTIERT

Definition einer Liste

```
In[12]:= l1 = {1,5,9,2,5,2,1}
```

Vektor definieren und normieren

```
In[14]:= v = {1,1,1}
Out[14]= {1, 1, 1}
In[15]:= Normalize[v]
          1          1          1
Out[15]= {-----, -----, -----}
          Sqrt[3]   Sqrt[3]   Sqrt[3]
```

# FUNKTIONALES DENKEN

WANDELN SIE SICH AUF

# ANWENDEN

## MAP[]

**Map**[function , List]

**Out:** {f(e1),f(e2),...,f(en)}

## BEISPIEL

**In[6]:=** f1[x\_] := x^2+1

...

**In[10]:=** Map [f1,{1,2,3,4,5}]

**Out[10]=** {2, 5, 10, 17, 26}

# ITERATION

Sei eine Funktion von  $x$ , der Befehl  $\text{Nest}[f,x,5]$  wendet die Funktion 5x an.

```
In[23]:= Nest[f,x,5]
Out[23]= f[f[f[f[f[x]]]]]
```

## ITERATION ZUR APPROXIMATION VON WURZEL 2 (NEWTONVERFAHREN)

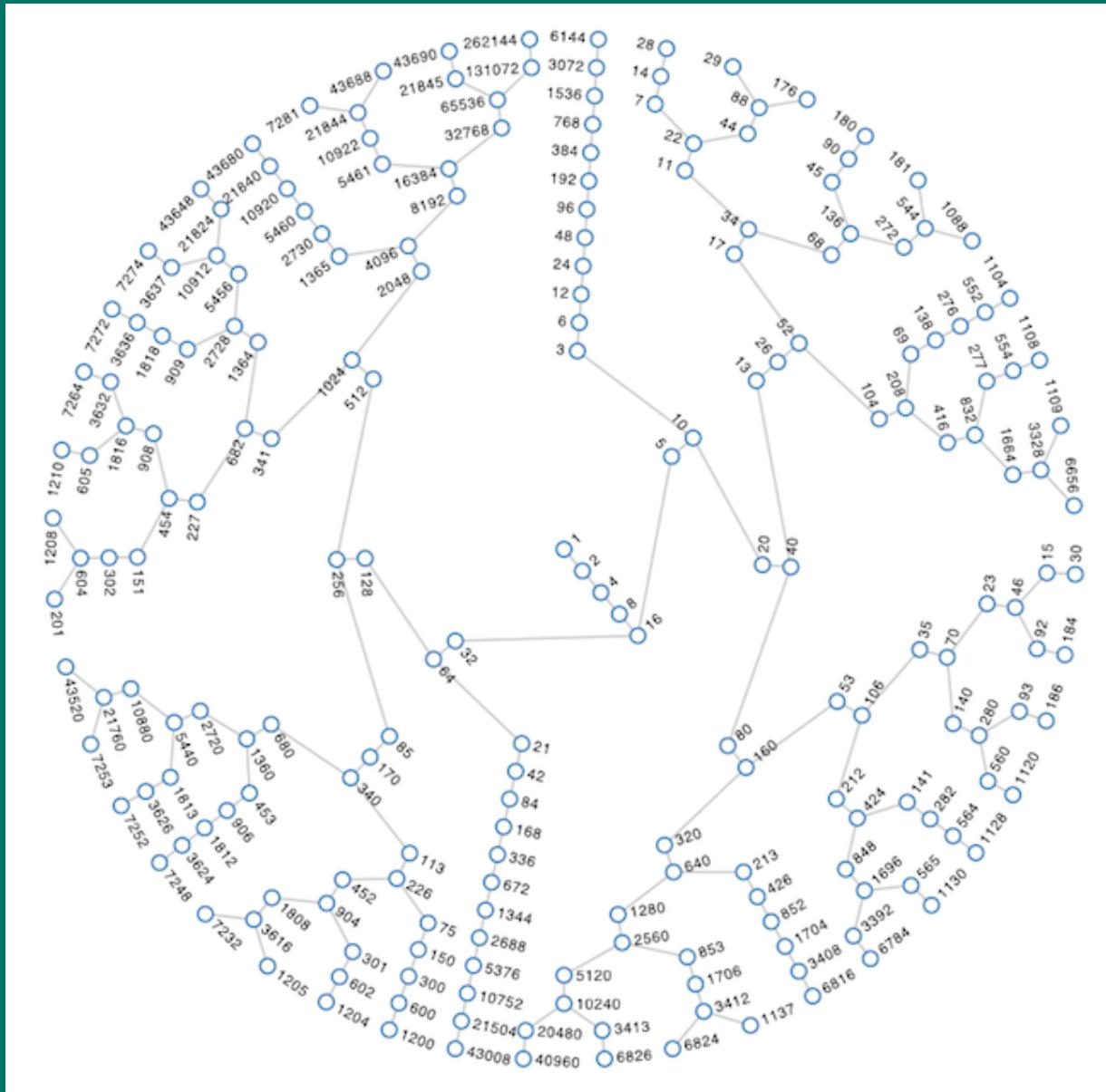
```
In[10]:= fwurzel[x_]:= 1/2(x+2/x)
In[11]:= f8It[x_]:=Nest[fwurzel,x,8]
In[12]:= f8It[0.3]
Out[12]= 1.41421
In[25]:= N[Sqrt[2],10]
Out[25]= 1.414213562
```

# COLLATZ FUNKTION

$$T : \mathbb{N} \rightarrow \mathbb{N}$$

$$T(x) = \begin{cases} 3x + 1, & \text{für } n \text{ ungerade} \\ \frac{x}{2}, & \text{für } n \text{ gerade} \end{cases}$$

# DARSTELLUNG VON COLLATZ FOLGEN



Mathematics is not yet ready for such problems Paul Erdős

P. Erdős bezieht sich auf das Collatz Problem

# ZITAT PAUL ERDŐS

4

Edward G. Belaga and Maurice Mignotte

$$T = T_d : \mathbb{N} \longrightarrow \mathbb{N}; \quad T = T_d(n) = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even;} \\ \frac{3n+d}{2} & \text{if } n \text{ is odd.} \end{cases} \quad (6)$$

In the above notations (1),  $T = T_1$  and  $T_d = T_{M_2, R_2}$  (5), with  $M_2 = \{1, 3\}, R_2 = \{0, -d\}$ . This makes clear how far “below” we are with the  $(3m+d)$ –extension of the Collatz map from the complexity of the general Conway case and its universal unsolvability. It does not preclude, of course, the possibility that the  $(3m+d)$ –problem and even the original Collatz problem might be still unsolvable for less universal reasons.

Incidentally, the question of what is the minimal  $p > 2$  which guarantees the existence of universal computational devices  $T_{M_p, R_p}$  (cf. [121]) remains an open problem – the first one from a series of open problems which relate the arithmetic properties of the definition of a Conway map to the unsolvability of corresponding halting conditions to the pseudo-randomness of the behaviour of trajectories of the corresponding discrete dynamical system (cf. Problems and Observations (1) below).

### 3 The Unsolvability Option and Its Far-Reaching Formal and Heuristic Ramifications

One usually quotes (with the first reference apparently traced to [104]) the well-known, startling remark of the late Paul Erdős concerning the Collatz problem, “*Mathematics is not yet ready for such problems,*” to certificate its exceptional difficulty. But it could be also perceived as a hint at an exceptionally rich mathematical “harvest” which we might expect from the sustained efforts to solve this problem.

This is the point of the following informal theses inspired by a certain vision, as if from an outer space, of the Diophantine equations theory, this mountainous “landscape”, with its lovely oases, its deserts, its “Himalayas” challenging skills and perseverance of “Diophantine climbers”, and its forbidding, impenetrable “peaks”, unsolvable Diophantine equations. We hope that the theoretical and experimental results presented in the following sections will well illustrate the suggestive power of these informal insight.

**Thesis 1. Out of the Diophantine Equations Wilderness, with a Lesson:** The presence of unsolvability phenomena in a formally complete mathematical framework brings with it the emergence of a great many isolated and, at first glance, mutually unrelated “mountainous islands”, i.e., beautiful, deep, rich in consequences, and difficult “local”, i.e., problem-oriented theories, with extremely complicated, lengthy proofs, often preceded and accompanied by intricate, bulky computations, of the most important

# DEFINITION UND BERECHNUNG DER COLLATZ FOLGE MIT MATHEMATICA

```
In[26]:= Collatz[n_] := If[n==1,1,If[EvenQ[n], n/2, 3n + 1]]
```

```
In[29]:= Collatz50[n_] :=NestList[Collatz,n,50]
```

```
In[30]:= Collatz50[123]
```

```
Out[30]= {123, 370, 185, 556, 278, 139, 418, 209, 628, 314, 157,  
> 472, 236, 118, 59, 178, 89, 268, 134, 67, 202, 101, 304, 15  
> 76, 38, 19, 58, 29, 88, 44, 22, 11, 34, 17, 52, 26, 13, 40,  
> 20, 10, 5, 16, 8, 4, 2, 1, 1, 1, 1, 1}
```

# LISTEN VON ZAHLEN

```
(* Ungerade Quadratzahlen *)
```

```
In[73]:= Table[i^2, {i, 1, 20, 2}]
```

```
Out[73]= {1, 9, 25, 49, 81, 121, 169, 225, 289, 361}
```

```
(* Zufallszahlen *)
```

```
In[76]:= Table[Random[Integer, {1, 10}], {i, 1, 16}]
```

```
Out[76]= {1, 5, 4, 7, 9, 10, 9, 10, 5, 5, 8, 6, 8, 4, 9, 10}
```

```
(* Sortierte Listen *)
```

```
In[88]:= Sort[Table[Random[Integer, {1, 40}], {i, 1, 10}]]
```

```
Out[88]= {13, 14, 15, 15, 18, 19, 19, 20, 26, 34}
```

# SUBSTITUTION

Eine Variable in einem Ausdruck kann durch einen Wert oder eine neue Variable ersetzt werden.

```
In[31]:= x + x^3 /. x -> 2
```

```
Out[31]= 10
```

```
In[35]:= fwurzel[x_]:= 1/2(x+2/x)
```

```
In[36]:= Nest[fwurzel,x,5] /. x -> 0.3
```

```
Out[36]= 1.41422
```

# SUBSTITUTION NUTZEN UM LÖSUNGEN ZU ÜBERPRÜFEN

```
In[37]:= loesungen = Solve[4x+x^3==0,x]  
  
Out[37]= {{x -> 0}, {x -> -2 I}, {x -> 2 I}}  
  
In[38]:= 4x+x^3 /. loesungen  
  
Out[38]= {0, 0, 0}
```

# RECHNEN MIT MATRIZEN

```
In[39]:= DiagonalMatrix[{1,2,3,4}] // MatrixForm
Out[39]//MatrixForm= 1   0   0   0
                      0   2   0   0
                      0   0   3   0
                      0   0   0   4
```

```
In[40]:= M1 = {{1,2,3,4},{5,6,7,8},{9,10,11,12},{13,14,15,16}}
In[41]:= M1 // MatrixForm
Out[41]//MatrixForm= 1   2   3   4
                      5   6   7   8
                      9   10  11  12
                     13  14  15  16
```

# BESTIMMEN SIE DIE DETERMINANTE VON

$$A = \begin{pmatrix} 4 & 1 \\ -6 & -\frac{3}{2} \end{pmatrix} \quad \text{und} \quad B = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 0 & -1 \\ 0 & -4 & -7 \end{pmatrix}$$

```
In[48]:= A = {{4,1}, {-6,-3/2}}
```

```
In[49]:= Det[A]
```

```
Out[49]= 0
```

```
In[51]:= B = {{1,2,3}, {1,0,-1}, {0,-4,-7}}
```

```
In[56]:= Det[B]
```

```
Out[56]= -2
```

# LÖSEN SIE DAS LINEARE GLEICHUNGSSYSTEM

$$x + 2y + 4z = 8$$

$$5x + 7y + 15z = 12$$

$$2x + 3y + 7z = 10$$

```
In[59]:= A = {{1,2,4},{5,7,15},{2,3,7}}
```

```
In[65]:= B = {8,12,10}
```

```
In[68]:= x = Inverse[A].B
```

```
Out[68]= {-14, 1, 5}
```

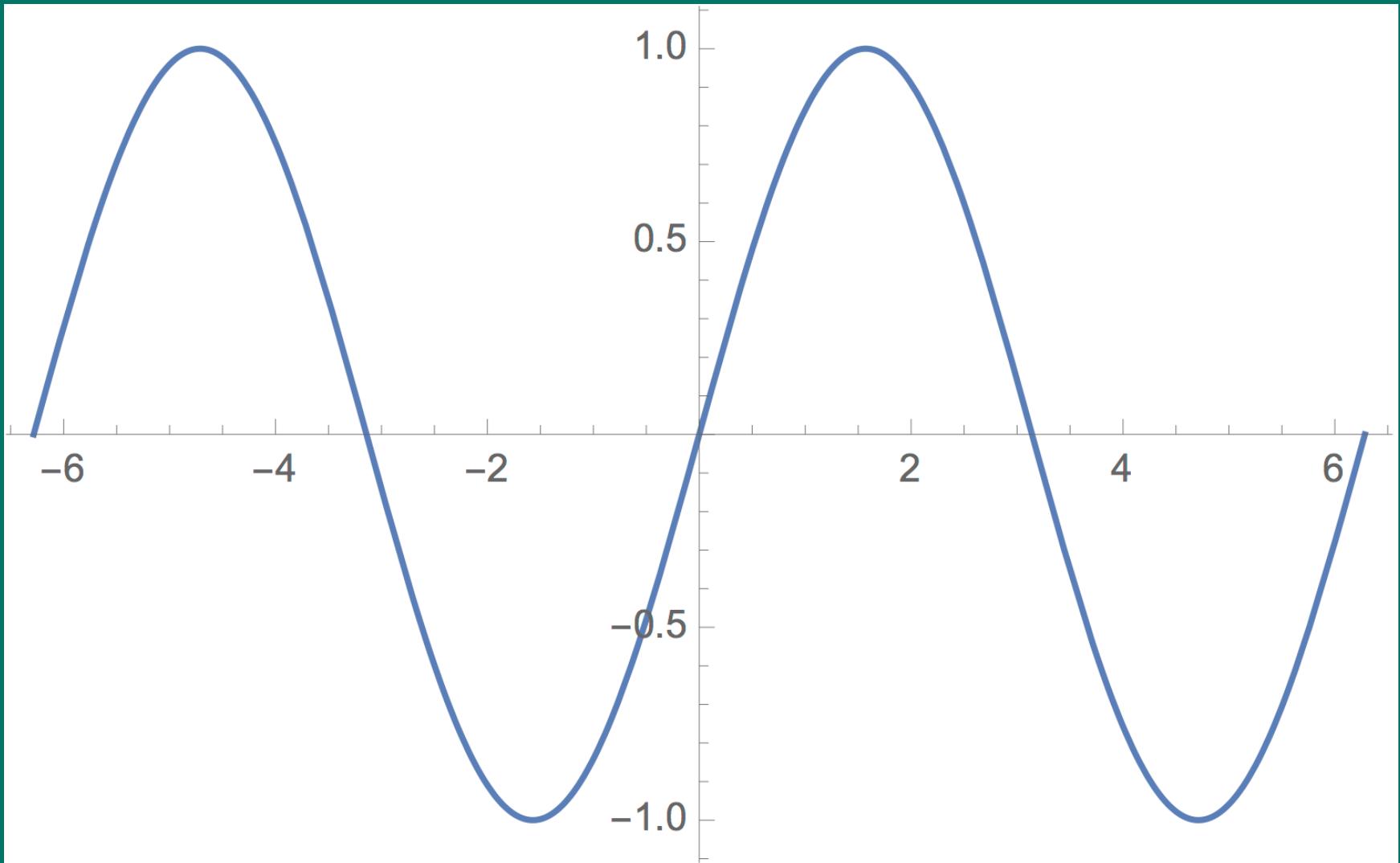
$$x = A^{-1}B$$

mit

$$A = \begin{pmatrix} 1 & 2 & 4 \\ 5 & 7 & 15 \\ 2 & 3 & 7 \end{pmatrix} \quad B = \begin{pmatrix} 8 \\ 12 \\ 10 \end{pmatrix}$$

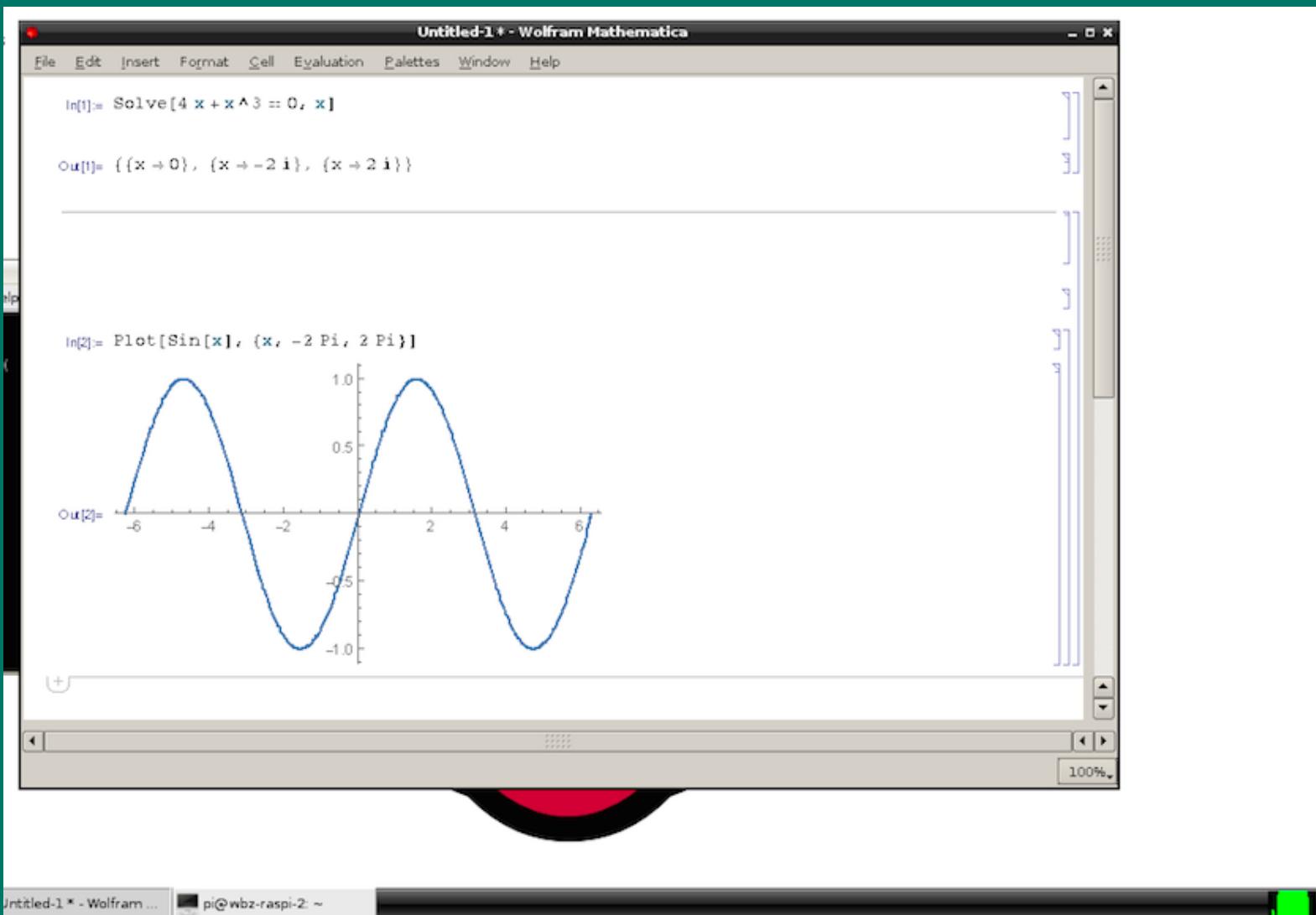
# VISUALISIEREN

```
Plot[Sin[x], {x, -2*Pi, 2*Pi}]
```



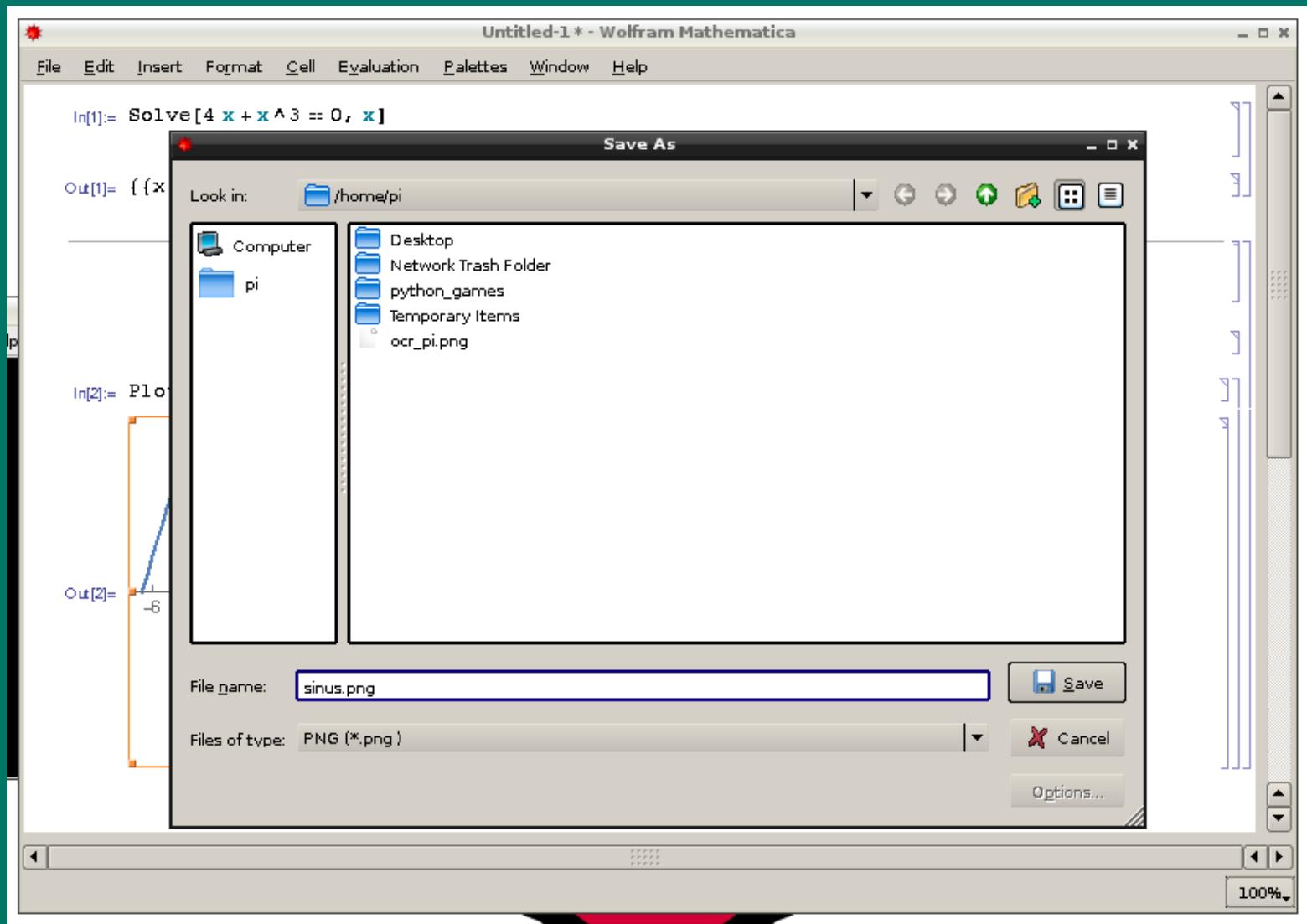
# MATHEMATICA AUF DEM RASPBERRY PI

## BRAUCHT ETWAS GEDULD

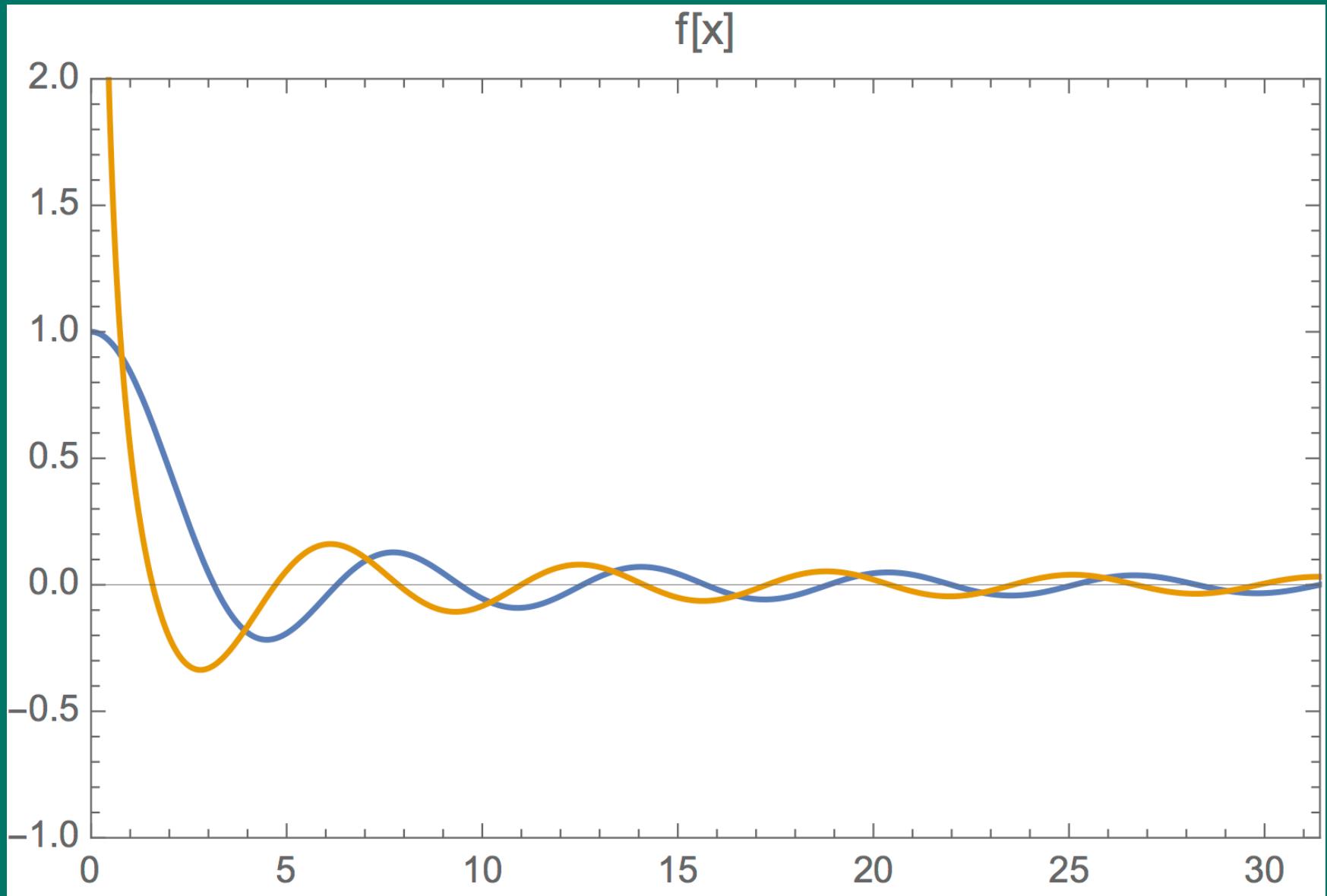


# SPEICHERN MIT KONTEXTMENÜ

- Rechte Maustaste (Save Graphic as)

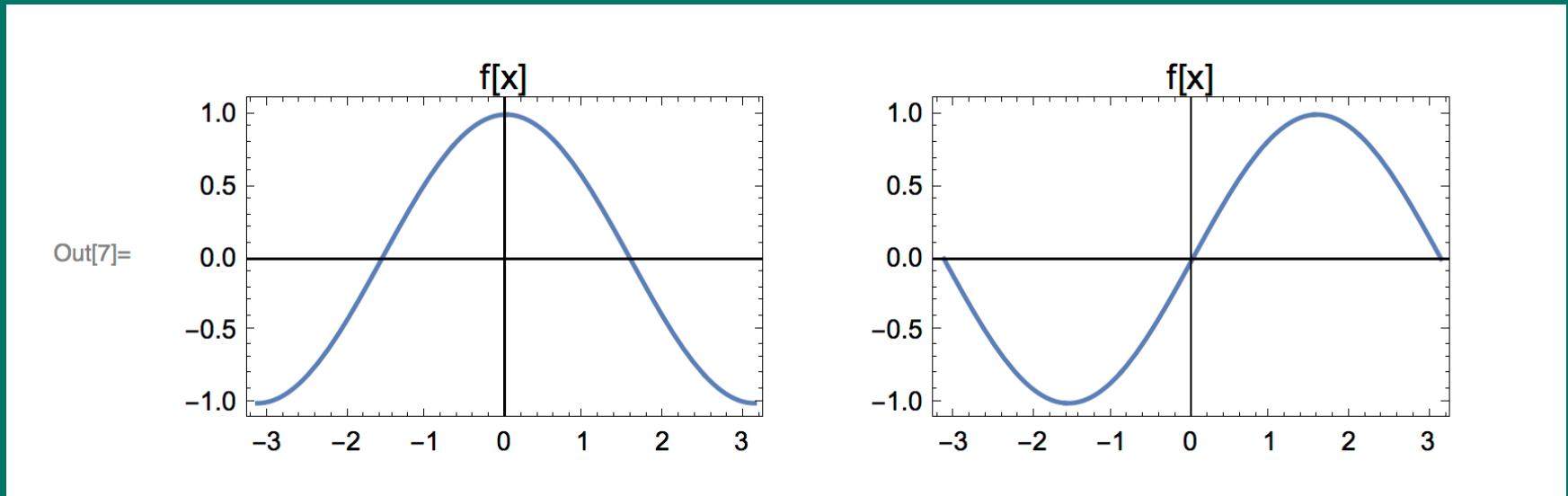


```
Plot[{Sin[x]/x, Cos[x]/x}, {x, 0, 10*Pi},  
PlotRange -> {{0, 10*Pi}, {-1, 2}}]
```



# VIELE DARSTELLUNGSMÖGLICHKEITEN

```
GraphicsGrid[{{Plot[Cos[x], {x, -Pi, Pi}],  
 Plot[Sin[x], {x, -Pi, Pi}]}]]
```

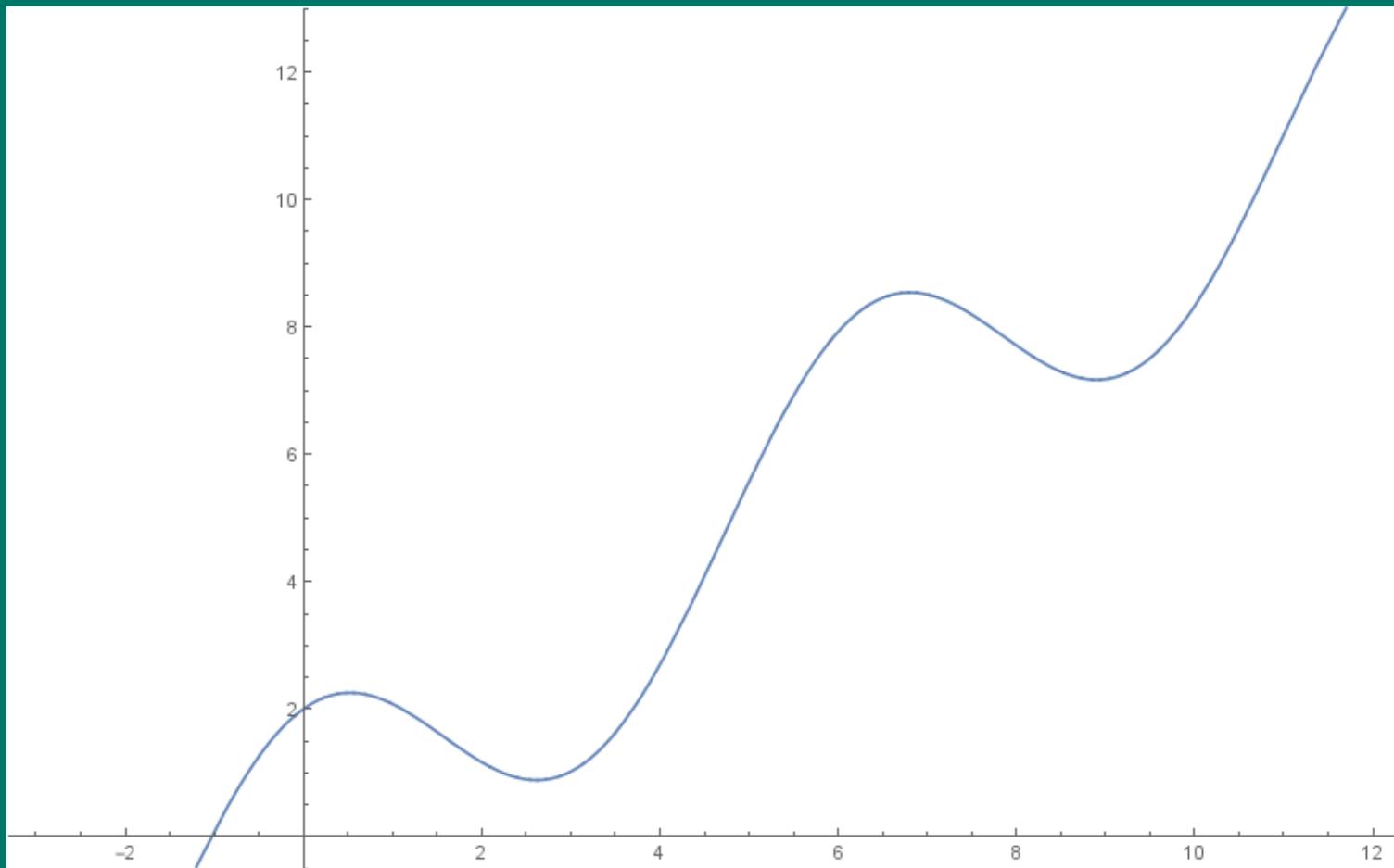


# PLOT

$$f(x) \mapsto x + 2 \cdot \cos(x)$$

```
f[x_] := x + 2 * Cos[x];
Export["nichtlinfig.png",
Plot[f[x], {x, 0, 5 Pi},
 PlotRange -> {{0, 5 Pi}; {-0.5, 17}},
 ImageSize -> 800]]
```

$$f(x) \mapsto x + 2 \cdot \cos(x)$$

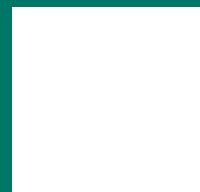


# ANIMATION

```
f[x_, t_] := Sin[x + t] + Sin[x - 2*t];
Animate[
 Plot[x*Sin[x*t], {x, -2*Pi, 0},
 PlotRange -> {-7, 7}], {t, 0.2, 6.5}]
```

# ANIMATED GIFS

```
Export[ "disks.gif",
  Table[ Graphics[ Disk[ {0.1, 0}, Sin[t]], ImageSize -> Tiny,
    PlotRange -> 1.2], {t, 0, Pi, 0.2} ]]
```



# ANIMATED GIFS

## (LANGE RECHENZEIT MIT GROSSEN PLOTS)

```
f[x_, t_] := Sin[x*t];
Export["welle.gif",
Table[Plot[f[x, t], {x, 0, 5 Pi},
PlotRange -> {{0, 5 Pi}; {-1, 1}}], {t, 0.1, Pi, 0.02}]]
```

## und weitere Beispiele...

```
Solve[11*x^3-9*x+17==0,x]
```

```
Expand[(y+1)^10]
```

```
Plot[{4*Sin[2*x],Cos[2*x]^2},{x,0,2*Pi}]
```

```
Plot3D[Cos[x^2+y^2],{x,0,Pi},{y,0,Pi}]
```

```
Sum[1/n^2,{n,1,Infinity}]
```

```
Floor[\[Pi]^E/3]
```

```
Fibonacci[47]
```

WISSENSCHAFTLICHES RECHNEN MIT

PYTHON

&

SCIPY

# TUTORIALS + QUELLEN

- Wolfram Mathematical Tutorial Collection  
(Tutorials, wissenschaftliches Rechnen, Fr. 0.-)
- Mathematica® in Action: Problem Solving Through Visualization and Computation  
(Buch, wissenschaftliches Rechnen, ca. Fr. 60.- )
- A Primer on Scientific Programming with Python  
(Buch, wissenschaftliches Rechnen, ca. Fr. 100.-)
- Skript: Wissenschaftliches Rechnen mit Python  
(Skript, wissenschaftliches Rechnen, Fr. 0.-)

# TUTORIALS + QUELLEN

- Programmierkonzepte mit Python und der Lernumgebung TigerJython  
(Online Buch, Einstieg in die Programmierung mit Python, Fr. 0.-)
- Programmieren lernen  
(Online Skript, Einstieg in die Programmierung mit Python, Fr. 0.-)
- Programmieren lernen Aufgaben für den Informatikunterricht  
(Online Aufgabensammlung und Lösungen unter anderem auch zu Python, Fr. 0.-)

# PYTHON AUS DER KOMMANDOZEILE

- Terminalfenster öffnen
- Befehl ausführen

```
$ python  
->>> print "hello World"
```

# MIT KOMPLEXE ZAHLEN DIREKT RECHNEN

```
>>> from math import *
>>> w = sqrt(2)
>>> w
1.4142135623730951

>>> (1.0/w+1.0/w*1j)**6
(-0-0.9999999999999993j)

>>> (1/w+1/w*1j)**24
(0.9999999999999973+0j)
```

# SCIPY

## SCIENTIFIC TOOLBOX FOR PYTHON

# INSTALLATION

```
$ sudo apt-get install python-smbus ipython bluetooth \
bluez-utils python-cwiid python-scipy python-numpy \
python-pygame python-setuptools libsdl-dev
```

ODER KLONEN VORINSTALLIERTER PROGRAMME  
MATHEMATICA / SCIENTIFIC PYTHON / WEB SERVER /  
ACCESS-POINT

# SCIPY

- ist eine wissenschaftlicher Werkzeugkasten für Mathematik und Naturwissenschaften.
- nutzt Arrays von NumPy
- ist open-source
- ist auch der Name einer Konferenz
  - SciPy 2012
  - SciPy 2013

## SciPy: numerical algorithms galore

- **linalg** : Linear algebra routines (including BLAS/LAPACK)
- **sparse** : Sparse Matrices (including UMFPACK, ARPACK,...)
- **fftpack** : Discrete Fourier Transform algorithms
- **cluster** : Vector Quantization / Kmeans
- **odr** : Orthogonal Distance Regression
- **special** : Special Functions (Airy, Bessel, etc).
- **stats** : Statistical Functions
- **optimize** : Optimization Tools
- **maxentropy** : Routines for fitting maximum entropy models
- **integrate** : Numerical Integration routines
- **ndimage** : n-dimensional image package
- **interpolate** : Interpolation Tools
- **signal** : Signal Processing Tools
- **io** : Data input and output

# RECHNEN MIT POLYNOMEN

```
>>> from scipy import *
>>> p = poly1d([3,4,5])
>>> print p
    2
3 x + 4 x + 5

>>> print p**2

      4      3      2
9 x + 24 x + 46 x + 40 x + 25

#
```

# LÖSEN NICHT LIN. SYSTEMEN

$$f(x) = 0$$

```
>>> from scipy import *
>>> from scipy.optimize import fsolve

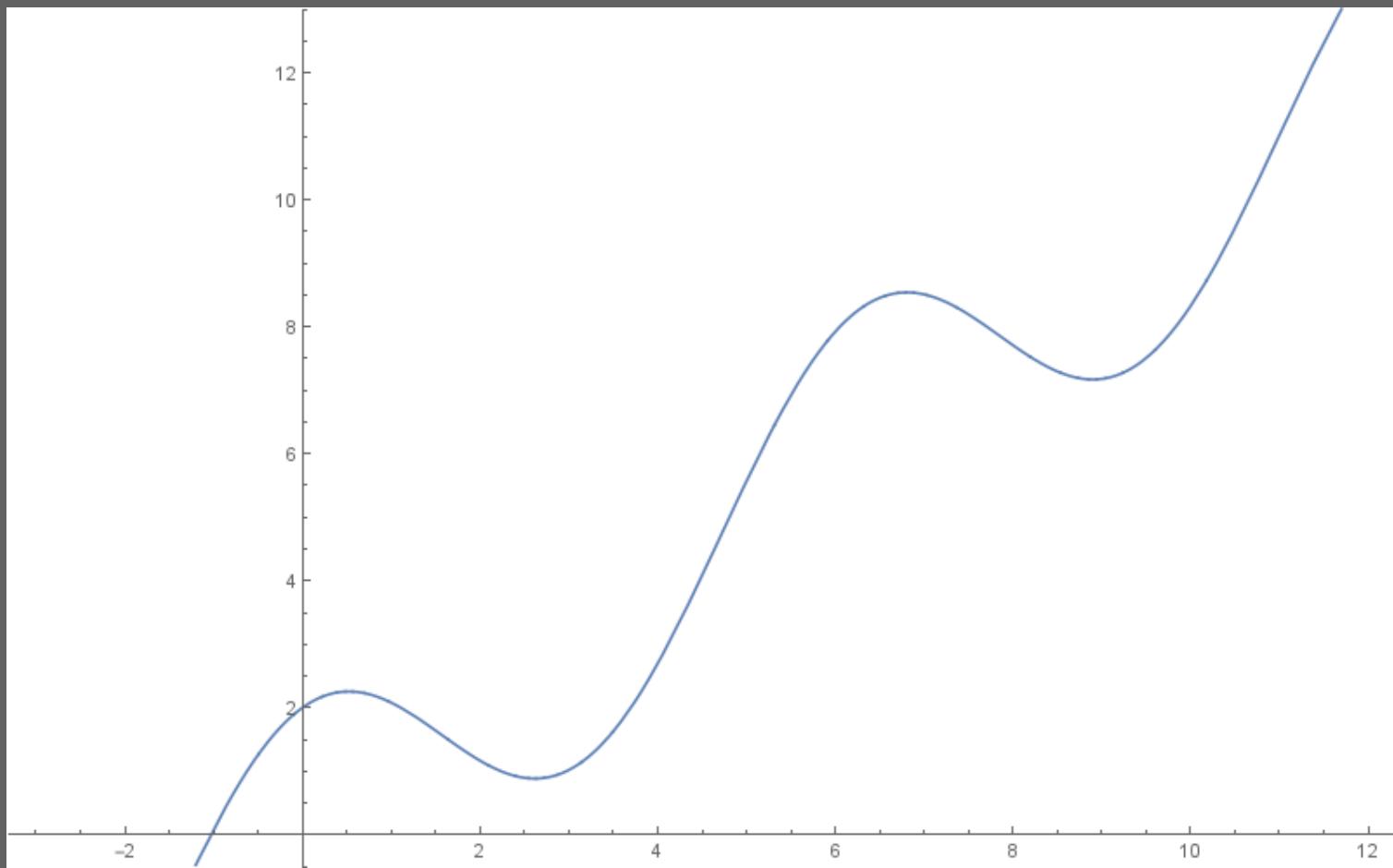
>>> def func(x):
    return x + 2*cos(x)

>>> x0 = fsolve(func, 0.3)

>>> print x0
[-1.02986653]

#
```

$$f(x) \mapsto x + 2 \cdot \cos(x)$$



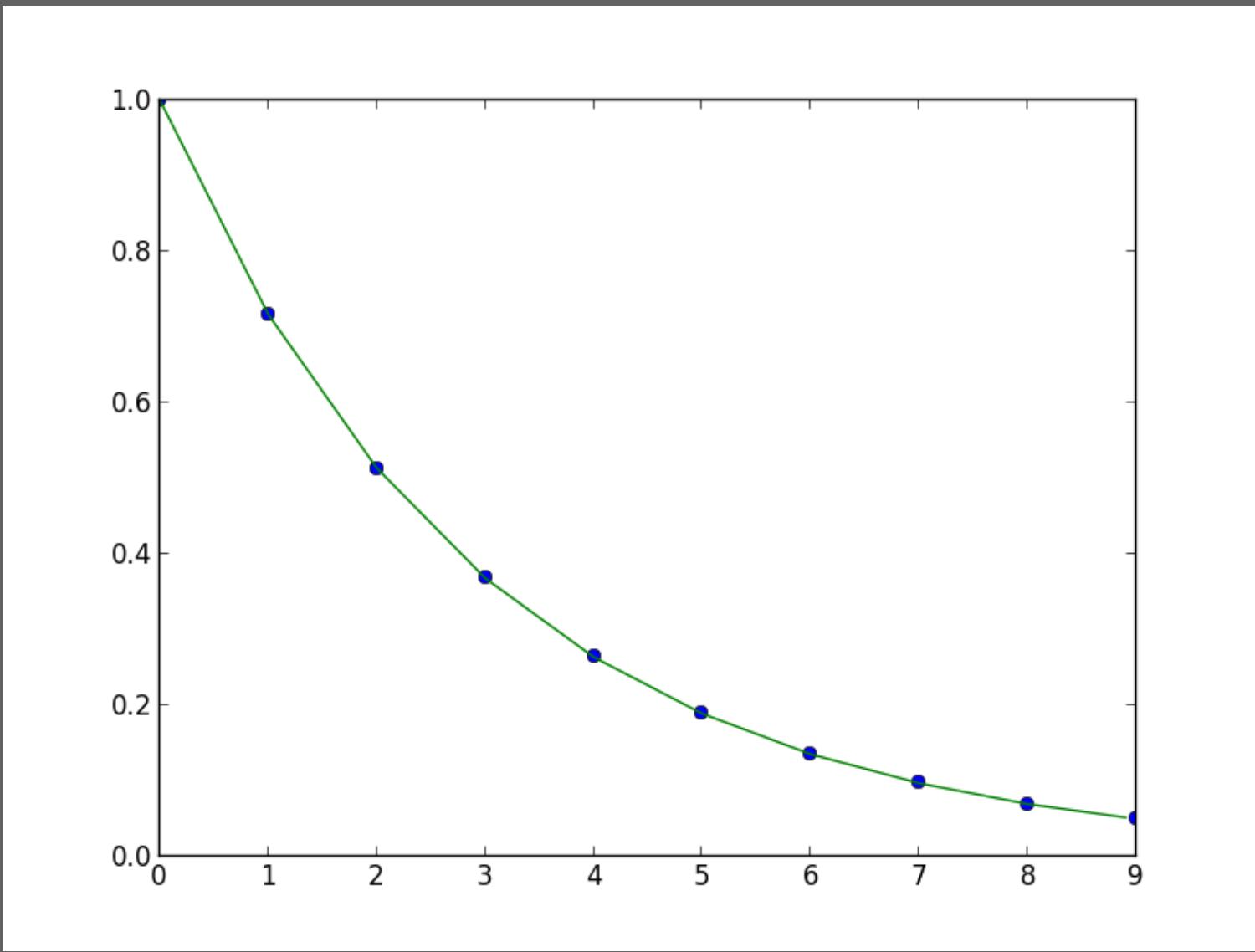
# INTERPOLATION

```
>>> import matplotlib
>>> matplotlib.use("Agg") # ohne Grafikausgabe
>>> import scipy as sp
>>> import scipy.interpolate
>>> import matplotlib.pyplot as plt
>>> x = sp.arange(0, 10)
>>> y = sp.exp(-x/3.0)
>>> f = sp.interpolate.interp1d(x, y)

>>> xnew = sp.arange(0,9, 0.1)
>>> ynew = f(xnew)
# use interpolation function returned by `interp1d` 

>>> plt.plot(x, y, 'o', xnew, ynew, '-')
>>> plt.savefig("interpolate.png")

#
```



# SINUSFUNKTION MIT KUBISCHEN SPLINES APPROXIMIEREN

```
import matplotlib
matplotlib.use("Agg") # ohne Grafikausgabe
from math import *
import scipy as sp
import scipy.interpolate
import matplotlib.pyplot as plt

x = sp.arange(0,2*pi+pi/4,2*pi/8)

y = sp.sin(x)

tck = sp.interpolate.splrep(x,y,s=0)

xnew = sp.arange(0,2*pi,pi/50)

ynew = sp.interpolate splev(xnew,tck,der=0)

plt.figure(1)
plt.plot(x,y,'x',label="linear")
plt.plot(xnew,ynew,label="cubic spline")
```

# LINEARE ALGEBRA

## MIT SCIPY.LINALG

# MATRIX DEFINIEREN & MATRIXMULTIPLIKATION

```
>>> from scipy import linalg
>>> import scipy as sp
# Definition 2x2 Matrix
>>> A = sp.mat('[1,2;3,4]')
# oder so
>>> A = sp.mat([[1, 2],
               [3,4]])

# Matrixmultiplikation
>>> A * A
matrix([[ 7, 10],
       [15, 22]])

#
```

# INVERTIEREN

```
>>> from scipy import linalg
>>> import scipy as sp
# A ist noch definiert
>>> A
matrix([[1, 2],
       [3, 4]])

# A^-1 der Variablen A_inv zuordnen
>>> A_inv = sp.mat(linalg.inv(A))

>>> A_inv
matrix([[-2.,  1.],
       [ 1.5, -0.5]])

# Test: A*A^-1
>>> A*A_inv
matrix([[1.0000000e+00, 0.0000000e+00],
       [8.88178420e-16, 1.0000000e+00]])

#
#
```

# NORMALPROJEKTION

GESUCHT NORMALPROJEKTION EINES  
PUNKTES AUF EINE EBENE

Sei die Ebene definiert durch eine Basis

$$\vec{e}_1 = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}, \vec{e}_2 = \begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix}$$

$$Proj_{Matrix} = A(A^T A)^{-1} A^T$$

mit

$$A = \begin{pmatrix} \vec{e}_1 & \vec{e}_2 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 0 & 2 \\ 1 & 1 \end{pmatrix}$$

```
>>> A = np.mat([[0,1],  
                 [0,2],  
                 [1,1]])  
  
>>> A.T  
matrix([[0, 0, 1],  
       [1, 2, 1]])  
  
>>> proj=A*np.mat(linalg.inv(A.T*A))*A.T  
  
>>> proj  
matrix([[0.2, 0.4, 0. ],  
       [0.4, 0.8, 0. ],  
       [0. , 0. , 1. ]])  
  
#
```

**Algebra**

- ⊖ Liste
  - $\mathbf{A} = \begin{pmatrix} 0 & 1 \\ 0 & 2 \\ 1 & 1 \end{pmatrix}$
  - $\mathbf{AT} = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 2 & 1 \end{pmatrix}$
  - $\mathbf{ATA} = \begin{pmatrix} 1 & 1 \\ 1 & 6 \end{pmatrix}$
  - $\mathbf{ATA}^{-1} = \begin{pmatrix} 1.2 & -0.2 \\ -0.2 & 0.2 \end{pmatrix}$
- ⊖ Plane3D
  - $a: -2x + y = 0$
- ⊖ Point3D
  - $B = (0, 0, 1)$
  - $C = (1, 2, 1)$
  - $O = (0, 0, 0)$
  - $P = (2.34, -1.93, 0)$

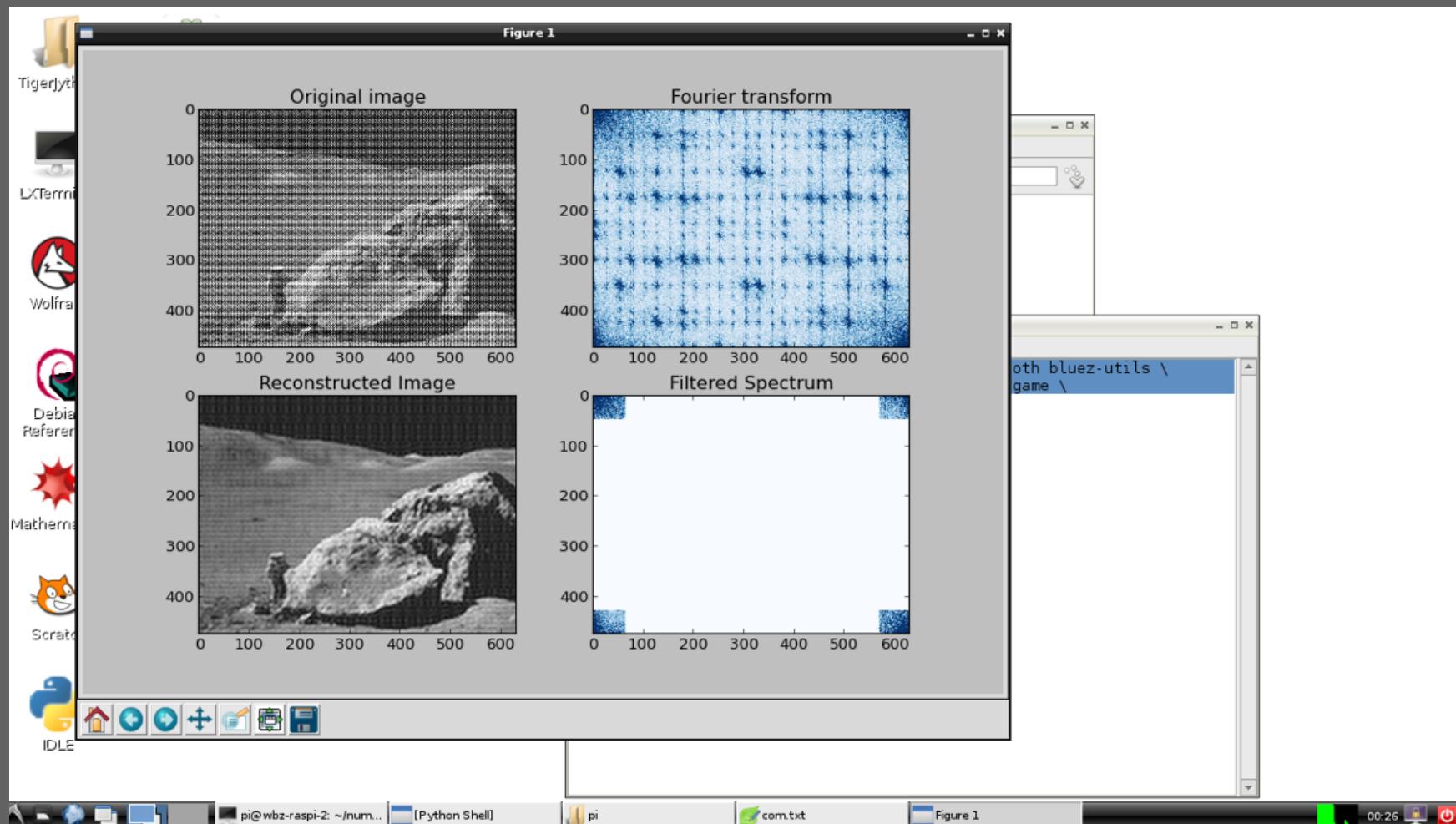
**Grafik 3D**

The 3D plot displays a Cartesian coordinate system with x, y, and z axes. A plane is shown in light blue, intersecting the z-axis at 4. The plane equation is  $a: -2x + y = 0$ . A point  $P$  is plotted in red at coordinates  $(2.34, -1.93, 0)$ . The plot also shows the origin  $O$ , point  $B$  at  $(0, 0, 1)$ , and point  $C$  at  $(1, 2, 1)$ .

Eingabe:

# FOURIER ANALYSE MIT SCIPY

## Bild und Quellcode



```
import sys
import numpy as np
from matplotlib import pyplot as plt

def plot_spectrum(F, amplify=1000, ax=None):
    """Normalise, amplify and plot an amplitude spectrum."""
    mag = abs(F)
    mag *= amplify/mag.max()
    # Next, clip all values larger than one to one.
    mag[mag > 1] = 1
    if ax is None:
        ax = plt.gca()
    ax.imshow(mag, plt.cm.Blues)

fname = 'moonlanding.png'
im = plt.imread(fname).astype(float)
print "Image shape: %s" % str(im.shape)

F = np.fft.fft2(im)
```

```
# Define the fraction of coefficients (in each direction) we keep
keep_fraction = 0.1
# Call ff a copy of the original transform.
Numpy arrays have a copy
# method for this purpose.
ff = F.copy()

# Set r and c to be the number of rows and columns of the array.
r,c = ff.shape

# Set to zero all rows with indices between r*keep_fraction and
# r*(1-keep_fraction):
ff[r*keep_fraction:r*(1-keep_fraction)] = 0

# Similarly with the columns:
ff[:, c*keep_fraction:c*(1-keep_fraction)] = 0

im_new = np.fft.ifft2(ff).real
```

```
fig, ax = plt.subplots(2, 2, figsize=(10,7))
ax[0,0].set_title('Original image')
ax[0,0].imshow(im, plt.cm.gray)
ax[0,1].set_title('Fourier transform')
plot_spectrum(F, ax=ax[0,1])
ax[1,1].set_title('Filtered Spectrum')
plot_spectrum(ff, ax=ax[1,1])
ax[1,0].set_title('Reconstructed Image')
ax[1,0].imshow(im_new, plt.cm.gray)
plt.show()

#
```

# QUELLEN + TUTORIALS

- SciPy-Kursmaterial
- Lecture Notes Python scientific by many Authors
- Lecture notes by Travis Oliphant, 2004
- Reference guide, tutorial
- Online-Kurse zu Python und weiteren Dingen

# RASPBERRY PI

## ALS WEB SERVER UND ACCESS-POINT

# PROJEKTIDEE: INTERAKTIVE POSTERSESSION



# EINSATZ AM INFOTAG 2014

## UNIVERSITÄT BASEL

### BESUCHERINNEN UND BESUCHER KÖNNEN AUF IHREN MOBILEN GERÄTEN EXPERIMENTIEREN!

Start      1 Hallo  2 Form  3 Farbe  4 Interaktion  5 Zufallsbilder  6 Visuelle Effekte  7 Spinnweben      About  Guide

### Zufallsbilder

```
1 background(0);
2 size(500,445);
3
4 for (int i=1; i<=900; i++){
5   stroke(random(33),random(299),random(200));
6   line(random(width), random(height),
7       random(width), random(height));
8 }
9
```

Run Code      Toggle Rulers



# EIN RASPBERRY PI KANN ALS SERVER EINGESETZT WERDEN

Damit könnte die folgende Frage mit Ja beantwortet werden.

Gibt es hier ein W-Lan ?

# INSTALLATION

- Webserver
- DHCP Server
- Wifi Access Point
- Netzwerk Konfiguration
- DNS Umleitung

# DETAILIERTE ANLEITUNG

## LINK ZU GITHUB

The screenshot shows a GitHub repository page for the user 'mgje' named 'RaspberryPI'. The repository has 9 commits, 1 branch (master), 0 releases, and 1 contributor (mgje). The README.md file has been updated 7 minutes ago. The repository page includes sections for 'Raspberry Pi', 'Installation - Setup - Configuration', and 'Apache Webserver'. A sidebar on the right provides links to 'Code', 'Issues', 'Pull Requests', 'Wiki', 'Pulse', 'Graphs', and 'Settings'. It also displays the HTTPS clone URL: <https://github.com/r>.

This repository Search Explore Gist Blog Help mgje + ⌂ ⌂ ⌂ ⌂ ⌂ ⌂

mgje / **RaspberryPI** Unwatch 1 Star 0 Fork 0

Rasspberry Pi Images — Edit

9 commits 1 branch 0 releases 1 contributor

branch: master **RaspberryPI** / +

Update README.md

mgje authored 7 minutes ago latest commit 9de9e4e09d

README.md Update README.md 7 minutes ago

README.md

## Raspberry Pi

- Rasspberry Pi Image with Mathematica, AccessPoint, DHCP-Server, Apache

## Installation - Setup - Configuration

### Apache Webserver

Code Issues 0 Pull Requests 0 Wiki Pulse Graphs Settings

HTTPS clone URL <https://github.com/r>

You can clone with [HTTPS](#), [SSH](#), or [Subversion](#).

Clone in Desktop Download ZIP

# INSTALLATION DER PAKETE

*#web Server*

```
$ sudo apt-get install apache2
```

*#DHCP Server*

```
$ sudo apt-get install isc-dhcp-server
```

*#Access-Point*

```
$ sudo apt-get install hostapd iw
```

*#DNS Weiterleitung*

```
$ sudo apt-get install -y dnsmasq
```

ODER KLONEN VORINSTALLIERTER PROGRAMME  
MATHEMATICA / SCIENTIFIC PYTHON / WEB SERVER /  
ACCESS-POINT

# KONFIGURATION MIT TEXTEDITOR Z.B. SSID UND WIFI CHANNEL

```
$ sudo nano /etc/hostapd/hostapd.conf
```

```
# Schnittstelle und Treiber
interface=wlan0
driver=rtl871xdrv
# WLAN-Konfiguration
ssid=Raspi2
channel=9
# ESSID sichtbar
ignore_broadcast_ssid=0
...
```

# ZUGANGSVERSCHLÜSSELUNG

```
$ sudo nano /etc/hostapd/hostapd.conf
```

```
...
wpa_key_mgmt=WPA-PSK
#rsn_pairwise=CCMP
wpa_key_mgmt=WPA-PSK
wpa_pairwise=TKIP
rsn_pairwise=CCMP
# Schluesselintervalle / Standardkonfiguration
wpa_group_rekey=600
wpa_ptk_rekey=600
wpa_gmk_rekey=86400
# Zugangsschluessel (PSK) / hier in Klartext (ASCII)
wpa_passphrase=raspberrypi
```

# PATCH FOR THE RTL8188CUS HARDWARE DRIVER EDIMAX 7811UN DRAHTLOSER NANO ADAPTER

```
$ wget http://www.adafruit.com/downloads/adafruit_hostapd.zip
$ unzip adafruit_hostapd.zip
$ sudo mv /usr/sbin/hostapd /usr/sbin/hostapd.ORIG
$ sudo mv hostapd /usr/sbin
$ sudo chmod 755 /usr/sbin/hostapd
$ sudo update-rc.d hostapd enable
```

# NETZWERKEINSTELLUNGEN

```
sudo nano /etc/network/interfaces
```

```
auto lo

iface lo inet loopback
iface eth0 inet dhcp
#stand alone static number
#iface eth0 inet static
# address 191.168.41.1
# netmask 255.255.255.0

allow-hotplug wlan0

# static configuratin for dhcp server
iface wlan0 inet static
# statische Gateway-Adresse
address 192.168.42.1
netmask 255.255.255.0

up iptables-restore < /etc/iptables.ipv4.nat
```

# ROUTING MIT HILFE VON IPTABLES

- wlan0 -> eth0

```
$ sudo sh -c "echo 1 > /proc/sys/net/ipv4/ip_forward"
$ sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
$ sudo iptables -A FORWARD -i eth0 -o wlan0 -m state
--state RELATED,ESTABLISHED -j ACCEPT
$ sudo iptables -A FORWARD -i wlan0 -o eth0 -j ACCEPT
$ sudo iptables -t nat -S
$ sudo iptables -S
$ sudo sh -c "iptables-save > /etc/iptables.ipv4.nat"
```

# TESTEN DER DIENSTE

```
$ sudo service isc-dhcp-server start
$ sudo service isc-dhcp-server status
$ sudo service hostapd start
$ sudo service hostapd status
$ sudo service apache2 restart
$ sudo service hostapd status
```

# TUTORIALS + QUELLEN

- [Der eigene Webserver mit dem Raspberry Pi](#)
- [Raspberry Pi als Webserver: So gehts](#)
- [Raspberry Pi als Webserver - Apache 2 Installation](#)
- [How to Make a Raspberry Pi Web Server](#)
- [Setting up a Raspberry Pi as access point](#)

# ZUSAMMENFASSUNG

- Mathematica auf dem Raspberry Pi
- Programmieren mit Python und SciPy
- Serverdienste installieren und konfigurieren

Die gesamte Präsentation finden Sie unter

<http://raspi.datzko.ch/>

und

<http://mgje.github.io/presentations/>

